THE ENGINEERING JOURNAL

VOLUME 27

JANUARY-DECEMBER, 1944

PUBLISHED BY

THE ENGINEERING INSTITUTE OF CANADA

2050 MANSFIELD STREET

MONTREAL, QUE.

THE ENGINEERING JOURNAL

INDEX TO VOLUME XXVII
JANUARY TO DECEMBER 1944

Page

Acres, H. G., The Design of the Shipshaw Power Development.... 221
  Discussion.... 449
Air Transport, The Post-War Possibilities of, Charles I. Stanton.... 18
Aircraft Construction, Plastic Plywoods in, R. D. Hiscocks.... 4
Alaska Highway Bridges, Problems in Design of, Raymond Archibald, John W. Guppy, and William K. Greene.... 353
Aluminium, Machining of, R. H. Ashcraft.... 304
ASME-EIC Agreement.... 45
Annual General and Professional Meeting, Fifty-Eighth,
  Message from the City of Quebec.... 37
  Programme.... 38
  Report of Meeting.... 152
  Said at the Annual Meeting.... 160
Annual General and Professional Meeting, Fifty-Ninth.581, 637
Archibald, Raymond, William K. Greene, John W. Guppy, Problems in Design of Alaska Highway Bridges 353
Architects vs Brian R. Perry....105, 473, 632
Architects vs Engineers....105, 473, 632
Ashcraft, R. H., Machining of Aluminium.... 304
Association of Professional Engineers of Ontario.... 131
Auld, J. R., Electric Systems in Military Explosive Plants 400

Bailey Bridge, Colonel E. C. Thorne.... 513
Barnes, J. C., Nomograph for Equations for the Form $YX^n = Z$.... 543
Batt, William L., Management's Need of Broader Vision 140
Beaubien, deGaspé, Biography.... 111
Beaubien, deGaspé, Your Institute.... 164
Benefit Plans for Canadian Workers, M. A. MacKenzie and N. E. Sheppard.... 32
Bogle, Major R. T., Lt.-Col. A. O. Monk, The Corps of Royal Canadian Electrical and Mechanical Engineers. 616
Book Reviews....328, 437, 597
Branches, Membership and Financial Statements of.... 100
Branches, Reports.... 96

Branches, News of—

  Border Cities....123, 178, 377, 525
  Calgary....178, 269
  Edmonton....58, 377, 435, 642
  Halifax....58, 123, 269, 324, 377, 594
  Hamilton....58, 123, 269, 324, 379, 435, 557, 594, 642
  Kingston....58, 179, 270, 379
  Lakehead....123, 325, 435, 594
  Lethbridge....325, 644
  London.... 595
  Moncton....59, 123, 380, 644
  Montreal....59, 124, 179, 270, 379, 644
  Niagara Peninsula....60, 270, 645
  Ottawa....60, 124, 180, 271, 381, 596, 646
  Peterborough....61, 181, 271, 325, 381
  Quebec.... 646
  Saguenay....271, 326, 436, 525
  Saint John.... 181
  St. Maurice Valley....436, 526
  Saskatchewan....61, 181, 271, 327, 647
  Sault Ste. Marie....61, 182, 327
  Toronto....62, 125, 182, 271, 327, 382, 595, 648
  Vancouver....62, 182, 271, 328, 382, 648
  Winnipeg....597, 648
Brault, Paul G. A., Launching 10,000-ton Cargo Vessels. 9
British Electrical Industry, The Growth of Research in the, V. Watlington.... 570

Cameron, K. M., President's Retiring Address.... 160
Canada, Department of Reconstruction.... 590
Canadian Construction Association, The Role of the Construction Industry in Post-War Years.... 35
Canadian Electrical and Mechanical Engineers, The Corps of, Lt.-Col. A. O. Monk, Major R. T. Bogle... 616

Page

Canadian Lumbermen's Association establishes new prize 516
C.O.T.C.... 43
Canadian Standards Association, Origin and Development of, W. R. McCaffrey.... 538
Cannon, Machining of, Major E. G. Moffat.... 460
Cartridge Cases, The Manufacture of Large Calibre, John T. Harris.... 564
Cemented Carbide Tools and Chip Control, Harry Crump 301
Chant, Group Capt. S. N. F., Preparing R.C.A.F., Personnel for Rehabilitation.... 627
Chemical Institute of Canada....369, 473
Chenevert, J. G., The Intercepting Sewer System in Quebec City.... 503
Chip Control, Cemented Carbide Tools and, Harry Crump.... 301
Classification and Remuneration of Engineers.... 547
Collective Bargaining and the Engineer..104, 261, 308, 369, 421, 471, 514, 554, 583
Combustion Gas Turbine, Armin K. Leuthold.... 488
Construction Industry in Post-War Years.... 35
Cook, W. H., Emergency Refrigeration of Cargo Spaces. 417
Corporation of Professional Engineers of Quebec Proposed Agreement with the E.I.C.... 585
Correspondence....46, 107, 478, 518, 554, 588, 634
Council Meetings 50, 108, 167, 171, 315, 371, 424, 519, 552, 637
Council Report for the Year 1943.... 86
Crump, Harry, Cemented Carbide Tools and Chip Control.... 301
Cutting Fluids and their Relationship to Metal Cutting, William H. Oldacre.... 536

Defence Projects in Northwest Canada 1940-1944.... 498
Desbarats, Georges Joseph, an Appreciation.... 321
Discussions—
  The Engineer as Planner, Ralph E. Flanders.... 46
  Stretching our Resources, C. B. Stenning.... 82
  The Continuing Need for the Conservation of Resources, Howard Coonley.... 82
  Trends in Industrial Relations, J. C. Cameron.... 107
  Social Security Planning in the English-Speaking World, Maurice Stack.... 148
  Development of Steam Production at Arvida, M. G. Saunders.... 338
  Post-War Planning.... 364
  The Design of the Shipshaw Power Development, H. G. Acres.... 449
  Post-War Planning.... 479
Doherty, Robert Ernest, Hon. M.E.I.C....162, 166
Doherty, Robert Ernest, The Engineering Profession Tomorrow.... 446
Dowd, Dr. K. E., Nutrition in Relation to Efficiency... 576
DuBose, McNeely, The Engineering History of Shipshaw 194

Earthquake Damage at Cornwall, Robert F. Legget.... 572
Elections and Transfers....51, 109, 171, 264, 317, 372, ...373, 521, 553, 639
Electric Systems in Military Explosive Plants, J. R. Auld 400
Electrical Equipment at Shipshaw, R. A. H. Hayes.... 250
Ends and Means in Soil Mechanics, Dr. K. Terzaghi... 608
Engineering Education after the War.... 314
Engineering Education? How Can We Improve, George B. Langford.... 573
  Discussion.... 575
Engineering History of Shipshaw, McNeely DuBose.... 194
Engineering Profession Tomorrow, Robert E. Doherty.. 446
Engineers' Council for Professional Development Annual Meeting.... 582
Engineers in the Quebec Civil Service.... 263
Engineer's Need of Humanities, The, Dr. R. C. Wallace 626
Explosive Plants, Electric Systems in Military, J. R. Auld 400

Financial Statements—
  Of the Institute.... 91
  Of the Branches.... 100

Page

Fitzgerald, G. W. N., The Technique of Testing High Voltage Bushings ... 532
Foremanship, D. D. Panabaker ... 297
Franco-Canadian Scientific and Technical Association ... 583
Fry, Lawford H., Railroad Equipment in Wartime ... 22

Gagnon, Monseigneur Cyrille, Greetings from Laval University ... 161
Gallay, Wilfred, Plastics in Engineering ... 72
Ganaraska Survey, A. H. Richardson ... 463
Discussion ... 589
Gas Turbine, The Combustion, Armin K. Leuthold ... 488
Gas Turbines and Jet Propulsion, Dr. Lionel S. Marks ... 622
Godbout, Hon. Adélard, The Engineer and Quebec ... 162
Greene, William K., Raymond Archibald, John W. Guppy, Problems in Design of Alaska Highway Bridges ... 353
Griesbach, Walter, Construction of Shipshaw No. 2 Power Development ... 234
Guppy, John W., Raymond Archibald, William K. Greene, Problems in Design of Alaska Highway Bridges ... 353

Harris, John T., The Manufacture of Large Calibre Cartridge Cases ... 564
Hayes, R. A. H., Electrical Equipment at Shipshaw ... 250
Hiscocks, R. D., Plastic Plywoods in Aircraft Construction ... 4
Holden, O., Ogoki Diversion ... 347
Hvilivitzky, J., and J. H. Ings, Some Structural Design Features of the Polymer Corporation Steam Power Plant ... 394

Industrial Research in Post-War Canada, C. J. Mackenzie ... 136
Ings, J. H., and J. Hvilivitzky, Some Structural Design Features of the Polymer Corporation Steam Power Plant ... 394
Institute Committee on Classification and Remuneration of Engineers ... 547
Institute Committee on Employment Conditions ... 308, 369, 421, 471
Institute Committee on Industrial Relations ... 32, 85
Institute Committee on Post-War Problems ... 459
Institute Committee on Quality Control ... 584
Institute Committee on the Engineer in the Civil Service 42
Institute Membership, The Composition of ... 515
Institute Prize Winners, Biographies ... 176
Irvine, W. A., Post-War Planning by Industry ... 26

Jacobsen, E. R., Washington Letter...48, 106, 167, 370, 423, 473, 517, 550, 587, 635
Jet Propulsion, Gas Turbines and, Dr. Lionel S. Marks ... 622
Job Evaluation, D. W. Weed ... 85

Lake Manouan Storage Dam, F. L. Lawton ... 200
Langford, George B., How Can We Improve Engineering Education? ... 573
Discussion ... 575
Launching 10,000-Ton Cargo Vessels, Paul G. A. Brault. 9
Laval University, Greetings from ... 161
Dr. Cameron praises Laval ... 161
Lawton, F. L., The Manouan and Passe Dangereuse Water Storage Developments ... 200
Lefebvre, Olivier Odilon, an Appreciation ... 268
Legget, Robert F., Earthquake Damage at Cornwall ... 572
Legget, Robert F., River Valley Development ... 624
Leuthold, Armin K., The Combustion Gas Turbine ... 488
Library Notes...63, 126, 183, 273, 328, 383, 437, 483, 527, 558, 597, 650

McCaffrey, W. R., Standardization in Canada ... 538
Mackenzie, C. J., Industrial Research in Post-War Canada ... 136
MacKenzie, M. A., Some Observations on Benefit Plans for Canadian Workers ... 32
Machining Magnesium Alloys, Carl J. Wiberg ... 306
Machining of Aluminium, R. H. Ashcraft ... 304
Machining of Cannon, Major E. G. Moffat ... 460
Magnesium Alloys, Machining, Carl J. Wiberg ... 306
Management's Need of Broader Vision, William L. Batt 140
Manouan and Passe Dangereuse Water Storage Developments, F. L. Lawton ... 200
Marks, Dr. Lionel S., Gas Turbines and Jet Propulsion 622
Mead, Daniel Webster, Hon. M.E.I.C. ... 162, 165
Metal Cutting, Cutting Fluids and their Relationship to, William H. Oldacre ... 536
Miller, Warren C., Planning Now for Post-War Construction Projects ... 459

Moffat, Major E. G., The Machining of Cannon ... 460
Monk, Lt.-Col. A. O., Major R. T. Bogle, The Corps of Royal Canadian Electrical and Mechanical Engineers 616
Montreal Terminal, C.N.R., Railway Signalling and Interlocking, James J. Van Horn ... 288
Montreal Tramways Company, A Subway Plan for Montreal ... 357
Morrison, I. F., A Note on a New Form of the Three-Moment Equation ... 143

News of Other Societies ... 131, 369, 422, 473, 582, 583
Nomograph for Equations for the Form $YX^n=Z$, J. C. Barnes ... 543
Nutrition in Relation to Efficiency, K. E. Dowd ... 576
Nylon, C. J. Warrington ... 285

Obituaries—

Atwood, William Stephen ... 266
Blanchard, Aubrey B. ... 267
Bogart, John Laurence Haslett ... 267
Braden, Norman Short ... 592
Chapais, Charles ... 267
Coutlee, Charles Robert ... 119
Cox, Leonard Martin ... 323
Cummings, Eugene Walker Dimock ... 482
Dalkin, George R. ... 119
Dawson, William Ball ... 375
Desbarats, Georges Joseph ... 321
Dubuc, Colonel Arthur Edouard ... 556
Dugas, Major Alexandre ... 557
Dupuis, Louis Charles ... 56
Evans, Edwin George ... 120
Ewart, Henry Edward ... 320
Fay, Frederic Harold ... 523
Foreman, Alvah Ernest ... 267
Freeland, John James ... 376
Fulton, William ... 56
Gibbs, Charles R. ... 119
Gurnham, Robert Allan ... 524
Hanning, George Foster ... 641
Harris, Richard Crosby ... 557
Hertzberg, Major-General C. S. L. ... 120
Howard, Lawrence James Meredith ... 641
Hunter, James H. ... 121
Jacobs, Wing-Commander David Sinclair ... 462
Junkins, Sydney Edwin ... 592
Kenny, Air Vice-Marshal Walter Robert ... 323
King, Harry Molyneux ... 57
Kingston, Charles Burrard ... 524
Lefebvre, Olivier Odilon ... 268
Logie, Lieutenant Richard Bucknam ... 557
MacKenzie, Charles E. ... 121
Morgan, Alfred Hedley ... 482
Mutchler, James Irving ... 642
Newell, Fred ... 121
Newton, Samuel Robert ... 593
Palmer, Robert Edward ... 323
Patterson, Thomas Bilton ... 434
Penman, Alan Carleton ... 524
Plamondon, Adrien ... 322
Porter, John Bonsall ... 322
Russell, William B. ... 593
Smart, Russel Sutherland ... 376
Stevenson, Charles L. ... 122
Stewart, Robert A. ... 57
Thorne, Benjamin Leonard ... 320
Wain, John Bernard ... 57
Westbye, Peder Pederson ... 57
Wilson, Harry Alton ... 482
Woodman, John ... 557

Officers of the Institute, Newly Elected, Biographies ... 112
Ogoki Diversion, O. Holden ... 347
Oldacre, William H., Cutting Fluids and their Relationship to Metal Cutting ... 536

Panabaker, D. D., Effective Foremanship ... 297
Passe Dangereuse Water Storage Development, F. L. Lawton ... 200
Personals ... 53, 117, 173, 265, 318, 373, 432, 480, 522, 555, 591, 640
Piette, Guillaume, Improved Soil Stabilization ... 413

Page

Plastic Plywoods in Aircraft Construction, R. D. Hiscocks.... 4
Plastics in Engineering, Wilfred Gallay.... 72
Plywoods in Aircraft Construction, R. D. Hiscocks.... 4
Polymer Corporation Steam Power Plant, Some Structural Design Features of the, J. H. Ings and J. Hvilivitzky.... 394
"Portable" Invasion Harbour.... 581
Post-War Canada, Industrial Research in, C. J. Mackenzie.... 136
Post-War Construction Projects, Planning Now for, Warren C. Miller.... 459
Post-War Planning, John E. Armstrong, R. M. Brophy, G. A. Gaherty, Arthur Surveyer, R. L. Weldon and H. G. Welsford. Supp. to March *Journal*....
Discussion....364, 479, 516
Post-War Planning by Industry, W. A. Irvine.... 26
Post-War Possibilities of Air Transport, Charles I. Stanton 18
Post-War Years, The Role of the Construction Industry in 35
Preliminary Notice....65, 129, 186, 275, 331, 388, 439, 485, 529, 559, 599, 652
President's Visit to the Maritimes....165, 311
President's Visit to the Ontario Branches.... 475
President's Visit to the West....548, 630
Prince Rupert-Hazelton Highway, B.C., J. M. Wardle.. 280
Prize Awards 1944.... 429

Railroad Equipment in Wartime, Lawford H. Fry.... 22
Railway Signalling and Interlocking, Montreal Terminal, C.N.R., James J. Van Horn.... 288
Recent Graduates in Engineering.... 429
Refrigeration of Cargo Spaces, W. H. Cook.... 417
Registration in Engineering at Canadian Universities... 634
Remuneration of Engineers in the Civil Service.... 42, 263
Research in the British Electrical Industry, The Growth of, V. Watlington.... 570
Richardson, A. H., The Ganaraska Survey.... 463
Discussion.... 589
River Valley Development, Robert F. Legget.... 624
R.C.A.F. Personnel for Rehabilitation, Preparing, Group Capt. S.N.F. Chant.... 627
Royal Canadian Electrical and Mechanical Engineers (R.C.E.M.E.)....261, 312, 368, 421, 470, 616

Saunders, M. G., The Development of Steam Production at Arvida.... 338
Discussion.... 343
Sewer System in Quebec City, The Intercepting, J. G. Chenevert.... 503
Sheppard, N. E., Some Observations on Benefit Plans for Canadian Workers.... 32
Ships Named for Engineers.... 104
Shipshaw, Electrical Equipment at, R. A. H. Hayes.... 250
Shipshaw, Engineering History of, McNeely DuBose... 194
Shipshaw No. 2 Power Development, Construction of, Walter Griesbach.... 234
Shipshaw Power Development, Design of, H. G. Acres.. 221
Discussion.... 449

Page

Social Security Planning in the English-Speaking World, Maurice Stack.... 146
Discussion.... 148
Soil Mechanics, Ends and Means in, Dr. K. Terzaghi... 608
Soil Stabilization, Guillaume Piette.... 413
S.P.E.E., Engineering Education after the War.... 314
Stack, Maurice, Social Security Planning in the English-Speaking World.... 146
Discussion.... 148
Standardization in Canada, W. R. McCaffrey.... 538
Stanton, Charles I., The Post-War Possibilities of Air Transport.... 18
Steam Power Plant, Some Structural Design Features of the Polymer Corporation, J. H. Ings and J. Hvilivitzky 394
Steam Production at Arvida, The Development of, M. G. Saunders.... 338
Discussion.... 343
Stenning, C. B., Stretching our Resources.... 78
Discussion.... 82
Stretching our Resources, C. B. Stenning.... 78
Discussion.... 82
Subway Plan for Montreal.... 357
Surveyer, Dr. Arthur, Taxation of Private Enterprise... 49

Taxation of Private Enterprise, Dr. Arthur Surveyer... 49
Technical Institutes in Canada, The Desirability of Establishing, C. R. Young.... 150
Terzaghi, K., Ends and Means in Soil Mechanics.... 608
Testing High Voltage Bushings, The Technique of, G. W. N. Fitzgerald.... 532
Thorne, Colonel E. C., The Bailey Bridge.... 513
Three-Moment Equation, A Note on a New Form of the, I. F. Morrison.... 143
Town Planning, An Editorial.... 472

University of Toronto, Engineering Students' Costs.... 110

Van Horn, James J., Railway Signalling and Interlocking, Montreal Terminal, C.N.R.... 288

Wallace, Dr. R. C., The Engineer's Need of Humanities. 626
Wardle, J. M., Canada's Wartime Road.... 280
Wardle, J. M., Prince Rupert-Hazelton Highway, B.C.. 280
Warrington, C. J., Nylon.... 285
Wartime Bureau of Technical Personnel....43, 44, 472
Wartime Labour Relations Regulations....104, 261, 309
Wartime Transportation, Effects of Peacetime Developments on, Lawford H. Fry.... 22
Washington Letter, E. R. Jacobsen....48, 106, 167, 370, 422, 473, 517, 550, 587, 635
Watlington, V., The Growth of Research in the British Electrical Industry.... 570
Weed, D. W., Job Evaluation.... 85
When is an Engineer not an Engineer?.... 368
Wiberg, Carl J., Machining Magnesium Alloys.... 306

Young, C. R., The Desirability of Establishing Technical Institutes in Canada.... 150

THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 27 | MONTREAL, JANUARY 1944 | NUMBER 1

"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

★ ★ ★

PUBLISHED MONTHLY BY

THE ENGINEERING INSTITUTE OF CANADA

2050 MANSFIELD STREET - MONTREAL

Price 50 cents a copy, $3.00 a year: in Canada, British Possessions, United States and Mexico. $4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, $2.00 a year. —Entered at the Post Office, Montreal, as Second Class Matter.

CONTENTS

H.M.S. *FORMIDABLE*, photographed from the quarterdeck of the *Warspite* (British Admiralty Photo) . . . . Cover

PLASTIC PLYWOODS IN AIRCRAFT CONSTRUCTION . . . 4
R. D. Hiscocks

LAUNCHING 10,000-TON CARGO VESSELS 9
Paul G. A. Brault, M.E.I.C.

THE POSTWAR POSSIBILITIES OF AIR TRANSPORT . . . 17
Charles I. Stanton

RAILROAD EQUIPMENT IN WARTIME 22
Lawford H. Fry

POSTWAR PLANNING BY INDUSTRY 26
W. A. Irvine

SOME OBSERVATIONS ON BENEFIT PLANS FOR CANADIAN WORKERS 32
M. A. Mackenzie
N. E. Sheppard

THE ROLE OF THE CONSTRUCTION INDUSTRY IN POST-WAR YEARS 35

ANNUAL MEETING ANNOUNCEMENTS 37-41

FROM MONTH TO MONTH 42

PERSONALS 53
Visitors to Headquarters 56
Obituaries 56

NEWS OF THE BRANCHES 58

LIBRARY NOTES 63

PRELIMINARY NOTICE 65

EMPLOYMENT SERVICE 67

INDUSTRIAL NEWS 68

THE ENGINEERING INSTITUTE OF CANADA

MEMBERS OF COUNCIL - 1943

PRESIDENT

K. M. CAMERON, Ottawa, Ont.

VICE-PRESIDENTS

†W. P. BRERETON, Winnipeg, Man.
*H. CIMON, Quebec, Que.
†L. F. GRANT, Kingston, Ont.
*J. L. LANG, Sault Ste. Marie, Ont.
†C. K. McLEOD, Montreal, Que.
*G. G. MURDOCH, Saint John, N.B.

PAST-PRESIDENTS

*T. H. HOGG, Toronto, Ont.
†C. J. MACKENZIE, Ottawa, Ont.
‡C. R. YOUNG, Toronto, Ont.

COUNCILLORS

†J. E. ARMSTRONG, Montreal, Que.
†H. E. BRANDON, Toronto, Ont.
*S. G. COULTIS, Calgary, Alta.
*G. L. DICKSON, Moncton, N.B.
‡E. V. GAGE, Montreal, Que.
*F. W. GRAY, Sydney, N.S.
*E. D. GRAY-DONALD, Quebec, Que.
*J. HAIMES, Lethbridge, Alta.
†R. E. HEARTZ, Montreal, Que.
*W. G. HUNT, Montreal, Que.
*E. W. IZARD, Victoria, B.C.
†A. JACKSON, Kingston, Ont.
*J. R. KAYE, Halifax, N.S.
‡J. A. LALONDE, Sorel, Que.
†A. M. MACGILLIVRAY, Saskatoon, Sask.
*N. MacNICOL, Toronto, Ont.
†N. B. MacROSTIE, Ottawa, Ont.
*T. A. McELHANNEY, Ottawa, Ont.
*A. W. F. McQUEEN, Niagara Falls, Ont
†G. E. MEDLAR, Windsor, Ont.
†J. P. MOONEY, Saint John, N.B.
†E. NELSON, Edmonton, Alta.
†H. G. O'LEARY, Fort William, Ont.
*A. E. PICKERING, Sault Ste. Marie, Ont.
*G. MacL. PITTS, Montreal, Que.
*W. J. W. REID, Hamilton, Ont.
*J. W. SANGER, Winnipeg, Man.
†C. SCRYMGEOUR, Dartmouth, N.S.
*H. R. SILLS, Peterborough, Ont.
†J. A. VANCE, Woodstock, Ont.
†H. J. WARD, Shawinigan Falls, Que.
†J. W. WARD, Beauharnois, Que.
†C. E. WEBB, Vancouver, B.C.

* For 1943. † For 1943-44 ‡ For 1943-44-45

TREASURER

C. V. CHRISTIE, Montreal, Que.

GENERAL SECRETARY

L. AUSTIN WRIGHT, Montreal, Que.

SECRETARY-EMERITUS

R. J. DURLEY, Montreal, Que.

ASSISTANT GENERAL SECRETARY

LOUIS TRUDEL, Montreal, Que.

STANDING COMMITTEES

FINANCE
C. K. McLEOD, *Chairman*
J. E. ARMSTRONG
deG. BEAUBIEN
C. V. CHRISTIE
G. A. GAHERTY

LEGISLATION
J. L. LANG, *Chairman*
R. L. DOBBIN
R. J. DURLEY

PAPERS
L. F. GRANT, *Chairman*

LIBRARY AND HOUSE
E. V. GAGE, *Chairman*
A. T. BONE
J. S. HEWSON
M. S. NELSON
G. V. RONEY

PUBLICATION
J. A. LALONDE, *Chairman*
R. DeL. FRENCH, *Vice-Chairman*
A. C. D. BLANCHARD
H. F. FINNEMORE
T. J. LAFRENIERE

SPECIAL COMMITTEES

BOARD OF EXAMINERS AND EDUCATION
R. A. SPENCER, *Chairman*
I. M. FRASER
W. E. LOVELL
A. P. LINTON
H. R. MacKENZIE
E. K. PHILLIPS

GZOWSKI MEDAL
W. H. POWELL, *Chairman*
H. V. ANDERSON
T. H. JENKINS
V. A. McKILLOP
E. O. TURNER

DUGGAN MEDAL AND PRIZE
J. M. FLEMING, *Chairman*
R. C. FLITTON
H. M. WHITE

PLUMMER MEDAL
O. W. ELLIS, *Chairman*
J. CAMERON
R. L. DOBBIN
R. E. GILMORE
L. E. WESTMAN

LEONARD MEDAL
A. E. CAMERON, *Chairman*
A. E. MacRAE
F. V. SEIBERT
E. STANSFIELD
G. W. WADDINGTON

JULIAN C. SMITH MEDAL
K. M. CAMERON, *Chairman*
C. J. MACKENZIE
C. R. YOUNG

MEMBERSHIP
J. G. HALL, *Chairman*
S. R. FROST
N. MacNICOL

PROFESSIONAL INTERESTS
J. B. CHALLIES, *Chairman*
O. O. LEFEBVRE, *Vice-Chairman*
J. E. ARMSTRONG
G. A. GAHERTY,
H. W. McKIEL
J. A. VANCE

STUDENTS' AND JUNIORS' PRIZES

Zone A (Western Provinces)
H. N. Ruttan Prize
W. P. BRERETON, *Chairman*
A. M. MACGILLIVRAY
C. E. WEBB

Zone B (Province of Ontario)
John Galbraith Prize
L. F. GRANT, *Chairman*
H. E. BRANDON
N. B. MacROSTIE

Zone C (Province of Quebec)
Phelps Johnson Prize (English)
C. K. McLEOD, *Chairman*
R. E. HEARTZ
W. G. HUNT

Ernest Marceau Prize (French)
H. CIMON, *Chairman*
J. A. LALONDE
E. D. GRAY-DONALD

Zone D (Maritime Provinces)
Martin Murphy Prize
G. G. MURDOCH, *Chairman*
G. L. DICKSON
J. R. KAYE

INTERNATIONAL RELATIONS
M. J. McHENRY, *Chairman*
R. W. ANGUS
E. A. ALLCUT
A. E. BERRY
C. CAMSELL
J. B. CHALLIES
J. M. R. FAIRBAIRN
O. O. LEFEBVRE
W. H. MUNRO
C. E. WEBB
C. R. YOUNG

THE YOUNG ENGINEER
H. F. BENNETT, *Chairman*
J. BENOIT
D. S. ELLIS
J. N. FINLAYSON
R. DeL. FRENCH
R. F. LEGGET
A. E. MACDONALD
H. W. McKIEL

POST-WAR PROBLEMS
W. C. MILLER, *Chairman*
F. ALPORT
J. S. BATES
deGASPE BEAUBIEN
A. L. CARRUTHERS
J. M. FLEMING
E. R. JACOBSEN
G. R. LANGLEY
H. MASSUE
G. L. MacKENZIE
D. A. R. McCANNEL
A. W. F. McQUEEN
G. MacL. PITTS
P. M. SAUDER
D. C. TENNANT
H. G. WELSFORD

WESTERN WATER PROBLEMS
G. A. GAHERTY, *Chairman*
C. H. ATTWOOD
L. C. CHARLESWORTH
A. GRIFFIN
D. W. HAYS
G. N. HOUSTON
T. H. HOGG
O. O. LEFEBVRE
C. J. MACKENZIE
H. J. McLEAN
F. H. PETERS
S. G. PORTER
P. M. SAUDER
J. M. WARDLE

ENGINEERING FEATURES OF CIVIL DEFENCE
J. E. ARMSTRONG, *Chairman*
P. E. ADAMS
J. N. ANDERSON
S. R. BANKS
H. F. BENNETT
W. D. BRACKEN
W. P. BRERETON
J. M. DAVIDSON
R. S. EADIE
E. V. GAGE
G. A. GAHERTY
R. J. GIBB
A. GRAY
J. GRIEVE
J. L. LANG
R. F. LEGGET
I. P. MACNAB
J. A. McCRORY
H. J. McEWEN
C. B. MUIR
W. H. MUNRO
J. A. A. PICHÉ
G. MacL. PITTS
C. J. PORTER
M. G. SAUNDERS
W. O. SCOTT
T. G. TYRER
H. K. WYMAN

INDUSTRIAL RELATIONS
WILLS MACLACHLAN, *Chairman*
E. A. ALLCUT
D. BOYD
J. P. BRIERLEY
J. C. CAMERON
E. R. COMPLIN
J. A. COOTE
R. DUPUIS
S. M. GOSSAGE
F. W. GRAY
E. G. HEWSON
I. F. McRAE
A. M. REID
W. J. W. REID

DETERIORATION OF CONCRETE STRUCTURES
R. B. YOUNG, *Chairman*
E. VIENS, *Vice-Chairman*
G. P. F. BOESE
A. G. FLEMING
W. G. C. GLIDDON
O. O. LEFEBVRE
J. A. McCRORY
C. J. MACKENZIE
J. H. McKINNEY
R. M. SMITH

THE ENGINEERING INSTITUTE OF CANADA

OFFICERS OF BRANCHES

BORDER CITIES
Chairman, J. B. DOWLER
Vice-Chair., A. H. MacQUARRIE
Executive, G. W. LUSBY J. M. WYLLIE
J. F. G. BLOWEY
(Ex-Officio), G. E. MEDLAR
G. G. HENDERSON
Sec.-Treas., W. R. STICKNEY,
1614 Ontario Street,
Walkerville, Ont.

CALGARY
Chairman, J. G. MACGREGOR
Executive, F. A. BROWNIE
H. R. HAYES
A. HIGGINS
W. E. ROBINSON
(Ex-Officio), S. G. COULTIS
G. P. F. BOESE
H. J. McEWEN
Sec.-Treas., K. W. MITCHELL,
803-17th Ave. N.W.,
Calgary, Alta.

CAPE BRETON
Chairman, J. A. MacLEOD
Executive, J. A. RUSSELL M. F. COSSITT
(Ex-Officio), F. W. GRAY
Sec.-Treas., S. C. MIFFLEN,
60 Whitney Ave., Sydney, N.S.

EDMONTON
Chairman, C. W. CARRY
Vice-Chair., B. W. PITFIELD
Executive, J. A. ALLAN
J. W. JUDGE
E. D. ROBERTSON
J. D. A. MACDONALD
I. F. MORRISON
H. W. TYE
(Ex-Officio), D. HUTCHISON
E. NELSON
Sec.-Treas., F. R. BURFIELD,
Water Resources Office,
Provincial Government,
Edmonton, Alta.

HALIFAX
Chairman, G. J. CURRIE
Executive, R. J. BETHUNE J. W. MARCH
J. E. CLARKE C. D. MARTIN
K. L. DAWSON L. E. MITCHELL
D. C. V. DUFF H. A. RIPLEY
J. H. M. JONES R. B. STEWART
(Ex-Officio), A. E. FLYNN
C. SCRYMGEOUR
P. A. LOVETT
Sec.-Treas., S. W. GRAY,
Wartime Bureau of Technical,
Personnel, 84 Hollis Street,
Halifax, N.S.

HAMILTON
Chairman, T. S. GLOVER
Vice-Chair., H. A. COOCH
Executive, C. H. HUTTON
R. J. G. SCHOFIELD
NORMAN EAGER
A. H. WINGFIELD
(Ex-Officio), W. J. W. REID
STANLEY SHUPE
A. R. HANNAFORD
Sec. Treas., W. E. BROWN,
91 Barnesdale Blvd.,
Hamilton, Ont.

KINGSTON
Chairman, S. D. LASH
Vice-Chair., H. W. HARKNESS
Executive, R. J. CARTER
D. C. MACPHERSON
H. R. ROGERS F. A. ATHEY
(Ex-Officio), L. F. GRANT
A. JACKSON K. M. WINSLOW
Sec.-Treas., R. A. LOW,
Dept. of Civil Engineering,
Queen's University,
Kingston, Ont.

LAKEHEAD
Chairman, R. B. CHANDLER
Vice-Chair., S. T. McCAVOUR
Executive, S. E. FLOOK
O. J. KOREEN
E. L. GOODALL
J. I. CARMICHAEL
W. H. SMALL
A. D. NORTON
E. A. KELLY
J. S. WILSON
(Ex-Officio), E. M. G. MacGILL
(Mrs. E. J. Soulsby)
E. J. DAVIES H. G. O'LEARY
Sec.-Treas., W. C. BYERS,
c/c C. D. Howe Co. Ltd.,
Port Arthur, Ont.

LETHBRIDGE
Chairman, J. M. DAVIDSON
Vice-Chair., C. S. DONALDSON
Executive, A. G. DONALDSON G. S. BROWN
N. H. BRADLEY
(Ex-Officio), J. HAIMES
Sec.-Treas., R. B. McKENZIE,
McKenzie Electric Ltd.,
706, 3rd Ave. S., Lethbridge, Alta.

LONDON
Chairman, T. L. McMANAMNA
Vice-Chair., R. S. CHARLES
Executive, H. F. BENNETT
W. C. MILLER
F. T. TAYLOR
F. C. BALL
V. A. McKILLOP
(Ex-Officio), F. T. JULIAN
J. A. VANCE
Sec. Treas., H. G. STEAD,
60 Alexandra Street,
London, Ont.

MONCTON
Chairman, J. A. GODFREY
Vice-Chair., A. S. DONALD
Executive, E. R. EVANS H. W. HOLE
A. GORDON G. C. TORRENS
G. E. SMITH
(Ex-Officio), H. J. CRUDGE
G. L. DICKSON
Sec.-Treas., V. C. BLACKETT,
Engrg. Dept., C.N.R.
Moncton, N.B.

MONTREAL
Chairman, R. S. EADIE
Vice-Chair., C. C. LINDSAY
Executive, H. F. FINNEMORE
R. C. FLITTON
G. D. HULME
C. E. GELINAS
K. G. CAMERON
G. H. MIDGLEY
(Ex-Officio), C. K. McLEOD
J. E. ARMSTRONG
R. E. HEARTZ
W. G. HUNT
J. A. LALONDE
G. MacL. PITTS
E. V. GAGE
Sec.-Treas., L. A. DUCHASTEL,
40 Kelvin Avenue,
Outremont, Que.

NIAGARA PENINSULA
Chairman, G. E. GRIFFITHS
Vice-Chair., W. D. BRACKEN
Executive, A. G. HERR
C. G. MOON
G. F. VOLLMER
H. E. BARNETT
J. W. BROOKS
G. MORRISON
D. S. SCRYMGEOUR
(Ex-Officio), C. G. CLINE
A. W. F. McQUEEN
Sec.-Treas., J. H. INGS,
2135 Culp Street,
Niagara Falls, Ont.

OTTAWA
Chairman, G. H. FERGUSON
Executive, W. H. G. FLAY
G. A. LINDSAY
R. YUILL
W. H. B. BEVAN
J. H. BYRNE
(Ex-Officio), T. A. McELHANNEY
K. M. CAMERON
N. B. MacROSTIE
Sec. Treas., A. A. SWINNERTON
Dept. of Mines & Resources,
Ottawa, Ont.

PETERBOROUGH
Chairman, A. R. JONES
Executive, R. L. DOBBIN
A. L. MALBY
F. R. POPE
C. R. WHITTEMORE
(Ex-Officio), D. J. EMERY
H. R. SILLS
Sec.-Treas., A. J. GIRDWOOD,
308 Monaghan Road,
Peterborough, Ont.

QUEBEC
Life Hon.-Chair., A. R. DÉCARY
Chairman, RENÉ DUPUIS
Vice-Chair., E. D. GRAY-DONALD
Executive, S. PICARD G. ST-JACQUES
L. GAGNON A. E. PARÉ
G. W. WADDINGTON Y. R. TASSÉ
(Ex-Officio), H. CIMON
R. B. McDUNNOUGH
P. MÉTHÉ
Sec.-Treas., PAUL VINCENT,
Colonization Department,
Room 333-A, Parliament Bldgs.,
Quebec, Que.

SAGUENAY
Chairman, CHAS. MILLER
Vice-Chair., G. B. MOXON
Executive, J. FRISCH W. E. COOPER
F. T. BOUTILIER
(Ex-Officio), R. H. RIMMER J. W. WARD
ALEX. T. CAIRNCROSS
Sec.-Treas., ALEX. T. CAIRNCROSS,
8-C Brittany Row,
Arvida, Que.

SAINT JOHN
Chairman, A. O. WOLFF
Vice-Chair., C. D. McALLISTER
Executive, G. M. BROWN
C. C. KIRBY
(Ex-Officio), G. G. MURDOCH
J. P. MOONEY
D. R. SMITH
G. W. GRIFFIN
Sec.-Treas., F. A. PATRIQUEN,
P. O. Box 1417
Saint John, N.B

ST. MAURICE VALLEY
Chairman, J. H. FREGEAU
Vice-Chair., R. DORION
Executive, G. B. BAXTER
E. BUTLER
A. G. JACQUES
R. D. PACKARD M. EATON
E. T. BUCHANAN J. JOYAL
W. E. A. McLEISH H. G. TIMMIS
(Ex-Officio), VIGGO JEPSEN
H. J. WARD
Sec.-Treas., DAVID E. ELLIS,
Shawinigan Water & Power
Company,
P.O. Box 190,
Three Rivers, Que.

SASKATCHEWAN
Chairman, A. M. MACGILLIVRAY
Vice-Chair., J. McD. PATTON
Executive, F. E. ESTLIN
E. K. PHILLIPS
J. I. STRONG
F. C. DEMPSEY
N. B. HUTCHEON
J. G. SCHAEFFER
R. A. SPENCER
(Ex-Officio), A. P. LINTON
Sec. Treas., STEWART YOUNG,
P.O. Box 101, Regina, Sask.

SAULT STE. MARIE
Chairman, N. C. COWIE
Vice-Chair., A. M. WILSON
Executive, C. O. MADDOCK
C. R. MURDOCK
G. W. MacLEOD
K. G. ROSS
H. W. SUTCLIFFE
(Ex-Officio), J. L. LANG
A. E. PICKERING
L. R. BROWN
Sec. Treas., O. A. EVANS,
159 Upton Road,
Sault Ste. Marie

TORONTO
Chairman, W. H. M. LAUGHLIN
Vice-Chair., S. R. FROST
Executive, F. J. BLAIR R. F. LEGGET
E. G. HEWSON A. H. HULL
C. F. MORRISON E. A. CROSS
(Ex-Officio), H. E. BRANDON W. S. WILSON
T. H. HOGG C. R. YOUNG
N. MACNICOL
J. M. VAN WINCKLE
Sec.-Treas., S. H. DEJONG,
Dept. of Civil Engineering,
University of Toronto,
Toronto, Ont.

VANCOUVER
Chairman, T. V. BERRY
Vice-Chair., A. PEEBLES
Executive, J. P. FRASER F. H. BALLOU
E. S. JONES R. C. PYBUS
G. W. ALLAN J. A. TAMES
(Ex-Officio), C. E. WEBB
W. N. KELLY
Sec.-Treas., P. B. STROYAN,
2099 Beach Avenue,
Vancouver, B.C.

VICTORIA
Chairman, KENNETH REID
Vice-Chair., A. L. FORD
Executive, H. L. SHERWOOD
A. N. ANDERSON
F. C. GREEN
J. H. BLAKE
(Ex-Officio), E. W. IZARD
A. S. G. MUSGRAVE
Sec.-Treas., R. BOWERING,
41 Gorge Road West,
Victoria, B.C.

WINNIPEG
Chairman, J. T. DYMENT
Vice-Chair., T. H. KIRBY
Executive, C. V. ANTENBRING
N. M. HALL
B. B. HOGARTH
R. H. ROBINSON
R. A. SARA
(Ex-Officio), W. P. BRERETON
J. W. SANGER
D. M. STEPHENS
Sec.-Treas., T. E. STOREY,
55 Princess Street,
Winnipeg, Man.

PLASTIC PLYWOODS IN AIRCRAFT CONSTRUCTION

R. D. HISCOCKS

Engineer in Charge of the Structural Laboratory, Aeronautical Division, National Research Council, Ottawa, Ont.

Paper presented at a joint meeting of The American Society of Mechanical Engineers and The Engineering Institute of Canada, at Toronto, Ont., on September 30th, 1943.

At the beginning of the war it was believed in the National Research Council of Canada that the possibilities of the wooden aeroplane had not been fully appreciated. It was considered that the factors which govern the speed with which a prototype machine might be developed and placed in full scale production weighed heavily in favour of wood, especially when the question is examined in the light of Canadian facilities.

As a result, we undertook in the Structures Section to set up a small pilot plant in order to test and develop these ideas, with the particular object of demonstrating that recent advances in materials and techniques can be applied to the rapid production of an aeroplane which is not merely a metal substitute but a machine of technical merit.

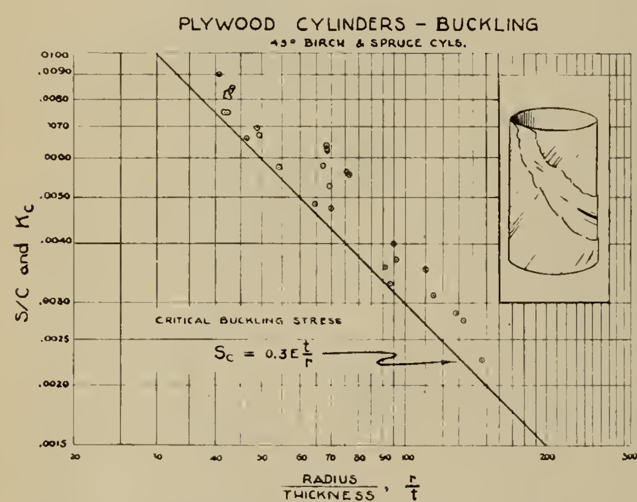


Fig. 1—Tests on plywood cylinders in compression.

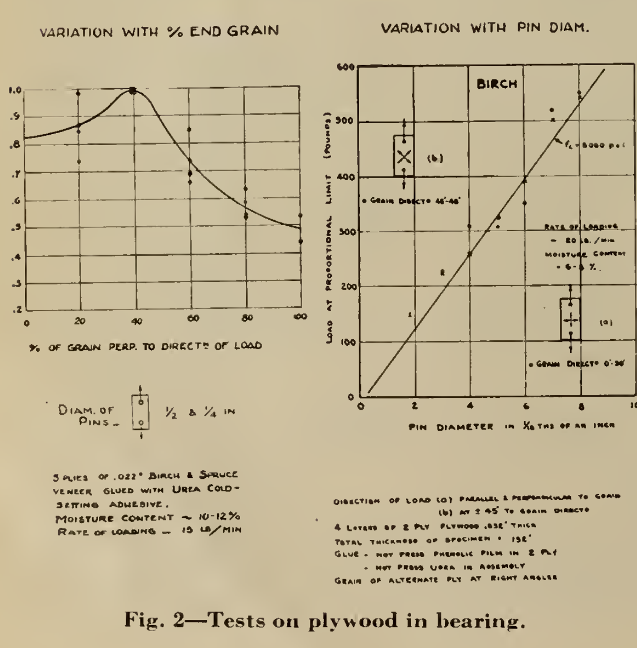


Fig. 2—Tests on plywood in bearing.

Wood as a Structural Material

Although wood is one of the oldest structural materials in the world, surprisingly little information has accumulated as to its strength properties. Admittedly far from the isotropic ideal dear to the elastician, the elastic properties of the material are specified by at least twelve constants, or rather parameters, which vary with moisture content, specific gravity and even from the heartwood to the sapwood of the same tree. Time effects are important and, particularly when shear loads are involved, both deflection and loads at failure will vary with the time the load has been applied. This may sound like a rather vague proposition for an engineering material, but if the experimental data on the external loading condition of an airframe are critically examined, it is apparent that the only logical assessment should be on a statistical basis; therefore, providing the probable variations fall within reasonable limits, there is no inconsistency in employing a material the strength properties of which are not uniquely determined. Moreover, since the leading dimensions of an aeroplane are defined chiefly by aerodynamical and operational requirements, few compact structural sections can be employed without an excessive penalty in weight. Stiffness, therefore, rather than considerations of ultimate strength usually governs the design. In elastic stability problems, it can be shown that the ratio of Young's modulus to density, to density squared, or even to density cubed, is the figure of merit for any material, and that under such conditions an expanded material, such as wood, is supreme. Finally, with the present insistence on perfectly smooth surfaces, it is not difficult to see that contemporary metal construction is considerably handicapped.

In view of the broad scope of the problem, it was felt at the Research Council that useful results could most quickly be obtained by concentrating on one or two design problems, performing such basic tests as from time to time appeared desirable and acquiring in the process a good deal of useful experience in shop technique.

Tests to Obtain Basic Data

One cannot proceed very far with the design of shell structures without some basic data and a few of our first tests were conducted on plywood cylinders in compression (See Fig. 1). Some of these cylinders were hot-press moulded with a rubber bag in the autoclave, others were formed with two-ply veneer and cold-press resin on a wrapping machine. The grain of the wood was in all cases at 45 deg. to a generator, with inner and outer plies parallel and the grain of the core plies at right angles. The diameter of the cylinders ranged from 6 to 24 inches. We have been able to detect a slight length effect with matched specimens but consider that it is negligible for all practical purposes.

It is interesting to observe that the critical compressive buckling stress can be expressed in the familiar form $S_c = KE\frac{t}{R}$ where K is an experimental constant, E is the modulus of elasticity of the material, in our case parallel to the direction of the load, t is the wall thick-

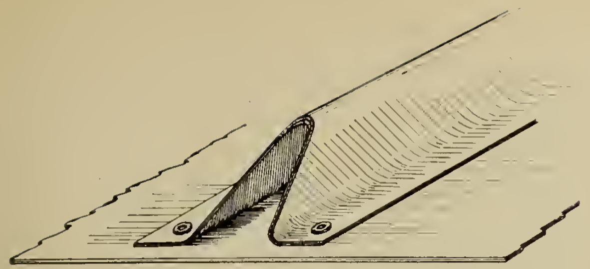


Fig. 3—Tapering and securing ends of stiffeners.

ness and R the radius of curvature. A conservative value for design purposes is obtained by taking $K=0.3$, a value which has enjoyed considerable popularity in the design of metal structures for years.

We have conducted few bending tests on cylinders to date and in most applications the problem is complicated by the addition of shear loads. The results of a few bending tests indicate that the critical stress, again as in the case of metal cylinders, is some 25 to 40 per cent higher than the critical value in compression.

The results of a fair number of compression tests on plywood blocks show that, with compact sections, the elastic modulus and ultimate strength vary rapidly with changes in the grain angle.

The low bearing strength of wood perpendicular to the grain is a shortcoming which can be avoided by the use of plywood. The values shown in Fig. 2 have been found useful in the design of joints employing rivets or short bolts. With concentrated loads of any magnitude the size and number of pins required to transmit the forces directly to the plywood structure may become formidable and the need arises for an intermediate material having a high bearing strength, reasonable tensile and shear values, and a moderate density. Phenolic fabric base laminates were found satisfactory for this purpose. These are available with a bearing strength of the order of 30,000 lb. per sq. in. Form factors are apt to be unpredictable, however, and it is good practice to conduct a few simple tests in order to determine safe loads for any specific condition.

Bonding and Gluing

The phenolics usually will bond to wood effectively only with hot press resins. Since the temperature coefficients of linear expansion for the plastics usually differ substantially from those of wood, it is important to avoid excessive temperature stresses. We consider that the most satisfactory expedient is to first glue a thin layer of veneer to the laminate with hot press adhesive and then to bond the wood face to the remainder of the structure with a cold setting adhesive. The same considerations apply in bonding metal to wood.

The problem of diffusing a concentrated load into a shell structure is always troublesome. Particular care should be taken with plywood structures because wood has no elastic limit in tension. Highly localized tensile stresses may cause failure even if the average stress in a member is quite moderate because the material cannot yield plasticity and distribute the local stresses.

Many of the weathering difficulties which have arisen with wooden aeroplanes in the past can be attributed to the use of primitive glues and it is safe to say that recent advances in the art are largely the outcome of improvements which have occurred in glues. Many synthetic resin adhesives are now available which have a high resistance to water, ample shear strength and are proof against mould and extremes of temperature. Quite a number will even survive the boiling water test, which is still required by some specifications, although it has never been explained why anyone should want to boil an aeroplane.

Contrary to popular opinion, high pressures are not required in gluing and it is quite possible to construct satisfactory joints with a pressure of less than one lb. per sq. in. if the viscosity of the glue is not excessive. The pressure requirements are determined solely by the forces necessary to obtain a thin glue line and, if the veneers are thin and the pressure uniformly distributed, then the forces required are small. With more rigid sections, high pressures are essential only if the faces of the wood do not match reasonably well. On thin members, nails or screws will provide ample pressure, but it should not be assumed that the nails or screws will be effective after the glue has set, because large shear deflections, sufficient to fail the glue, are necessary for these elements to assume any load.

In a three-ply test specimen it is not very difficult to produce a bond with a shear strength equal to that of the wood, but it does not follow that every joint can transmit a load corresponding to the block shear strength of the wood. For example, the stresses in the

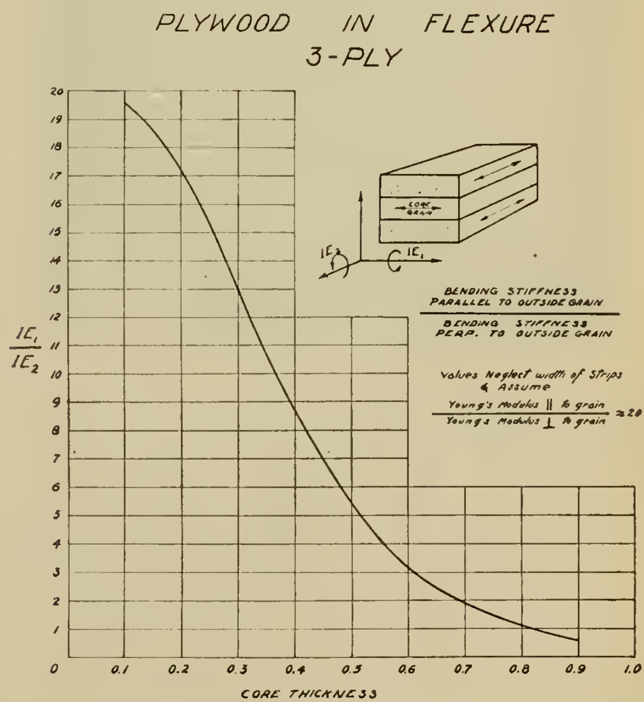


Fig. 4—Effect of core thickness on plywood in flexure.

Fig. 5—Moulded plywood rear fuselage for Harvard trainer.

Fig. 6—Method of building the skin.

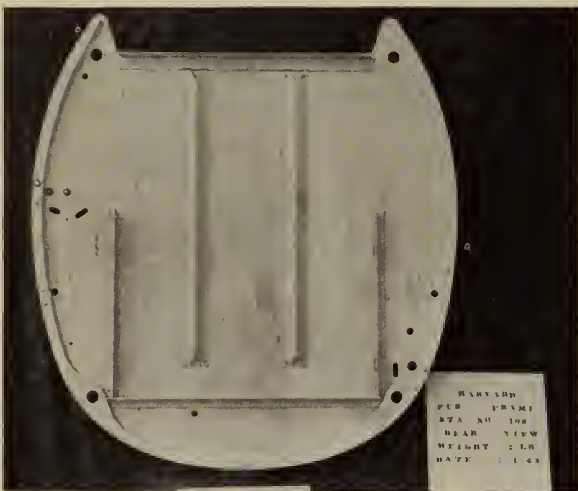


Fig. 7—Bulkhead with frame and stiffeners.

joint may be far from pure shear and it is not surprising that for a thin specimen and with the grain in the core parallel to the face grain, the load at failure is of the order of 25 per cent of the strength of the wood in pure shear. A further reduction results when the grain of the intermediate ply is not parallel to the load; at 90 deg., for example, there is a further decrement of 30 to 50 per cent due to the rolling effect of the wood fibres.

Sometimes failures in box beams are unfairly charged to the glue. A thin web will buckle at very moderate shear stresses and continue to carry the load in diagonal tension. As the result the maximum shear stresses in the flange-web joint are more than double the values calculated from simple shear considerations.

It relieves the load on glued joints considerably if the ends of stiffeners are tapered as in Fig. 3. In flooring, decking and so forth where local distortion may be large, rivets are found extremely effective in discouraging peeling in the glue joint.

In gluing it is of the utmost importance to match the moisture content of the pieces which are to be glued together. If a thin strip of veneer is coated with liberal quantities of a water-soluble glue and bonded to a heavier piece which is perfectly dry, it is obvious that the wet member will contract in drying and the result will be a badly warped component. Moreover, wood is a hygroscopic material and no amount of finishing will prevent it from shrinking and swelling with changes in the moisture content of the air. Most of the dimensional change occurs in a direction perpendicular to the grain so that if two pieces of veneer are glued together with the grain at right angles, the panel will only remain flat at one value of the relative humidity.

For a stable material it follows that three plies of veneer are the minimum. Unfortunately, conventional three ply is composed of veneers of equal thickness and the bending stiffness parallel to the face grain is some 12 times the stiffness at right angles. Therefore, unless special design considerations demand much greater stiffness in some one direction, it is preferable to employ a construction which gives a comparable stiffness in both directions. Figure 4 shows how this can be done by using a thicker or thinner core.

Experiments in Construction of Fuselage and Control Surfaces

Turning our attention to more ambitious experiments, Fig. 5 indicates the general structure of a rear fuselage which we designed and constructed in moulded plywood. It did not appear desirable to redesign the forward portion of the structure because the existing steel tube framework with detachable side panels permitted access to a large amount of equipment which could not readily be moved. Hence the detail design of this portion was dictated somewhat by the original metal layout, but every attempt has been made to approach the true monocoque form. The skin is sufficiently thick to carry all loads except in the vicinity of cut outs and in the forward portion where the loads from the four attachment points are distributed by stub longerons. Light wooden frames maintain the correct shape. Plastic pads transit the axial loads from the attachment fittings to the longerons. It is interesting to note that the problem of stress diffusion is frequently less difficult with plywood than with metal structures; with the longerons, for example, we have endeavoured to taper the cross sectional area and to graduate the elastic properties by varying the construction so that the glue joint between the longeron and the skin is uniformly stressed.

This fuselage was static tested in six different flight and landing conditions, and proved well up to design requirements. Weighing 154 lb. as tested, it has carried a down load on the tail equal to the design breaking load for a Spitfire fighter aircraft. In the landing attitude it has sustained a tailwheel reaction slightly in excess of two and one half tons.

The skin, which is moulded in two halves as shown in Fig. 6, is composed of four layers of spruce veneer bonded with thermo-setting urea glue. The veneers are trimmed to shape and stapled in place on a wooden mould with the inner and outer layers at right angles to the middle layers and at an angle of 45 deg. to the fuselage centre line. Successive layers are coated with adhesive and assembly-sealed in a rubber bag and cooked with steam in the autoclave for about 35 minutes at a temperature of 240 deg. and a pressure of 30 lb. per sq. in.

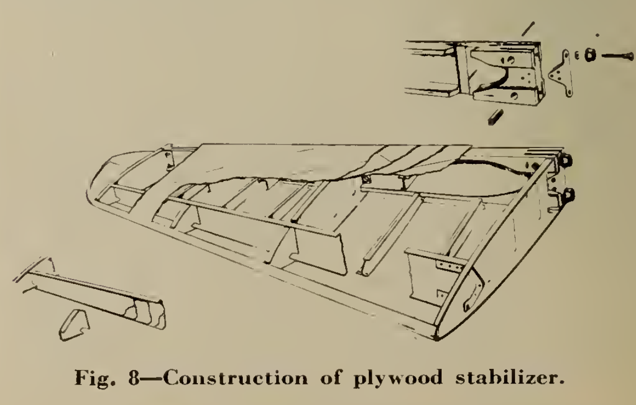


Fig. 8—Construction of plywood stabilizer.

Figure 7 is a rear view of the front bulkhead. We prefer to fabricate the frames separately and mounting these in a jig, to glue the half skin to the frames with cold setting glue. Woodscrews, at a liberal pitch, are supplemented with webbing at appropriate sections to apply to pressure and with the drying accelerated by infra-red lamps the entire operation is completed in less than an hour.

In the stabilizer structure shown in Fig. 8 the skin is hot press moulded and stiffened with channel section moulded stiffeners. The ribs are also flanged and bonded in a rubber bag. For the rear spar we chose an I beam section with the grain in the plywood web running diagonally. The root fitting consists of a pair of ball and socket joints attached to trunnions. These trunnions transmit the loads to a phenolic laminate inserted in the spar flanges. The total stabilizer weight is 23 lb. On test it carried 2200 lb. without evidence of distress.

The elevator is similar. The skins and stiffeners are assembled on the bench and then glued to the channel section spar and end ribs in one operation. Finally the moulded leading edge is glued in place. The complete weight less mass balance is 13 lb. The elevator structure failed at a test load of 1040 lb. or 140 per cent of the design load.

With the rudder, as in the previous components we endeavoured to make the skin the major structural element. The bottom fairing, which is detachable, is composed of fabric impregnated with ureaformaldehyde resin and moulded in the autoclave. Weighing 18 lb. complete with mass balance, it was tested to 150 per cent of the design load without any evidence of failure.

We have also built and tested a number of components along more conventional lines, as for example,

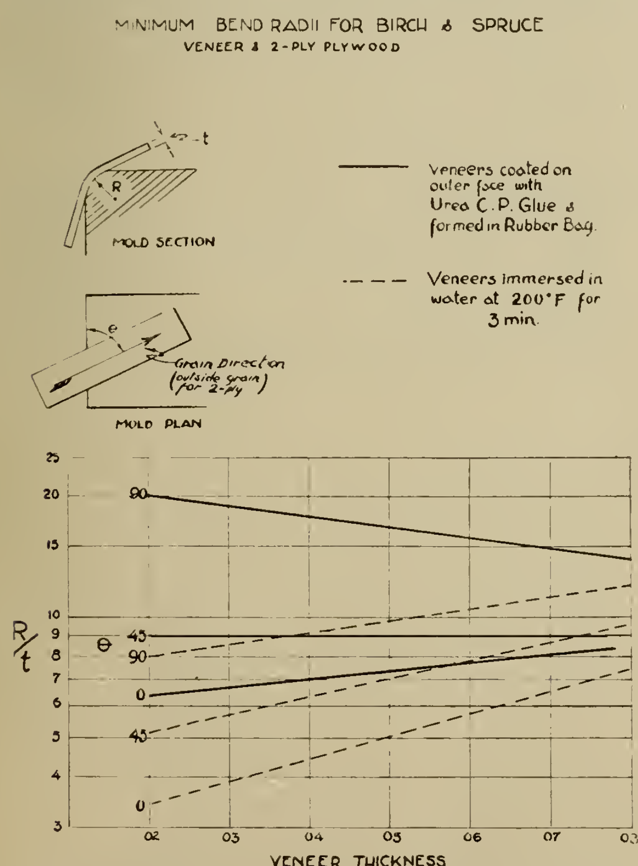


Fig. 9—Minimum bend radii for veneer and two-ply plywood.

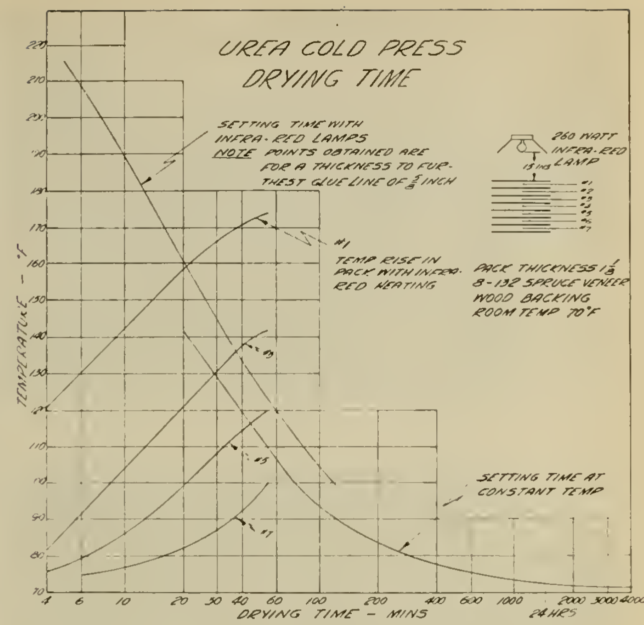


Fig. 10—Drying time with infra-red lamps.

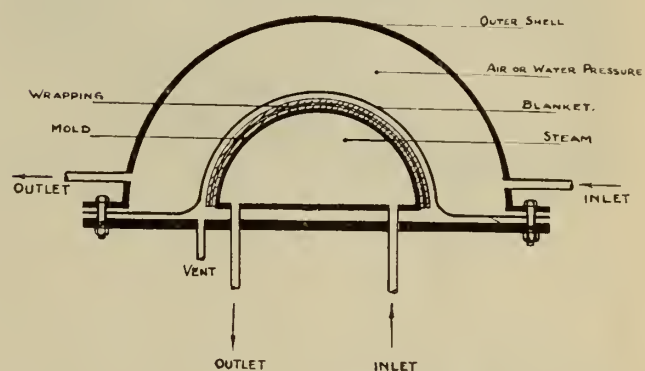


Fig. 11—Experimental autoclave with metal mould.

a rudder with full depth diagonal ribs. The spar, ribs and trailing edge are first assembled and then the skin is glued in place using small self-tapping screws to apply pressure. The final operation consists of gluing the leading edge in place.

Bending, Cooking and Moulding Plywood

One of the first things one needs to know in designing these structures is a safe bend radius to use with the various veneers. The values shown in Fig. 9 we consider to be a practical minimum.

Infra-red lamps will greatly accelerate the drying of cold setting resin adhesives. The curve in Fig. 10 indicates the time required to achieve a reasonable shear strength at a constant temperature. The time is very considerable at the temperatures which frequently prevail in workshops. The diagram shows some time-temperature curves for a thick pack of veneers exposed to an infra-red lamp under these conditions. As a simple example consider a glue line 1/8 in. below the surface. During the first eight-minute interval the average temperature is roughly 120 deg. and at that temperature we see from this curve the total time required would be 40 minutes for a glue to set. Therefore, in eight minutes we obtain 20 per cent of the required cooking. During the next interval, the average temperature is about 145 deg. and the total time required would be 20 minutes, therefore, in eight we obtain an additional 40 per cent of the required cooking.

Fig. 12—Disposable fuel tank made of plywood.

Fig. 13—Assembly of plywood fuel tank.

Adding the percentage to a total of 100 per cent, we obtain the required time with this lamp and distance in a glue line ⅛ in. below the surface. This curve is based on experimental results with a ⅝-in. panel and shows the considerable time saving which can be realized.

No description of the bag moulding art is necessary as it has received a good deal of attention in the literature lately. Lockheed employed the fluid pressure idea fifteen years ago to produce a number of extremely refined aeroplanes but the production possibilities of the method have only recently received attention. The wooden mould, rubber bag and autoclave, as currently used is a convenient arrangement for experimental work, but suffers numerous drawbacks for large scale production. Wooden moulds are woefully impermanent when subjected to frequent heating and cooling cycles, a great deal of time and heat is wasted in cooking the great bulk of the mould, and its size and general awkwardness present a considerable handling problem not to mention the wear and tear on rubber bags. Alternative methods are in use with varying degrees of success, but we believe that a metal mould in the majority of production applications will quickly pay for itself. Figure 11 shows a section through such a mould. The form is of metal and internally heated, preferably with steam. The veneer and glue assembly is placed on the form and stapled to wooden inserts at the edges. Over this assembly is placed a reasonably air tight blanket, it does not need to be rubber and even a few leaks do not matter. Finally a light outer shell is dropped in place and sealed. Compressed air can therefore provide the pressure independently of the temperature. We have performed a number of cookings on a unit of this type, the temperature rise is extremely rapid and the results uniformly satisfactory.

One of the most interesting plywood enterprises in which we have been engaged is a jettisonable or disposable fuel tank for a long-range fighter aircraft as shown in Fig. 12. The machines carry two of these tanks, one under each wing, and when the fuel is consumed the tank is dropped. Therefore, cheapness and simplicity of construction is essential.

We start with a two-ply veneer which is wound on a collapsible drum. Metal bands are loaded with a lever weight arrangement to apply pressure. Infra-red lamps supply the heat necessary to set the cold press resin as the two-ply ribbon is wound on the drum. The nose and tail are of the same shape and are made of 5 layers of two-ply, hot press moulded wood (see Fig. 13). Laminated rings which also carry the loads from the attachment fittings serve as a doubler between the ends and the cylindrical portion. Pipe and attachment fittings are riveted in place first, then the ends glued on and a fairing added. The tanks are flushed with a gasoline resistant sealing compound, pressure tested and with a coat of paint ready for service.

We have performed a number of tests on these tanks but none so drastic as that which recently occurred when one laden with 100 octane fuel was accidentally released from an aircraft about to land. The tank dropped a distance of four or five feet and commenced a journey across the field at some 100 m.p.h. Although enveloped in spray it did not ignite and despite considerable damage was still a complete unit when retrieved by the somewhat shaken ground crew.

LAUNCHING 10,000-TON CARGO VESSELS

PAUL G. A. BRAULT, M.E.I.C.
United Shipyards Limited, Montreal

Paper presented before the Montreal Branch of The Engineering Institute of Canada, on March 4th, 1943

The six-berth shipyard at Bickerdike Basin, Montreal, known as United Shipyards Limited, was built for the purpose of producing 10,000-ton cargo vessels. During construction of the yard it was necessary to determine the length, position and make-up of the launching groundways and also the excavations needed to provide launching clearances.

To this end complete launching calculations were computed. These calculations served for the design of the launching cradle and launching arrangements as well.

The Vessel

The principal dimensions of the vessels to be launched are as follows:—

Length between perpendiculars	416 ft.
Length from stern to aft perpendicular	17 ft. 6½ in.
Length from fore perpendicular to bow	7 ft. 10¼ in.
Length overall	441 ft. 4¾ in.
Midship moulded breadth	56 ft. 10½ in.
Midship moulded depth	37 ft. 4 in.
Rake or F.P. to intersection of keel and stem bar	7 ft. 9 in.

A table of offsets lifted from the loft floor defined the moulded shape of the hull. From this table a series of Bonjean curves were established which permitted the calculation of buoyancy and centre of gravity of buoyancy at any displacement desired.

The vessels are erected with keel line at a slope of ⅝ in. to the foot, and the intersection of the aft perpendicular with the keel line is at elevation 100.0 ft.

The Yard

The disposition of the six berths is shown in Fig. 1. The relationship of the two groups of three berths was governed by the local rock contour of the site. The dark hatched areas represent the crib cofferdam necessitated by seasonal water level variation. In way of each berth the cofferdams are joined by a series of removable bents and stoplogs. This distance from face of stoplog to aft perpendicular during construction is 58 ft. The clear distance between cofferdams when bents and stoplogs are removed is 65 ft.

Several features of the yard affected the design of the launching arrangements. Although the water in the basin is tideless, its elevation during the launching season (Apr. 15th to Dec. 15th) may vary from elevation 106 to elevation 92 minimum. The summer average is approximately at elevation 95. At the first winter freeze up, however, the water may rise to elevation 116. This condition required the building of a watertight cofferdam system which would permit hull construction during the winter months.

The jagged rock bank on the east side of Berth No. 3 left after excavating for launching clearance extends about 250 ft. beyond the end of groundways and parallels the berth about 35 ft. from its centre line. This leaves only 6 ft. clearance during a launch and the danger of any loose cradle timber becoming snagged made it advisable to design the launching cradle in such

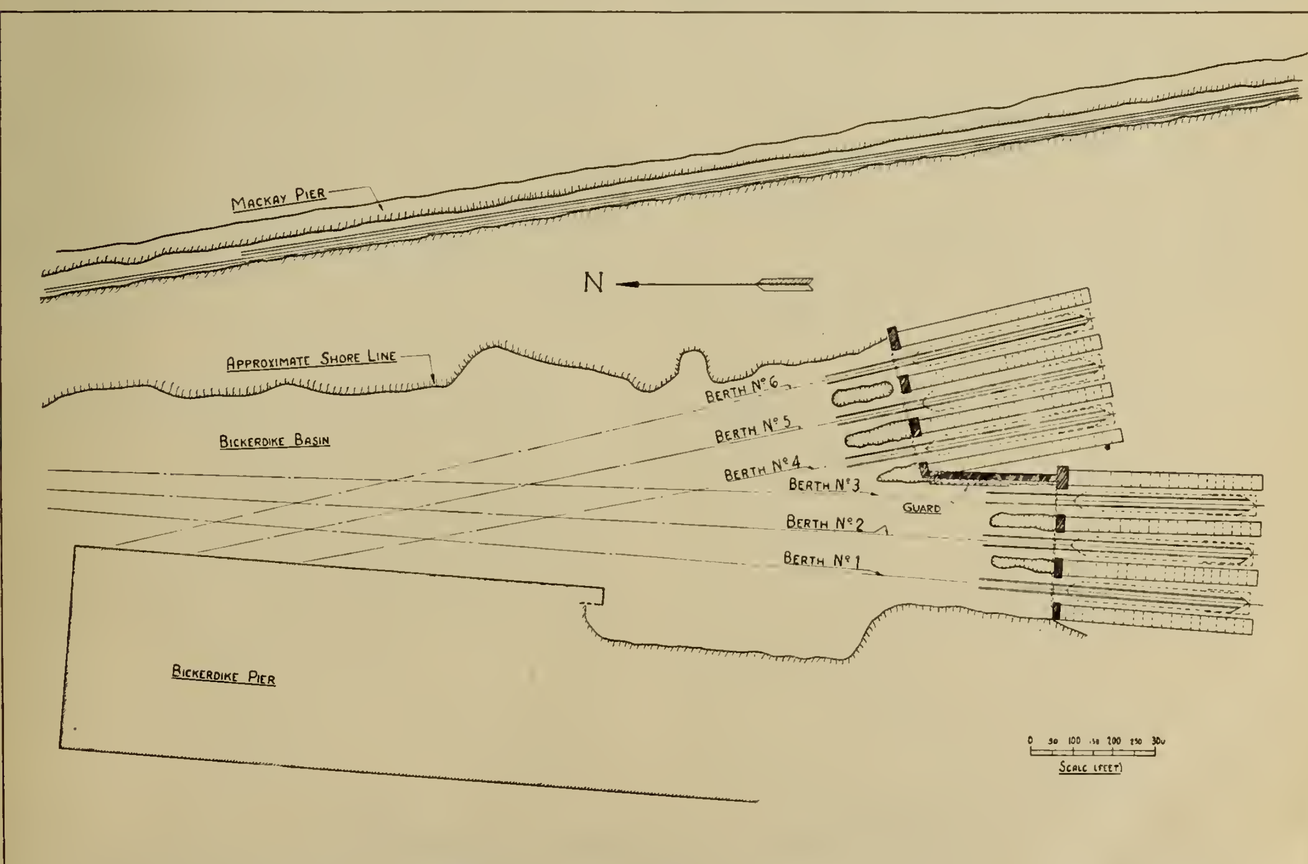


Fig. 1—Arrangement of building berths at Bickerdike Basin.

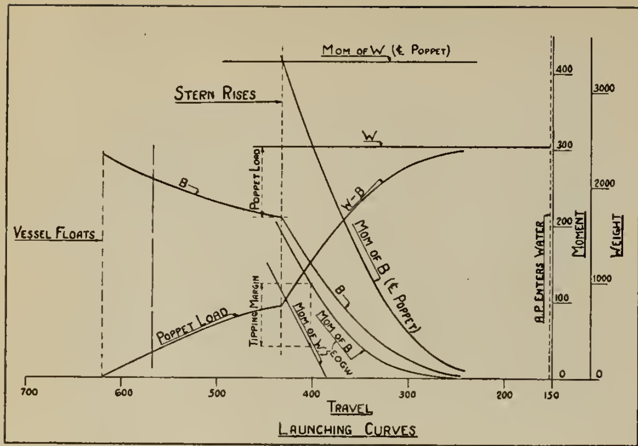


Fig. 2—Launching curves showing the forces and moments acting on vessel during launching.

a manner that all parts be thoroughly secured and that the removal of the cradle after launching be controlled.

At this same berth the lack of water between the vessel and the bank during a launch sets up a transverse head which causes the vessel to move towards the bank immediately after leaving the groundways. In order to protect the hull from damage a timber guard was built off the adjoining cofferdam.

The vessel when launched offers about 12,000 sq. ft. of exposed surface to prevailing east or west winds. The basin is narrow and presents a limited area for tugs to manoeuvre in. These facts made it desirable to apply drags to the vessel to bring it to rest immediately after the launch.

Static Launching Calculations

Calculations of moments of vessel's weight and buoyancy about the fore poppet and end of groundways for various travels were made. These computations were based on the following assumptions:—

Launching weight of vessel......	2,430 long tons
Weight of launching cradle.....	90 long tons
Declivity of vessel and groundways......................	⅝ in. per ft.
Camber of groundways.........	nil
Length of groundways aft of A.P.	180 ft.
Distance from keel to sliding surface.....................	3 ft.
Elevation of water.............	92.0 ft.

The results of these calculations are plotted graphically in Fig. 2, and indicate the maximum static fore poppet load to be about 750 tons and the margin against tipping about the end of groundways to be about 82,000 ft.-tons.

The curves show the variation of load on fore poppet during launching due to weight (W) and buoyancy (B), also the moments of W and B about the centre of fore poppet and about the after end of ground ways (EOGW). They indicate that pivotting occurs at a travel of 433 ft. after start of launch. A one-foot rise or fall in water level would shorten or increase the travel by 19.2 ft.

Assuming a straight line variation of pressure on the overlap on the groundways, calculations showed a maximum way end pressure of 5 tons per sq. ft. Under normal conditions, i.e., water at elevation 95.0 and length of ways aft of A.P. of 230 ft., the indicated way end pressure was under 3 tons per sq. ft.

At the theoretical pivotting position the draft at the aft perpendicular figured at 14.5 ft. Assuming a 100-ft. over-run beyond the theoretical pivotting point, the draft would be 19.7 ft. This latter figure was used to determine the required excavations of the basin needed to provide launching clearance.

The Groundways

The two groundways on each berth are at 20 ft. centres and extend from the bow to approximately 230 ft. beyond the aft perpendicular. Their over all length is about 630 ft. They are straight and without transverse inclination or longitudinal camber.

The width of each groundway is a function of the launching weight (2,520 tons), length of sliding ways (349 ft.) and the desired initial mean pressure (2.0 tons per sq. ft.). Thus the width required equals:

$$\frac{2520}{2.0 \times 349} \times \tfrac{1}{2} \times 12 = 21.7 \text{ in.}$$

Each groundway consists of two continuous rows of 12 by 12 dressed B.C. fir timbers placed side by side with staggered butt joints and bolted with through ¾ in. bolts at about 42 in. centres. A 6 by 12 ribband, extending 3 in. above the top of the groundways, runs continuously on the outboard side and is wedged at 7 ft. centres to anchored timber blocks. The dressed size of the timbers being 11½ by 11½ in., the width provided equals 23 in. less 1 in. ribband clearance, or 22 in. net.

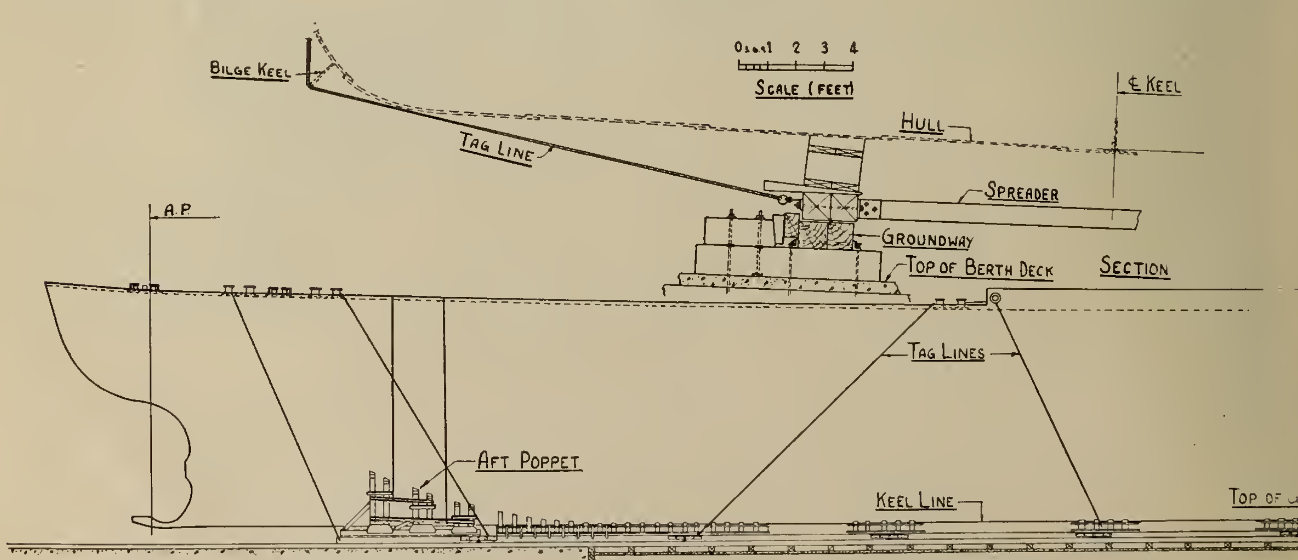


Fig. 3—General arrangement of

A temporary cofferdam was built to permit construction in the dry of the aft end of groundways. After completion, this cofferdam was removed, thus permanently flooding the area. The aft 307 ft. of ways are laid on continuous concrete pedestals poured upon rock. The remainder are supported on the berths' timber bents (7 ft. centres) which are also on rock foundation. The rock between the ways was excavated for a distance of 28 ft. forward of the end of groundways to provide clearance for the drop of the vessel in the event of launching at minimum water level.

In anticipation of possible heavier launchings in the future, the submerged length of the groundways was built 6 in. wider than the forward portion. A removable filler piece was inserted along the ribband to align with the ribband on the remainder of the ways.

The Releasing Arrangement

There are two common methods of controlling the force component down the ways. They are the releasing trigger and the burning sole plates. The latter method was adopted at United Shipyards Limited due to its extreme simplicity and its ready adaptability to prevailing conditions. Although the sponsor does not actually release the vessel as is the case usually with the trigger, the method adopted is not without its interest value as the burning of the sole plates is a point of unfailing attraction to all who witness the launching.

The sole plate, one at each sliding way, is a steel plate bolted to two holding plates, one of which is bolted to the forward end of the sliding way and the other bolted to the groundway as described later under "Fore Poppet" and shown in Fig. 6. The net section and bolting of each sole plate is designed for one half of the total force component down the ways, neglecting friction on the groundway lubricant.

The force component down the ways (F) is equal to the launching weight times the sine of the angle of declivity of the ways, or $F = 2520 \times .052 = 131.6$ tons. It is transmitted to the sliding ways by friction between the hull and cradle and reacted by the rock foundation through the berth structure and compression in the groundways.

The centre of each sole plate is perforated with twelve 11/16 in. diameter holes at 1½ in. centres. The spaces between holes are numbered consecutively from the outer edges of the plate towards its centre. In this manner the burning of both sole plates is more readily controlled and uniformity of remaining section in each plate assured.

The area of metal broken gives a measure of the actual force acting upon the vessel.

The Cradle

The general elevation in Fig. 3 indicates the three principal parts of the cradle, built between the sliding ways and the vessel. They are the aft poppet, the main blocking and the fore poppet. The midship section shows how the wire rope tag lines and the sliding way spreaders combine to prevent any transverse movement of the cradle during the launch. All individual parts of the cradle, such as wedges, planks, blocks, etc., are thoroughly tied to the sliding ways. This assures complete salvage of all items as well as preventing any part floating away separately while the vessel is entering the water. The 1 in. wire rope connecting the forward sliding way section to the drag cable shackle serves eventually to anchor the cradle to the drag after the vessel has come to rest.

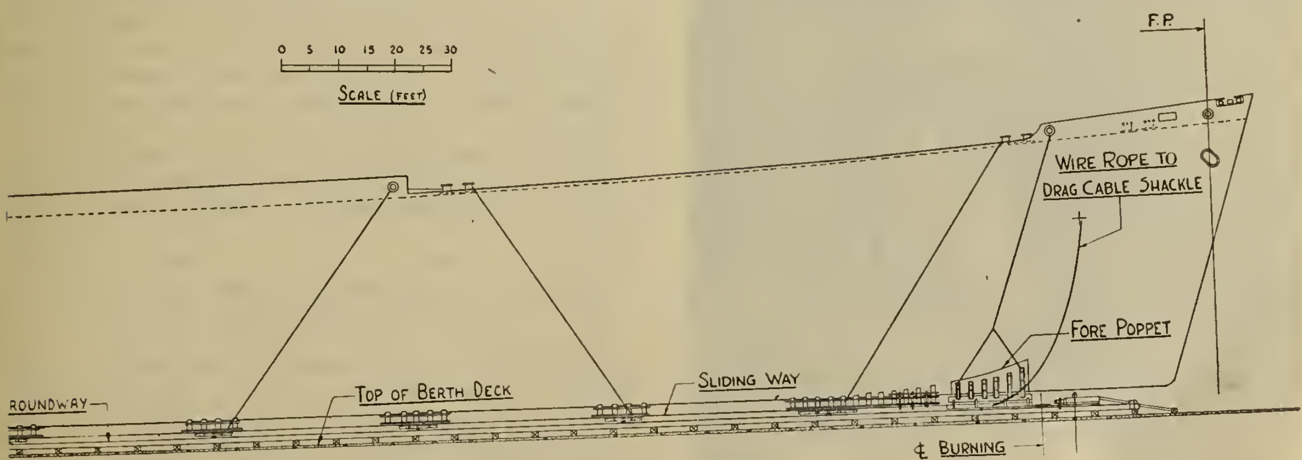
The Sliding Ways

The total length of each sliding way, one on the port groundway and the other on the starboard, is 349 ft. Each is made up of nine sections 36 ft. long and one aft section 25 ft. long. Each section consists of two 12 by 12 dressed B.C. fir timbers bolted together with through ¾ in. diameter bolts at 51 in. centres. The length and position relatively to the vessel of each sliding way is determined by practical considerations of the fore and aft poppet construction.

The design of the joint connecting each section of sliding way to the succeeding section is of prime importance due to the type of releasing arrangement adopted. Conceivably, if a joint were not adequate, the vessel might launch itself by merely breaking down its friction on the cradle forward of the weak joint. Thus the fore poppet would be left behind thereby causing probably disastrous results.

A joint is designed for one half the force component down the ways, neglecting the lubricant friction, less the friction between the hull and cradle forward of the joint being considered. The first joint forward consists of two link plates which engage a 3 in. diameter through pin in each adjoining section. Each through pin in turn engages two side plates which are adequately bolted to its section. The second joint from the forward end is similar to the first joint but with 2 in. diameter through pin and smaller side plates. To permit interchangeability of sections, all remaining joints are made the same as the second joint (see Fig. 4). Two of the side plate bolts at each joint engage an angle on the outboard side. This angle has a hole in its outstanding leg which serves to connect the tag lines and tie up cradle components.

Each port section of sliding way is connected to its



cradle. showing ways and poppets.

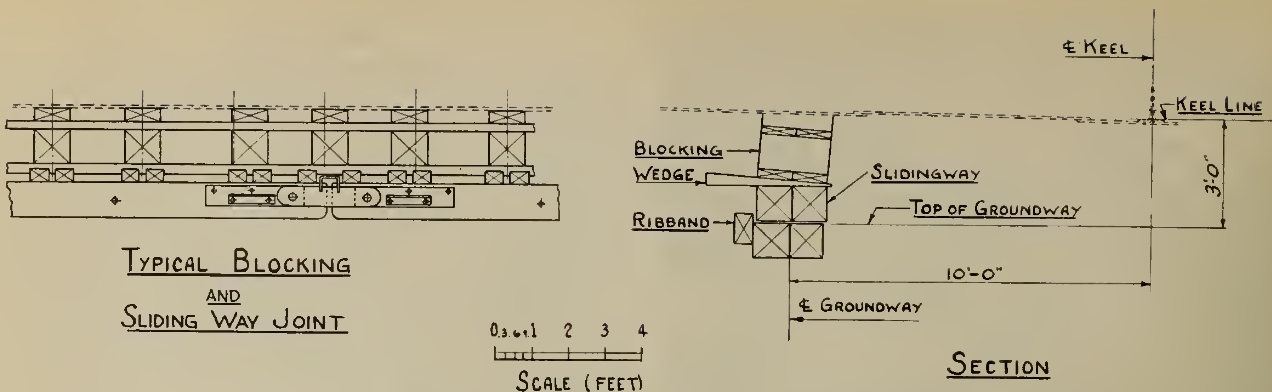


Fig. 4—Typical cradle blocking, and sliding-way joint.

corresponding starboard section by two 8 by 8 timber spreaders positioned at the third points.

The sliding ways are spaced 1 in. clear of the groundway ribband by means of thumbplates. These thumbplates are steel plates 1 in. thick by 2½ in. wide, bent into the shape of an angle 2½ by 1 in. Two thumbplates are placed at each sliding way section. They are all numbered and are carefully checked when removed just prior to launching in order to make sure that none have remained in place.

The one inch space between the groundway ribband and the sliding way is covered by a ¼ in. wood strip for the full length of the cradle. This is a precaution against nuts, bolts, washers, etc., becoming lodged in the clearance space during the construction period of the cradle. These covers are removed just before the thumbplates are taken out whereupon a last inspection of the clearance space is made before launching.

Cradle Blocking

Typical cradle blocking is shown in Fig. 4, and occurs at each hull frame. The blocks between the two layers of longitudinal 3 by 12 planks are 12 in. by 12 in. by 2 ft. long. The fitting block is also 12 in. wide. The wedges are cut from 4 by 6 in. hard wood, 3 ft. 6 in. long and have a slope of 1 in 12 in. The four corners of the driving end of each wedge are chamfered. The sliding way joints provide 1 in. clearance between sections. The ends of all sliding way sections are rounded at the lower edge to prevent scoring of the groundways.

The Aft Poppet

The maximum strain on the aft poppet occurs after the stern keel blocking has been removed and remains until the aft poppet passes beyond the end of groundways. The load it must carry is indeterminate but it must support the overhang of the vessel aft of the poppet. This overhang is about 56 ft. at the upper deck and about 39 ft. at the keel line.

Fig. 5—Starboard aft poppet showing wire rope arrangements for its salvage.

The cradle is removed from under the vessel by anchoring the cradle to the drag blocks and having the tugs haul the vessel off by the stern. The keying action of the aft poppet on the finer lines of the vessel's stern made it necessary to construct the aft poppet in such a manner that it would remain with the vessel during this hauling off operation. As shown in Fig. 5, the aft poppet is therefore built as a separate unit, free from the sliding ways at the bottom of its wedge riders and tied to the vessel by two ¾ in. wire ropes on each side. The six vertical members with bracing longitudinal channels and wedge rider are built and handled in one piece. The saddle plates, tie rods and angles, etc., are assembled separately. Note the wire ropes connected to the poppet distinct from the tag lines connected directly to the sliding ways. To salvage the aft poppet the wire rope tag lines are thrown off and the poppet allowed to sink to the bottom of the basin at a convenient spot, the proportion of steel in the unit being purposely sufficient to assure the unit will not float. Buoys at the ends of the wire rope tag lines serve to spot the position of the poppet whereupon it is raised from the bed of the basin by a floating crane.

The very purpose of the shipyard dictated that all cradle parts be so proportioned that they could be reused repeatedly. For this reason the vertical uprights of the aft poppets are capped with a cross timber instead of running up directly to the hull. These cross timbers serve as fitting pieces and can be readily replaced for adjustments on different vessels, thus preserving the main structure intact.

The Fore Poppet

The fore poppet is the bearing about which pivotting of the vessel occurs during launching. The poppet must provide the means of pivotting and at the same time properly distribute the resulting concentrated load to the groundways. Both of these functions are obtained by the use of crushing blocks.

The fore poppet and releasing arrangements are shown in Fig. 6. The sliding way holding plate and sole plate are 23 in. wide and ½ in. thick. The groundway holding plate is 24 in. wide due to the 1 in. difference of centres between the sliding way and groundway. Should the starting friction on the lubricant be too high, two 100-ton hydraulic jacks are provided, one at each groundway, which are connected to a single pump. The tie down is to take care of the local moment set up by the sole plate load being reacted at the centre of the groundway. Note the connection on the outboard side of the sliding way used to anchor the cradle to the drag blocks after the launch.

Previous to pivotting, the keel line and the bottom of

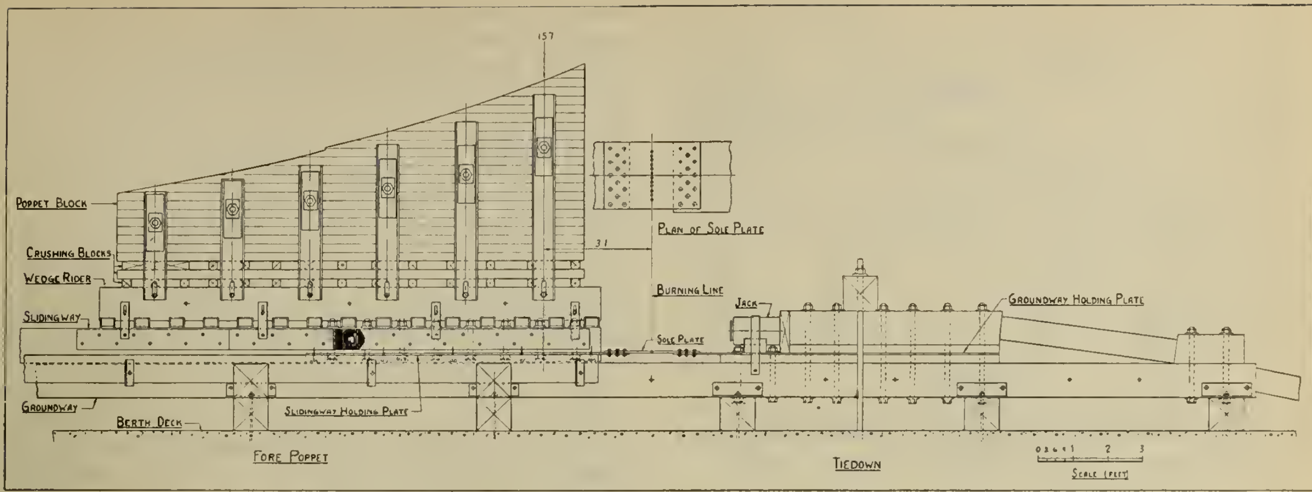


Fig. 6—Elevation of fore poppet and releasing arrangement.

the poppet block are parallel to the groundways. During pivotting, the angle between the bottom of the poppet block or keel and the groundways changes from 0 to about 3 deg. Theoretically, if the vessel and cradle were absolutely rigid an infinitely small angle between the keel line and the groundway would cause all the load on the ways to be concentrated at a single point of contact. This load would be equal to the launching weight (W) less the buoyancy (B) at that instant. Since the vessel is not absolutely rigid the poppet load therefore cannot be 750 tons as static calculations showed. Keeping in mind the fact that as the launch proceeds the angle between the keel and groundways is continually increasing, but that at the same time the load on the ways ($W - B$) is continually diminishing, there comes a time when the change of angle is sufficient to overcome the elasticity of the vessel and the load on the groundways actually becomes concentrated. The crushing block arrangement is a deliberate effort to create a non-rigid space, of fixed length, between the hull and the groundways which will take the change of angle and spread the load uniformly over a known length.

The method used in proportioning the crushing blocks is as follows:—

(a) Determine a graph of the unit stress per square inch required to obtain various percentages of crushing of the blocks to be used. (Several tests were made with clear spruce wood. The average of these tests is shown in Table I).

(b) From the static launching calculations determine the angle (α) between the keel and groundways and the load ($W - B$) on the ways for various travels after pivotting has commenced.

(c) Assume a depth of crushing blocks and determine the amount of crushing (D in.) at the forward end of the poppet. This crushing should be about 35 per cent of the depth of blocking.

(d) For each travel in (b) determine the length (L) of poppet in contact with the ways assuming that the full crushing (D) has taken place.

$$L = \frac{D}{\tan \alpha}$$

(e) For each travel in (b) determine the load (P) per square foot on the ways.

Then $P = \dfrac{W - B}{L\,b}$ where b = width of sliding ways in contact.

It will be found that this quantity (P) increases to a maximum as the travel increases and then begins to diminish with further increase in travel. The permissible load on the groundway lubricant is about 10 to 11 tons per sq. ft. Should the maximum calculated load P be higher than this, the depth of crushing blocks must be increased and the calculations repeated till found satisfactory. At the travel at which the maximum pressure per square foot occurs the quantity L represents the required length of poppet block.

(f) With a poppet of length L and crushing at its forward end equal to D, the crushing D_z at any intermediate block distance z from the aft end will be $\frac{z}{L} \times D$. From Table I the pressure per square inch to obtain D_z may be found.

(g) Since the pressure per lineal foot of poppet equals $P \times b$, it follows from f) that the area of crushing blocks required for each foot of poppet is known. For practical reasons, it is better to fix the area of blocking and vary its spacing rather than vary the blocking area at a uniform spacing.

TABLE I

Table showing percentages of deformation of clear spruce blocking when subjected to various unit pressures.

Pressure in lbs. per sq. in.	Crushing percentage of depth
100	0.83
200	1.67
300	2.50
400	3.83
500	8.33
600	17.50
700	26.67
800	35.83
900	45.00

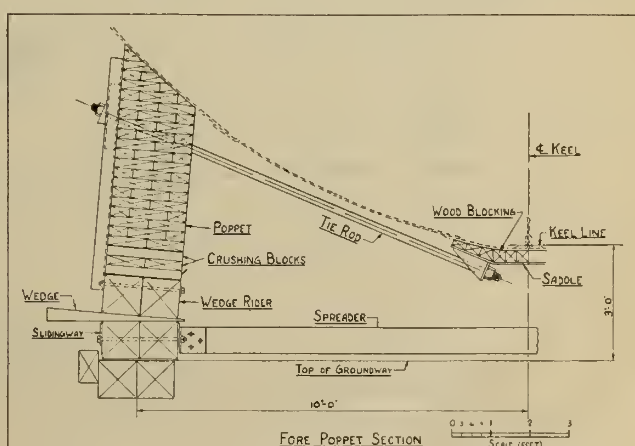


Fig. 7—Section at forward end of fore poppet.

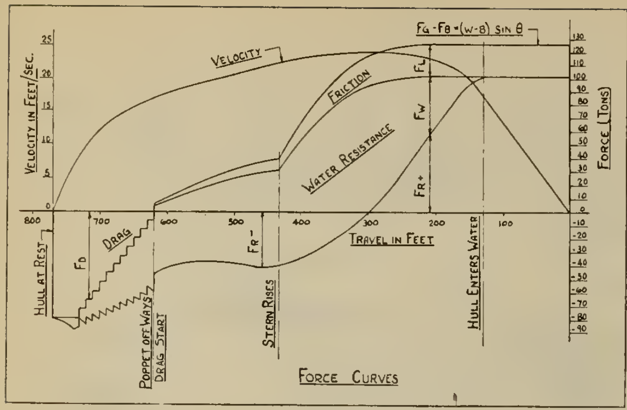


Fig. 8—Calculated force and velocity curves plotted on a travel base.

In the design (Fig. 6) D was assumed 3.6 in. This gave a maximum P of 10.4 tons per sq. ft. occurring at a travel of 87 ft. beyond the static pivotting point. The angle was 1 deg. 13 min. giving a length L of 13.7 ft. The total poppet load at this position of maximum unit pressure was 520 tons.

The poppet block is 23 in. wide and is built up with layers of 3 in. planks thoroughly nailed together. It was constructed in the shop and the top surface carved to the hull shape from mould loft templates.

Since the poppet load must necessarily be carried by the sliding ways, the stresses there are at right angles to the wood grain. There appeared to be no object therefore to construct the poppet block of stronger end on timbers with stresses parallel to the grain.

Figure 7 shows a cross section at the forward end of the fore poppet. Note the staggered arrangement of the poppet block planks. The tie rods are 2⅜ in. diameter steel rounds threaded at both ends but not upset. A thick steel pad is used at the upper end of the tie rod to properly distribute the load to the timber. The saddle plates are 6 by ½ in. with welded brackets.

The Lubricants

The lubricants used are Paragon stearine as base coat and Paragon grease as slip coat. These are mineral products developed exclusively for launching purposes. The base coat serves to smooth out any unevenness in the groundway timbers and is tough enough to resist the launching loads without squeezing out or disintegrating.

The base coat is ¼ in. thick and, in order to obtain good adherence, is applied when the groundways are thoroughly dry. To lay the base coat the groundways are first cleaned and divided into rectangular areas by 1 by ¼ in. wood slats lightly nailed at about 4 ft. centres. The stearine is then melted and each rectangular area filled by pouring on the melted stearine with hand ladles. The slats are then removed and the spaces so left are also filled, after which the whole area is smoothed off with hot irons. A brush coat of stearine is also applied to the underside of the sliding ways.

A ¼ in. thick layer of slipcoat is smeared on by hand on top of the base coat before placing the sliding ways in position. No grease irons are used. The 1 in. clear space between the ribband and the sliding ways is packed with grease before applying the covers.

Three successful launchings in one summer season have been made on the same base coat without any appreciable reduction in its thickness. After a winter season, however, it is better to renew the base coat entirely. The removed base coat may be melted, strained and salvaged for re-use.

A fresh new slip coat is used at every launch. After launching the grease is scrapped up and discarded as it cannot be salvaged and is no longer serviceable.

Force Calculations

In order to obtain some conception of the amount of drag needed to bring the vessel to rest immediately after the launch and the amount of travel that drag would require, it was necessary to make force calculations based on the static launching computations.

The force acting upon the vessel at any time during the launch may be expressed as follows:—

$$F_r = F_g - F_b - F_L - F_w - F_d$$

F_r is the net resultant force in tons and may, without appreciable error, be considered acting parallel to the ways during the launch and parallel to the water after the launch.

F_g is the component of launching weight down the ways and equals $W \sin\theta$ where W equals the launching weight in tons and θ the angle of inclination of the ways.

F_b is the component buoyancy down the ways and equals $B \sin\theta$ where B is the buoyancy in tons. Note that $F_g - F_b = (W - B) \sin\theta$ or the net load on the ways $\times \sin\theta$ at any time.

F_L is the frictional resistance of the lubricant and equals $f(W - B) \cos\theta$ where f is the coefficient of friction. The coefficient f was assumed as 0.01, a deliberately low figure in order to obtain the most unfavourable condition for the drag.

F_w is the water resistance of the vessel and equals

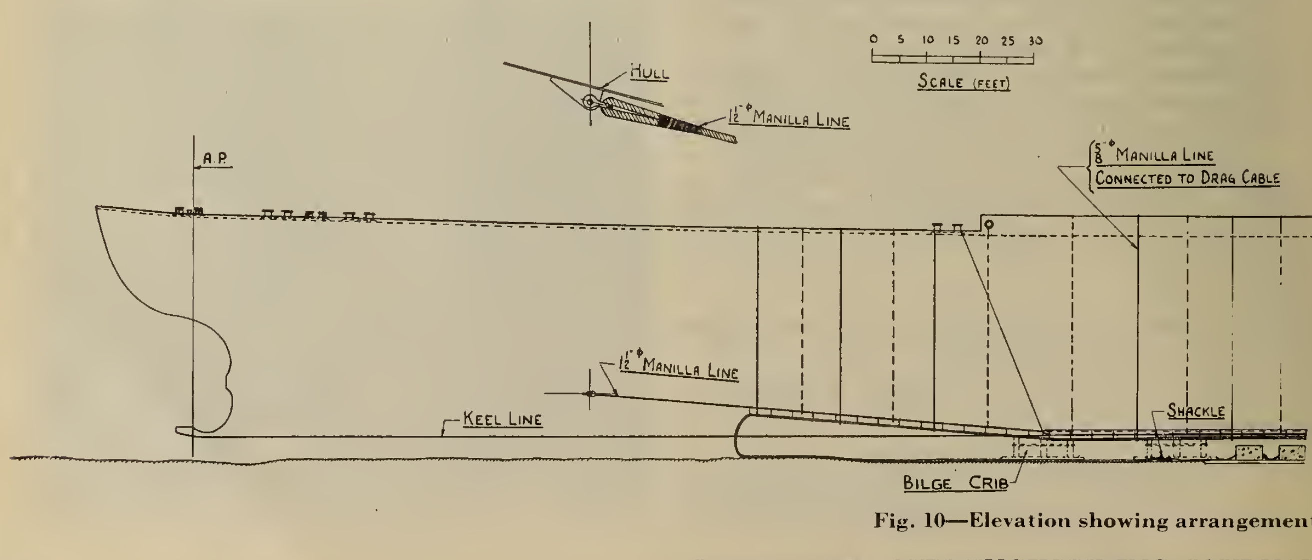


Fig. 10—Elevation showing arrangement

Kv^2 where v is the velocity of the vessel in feet per second and K a coefficient. In the calculations made, the value of K suggested by Henry H. W. Keith in *Principles of Naval Architecture*, Rossell and Chapman, Vol. 1, was used.

F_D is the drag resistance and is equal to kD where D is the weight of drag in tons and k its coefficient of friction on the ground. Both quantities must be assumed and if results are not satisfactory the assumption must be altered until it is so.

F_D was assumed as twelve equal weights of 10 tons each, adding successively to one another. Coefficient k was assumed equal to 0.65. The resulting force and velocity computations are shown in Fig. 8.

The Drags

The use of bundles of heavy chain for drag weights is the most common practice. United Shipyards, being a new yard, did not possess any chain and it was not thought expedient to either borrow or lease chain from other yards even if any was available. The decision was therefore made to use concrete blocks as drag weights.

In order to complete the force calculations, it was necessary to determine the friction coefficient of the blocks on the terrain they had to travel upon. This terrain was partly on concrete and partly on hard packed gravel. Accordingly, tests were made with a concrete block weighing 3650 lb. on conditions similar to those anticipated by the actual drag. These tests indicated a friction factor of about 0.65, a figure used in the computations.

The force calculations showing that twelve increments of 10 tons of drag would be suitable, it was decided to use twelve 5-ton concrete blocks on each side of the vessel. Each block is proportioned for needed volume to obtain the required weight, the only fixed dimension being the depth in order to permit driving of the wedges immediately behind the block. The blocks are shown in Fig. 9. Each block weighs 5 long tons. When extended, the distance from the centre of connecting pin to face of block is generally 13 ft. but blocks adjacent to the upper ends of bilge cribs have this length increased by 10 ft. The wire rope engages a steel spool which bears on the 3½ in. diameter connecting pin. The pin, in turn, bears on the embedded anchor plates. Lifting hooks are depressed in pockets to provide a clear surface on the top of the block so that the cradle wedges may be driven. The connections between the blocks are designed for 100 per cent of the weight of all the drag on one side of the vessel. A factor of 3 on the ultimate strength of the wire ropes was used and the steel parts proportioned at 20,000 lb. per sq. in. All blocks were made similar for complete interchangeability. The wire rope was arranged to straddle the width of the block, and placed below the vertical centre of gravity in order to obtain maximum stability and minimum liveliness as the block is set in motion.

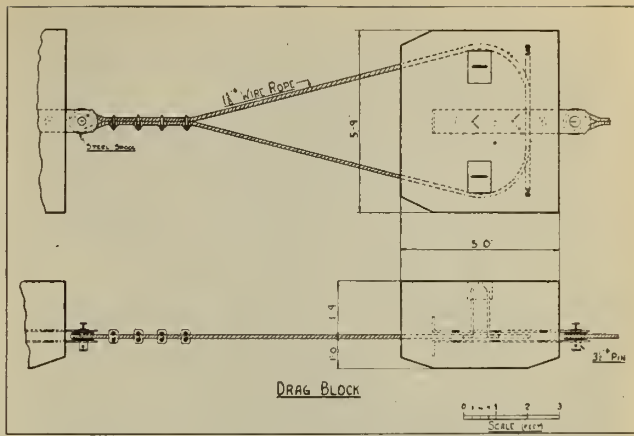


Fig. 9—Detail of 5-ton concrete drag block.

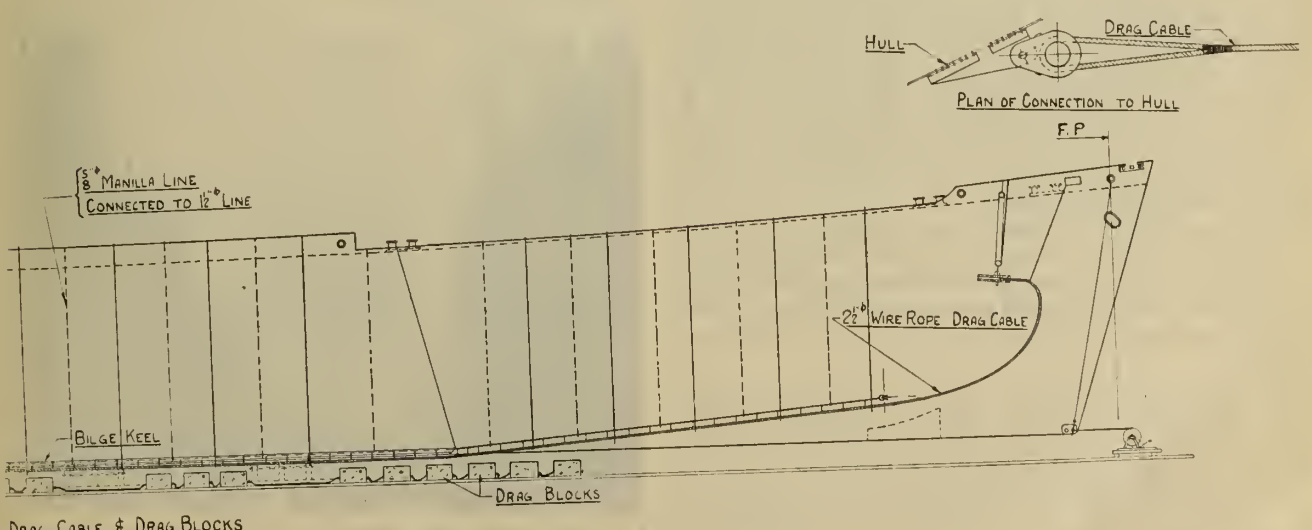
The initial position of the blocks is such that each has 10 ft. of movement before picking up the succeeding one. Transversely, the two sets of drags are at 35 ft. centres. A 3 by 8 wood guard rail was built off the outboard ends of the ribband wedge timbers due to the closeness of the inboard edge of the drag blocks. This rail extends from the uppermost drag block to the end of the groundways.

The Drag Cables

The drag cable must be of such a length that it will pick up the first drag block only after the launching cradle has left the end of the groundways. With the position of the first block determined, the resulting length of drag cable required is 404 ft.

It is necessary to control each drag cable so that it will not foul the staging towers (2 ft. away) during the launch and will not kink as it straightens out to pick up the drag. Several methods of tying up the drag cable were considered, the final arrangement being as depicted in Fig. 10.

The 2½ in. diameter wire rope drag cable weighs



of drag cable and drag blocks.

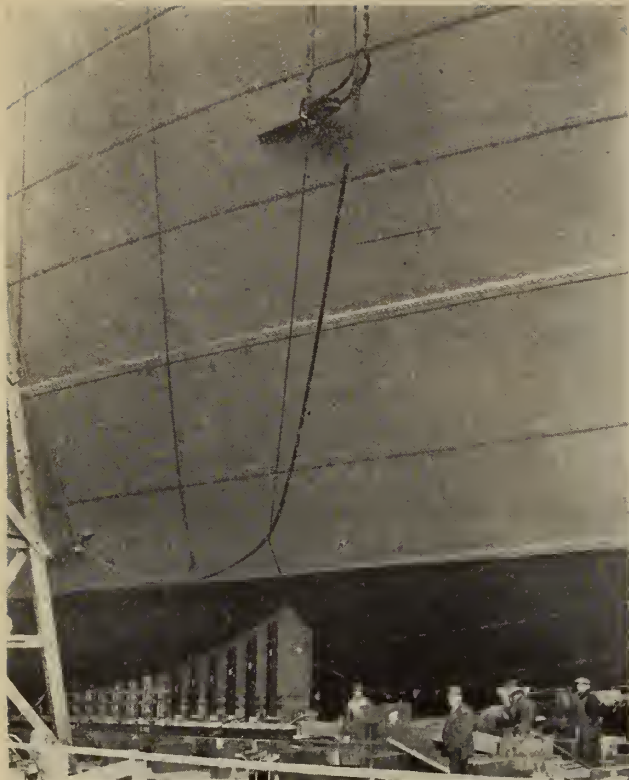


Fig. 11—View of bow of vessel showing starboard fore poppet and connection of drag cable to hull.

about 10 lb. per ft. and is 404 ft. long bight to bight of the 6-ft. spliced loop at its ends. The bilge cribs, drawn in dotted lines, are in way of the drag blocks thus necessitating the disposition of blocks shown. The connection of the gauge wire used to obtain the time-distance curve of the launch is indicated at the bow. A small loop at the end of the gauge wire was passed through the paravane hole and engaged a steel pin held by a light manilla line to the upper deck. Drawing up the pin freed the vessel whereupon the gauge wire was reeled back in.

To eliminate transverse sway, a 1½ in. diameter manilla rope connected at either end to temporary welded brackets is strung along the vessel's side and supported to the upper deck by ⅝ in. diameter manilla rope at 15 to 20 ft. intervals. The ¾ in. wire rope tag lines connected to the cradle (Fig. 3) pass over this 1½ in. line thereby holding it closely to the vessel. The drag cable is also tied at 15 to 20 ft. intervals by ⅝ in. diameter manilla ropes which pass over the sharp edges of the upper shell plate strake. The drag cable is further tied to the 1½ in. manilla line by light strands at 5 to 6 ft. centres. As the vessel slides down the ways, the cable ties break successively, thus uniformly paying out the cable to the ground.

The drag cable is connected to the bow of the vessel by a shackle which is pinned to a bolted steel bracket. The centre to centre distance between brackets is the same as port and starboard spacing of the drags on the berth. This connection and the fore poppet are shown in Fig. 11.

As the ship comes to rest under the influence of the drags, the elasticity of the cables causes the vessel to move forward slightly thus slackening the cables. At this moment the connecting pins are pulled out by the attached tackles and the shackles allowed to drop to the basin bed. The 1 in. wire rope connecting the shackles to the sliding ways (Fig. 3) thus anchors the cradle to the drag. A ¼ in. wire rope is also attached to each shackle and is of sufficient length to float a wood buoy at its other extremity.

After the vessel has been hauled off the cradle, men on rafts equipped with hand winches pick up the ¼ in. lines, raise the shackles from the bottom of the basin into the rafts and disconnect the 1 in. line to the sliding ways. After detaching the cables at the first drag block they are pulled inshore, coiled and stored for later use.

Launching

A schedule which lists all operations required is prepared for each launch. The principal items on the schedule include placing the drag blocks, removing the aft end staging, removing the stoplogs and bents, inspection by divers of the submerged groundways, tying up of the drag cable, driving the wedges, removing keel blocks and shoring, removing bilge cribs, ribband covers, thumbplates and burning of the sole plates.

All launchings with water over elevation 97.0 require the wedges to be driven before stoplogs and bents are removed. Thus it is not infrequent that the weight of the vessel remains on the grease some 24 hours before the launching time. This condition is not desirable but is unavoidable.

The wedges are driven in two separate rallies. Three pairs of rams are used during a rally, one pair at the aft end and the others at the third points of the cradle. Each pair works forward on its alloted number of wedges. Due to the solid rock foundation little trouble is experienced in transferring the weight of the vessel to the groundways. Generally speaking, when the second rally is completed, the keel block wedges may be removed by hand.

Interest in the burning of the sole plates extends even to the burners themselves, who vie with one another for the job. Four burners who have worked on the vessel to be launched are chosen for the operation.

Since the basin is tideless, the time of launching may be chosen at will. Usually, launchings occur at the hour which interferes least with the operation of the yard and is of the greatest convenience to the ceremonial party.

Figure 12 is a view taken after the first launch from Berth No. 3. Note that the launching cradle remains anchored to the drag blocks.

Observations

To check the force calculations and also to determine the velocity, starting and running friction of the lubri-

Fig. 12—Vessel being towed to outfitting basin after first launch from Berth No. 3.

cant, friction of the drag, an arrangement was set up to establish the time-distance curve for each of the first five launchings. The first derivative or slope of the time-distance curve gives the velocity of the vessel and the second derivative or the slope of the velocity curve gives the acceleration of the vessel. The acceleration multiplied by the launching mass gives the resultant force (F_r) acting on the vessel.

The arrangement consisted of a wood reel of known circumference (10.1 ft.) with sufficient gauge wire wrapped around it to extend over the total travel. The gauge wire was connected to the vessel as indicated in Fig. 10. A foot brake was attached to the reel to control its momentum as the vessel's velocity decreased. A small copper plate was inserted in the side of the reel. With each revolution of the reel this plate contacted two poles fixed to the axle supporting frame, thus closing a circuit. The poles were connected to a chronograph which had a magnetically operated pen holder. The pen scribed a continuous line on a paper attached to a drum which revolved at a constant known speed. Each contact the reel made with the poles operated the pen holder magnet thus causing a short side deviation of the line scribed by the pen. A stylus, following in the fresh ink line, was held by a second magnet which could be activated by a separate telegraph key, permitting thereby various independent time observations.

The results obtained are shown in Table II. The time-distance curves did not prove sufficiently accurate to produce a truly reliable second derivative or acceleration curve. As nearly as it could be judged, the friction coefficient of the drags was about 0.35 instead of the 0.65 established by the tests.

Customary sliding way telltales were placed at the aft end, mid-point and fore end of the cradle to determine the liveliness of the vessel before launching.

Nails, driven by the side saddle channels into a wood block fixed to the fore poppet wedge rider, indicated the amount of crushing which had taken place.

At the first launch (Hull No. 2) an attempt was made to establish the travel and time at which actual pivotting occurred. A 16 mm. movie camera was set up on shore and focussed on the stern of the vessel. A second similar camera was set on board the vessel and focussed on the shore line in the distance. Knowing the number of frames per second, the time of pivotting could be determined by viewing the film. An observer at each camera checked the time independently with stop watches. The travel at pivotting was obtained from the time-distance curve. Apparently actual pivotting took place about 22 ft. beyond the travel shown by the static launching calculations.

The first launching off Berth No. 3 was followed with great interest due to the water conditions on the port side. The vessel definitely contacted the guard (4 ft. 6 in. lateral movement) just previous to picking up the drag. There was also evidence of the sliding ways rubbing against the port ribband.

Just as Hull No. 3 on Berth No. 1 had come to rest after launching, a very strong wind arose and blew the vessel over to the guard on the east side of Berth No. 3 before the tugs could obtain control. The resulting side strain on the anchored cradle caused the link plates at the sliding way midjoints to sever their cotter pins thus dividing the sliding ways into two sections.

After the wedges had been fully driven under Hull No. 4, strong winds forced postponement of the launch for three days. The weight was therefore carried on the grease for this period of time and in freezing weather. The vessel started off on a successful launch about 15 seconds after breaking its sole plates.

The abnormal travel of Hull No. 5 before coming to rest was due to the drags moving on sanded snow and ice instead of packed gravel. The ice was 6 to 8 in. thick in the basin at the time and, in way of the launch, had previously been broken up into slabs by the tugs.

TABLE II

Observations taken at first five launchings. (Columns indicate the order in which the launchings took place.)

Hull number	2	1	3	4	5
Berth number	2	3	1	4	5
Temperature	57°F	56°F	32°F	28°F	1°F
Water elevation	94.7	94.6	96.0	95.2	95.6
Feet of water over end of groundways	8.9	8.9	9.7	10.0	10.4
Launching weight (long tons)	2520	2490	2490	2450	2250
Initial mean pressure (tons per sq. ft.)	1.94	1.92	1.92	1.88	1.73
Number of drag blocks	24	24	20	16	16
Aft sliding way telltale movement in ins.	0.75	0.75	0.65	0.75	—
Area of sole plate broken (sq. in.)	3.05	3.25	2.44	2.16	2.97
Breaking load (long tons)	84.4	87.0	66.3	57.8	79.5
Inches of crushing at fore end of fore poppet	3.8	3.3	3.1	3.1	3.0
Travels in feet:					
Keel enters water	102	103	76	92	84
Stern rises	402	400	373	—	—
Drags picked up	617	617	603	618	620
Vessel at rest	764	738	736	773	864
Time in seconds:					
Keel enters water	15.5	18.0	21.5	19.0	45.0
Stern rises	30.5	33.0	38.5	—	—
Drags picked up	43.5	47.5	54.5	49.5	79.0
Vessel at rest	66.0	67.0	79.0	70.0	127.0
Max. velocity (ft./sec.)	22.0	22.0	20.0	21.2	20.4
Starting friction factor	4.3	4.2	—	—	—
Running friction factor	1.78	1.56	—	1.78	2.67
Feet of movement of last drag block	37	20	43	92	185

Acknowledgements

The author wishes to express his acknowledgements to Mr. L. Voss, U.S. Maritime Commission and Mr. A. Aldrich, naval architect, Bethlehem Fairfield Corporation, for the valuable information supplied which contributed immeasurably to the design of the cradle. To Mr. J. S. Crandall, Codarck Associates, Mass., and Mr. W. J. Mares, Wartime Merchant Shipping Ltd., for their helpful and timely advice and suggestions. To Mr. F. P. Shearwood, whose guidance throughout was much appreciated. To shipwrights Crawford, McLeod, Bilodeau and rigger Pink, whose excellent executions of the plans made the success of the launchings a reality.

THE POST-WAR POSSIBILITIES OF AIR TRANSPORT

CHARLES I. STANTON
Administrator of Civil Aeronautics, Department of Commerce, Washington.

An address delivered at a joint meeting of The American Society of Mechanical Engineers and The Engineering Institute of Canada, at Toronto, Ont., on September 30th, 1943.

Just before World War I the railroads of the United States and Canada began to be subject to serious competition from other forms of transportation than coastal shipping. Just before the present World War the competition became three-dimensional. Up to 1935 air transport had handled comparatively small amounts of traffic, but thereafter it began to make substantial inroads on certain classes of railroad business. The post-war period will see a further increase in the amount of traffic handled by the airlines, and the competition will be proportionately keener.

Much discussion on the post-war prospect revolves around the question of whether the relationship between the airlines and the railroads will be one of mutual aid, or active competition. In our opinion the relationship will be mixed. For the most part, the services of one will supplement the services of the other. There is no use blinking the fact that in many fields of traffic they offer very different types of service, and that a large number of travelers and shippers will have a choice to make between air service or surface transport service. They will make this choice by balancing the advantages of one against the advantages of the other. Where cost is a primary consideration, the cheapest service will be used without regard to other factors. Where speed of delivery is paramount, air service will be used with little regard to cost. There will be instances, of course, where air service will be both the fastest and the most economical, as in the Canadian north country and in Alaska. This will also be true of a few inaccessible sections of the United States, and many parts of Mexico, Central, and South America.

Approximately 50 per cent of all passenger travel of more than 100 miles falls, I believe, into this category of traffic which can go either by air or by rail, depending upon whether greater speed or greater economy is desired. About two per cent of all transport of goods falls into the same category. How this traffic is distributed among the various competing means of transportation will be determined by the individual judgements of the many thousand users of transport services. Their judgements will be governed, in turn, by the relative success of the airlines and the railroads in improving existing services, reducing costs, and increasing the general convenience of their services to the public.

Many important decisions will depend upon whether the services of the airlines and railroads are to be regarded as primarily competitive or basically supplementary. In particular, the regulatory policies of our respective governments will be determined thereby. If the most fruitful relationship between the older and newer forms of transportation is to be one of co-ordinated joint activity, it will be sound policy for them to be under common ownership and direction. On the other hand, if competition is to be fostered, common ownership would not seem to be appropriate.

What are the principal factors that bear on the success of air transport in its struggle for traffic ?

I wish here to differentiate between two very different types of air transport. One is along routes where the potential traffic density is reasonably heavy. The other is along routes of lighter density. This differentiation is important because each type presents its own peculiar technical and economic problems.

Air Transport in the U.S. at Present

But first, let us glance at the air traffic picture as a whole. This is the way it appears to us in the United States. Existing rates of fare on the airlines are just over 5 cents per passenger-mile, on the average. Aircraft of 21 passenger capacity travel at a cruising speed of approximately 180 miles an hour at altitude. From taxiing out at one terminal to taxiing in at the next stop their average overall speed was roughly 155 miles an hour. A traffic survey by the Civil Aeronautics Board revealed that in 1940 the airlines carried about 20 per cent of the passengers traveling a thousand miles or more by public means of transportation, and 11 per cent of those traveling between points 200 miles or so apart, such as between New York and Washington. The exact ratio varied from region to region, depending upon a number of factors, particularly upon the comparative frequency of schedule and quality of service offered by the railroads and the airlines between specific points.

Air express charges, including pick-up and delivery service, range upward from 67 cents per ton-mile for heavy shipments over long distance; to 83 cents per ton-mile for a 10-pound package carried, say, from Washington to Montreal. While very small in comparison with the total movement of goods, air express has been steadily and rapidly increasing, rising more than 100 per cent in 1942.

Postage for air mail is double the charge for an ordinary letter. But air mail now carries about 10 per cent of all non-local letters. Historically, of course, the development of air transport in the United States was based upon the air mail. By the time of Pearl Harbor, however, air transport was much less dependent upon air mail than in earlier years. This was brought about in part by reduction of airline operating costs so that a large part of the air mail could be carried at a service rather than a subsidy rate, and in part by a decline in the proportion of total airline revenues represented by mail pay. It has always been our national policy to handle first-class mail by the fastest means of transport. Instead of transmitting only the most urgent letters at a surcharge, it should be the aim of postal policy to transmit every first-class letter by air without surcharge whenever delivery can be advanced thereby. Before the war the high cost, owing to use of air mail to promote development of air transportation, may have been a justifiable deterrent to the elimination of the surcharge on air mail, but this should not be so after the war. This is the import of the recent mail-pay decisions of our Civil Aeronautics Board, based upon the Post Office's Cost Ascertainment Report of 1942.

It seems likely that average cost for air mail will not exceed 0.4 mills per pound-mile, representing a 60 per cent decrease from the 0.96 mills prevailing during the fiscal year ending June 30, 1942. While it is still almost three times as high as the 0.14 mills cost for surface mail transport the difference does not seem to be large enough to justify restricted use of air for transport of first class mail. It is generally agreed, I think, that the dividends accruing to the United States from the development of its air transport system far outweigh any losses to the Post Office on air mail.

Lastly, almost all countries in the world—certainly ours—are now air-minded. Tens of thousands of people who had never previously thought of making a long trip by air are now flying back and forth everywhere. Now habituated to the convenience of swift travel through the sky, these people constitute a vast new market for air travel.

Recent Growth of Commercial Air Traffic

Let me briefly summarize the remarkable growth of commercial air transport in recent years. Between 1927 and 1942 the number of passengers riding the U.S. airlines increased from 8,700 to more than 4,000,000 a year. During the same period air mail increased from 1,270,000 to 44,600,000 lb. annually—air express and freight, from 46,000 to 22,300,000 lb. each year. Commercial air transport, I believe, will continue to grow steadily. According to a recent conservative estimate by our Civil Aeronautics Board there will be a five-fold increase in our domestic airline operations by 1947. For intercontinental and transoceanic air passenger traffic the Board estimates an eight-fold increase. We have scarcely scratched the surface of the air transport potential. Some of the less developed countries far outstrip us in this field. Take Alaska, for example, and a similar situation no doubt exists in Canada. On a per capita basis, Alaska has 100 times as many airplanes as the United States, flies 22 times as many passenger miles, hauls 75 times as much mail by air and approximately a thousand times as much freight and express. We need such intensive development elsewhere.

When the railroads had finished building their main East-West and North-South lines, they did not stop there. They began to criss-cross the country with secondary lines, and to double-track their main lines. We are, in my opinion, entering that phase of development in the commercial history of the airplane. We are on the threshold of great and intensive development requiring expansion along all lines.

When I speak of expansion, I do not mean adding a few more schedules from point to point or a few hundred miles of new routes a year. I mean adding hundreds of new schedules and thousands of miles of new routes. I mean carrying millions of new passengers, great quantities of express and freight, and most of the first class mail. We can meet the challenge presented by the possibilities inherent in air transport, only if we are prepared to take advantage of our unparalleled opportunities.

Possible Further Development

Let me illustrate some of the wider gaps in our pre-war air transport system.

There are in the United States 140 metropolitan districts, each containing 50,000 or more people. They constitute our major markets. Yet on June 30th of this year 22 of these were not certificated stops on our air transport system. Their only air service was provided by airports serving other cities.

In addition, many of those with direct service did not have schedules connecting them with one another. In September, 1940, only 201 of the 814 possible pairs of metropolitan districts in the northeastern section of the United States—or less than 25 per cent of the total —had two or more flights each way daily. Not all of these were direct flights, for I include those where reasonable connections were possible.

Of the remaining 613 pairs, only 111 had one flight each way daily either direct or by reasonable connections.

The coverage was still less adequate for smaller communities. Outside the metropolitan districts, we have 122 population centres with 25,000 to 50,000 people each. Of these, only 52 were certificated for direct air service. Of the 413 communities in the 10,000-25,000 population category, only 58 were certificated.

These figures alone should make it fairly obvious that we shall need many new air transport routes, many new schedules, and many new stops.

Optimum Distance for Air Travel

Air transport has been used almost exclusively for longer distances. It has been used little if at all for the shorter hauls. The explanation for this is obvious. Surface transport over short distances provides speed and comfort approximating that of air transport, and at lower cost—often at very much lower cost. If air transport is to be properly developed, it must try to become superior to rival forms of transport over shorter as well as longer distances. It must do this not only where surface transport is impeded by difficult terrain, but also where surface transport has no serious difficulties to overcome.

We have made some studies to determine the optimum distance for air travel, and you may find the figures applicable at least in part to Canada. In the northeastern section of the United States—that is, the region north of the Ohio river and east of the Mississippi —the optimum distance for air travel lies somewhere between 150 and 200 miles as measured by rail. Though we cannot be too sure, the optimum probably lies closer to 200 miles than 150, and it is significant that our basis of measurement has to be the distance in terms of surface transport.

As the distance of air travel increases above the optimum, the number of passengers declines. Many factors affect the rate of decline, and we have been unable to completely segregate their influence. Roughly, however, our studies indicate that the number of passengers declines inversely in proportion to the distance raised to the 3/2 power.

For example, between two cities 1600 miles apart, the number of airline passengers is only 12.5 per cent of the total between equal sized cities that are 400 miles apart. As the distance between cities increases, there is a very rapid decline in the number of passengers.

Also, the total number of passenger-miles declines. Roughly, this decline is inversely proportional to the square root of the distance. In the above example, the number of passenger-miles at 1600 miles is half the number at 400 miles.

Thus, even though the advantages of air travel increase with distance, the volume of travel declines as the distance increases.

Of course, this relation between distance and traffic holds good only for travel beyond the optimum distance of 150-200 rail miles. Below this optimum, there has scarcely been any air travel at all.

These figures, as I have said, are based upon data for the northeastern quadrant of the United States during a period when DC-3 or comparable equipment was in use. But I am sure these figures hold in a general way for all parts of the country and reveal the same phenomenon—a very rapid rise of air traffic up to the optimum distance, and then a fairly rapid decline of traffic as the distance exceeds that. Specific optimum distances and the rates of increase and decline will vary somewhat from section to section, according to the services available by surface transport. Now, contrast this air travel with travel in general.

Statistics reveal that the shorter the trip, the greater the volume of traffic and the greater the number of passenger miles, down to a very short distance. Common everyday experience confirms this.

For example, the average intercity bus trip prior to the war was less than 30 miles. The average trip by rail was about 50 miles. The average for rail and bus was about 40 miles. Even with air travel, this overall average would be raised only to approximately 42 miles.

For air transport the significance of these facts is this—the shorter-distance travel market, which is the mass market, has hardly been touched by air transport. It represents perhaps the largest chunk of travel business potentially available to the airlines and should be intensively developed.

To illustrate the relative amount of passenger traffic as the distance between stops is decreased, let us assume that two terminal cities are 600 miles apart by *rail*. Let us also assume that between these two cities lie five other cities spaced 100 *rail* miles apart. Assume further that the terminal cities are of the same size—100,000 population—and that the intermediate cities are of identical size, but only a fourth as large as the terminals—25,000 population.

In this case traffic will increase rapidly as stops are added. For example, the addition of a stop midway between the terminals will add traffic equal to 50 per cent of the traffic between the terminal cities alone. If, instead of the midway stop, two stops are added at 200-mile intervals, the increase in traffic will be about 160 per cent. On the assumption that the same relation between distance and passengers holds good down to 100 rail miles, the addition of the three other possible intermediate stops, making five intermediates, will more than double the number of passenger miles flown when the intervals were 200 miles. In fact, the traffic with stops every 100 miles would be over six times the traffic between the two terminals alone.

Certainly, the market for short-distance travel is one that should receive a great deal of attention. There is no alternative to the development of that market as a means of expanding air transport. Many argue that it costs more to provide short-distance than long-distance service—that as lengths of hop go down, unit costs go up, with the result that rising costs prohibit short-distance air travel. So far as I know, no careful analysis has been made of the many interacting factors involved in the relation of unit costs to length of hop. Perhaps the answer will not be available until the results of actual operations are known. Yet very serious attention should be given to this phase of the problem.

Long and Short Range Aircraft

The main cost difficulties revolve around the efficiency of the design of aircraft for different types of services, and are influenced by the location and design of the airports involved.

It may be possible that an airplane designed for optimum operation at 600-mile stops will be able to operate nearly as efficiently at 100 miles. On the other hand, it may be necessary to have specially designed planes to operate at minimum cost for stop distances of 100 miles or less. Whether the operating efficiency and costs of such a plane would be comparable to those of longer-range planes is the real question.

What is probably needed is a plane specifically designed for short range operation. Such a plane would perhaps have these characteristics:

1. Optimum efficiency at low altitude.
2. Short range—perhaps 300 miles.
3. Short take-off and landing runs.
4. Excellent manoeuvrability on the ground.
5. Small size—perhaps in some cases with a payload of as little as 5,000 lb., dependent upon the volume of traffic involved.
7. Light-weight inexpensive passenger equipment.
8. Adaptability to crosswind landings.

One main purpose of specially designing a plane would be to minimize the time lost in making a stop. With pre-war equipment 10 minutes was about the minimum time required to make a stop, even when no fueling was done. Perhaps after some experimentation, we can approach the average three-minute stops made by our express trains at intermediate points.

The ideal service for a traveller would be one of door-to-door delivery, so to speak.

But airports are generally some miles from the center of the city, very frequently out on the periphery of the city. Contrast this with the usual position of railroad stations.

In addition, there is generally only one air station for each population cluster, large or small, compared with the number of stops made by the railroads in large metropolitan areas.

Eliminate one or both of these difficulties, and mass short-distance travel business can be obtained.

There are some who pin their hopes on the helicopter to bring air transport services close to the door-to-door ideal. We think of them flying from roof-top to roof-top, or at least from very small landing areas in the heart and residential centers of a city.

The total lift of any helicopter now in the planning stage is not very large, however. Until a larger craft—something approaching the capacity of conventional transport planes—can be put into service, it does not seem to offer a practical solution to the problem of mass transport over short distances. We do not know, of course, how soon such a large craft may be available. But to judge from the time it has taken other new transport plane designed to be developed and placed into service, it seems to me that a large helicopter will not be ready during the first few post-war years.

I do not want to minimize the importance of the helicopter. Perfected in sizes ranging from a two-place machine to a machine with many times that capacity, it is capable of revolutionizing aviation, particularly, I should think, in some parts of Canada. What I want to emphasize is that it may take time—perhaps many years—to obtain such a machine, particularly the larger ones.

Meantime, there is the immediate necessity of adapting conventional planes and airports to the needs of mass short-distance air travel.

Obviously, every effort should be made to bring airports closer to the city. Also, we should begin to think and plan for multiple air stations in our large cities.

Such a development, it seems to me, would go far toward solving the short distance problem. If it were possible, for example, to increase the number of stations and locate them so that door-to-airport travel time was not more than 15 minutes, population centres 100 miles apart would be almost within commuting distance. With a 140 m.p.h. block-to-block speed, the overall door-to-door time would be approximately an hour and a half. Certainly, performance of this kind, particularly with high schedule frequency, would attract volume business.

The most important point about the development of efficient short-distance air service is this: It is needed not only for its own sake, but also for the fullest possible expansion of long-distance air travel. It is required to furnish the necessary feeder service to the trunk lines.

In sum, the expansion of our domestic air transport system requires:

1. The addition of many new airline stops.
2. A many-fold increase in short-distance services.
3. Intensive development of short-distance travel between large metropolitan populations; perhaps by means of multiple airports at each city.

With these steps taken, the expansion of traffic will be of a magnitude to astound most of us. There are also great expansion possibilities in the carrying of mail, express, and freight which should not be neglected. We have not been able to analyze these possibilities in detail largely because we have not had the necessary data. But it is reasonable to assume that population, distance, and service factors affect mail, express, and freight traffic in much the same general way as they affect passenger traffic. Optimum distances, of course, will probably differ for the various types of traffic, which will likewise be affected by such factors as schedule frequency. Yet I think it must be clear that traffic will be greater the larger the population involved, and the shorter the distance up to the optimum.

Need for Navigation Aids and Airports

But air transport requires more than planes and pilots to fly passengers, mail, and cargo. It equally requires air navigation facilities of many kinds and a vast network of airports. The U.S. Federal Airways system now totals 35,000 miles within our continental boundaries, a 700 per cent increase since 1927. Their length has almost doubled since 1932. Traffic along the airways is increasing at an astonishing rate. Recorded movements along the Federal skyways were 6,000,000 during 1942, mostly military of course. For the current year they will reach 13 or 14,000,000. We expect them to continue upward despite a probable slight dip immediately after the close of hostilities. We expect that by 1950 we shall have in our country at least a half million private, commercial, and military aircraft in active service. You will appreciate the significance of that when I tell you that at the end of 1941 we had in the entire country under 25,000 licensed civil aircraft, and probably less than half that number of military planes.

Fortunately, our airways system, unlike those of Europe, has been designed for mass traffic. It is closely co-ordinated with your Canadian system, as you no doubt know. In fact, your system is so closely coordinated with the U.S. and Alaskan systems that the three virtually form a single system, from the Rio Grande to Behring Sea. General Salinas Carranza, Director of Civil Aviation of Mexico, visited us a few months ago and declared his intention of extending a similar system throughout Mexico. He expressed the belief that the Central American countries will do likewise, and that we may well contemplate a vast continental airways system extending from the Canal Zone to the Arctic. We have also installed four intercontinental super radio stations which in the combined range blanket the world, providing direct communication from our shores to planes in flight almost anywhere on the globe. The major units are located at New York, New Orleans, San Francisco, and Honolulu, with supplementary stations at Seattle, Anchorage and many of the Pacific Islands.

Before the war, the Civil Aeronautics Administration made, at the direction of the Congress, a nation-wide survey of airports. This resulted in a tentative plan for a network of 4,000 airports to serve the more or less immediate needs of the country.

If these airports had been evenly distributed over the country, they would have formed a checkerboard of 27-mile squares. If the number of airports were increased from 4,000 to 6,000 and these were evenly distributed, the checkerboard squares would be reduced to 22 miles. Mountain and desert areas would need relatively fewer airports, of course, and these could therefore be allocated to more thickly populated zones.

At the present time we have almost 3,000 classified airports—1,000 short of the pre-war plan. Recent development has necessarily been concentrated upon the larger fields. As a result, there has been an eleven-fold increase in the number of our major civil airports—with paved runways at least 3,500 ft. long and capable of handling the transport type craft. Whereas we had only 76 such fields two years ago, we shall have 865 by the end of this year. Nor does this number include many large airdromes built solely for use by the armed forces. We also have 905 Class II ports, each with paved runways from 2,500 to 3,500 ft. long. These are situated, for the most part, near smaller cities and larger towns. In my opinion, we shall have to have many more of this class for future commercial flying. Nor can it be said that we have enough major ports, for those in many of our larger cities are already overcrowded.

Census figures reveal that in the United States there are 6,669 communities with a population of 1,000 or more. It seems reasonable to suppose that all communities of such size will desire to be accessible by airplane. Therefore, if we disregard those which lie so close together that they can make joint use of an airport, and consider the fact that larger cities will require several airports, we arrive at a national total of 6,000 airports as a reasonable target to shoot at in the early post-war years. This means that we need roughly twice as many airports as we now have, though, on the average, smaller ones. But the majority of the 6,000 would be for local private and commercial flying.

Now, what about the cost of providing the additional facilities necessary for adequate population and geographic coverage by air transport, discussed earlier?

Fortunately, the task is not as great as one might suppose, thanks to the efforts over a period of years of local, State and Federal officials, of legislators, and public-spirited citizens. Also, the armed services have installed many airports and other facilities which will probably be available for civilian use after the war.

We have done some studying on the question of what additional facilities will be needed for commercial air transport, and how much they will cost.

One of the most striking results of this study was to show the relatively small number of stops required to obtain a very high population and geographic coverage. This is the consequences of the manner in which our people "bunch up" in fairly large groups.

Of our 132,000,000 people in 1940, 63,000,000 or almost 48 per cent live in 140 metropolitan areas, each containing 50,000 or more people. Thus, if we disregard the possibility of multiple air stations at the very large places, 140 airports would be enough to serve almost half the population.

To reach about 90 per cent of the urban population, all cities of 10,000 up to 50,000 where the metropolitan population begins—we would need about 460 additional airports. (*Continued on page 25*)

RAILROAD EQUIPMENT IN WARTIME

EFFECTS OF PEACETIME DEVELOPMENTS ON WARTIME TRANSPORTATION

LAWFORD H. FRY

Director of Research, The Locomotive Institute, New York, N.Y.

Paper presented at a joint meeting of The American Society of Mechanical Engineers and The Engineering Institute of Canada, at Toronto, Ont., on September 30th, 1943.

In considering the influence of the war on present and future development of railroad equipment, one of the first things noted is that although the war is loading the railroads to the limit of their endurance, it did not find them unprepared. In the last ten years railroad equipment has been undergoing steady growth and improvement. In this, builders and users have participated actively, and the extraordinary demands made by war conditions have shown that their work was soundly done. With relatively small additions to equipment, a tremendously increased traffic is being handled. Net tons of freight hauled per mile of road per day increased from 4800 in 1940 to over 8100 in 1942. Passenger miles in May, 1943, were four times those of 1941.

In general, the effect of the war has been to emphasize the necessity for making the most efficient possible use of existing rolling stock. No great evolutionary changes in design have been produced. New designs have been avoided as far as possible to conserve engineering manpower. The building of new rolling stock has been rather severely restricted and the scarcity of critical materials has necessitated some changes in construction. In car construction, the shortage of steel plates has led to the use of emergency designs with wood taking the place of steel as far as practicable.

Importance of Good Road Bed

The present paper in discussing railroad equipment deals more particularly with rolling stock, with the strongest emphasis on motive power, but it must not be forgotten that rolling stock is only one of the legs of the three-legged stool of railroading. A railroad stands firm when its three supports, road, rolling stock, and personnel, are in proper proportion. To many the dynamic locomotive may make more appeal than the static track, but the track is the basis and foundation of railroading. The first public railroad, as we understand the term, the Liverpool and Manchester, was laid out and largely built before the directors had decided whether the trains should be pulled by horses, stationary steam engines, or steam locomotives. The genius of George Stephenson decided the choice in favor of the steam locomotive, and time has approved the decision.

It is fundamental that the civil engineer builds the railroad and that the structure which he provides, the track with its grades, curves, rails, and bridges, has an important influence on how the locomotive engineer finally shapes his machines to handle a given traffic.

One constant aim in railroading is to move more rapidly from place to place. To do this, it is not sufficient for the car and locomotive-engineers to provide easy riding cars and locomotives which can run a few miles an hour faster than their predecessors. Far more can be gained by civil engineering that will eliminate slow-downs than by locomotive engineering that adds five miles an hour to the top speed of the locomotive. The railroads have recognized this and their civil engineering work in the last ten years has been of great value in carrying the present abnormal traffic.

In the case also of the rolling stock, development work is bearing fruit. The war traffic is not being handled by material which has sprung full grown from the brains of our engineers. It is being carried by, and is proving the efficiency of, the rolling stock developed during peacetime. New equipment has had to be provided, and more is badly needed, but conservation of time and of the engineering manpower required for new designs has led to reproduction of existing types with only such changes as were made necessary by shortages of critical materials.

Locomotive Situation Reviewed

Before going into details, a brief over-all review of the locomotive situation is in order. Three forms of motive power are moving the war traffic—electric, Diesel, and the steam locomotives on which the railroads grew up. All three forms were in active development when the war came. The Pennsylvania Railroad had just completed electrification of 675 miles of the most heavily traveled part of its line, New York to Washington and Harrisburg, and in 1941 was hauling electrically more than 64 per cent of the system passenger mileage and more than 15 per cent of the system freight ton-mileage. The Diesel-electric locomotive had won a prominent place in switching, passenger, and freight service. The steam locomotive, which was handling the bulk of the nation's traffic, was showing active growth in power and efficiency.

Some individual locomotives are considered later in the paper, but before coming to these, some of the basic principles of the three forms of motive power are set forth. All three of them have their proper place in the railroad economy. Some enthusiastic souls who think that we should be modern without being hampered by engineering facts would have us relegate the steam locomotive to obsolescence. Cold analysis does not confirm this view, but supports the warm admiration that many of us have for steam. The most critical study leads to the conclusion that the steam locomotive must be the basic form of motive power all over the world for many years to come.

Differences between electric, Diesel, and steam power lie in the means used for transforming the potential thermal energy of a fuel into effective mechanical work at the rim of the driving wheels.

In the case of the electric locomotive, the energy developed at the driving wheels is generated in a stationary power plant and delivered over an elaborate transmission system. The electric locomotive is all driving mechanism. Tractive force is limited only by the weight on driving wheels. The energy from the line available for traction is practically unlimited so that the amount of horsepower that can be developed by the locomotive is restricted only by the amount of current that the motors can carry without overheating. For short bursts a heavy overload can be carried. This makes the electrical locomotive very effective in accelerating a train and in taking advantage of momentum grades. Weight for weight, the electric locomotive can out-haul the steam locomotive and the Diesel, but the high first cost of the transmission system limits efficient electric operation to lines of high traffic density. Under conditions such as prevail on the Pennsylvania

Railroad between New York and Washington, electric operation carries a volume of traffic which would require additional trackage if steam or Diesel power were used.

The steam locomotive is a self-contained mobile-power plant. The thermal energy of the fuel is transformed in firebox and boiler to produce steam. In the cylinders, the thermal energy carried by the steam is turned into mechanical energy which is transmitted directly through the rods to the driving wheels. This driving mechanism provides a very flexible and satisfactory transmission. Loss of power is small and change of speed is simple. In this lies one great advantage of the steam locomotive.

The Diesel locomotive is also a self-contained power plant, but the bulk and complications of boiler and superheater are avoided and the fuel liberates its thermal energy directly in the cylinders. Unfortunately, the internal-combustion engine must run with a narrow range of speed and is therefore not directly adapted to locomotive requirements. To provide the necessary flexibility in speed, complications are necessary. The Diesel cylinders drive an electric generator which transmits electricity to motors geared to the axles.

Comparison of steam and Diesel power is a favorite indoor sport for engineering controversialists. Reams of statistics have been spilled on the subject and more are in prospect. Our present purpose does not require us to be exhaustive or exhausting on the subject. We present only a few facts which seem to be clear-cut.

The Case of the Diesel Locomotive

A competent engineering authority responsible for the operation of both Diesel and steam power is on record to the effect that no Diesel locomotive is doing work which cannot be done by a steam locomotive. The Diesel is high in first cost, but has the advantages of requiring little water and a comparatively small bulk of fuel. Waterless operation is of advantage in desert country. Conversion of thermal energy into mechanical work is effected with high efficiency so that the weight of fuel to be carried is small. The unit cost of Diesel fuel oil is high, but because of the high thermal efficiency, the fuel cost per drawbar horsepower is not greatly different for the Diesel and the steam locomotive. This relation may be fundamentally affected by war and by post-war developments in the fuel field. The Diesel is necessarily an oil burner and requires a fairly definite grade of distillate. A change in oil conditions, which produced a scarcity of this fuel, would hamper the Diesel. The steam locomotive burns coal or low-grade oil and no major change is required to convert from one fuel to the other. Our ample coal reserves insure that the steam locomotive will not be starved out of existence in any foreseeable future.

In comparing steam and Diesel locomotives, a factor to be considered is "availability." The Diesel can be serviced more rapidly and can run a longer distance between refueling so that it is "available" for a greater number of hours a day. However, availability pays dividends only when traffic conditions enable the locomotives to be used during all the hours that it is available. E. E. Chapman of the Santa Fé has pointed out that availability is rather an abstract term as the actual use of both Diesel and steam locomotives is controlled by train schedules.

Examples of Locomotive Use

Some examples of the use of Diesel and steam locomotives are given.

In the New York Central main-line passenger service, a steam locomotive handles the heavy through trains for the 928-mile run from Harmon to Chicago. Schedules require trains to leave either terminal in the late afternoon and arrive early next morning. That afternoon the run is reversed. The time of lay-over from morning to evening is determined by the traffic requirements and could not be shortened by mechanical improvements in the locomotives. The steam locomotives in this service make from 20,000 to 24,000 miles a month.

On the Santa Fé, steam and Diesel locomotives handle passenger trains on the 2226-mile run between Chicago and Los Angeles. In steam service, locomotives are changed at Kansas City while the Diesel runs through. Fourteen engine crews handle the Diesel while the mountain-type steam locomotive on the 1789 miles from Kansas City to Los Angeles takes twelve crews. Extended runs of this character are standard practice on the Sante Fé.

Figures given by J. M. Nicholson, assistant to vice-president, Atchison, Topeka, and Santa Fé Railway, show that in regular service engine runs of over 1000 miles are scheduled for four trains daily operated by Diesel locomotives and for 10 trains daily operated by steam locomotives. In such work, the Diesel locomotives average about 18,500 miles a month with a maximum of about 27,000, while the steam locomotives average about 12,400 miles with a maximum of about 18,600. On the Santa Fé as of November, 1942, Diesel locomotives handled 7 per cent of the gross ton-miles of the system and 13 per cent of the passenger-car-miles.

In considering these figures, it should be borne in mind that the Diesel is handling preferred trains and that helper service on heavy grades and protection service against breakdowns is provided by steam locomotives.

In many cases efficient operation is provided by dual-purpose locomotive which can handle both passenger and freight service. An example is given by the 4000-hp Diesel-electric locomotives on the New Haven. These make two round trips between Boston and New Haven daily, one trip in passenger and the other in freight service. The daily run of four times 157 miles is 628 miles, and the monthly mileage is about 15,000.

An excellent example of the useability of steam locomotives is given by the heavy 2-8-8-2 compound Mallets of the Norfolk and Western. Thirty-five of these are operated in a pool out of a roundhouse at Shaffer's Crossing, Roanoke. The average time required to service and refuel these engines between trips in December, 1940, was 3¾ hours at Roanoke, which is the maintenance point for these locomotives. At the other end of their runs, the time for servicing averaged 2 hr. and 45 min. This figure represents the motive-power turning time which is the time the locomotive is out of service because of actual servicing requirements. The total time between runs depends also on train schedules, demand for power, and the availability of crews.

Some Representative Locomotives Handling War Traffic

Passing from performance to design, Table 1 has been drawn up to show a number of representative locomotives which are handling war traffic. Table 2 shows three novel designs recently put into service which will undoubtedly influence the future.

Table 1 includes two groups of four-cylinder Mallet articulated locomotives with respectively four and three driving axles in a set. In the rigid frame locomotives are three groups of two-cylinder locomotives having respectively five, four, and three driving axles. In each group, the various railroads differ somewhat in their choice of leading- and trailing-truck arrangement. In Table 1, the large 8-8-coupled Mallets have in one case four-wheeled trucks front and back, in one case two-wheeled trucks front and back, and in the third a four-wheeled front truck with a two-wheeled trailing truck. Even greater variety of truck arrangement is found in the 6-6-coupled Mallets. The C. & O. engine has a two-wheeled front and a six-wheeled trailer truck. In the rigid-frame locomotives, only the comparatively slow-speed ten-coupled locomotives have two-wheeled front trucks. All of the eight- and six-coupled engines have four-wheeled front trucks. All but two have four-wheeled trailer trucks.

In grouping the locomotives, they have been separated according to the number of driving wheels, but no attempt is made to divide them into freight and passenger service. No such division is practicable. The six-coupled locomotives, the Pacific, and the Hudson type are specifically designed for passenger, but a large proportion of the heavier locomotives from the eight-coupled 4-8-4 type up to the double eight-coupled articulated Mallets are designed and used for both freight and passenger service. The Norfolk and Western 2-6-6-4 engines make 65 m.p.h. with tonnage trains in regular freight service, and the Southern Pacific 4-8-8-2 locomotives with 63½-in. drivers are reported to be capable of running 80 m.p.h.

Attention is called to the usefulness of the 4-8-4 type for heavy-passenger or fast-freight service. With driving wheels of 75 in. diameter, this locomotive can develop a tractive effort which will fully utilize the weight on drivers and at the same time can make passenger-service speeds without an unduly high rotative speeds. Present practice shows that the old idea that a low-wheel engine was to be preferred for freight service is obsolete and should be discarded. A small driving-wheel diameter has the minor advantages of less weight, particularly in the unsprung parts, and with a given stoke, a better leverage for changing piston thrust into tractive effort. These are much more than offset in a high-wheel engine by the lowered rotative speed at a given train speed in miles per hour and in the better opportunity for correct counterbalancing. Much is to be gained by making driving wheels of ample diameter for all classes of locomotives.

Returning to Table 1, it is seen that in spite of the apparent diversity, the locomotives follow a fairly definite and uniform pattern. Although designers may express their personalities in details such as trucks, the logic of the engineering requirements is inescapable. The load on a driving axle ranges up to about 75,000 lb., varying according to the road structure and the restrictions provided by the chief engineer. The number of driving axles is chosen to meet the tractive force desired, and when more than five axles are to be driven, they are split into two groups with two pairs of cylinders and an articulated frame. The general tendency is to use a four-wheeled trailing truck to provide carrying capacity for a large firebox and boiler. Exceptional boiler capacity is provided in the C & O locomotive by the use of a 6-wheeled trailing truck.

Driving wheels range in diamater from 57 to 70 in. in the multi-axle articulated groups, from 69 to 74 in the ten-coupled, 72 to 80 in the eight-coupled, and 79 to 84 in the six-coupled group.

To sum up Table 1 briefly, we may say that the representative steam locomotives have three, four, five, six, and eight pairs of driving wheels, ranging from the 4-6-4 type used mainly for passenger service, up to the 4-8-8-2 Mallet type used for both passenger and freight service. With a driving axle load of about 68,000 lb. and a maximum tractive effort of about one-quarter of this, say 17,000 lb. per driving axle, the locomotives range in tractive effort from about 51,000 to 136,000 lb.

Table 1 lists four typical Diesel-electric locomotives. One freight locomotive rated at 5400 hp. is composed of four units, each with two four-wheeled trucks with all axles driven. Three 4000-hp. two-unit passenger or general-purpose locomotives are listed. They have two six-wheeled trucks, in each of which the center axle is idle and the outer axles are driven. One passenger locomotive has 36-in. wheels, the other three engines all have 40-in. wheels. All four locomotives have about 50,000 lb. on each axle. Weight on drivers ranges from 417,000 to 461,000 lb. in the passenger up to 924,000 lb. in the freight locomotives.

It will be noted that the weight on driving wheels and consequently the maximum tractive effort is high in relation to total weight if compared to that of the steam locomotives. This is accounted for by the fact that the characteristics of the Diesel engine with its practically constant speed forces the use of electric power transmission. Relatively small motors are used and are applied to a larger proportion of the total number of axles counting engine and tender than would normally be coupled if rods were used. Rapid acceleration at slow speeds is obtained, but this advantage may be more than offset by the limit to the horsepower at high speeds set by the electric motors. The steam locomotive has greater flexibility in overload capacity.

TABLE 1 REPRESENTATIVE LOCOMOTIVES

Road	Type	Diam. Driving Wheels, in.	Weight on drivers, lb.	Service	Horse-power	Trucks per unit
Steam locomotives						
U. P.	4-8-8-4	68	540,000	...	..	...
So. Pac.	4-8-8-2	63½	530,000	...	..	...
N. W.	2-8-8-2	57	530,000	...	..	..
C. & O.	2-6-6-6	67	470,000	...	..	..
U. P.	4-6-6-4	69	403,000	...	..	...
N. & W.	2-6-6-4	70	400,000	...	..	..
A.T.S.F.	2-10-4	74	372,000	...	..	..
C. & O.	2-10-4	69	373,000	...	..	...
A.T.S.F.	4-8-4	80	286,000	...	..	..
P.R.R.	4-8-2	72	271,000	...	..	..
D. & H.	4-8-4	75	270,000	...	..	...
N.Y.C.	4-8-2	72	266,000	...	..	..
A.T.S.F.	4-6-4	84	213,000	...	..	..
N.Y.C.	4-6-4	79	202,000	...	..	...
Diesel locomotives						
A.T.S.F.	2-unit	36	417,000	Pass.	4000	2 6-wheeled
A.T.S.F.	4-unit	40	924,000	Frt.	5400	2 4-wheeled
C.M.St.P.	2-unit	40	448,000	Pass.	4000	2 6-wheeled
N.Y.N.H. &H.	2-unit	40	461,000	Genl.	4000	2 6-wheeled

TABLE 2 RECENT LOCOMOTIVES

Road	Type	Diam. of Driving Wheels, in.	Weight on drivers, lb.
P.R.R.	4-6-4-4	77	355,000
P.R.R.	6-4-4-6	84	281,000
P.R.R.	4-4-4-4	80	268,000

Table 2 lists three novel locomotive designs put into service by the Pennsylvania Railroad recently. All are rigid-frame locomotives with two pairs of cylinders driving two groups of driving wheels. This avoids the high machine friction with four and five pairs of rod-coupled wheels and produces a free running engine. The 4-6-4-4 engine provides five pairs of driving axles for freight service. The 6-4-4-6 locomotive was exhibited at the New York World's Fair. With four pairs of driving wheels 84 in. in diameter coupled two and two and an exceptionally large boiler, it is designed to handle heavy passenger trains at high speeds. The 4-4-4-4 locomotives has also four driving axles coupled in groups of two each. It is equipped with the Franklin Steam Distribution and poppet valves and has shown high efficiency in service.

Freight Cars and Passenger Coaches

A survey of railroad equipment cannot omit consideration of cars. Without cars to carry the pay-load, the motive power could earn nothing.

The war effort has been well served by the earlier work on car design done by the railroads. Particular mention is made of the extensive research of the Association of American Railroads, Mechanical Division, on car trucks for high-speed freight service. The information obtained as to the desirability of snubbers has been of vital importance in the revival and accelerated use of tank cars handling oil products.

The A.A.R. Committee on Car Construction has recently issued a report listing seven emergency standard designs of open top freight cars. These designs prepared at the request of the War Production Board use wood to the greatest possible extent to save steel for war purposes. They include two 50-ton and one 70-ton gondolas, one 50- and one 70-ton hopper car, and one 50- and one 70-ton flat car.

Emergency drawings for two composite box cars have been prepared, but the A.A.R. committee points out the difficulty of maintaining such cars.

Designs for troop coaches, troop sleepers, and command, and kitchen cars have been prepared and put into construction. These are based on the A.A.R. standard 50 ft. 6 in. steel-sheathed box car and the framing can be used for such cars when troop movements are at an end.

Some Predictions

In trying to look into the future, I can do no better than call attention to some bold predictions made at the joint meeting of the A.S.M.E. and the Pacific Railway Club in Los Angeles on June 15, 1943, by Morris P. Taylor, Assistant Mechanical Engineer of the Southern Pacific Company.

Mr. Taylor called attention to a possible shift in the relative supply of coal and oil for fuel and to the increased amount of cheap electric power that may be available. There are factors that may affect seriously the availability of the various forms of motive power.

Dealing with locomotives and cars, Mr. Morris listed many possible developments. Some of these are already taking shape. In the case of the steam locomotive, careful consideration is being given to developments which will maintain its fundamental advantages and obtain higher efficiency and still greater usefulness.

Higher steam pressures and temperatures to obtain better thermal efficiency are in the offing. The present top pressure of 300 lb. per sq. in. is about the maximum that can be carried with the conventional type of fire-tube locomotive boiler. Water-tube boilers for pressures up to 600 or 800 lb. per sq. in. are already on drawing boards and promise the advantages of lighter weight and greater safety.

The opportunities offered by this better steam will be taken advantage of by better utilization of the steam in cylinders or in turbines. These things are definitely approaching.

A possibility also to be considered is the combustion gas-turbine locomotive, one of which has been built in Switzerland. Still further over the horizon is the possibility of a combined steam-and-mercury turbine locomotive which would cut water consumption in half and reduce greatly the fuel cost. These things may be termed visionary at present, but we have it on the highest authority that "without vision, the spirit perisheth."

THE POST-WAR POSSIBILITIES OF AIR TRANSPORT

(*Continued from page 21*)

Thus, about 600 airports would be sufficient to serve over 90 per cent of the urban population, and at least 20 per cent of the rural population.

But to go on and put every urban community within 50 miles of an air station, would require about 250 more airports, which would provide very complete geographical coverage.

About 850 air stations are therefore required for very complete population and geographical coverage. Less than 600 new airline stops would have to be added, for 273 are already authorized, of which 12 are in rural territory.

Altogether, these 850 stops would serve an urban and rural population of well over 80,000,000 people, almost two-thirds of the national total.

We would not, of course, have to start from scratch to obtain the necessary facilities for these 850 air stations. A large number of them already have most or all of the necessary installations.

The costs to improve the existing airports and to construct new ones would approximate $215,000,000. This is computed on the basis of Class II airports for most of the smaller places.

To install the additional radio ranges, weather reporting traffic control, and communication equipment, would cost an additional $12,000,000.

The total, about $227,000,000, seems a moderate price to pay for the facilities needed for an adequate air transport system.

The picture I have drawn has necessarily been based upon our experience in the United States. But subject to modification for local conditions, it is equally true, I believe, for all parts of North America. All of us have more or less the same problem to face, and I shall watch with lively interest how you go about solving yours. Whatever course you take, let me extend our sincerest wishes for unlimited visibility, a tail wind, and a happy landing.

POST-WAR PLANNING BY INDUSTRY

W. A. IRVINE
Secretary, Special Planning Committee, Canadian General Electric Company Limited, Toronto, Ont.

An address delivered before the Montreal Branch of The Engineering Institute of Canada, on November 25th, 1943

Canadian Productive Capacity

The war has shown the great extent of Canada's productive capacity. In 1942 over one and a quarter million persons were employed in the manufacturing industries alone, or about one-quarter of our total available working force.

Both employment and value of production have risen during 1943, but probably they are now close to the peak. The net value of manufactured goods produced during the year should be about four billion dollars.

As the net value of manufactured products in prewar years was about one and a half billion dollars, it is obvious that the greater portion of our present production is for essential war purposes.

Our great productive capacity is both an asset, and a problem. An asset because it assures us that we have the ability to produce most of what is required for a high standard of living. A problem because we must learn how to utilize it to the greatest possible extent.

Lesson from Lack of Preparation for War

Canada, particularly in her manufacturing industries, was almost entirely unprepared for war in 1939. Everyone will remember the sickening pause during 1940, continuing in many things through 1941, while we made our plans, adjusted our economy for war, and converted our industry to the manufacture of the goods of war. If we could have foreseen the course of future events, planning by comparatively few men in 1938 and 1939 might have done much to solve the conversion problem during 1940 and 1941.

The problem of conversion from war to peace will not be as severe as the former conversion from peace to war. For one thing, we can foresee more clearly what is likely to happen. On the other hand, we shall be resuming the production of many things which we had manufactured in prewar days. Many of the troubles and delays of the wartime conversion resulted from being asked to produce, in a hurry, things we had not made before.

So let us profit from past experience, and start now to prepare for peace. If we wait to make plans till peace comes, there will be a protracted conversion period. Delays in starting production of peacetime goods will aggravate the problems of inflation and unemployment after the war.

Time Required for Planning

Canadian industry today is going full out in the war effort and there is no suggestion that postwar planning should be allowed to interfere with it, in any way. That it need not, is shown by the example of an electrical manufacturing company where, with about 10,000 employees, only one man is working full time on planning. About 100 men find a few hours a week, between their wartime activities, to think about plans for postwar years.

Good planning can be done in this way because these are key men, with a breadth of experienced judgment, and a deep knowledge of the company's business. Many Canadian industries could carry out a planning programme on a similar basis, with a relatively small expenditure of time. Careful planning is not an easy undertaking, but it will yield large future returns.

Postwar Planning Compared with Future Planning

Many of the postwar innovations that are treated so glibly in the popular press are so visionary that we should distinguish clearly between postwar planning and what might better be termed future planning.

Postwar planning should be concerned with developments that are of a practical nature. These are the only things on which you can base concrete plans. Such plans should be worked out so completely that you could start to put them into effect tomorrow, if the war should end tonight.

Future plans concern schemes or proposals that may be in any stage from a dream in someone's mind to an experimental model which may be close to being a definite development. While there is little doubt that many of these things may find common use eventually, we must not allow ourselves to be fooled by what we hear or by what we see in the press, into thinking that they are just around the corner.

Desirable as they may seem to us, there will be much development to work out; many production problems to solve; and much hard sales resistance to overcome before they gain wide public acceptance. But do not underestimate the importance of these more visionary concepts, in future planning. They are the stuff from which we may distill products that will guarantee our continued future prosperity. On the other hand, do not confuse them with the definite schemes, which must be available for immediate action.

Advertising Postwar Products

There has been some criticism that the public may be misled by the exaggerated type of advertising of postwar products, which has been indulged in by a few concerns. There may be widespread disappointment, when it is found that these startling innovations cannot be purchased the day after the war ends. Oddly enough, this may have a beneficial result in checking purchasing in the immediate postwar period. A surging desire to buy before stocks are adequate would have an inflationary effect. As long as people are convinced that really improved models are just around the corner, some of them may be content to wait a little longer before they purchase.

Manufacturers have not been allowed to make tools, or carry on development work during the war. Thus, goods can only be put on the market quickly by using existing equipment to make prewar models. For this reason, there has been curiosity as to why some advertisers are featuring goods that they know cannot be produced in the immediate postwar years. There have been a number of explanations. Companies with greatly expanded volume of war production may be trying to build prestige that will assure them a share of the reduced postwar market.

Other companies may do it because their postwar plans must be kept secret for military or other reasons, and they may as well be fancy-free.

In some cases, it may be done more to confuse competitors than to inform the public.

Need for Planning

The saying that "the future belongs to those who prepare for it" is an apt argument for the value of planning at any time. A successful industry should be planning continuously. Postwar planning is really not a new problem, but an old one with a new name. It involves few new factors. It does require a more comprehensive understanding of our economy, and a little greater pressure for accomplishment, than is usual in normal development. Planning should put you in a position to shift to postwar conditions, smoothly and in high gear.

An industrialized country cannot be prosperous, unless its industries are also prosperous.

There is a reason for wanting to see all Canadian industries plan for greater future prosperity. The largest companies form only a small part of the whole Canadian industry. In very few cases does their output exceed one per cent of the gross output of manufactures in Canada. The sale of their products is dependent on the prosperity of all the other industries, and the jobs they create.

Free Enterprise

If the government should continue, and extend, the control and regulation of business after the war, and if it should operate the large plants that are now owned by the nation, there would be less need for planning by industry now. But it must be assumed that business will be free from government control in postwar years; that individuals will be free to exercise initiative; and business free to show enterprise.

Most of us believe in the system of free enterprise for industry, and resent unnecessary government control of, or interference with, business in normal times. If we are to keep our present business system free after the war, we must show enterprise now. While many postwar problems will require close co-operation between government and business to find a satisfactory solution, we believe that the main planning job for industry must be done by industry itself. The first step is for each individual concern to put its own house in order.

Planning by Government

Postwar planning covers a very broad field but it may be divided into five categories: international; national; regional; industrial, and individual companies.

In the international field, we have organizations such as the Canada-U.S. Joint Economic Committee of which Dr. W. A. Mackintosh is chairman.

The Dominion Government was quick to recognize the necessity of national planning. Starting early in 1942, they set up a variety of committees to investigate postwar problems. These include the Cabinet Committee on Reconstruction with its Advisory Committee on Economic Policy (usually known as the Clark Committee), its Advisory Committee on Reconstruction (called the James Committee) and its General Advisory Committee on Demobilization and Rehabilitation under Brigadier-General H. F. McDonald, deceased recently and succeeded by Associate Deputy Minister W. J. Woods of the Department of Pensions and National Health. The Senate have a Committee on Economic Re-establishment, under Senator Norman P. Lambert; while the Commons have their Committee on Reconstruction and Re-establishment, with Mr. J. G. Turgeon as chairman.

In the regional phase, most of the provinces and many municipalities have set up organizations for postwar planning. They are interested particularly in development of local natural resources; in construction; and in public works or public services.

For our own good, we should individually and collectively endorse all constructive plans made by governmental bodies. If the programmes they devise provide employment at the right time, it will take much of the load from the shoulders of industry, and contribute to raising the general level of prosperity.

They will probably spend a great deal of our money on these things, and the taxes necessary to carry them may be a heavy load in the future. We are interested in seeing that this money is put into projects that are either self-liquidating, or at least pay the intangible dividends that are provided by enterprises that are of genuine service to the community.

Planning by Business and Industry

In the field of business and industry, organizations such as the Canadian Chamber of Commerce, the Canadian Manufacturers Association, The Engineering Institute of Canada and others, are carrying on valuable studies in postwar planning.

We should not forget that labour has a great interest in continuing prosperity in Canada, and intends to have something to say about it. Both the Canadian Congress of Labour and the Trades and Labour Congress of Canada have submitted their recommendations to the Commons Committee on Reconstruction.

As yet, there has been little co-operative industrial planning in Canada, comparable to that done by organizations such as the Committee for Economic Development in the United States. Anyone familiar with the work of the C.E.D. will realize the needs and opportunities for correlating industrial planning in Canada, and extending it beyond the point to which it can be carried by individual concerns. Such an organization also provides a good channel for co-operation between government and industry.

In Canada industry is carried on in over 25,000 establishments, large and small. Each individual company must accept its share of the responsibility for making and maintaining the national prosperity. Each concern must help to create the prosperity in which it hopes to share.

In planning by industry, the work done by individual concerns is of paramount importance, because you must build up from the bottom and not down from the top. Many companies in Canada are doing outstanding work, but we do not think that planning is as widespread as it deserves to be, particularly among the smaller companies. You cannot hope to deal with postwar problems successfully, if you do not know what problems to expect. To be prepared for them requires study, analysis and planning.

Industrial Employment

While the purpose of this paper is to discuss industrial planning, perhaps the role to be played by the manufacturing industries has been over-emphasized. In the past, there has been a tendency on the part of many who have spoken, or written, about planning, to imply that industrial expansion alone can assure full employment, after the war. Actually, this is impossible, because the manufacturing industries in normal times employ only about 15 per cent of the total available working force. It is doubtful whether industry of every type, excluding agriculture, could possibly be expanded so as to employ more than one-third of the total working force.

The remainder of the gainfully employed are in occupations that process or produce primary goods, such as construction, mining, pulp and paper, lumber, electric power, fishing, cattle raising and agriculture; or in occupations that facilitate the exchange of goods and material, such as wholesale and retail trade, transportation and communication, accounting and financing; or in miscellaneous personal services, such as government, law enforcement, education, recreation, health or religion. To maintain a balanced state of full employment, all forms of the production of goods and services must be increased as compared with prewar years, and in many cases by a greater ratio than in the manufacturing industry.

This means that there must be many other forms of planning than that by industry, and in many cases such planning is clearly the responsibility of government.

Effect of National Conditions

In connection with postwar planning it is natural to ask how plans can be made now that are of any value, when national and international events may have such a profound effect on the future business and economic structure of Canada. Many things may affect business conditions after the war. There may even be what might now be considered radical changes in the economic situation, but we are convinced that few of them will happen overnight, and without some warning. Human nature being what it is, it is believed that things will not be very different in the years immediately after the war; and that is the period of particular concern in our planning.

A general in command of an army in the field cannot possibly know everything about the future strength and movements of the enemy. How little progress would be made, if he refused to plan his campaign because he lacked complete information about such factors. We are in a somewhat similar position. We must muster all of the facts that are at hand, and make a plan based on reasonable assumptions. Planning must then be kept fluid so that it can readily be adjusted to meet changing conditions as they develop.

C.G.E. Planning Committees

Discussion of postwar planning is often in such broad generalities that many people fail to grasp its application to their own problems. Now how should a manufacturing industry make plans for postwar years? Instead of laying down an abstract set of rules and routine. I would prefer to describe briefly what is being done by our company. While in many respects our planning may not suit your conditions, this course has the advantage of allowing me to speak from actual experience.

To direct the postwar planning of our company, the management appointed a Special Planning Committee. This is a group of eight men, including two managers of commercial departments two works managers and three works engineers. They are all key men in the organization and well fitted to this work by their experienced judgment and knowledge of the company's affairs. As you no doubt know, the products of the company cover a very wide field. They range from large pieces of custom built apparatus, of which only one may be built, to small products of repetitive manufacture which are made by the million, and sell for a few cents each. It is apparent that no one person, or small group, can have a sufficient breadth of knowledge, and experience of the details of all phases of the Company's activities, to enable them to gather all of the information, and make all the estimates, which would be necessary to build up a comprehensive plan for postwar years.

For many years it has been the practice of the company to appoint a small product committee for each major group of product lines. Such committees average about five members and always have representatives from the commercial, engineering and manufacturing groups that are concerned with their particular product line. It is their function to assure full co-operation between the commercial, engineering and manufacturing phases; to review all activities in connection with their products; and to make any possible recommendations for their continued successful operation.

At the present time, there are thirty-five of these Product Committees, with a total membership of about ninety. It was felt that they were in the best position to make the detailed studies and gather the data required for postwar plans.

Committees have certain weaknesses at times, but nothing has been found better for work of this kind. To do planning, commercial, engineering, manufacturing and often other phases of the business must be considered. Bring together a representative from each to talk things over, and you have a committee, whether or not you call it one. Giving them the formal status of a committee assures greater regularity and continuity in their work.

The secretary of the Special Planning Committee spends his full time on planning activities, and acts as liaison between the Product Committees and the Special Planning Committee.

Good planning must be based on creative thought and should not be spoilt by too much hurry. Unfortunately, the timing of planning is now so urgent that it must be speeded up, even at the risk of making it less effective. As the planning committees outlined each section of their work, they found it best to assign responsibility to one man, and set a definite date for completing it.

Engineering Development

The first step in the programme which was given to the Product Committees was to review engineering development. The members of each product committee were asked to check the possibility of redesigning each of their products, so as to secure greater utilization of new material which will be readily available after the war; to give greater styling and sales appeal; to meet anticipated competitive development; to allow extended applications; to conform to standardization and simplification programme; to improve quality and serviceability; or to take advantage of manufacturing equipment installed during the war. In short, to reduce our manufacturing cost or give greater value to the consumer.

Developments in materials will include entirely new material; materials available in large quantities which had been relatively scarce before the war; reduction in the price of materials from expansion of manufacturing facilities during the war; and extended applications resulting from wartime experience. Similar developments and extended applications have occurred in manufacturing processes and finishes.

In most lines, postwar manufacture will start with old designs and materials, but in many cases competition between producers of raw materials and our urge towards constant product improvement, will force us to modify designs and adopt new materials, as soon as possible after the war.

Engineers in manufacturing industries can make one of their principal contributions to postwar planning by keeping informed about new developments. They should keep thinking about where they could be used to good advantage in their products. In many cases, such developments may have a revolutionary effect on the design and manufacture, and consequently quality and cost, of products in future years.

Engineers should do everything possible to improve their co-operation with the commercial and manufacturing members. If sales for a product are slipping, the engineers are in the best position to make modifications, or improvements, that will reverse the trend.

On the other hand in dealing with the factory, engineers must avoid the attitude of "I've designed it, now you make it." Wherever possible, designs should be suited to existing factory equipment and production methods, particularly to take advantage of changes in equipment and methods introduced during the war.

Postwar Volume of Sales

The second step in the programme was to make an estimate of sales volume in postwar years. We usually refer to this year as V + 2. The figure 2 does not mean two years after victory. It is the first year after we have passed through the immediate postwar conversion period and when supply is substantially equal to demand.

Your first impression of making an estimate of sales volume in the V + 2 postwar year may be that you should perhaps employ an astrologer. Admittedly, you have only an estimate, but a carefully prepared estimate is very much better than a guess, or no estimate at all.

Three ways were considered for making this estimate. The first was to make a detailed survey of the market for each product, and contact every possible customer. From their future plans, a picture of postwar demand might be built up. The difficulties of making this type of estimate, under present conditions, are obvious. There would be so many gaps in the information that the total would be of little value. However, every possible effort is being made to keep in touch with customers, and their information is being used to check and revise estimates made in another way.

Another method of estimating has been widely used in the United States. They put together data on the gross national output in past years, and on the components of this output. They start with the assumption that there will be substantially full employment in the year V + 2. Knowing the size of their total working force, and the average output for each person gainfully employed, they can project their figures for gross national output of goods and services into an estimate of the total for the year V + 2. For example, if V + 2 should be the year 1946, the total would be 165 billion dollars. From their knowledge of the components of this total, the production of producers' goods and equipment would be 15 billion dollars. Breaking this down again, the electrical industry would make 1¼ billion dollars of electrical apparatus and equipment. From past figures for the electrical industry, General Electric can then determine their share of this volume and further make an allocation of this share among the various product lines. If you are interested in this method of attack, I suggest that you read "An Approach to Postwar Planning" by Messrs. R. P. Gustin and S. A. Holme, which was published in the Summer of 1942 issue of the *Harvard Business Review*, and also a 1943 publication of the U.S. Dept. of Commerce entitled "Markets After the War."

As far as we have been able to determine, Canadian figures for gross national output and its components are not as complete as those for the United States, and industry figures often do not exist. For these reasons, we have not attempted to use the method. We do intend to investigate it in more detail later, and use it as a check on the estimates we have made.

The third method, and the one we decided to use, is to review figures for the dollar volume of sales of each product line during prewar years. In order to get the trend as well as the volume in any particular year, figures were obtained for the period 1928 to 1942. As a basis for estimating, each committee then selected their best year during the period 1937 to 1939 inclusive. This figure represented what they had been able to sell in a year when business was good; when unemployment was relatively low; and which was not influenced by the effect of war orders.

Don't be misled by these estimates of sales volume in postwar years. No one can tell you how much you as an individual will actually sell in the year V + 2. The figures do tell you how much you might expect to sell if you get your share of the available market, when business is good and employment is high. In a sense, it is a maximum figure or a goal toward which you should strive. It is a level which you will exceed only in exceptional circumstances, as for example, if unusual export demand should make it desirable to continue to use overtime and marginal labour, after the war.

The Product Committees then evaluated factors which might change this estimated sales volume, in postwar years. First, they investigated the possibility of new markets after the war, and estimated how much they might expect to sell in fields not touched before the war.

Second, they surveyed extended or new uses of their products which might result from experience and new applications during the war, and estimated how much this might add to postwar sales.

Third, they investigated new products which have been developed during the war years to the point at which they can be readily adapted to peacetime application, and estimated the volume they might be expected to reach in postwar years.

Fourth, they investigated the effect of purchasing, or lack of purchasing, during the war. In some cases, this may result in an abnormally high, or low, volume of production after the war. Estimates were made of the time during which abnormal conditions are likely to exist. The effect of war purchasing varies widely, from apparatus for which there may be a surplus after government-owned war plants are closed, to appliances and other consumers goods which have not been manufactured for some time, and for which a large postwar demand is building up. For each product an estimate was made for the effect of this factor.

Fifth, other factors that might affect postwar volume were reviewed. An example is the competitive situation. Sales may be affected by new competition, and an estimate was made of its probable scope and activity.

Then taking the sales volume for the base year and adding to it the net effect of new markets; extended applications for old products; entirely new products; the effect of purchasing during the war; the competitive situation and other factors, gives an estimate for the sales volume in our postwar year V + 2.

This estimate gave the factories a definite picture of the manpower, floor space and manufacturing facilities which should be provided for postwar production.

Adding the estimates from the 35 committees gives the total estimated sales volume for the company in postwar years.

Commercial Activities

But it is not enough to simply estimate how much we might, or should sell, in a postwar year. To create the sale we must gauge the demand, and make the right thing, at the right time, to sell at the right price. So the next step was to ask the commercial members of each product committee to survey their sales activities.

In most lines, products have been scarce or unobtainable during the war. The ordinary relations between buyer and seller have been suspended. This break in normal conditions gives an opportunity to make a thorough appraisal of methods of sales and distribution. Where changes seem desirable, they can be put into effect with the minimum of dislocation.

Factory efficiency has been increased during recent years, and manufacturing costs have been decreased, by the efforts of methods men and cost investigators. In many lines, costs of sales and distribution exceed the manufacturing cost. Consequently, the competitive conditions in postwar years may tend to emphasize the need for lower cost of sales and distribution.

First, the committees considered whether it is desirable to make changes in their sales methods.

Second, they surveyed changes in commercial office and field organization that would be more effective in meeting postwar conditions.

Third, they investigated the possibility of more efficient channels or methods of distribution.

Fourth, the commercial men have been trying to determine probable changes in customers' requirements for postwar products, because many customers are concerned about postwar development. They are anxious to co-operate with them on development or experimental work, so that electrical equipment can be incorporated into their products in the most efficient manner.

Fifth, they have been trying to determine which customers are likely to show hesitancy about placing orders in the immediate postwar period and to devise sales promotion programmes that might stimulate sales from such customers. There has been a lot of talk about the excess capacity that has been installed during the war. Many customers would be reassured if they made an actual appraisal of their electrical equipment, to see where new apparatus could be used to good advantage. It should replace obsolete or inefficient machines, many of which have been given punishing service during the war.

Manufacturing Problems

The fourth step in planning was to apply the information on products and sales volumes to the factory problems. First, the factory members of the Product Committees prepared figures for the personnel, both direct manufacturing and indirect, used for each product line in a number of prewar years. Since skill and training is of importance, these figures were broken down into major occupational groups.

Second, they determined the floor space, both manufacturing and non-manufacturing, required for the known volume of factory output in a number of prewar years.

Third, notes were made of special equipment, types of building and other manufacturing facilities in prewar years.

Fourth, a close check was made on the probable condition of existing tools and equipment at the end of the war, and a programme for replacement or rehabilitation was drawn up. Where new equipment will be required for postwar products, it was specified.

Fifth, factory layouts were surveyed to see whether changes or new layouts would give greater efficiency in manufacture.

Sixth, they drew up a time schedule for conversion to peacetime production. Speed will be essential in getting into production after the war. In order to arrange for sales outlets and distribution; for advertising and sales promotion; and to build up stocks in the field, the commercial men must have a definite schedule. It should tell them just what, when, and how much, will be available for sale in the immediate postwar period.

While in some lines a decade or more of technological progress has been crowded into the war years, the effect cannot be apparent during the immediate postwar period. It will take time to apply this new knowledge to peacetime products.

There will be a few major industries in which as much as one-fifth of the output in V + 2, will be new products that did not exist before the war. The rest will be old products, or redesigns and modifications of older lines.

The extent of this conversion problem and the time required for conversion is often exaggerated. Aside from special war goods which have no possible peacetime application, a large fraction of Canadian industry made about the same products during the war as they made in prewar years and will make in postwar years. There are a number of industries in which conversion is a severe problem, but it is difficult to escape the impression that too much emphasis has been given to them. In our company the period between V and V + 2 will vary from a few weeks to three years. In many product lines, the conversion problem will be simply that of securing allocation and delivery of material for the first peacetime orders.

Using the statistics and information that have already been detailed, each Product Committee estimated the number of employees, factory floor space, equipment and other manufacturing facilities necessary to manufacture their estimated postwar volume of products.

Company Plan

It then becomes the function of the Special Planning Committee to integrate all of the Product Committee reports into an overall plan for the company.

First, figures were obtained for the estimated peak employment and floor space in each plant.

Second, estimates were made of the total number of employees who may wish to stay with the company after the war. These figures were segregated by factories.

Third, figures for the estimated postwar personnel required for each product line were segregated into the factories where these products are built. Comparing the totals with the figures of the number of employees who wish to have employment gives probable shortages and excesses of labour in each plant.

Similarly, a comparison of existing floor space with requirements estimated for postwar years gives the probable shortages or excesses in each plant. Manufacturing equipment and other facilities are dealt with in similar fashion.

These studies show where changes of manufacturing location are desirable and enable the Special Planning Committee to draw up a master recommended manufacturing plan for the company.

Other Effects of Planning

Any possible strengthening of your company organization will aid in meeting the stress of postwar years. It has been found that several interesting by-products of planning have this desirable effect.

First, it leads men to concentrate on their future problems in a way that they would seldom do if the effort were not organized. At the same time, they tend to make a more comprehensive review of their problems.

The second is that more of our men become familiar with the company's affairs.

A third is that it tends to promote greater co-operation between the commercial, engineering and manufacturing departments in dealing with postwar problems. It tends to break down their preoccupation with their individual problems, and take a renewed interest in the company as a whole. It gives them an opportunity to advance dormant ideas for consideration.

The chances are that any company that carries through a planning programme of this type will be satisfied that these secondary effects, and the data and statistics which have been assembled, make the planning effort worth while. This would be so, even if activities were stopped at that point and no further effort were made to put the plans into effect.

Problem of Full Employment

So our planning has told us what we may expect to produce if business is good in postwar years, and has allowed us to plan the personnel and manufacturing facilities to make it. But this is by no means the end of the problem.

A census of troops in the field showed that the thing they have uppermost in their mind is a job when they return home. Unless there are jobs for them, it will be difficult to explain how the economy of the country could run full out during the war and produce enormous quantities of goods for them to waste on the battle field, but cannot provide jobs for everyone in the production of useful goods in time of peace. Desirable as this goal of full employment may be, it will not result automatically from just wishing for it, or even saying in the most determined manner that you must have it. It will result only from planning for it and working for it.

Full employment is a deceptive term. It is undesirable to attempt to maintain the present high level of employment, because it depends too much on marginal labour—adolescents who should be completing their education; older men who should be pensioned; housewives who should be looking after homes and families; and people drawn from less essential occupations.

Even in normal times you cannot hope to have jobs for the entire available working force. Some are unemployable, and a certain number of people are out of employment through sickness, accidents, or while changing jobs. A better term for the goal might be "substantially full employment."

Many people have secured better paid or more congenial occupations in war industry. There is not only the prime problem of attempting to provide jobs for them, but also the secondary problem of their reluctance to return to work which may seem less desirable to them.

The best way to create the desirable condition of high employment is through the exchange of goods and services which will result in a higher standard of living in Canada. Aside from what must be done by government and in other ways, the solution to the part that industry can play in providing employment lies in production and distribution. We must plan what we are going to sell in postwar years and then do the best possible merchandising job to build up public demand for our products. Production to satisfy this increased demand will automatically result in employment for a greater number of people.

To maintain substantially full employment in industry in Canada, it would be necessary to produce roughly 50 per cent more than before the war. It is doubtful whether entirely new products could possibly account for more than 10 to 15 per cent, so 35 to 40 per cent of the increase must come from extended uses of old products.

Effects of National Events

Assuming that we secure our share of the available market in a year when business is good in Canada, our plan tells us how much we may expect to sell, where it will be produced, and the number of people required to make it, and the equipment and factory floor space that must be provided.

Carrying the plan to this stage does not mean that planning is finished. Every international and national event that affects the national economy of Canada affects our planning, in greater or lesser degree. So we must keep informed about probable changes during postwar years in gross national output and income, employment, hours of work and working conditions, availability of capital and investments in durable equipment, government measures to promote re-establishment and reconstruction, government policies or tariffs and trade, taxation, price and commodity controls, immigration, money and inflation, disposal of surplus materials and equipment in government-owned plants, and all the other factors that will shape the conditions likely to exist in Canada in V + 2. As the national picture changes, we must conform by changing our planning.

Assembling the data for your plan will lead to a natural curiosity as to what others are doing. Your planning can be supplemented and additional information of value can be obtained by working with the vendors from whom you purchase and the customers to whom you sell. In some cases you may also wish to contribute to industry planning through trade or business associations.

Engineers should be interested in planning because they are well suited to the work. Their training fits them to handle facts and figures in a logical, analytical way that disregards dreams and fancies. Facts are the only thing from which you can fashion a practical workable postwar plan.

They say that good men do their best work when challenged by a big problem. There is no doubt that in postwar years engineers will continue to prove that this saying is true.

SOME OBSERVATIONS ON BENEFIT PLANS FOR CANADIAN WORKERS

M. A. MACKENZIE, M.A.
Professor Emeritus of Mathematics
N. E. SHEPPARD, M.A.
Faculty of Arts, University of Toronto
Fellows of the British Institute of Actuaries

An article written at the request of the Institute Committee on Industrial Relations, being one of a series prepared for the *Journal*

Primitive man was mainly concerned in supplying his own daily nourishment. If he had freedom to wander, he cared little about the future and used nature to store his food for him on the hoof. On the other hand, if he was restricted to a local area by natural or human barriers he generally chose some place where the food was supplied by nature at one or more times in the year; his mate looked after the storage of the excess food for the unproductive seasons of the year. As an example of the first type of man we have only to look at the Eskimo who moved to where food could be found in each season of the year. For the second type we might consider the Indian on the Pacific coast who stored up the salmon by drying in the fall of the year when the fish returned to their original rivers. But with these primitive types doubtless only a small proportion of the children born reached maturity. Moreover the old or crippled who managed to survive had to rely upon their relatives for sustenance and protection. Nowadays we have taken it as a matter of course that the state will look after the education and to some extent the health of the young; and the modern tendency is for the aged to be maintained not by their own descendants but by society in general.

Need for Benefit Plans

As man obtained protection from outside physical violence he applied his energies to working up a business or trade in which he often became an expert. In more modern times we have, for example, the retailer, craftsman, or independent professional man who finds success coming his way and who then sees the necessity of employing others to help him. So long as the number of such employees was small, and the proprietor was able to choose proper individuals, he seldom had to contend with the care of their families, though he sometimes did look after his old employees when their working days were over. If, however, the business prospered greatly and the number of employees became large, and especially if the business became incorporated, the organization found it necessary to look into some of the risks to which an employee might be subjected. These risks are,

- early death in service, leaving dependents;
- disability while employed; and
- a long period of old age after working days are no longer possible.

Many plans have been developed to give the employee security against these three risks, but the principal difficulty encountered is that of finding out what the cost of any set of benefits will be and how this cost should be divided equitably between the interested parties.

Dependents After Death of Wage-earner

In the case of death the matter is rather simple if a lump sum of money is all that is required. During past years many sets of experiences have been examined from which proper mortality rates have been established. If, however, even in the case of death, periodic payments are to be made to a widow, the matter becomes very involved, as many further contingencies must be taken care of. Many employers have adopted group insurance to cover this contingency, providing for the payment of a lump sum at the death of an employee. There are, however, not many widows in a position to obtain proper advice on the spreading out or spending of such a payment.

Disability of Wage Earner

With regard to disability encountered during service, the real problem is to find the person who can with unerring judgment say when an employee is disabled and to what extent. Also mortality rates for disabled persons are very difficult to obtain, partly because of faulty classification and partly also because in many instances a disabled person who has been granted a pension has been able to adjust himself and as a result to claim his pension for a large number of years. Some employers take care of this risk out of current revenue year by year, either directly or to some extent through Workmen's Compensation facilities. Others try to incorporate it in their pension plans.

Retirement on Pension

The main risk that we wish to consider in this article is that of the retirement of an employee on pension after many years of faithful service. It should be pointed out that firms, organizations and municipalities do not run into this problem until they have been in operation from 30 to 50 years. Even then it may be a serious matter if the concern has been growing rapidly, as the number of original employees who survive their days of useful service will naturally be very small compared to the total number of active employees; and moreover, the old inefficient employee is sometimes given a less exacting job. However, as those cases begin to increase in number the directing body is unable to find enough suitable jobs and they proceed to establish a pension scheme in order to avoid having to decide each case on its merits. We have often found that while the benefits of such schemes may appear on the surface to be fairly generous, their ultimate effect and ultimate cost have not been looked into. In this connection, in looking over the annual statements of some of our Canadian businesses, one is struck by the absence of any reference to a liability covering pensions payable in the future to present employees, although a detailed pension plan may have been in operation for many years. Auditors are insistent upon building up depreciation for machinery and equipment but not much seems to be done about the depreciation of the human machine.

Contributory and Non-contributory Schemes

This problem of growing old in service is difficult to solve because conditions vary so greatly from one business to another. The first question to be decided is that of who is to pay for the pension benefits. The easy road is to make the present working generation provide the pension payments for the immediate past generation of workers. On the other hand the ideal situation would be that in which each man accumulates his own deposits sufficient to cover any pension payments he may require. The modern trend is for the employee and the employer to pay dollar for dollar currently during the working days of the employee. The cost part of the scheme, however, especially for the older employees, is generally left unsettled or allowed to drift along after the scheme has been put into operation. Naturally the employee is only concerned with the size of his annual pension, which generally bears, or ought to bear, some relation to the immediate salary before retiring.

The big problem in finding out the appropriate cost is to preserve equilibrium between what will be ultimately paid out in pension payments and the accumulation of the contributions paid in by and on behalf of the average employee. Several factors enter into the determination of the adequate rate of contribution. Some of them are, for instance, the rate of interest which can be counted upon, the age at entry into service, the determination of the normal retirement age, the rates of leaving service for any reason up to this age, according to the sex of the employee, and the mortality rates applicable to pensioned employees. Data bearing on the above points must be collected from reliable sources to form a basis for projecting the present and past experience into the future. Even as to the normal retiring age one encounters considerable variation. One man may be ready for pension at 60, another should be pensioned at 65, while a third man may be able to give good service even after he is 70 years of age. Again, moneys must be accumulated by investment, but the rate of interest earned or to be earned varies with the times and the type of investment. The tendency is for mortality rates to decrease as time goes on.

Pensions for Women

In days gone by, not many women stayed in the service of an employer long enough to obtain a pension but employers are now finding it necessary to extend their pension schemes to take care of an increasing number of women who will become eligible for pension. Pensions for women cost more than those for men. As an example, in round figures, $10,000 in cash will provide roughly $100 a month for life to a man aged 70, whereas the same $10,000 would provide only $85 a month for a woman of the same age. These are the rates at present charged on a 4 per cent interest basis by the Annuities Branch of the Dominion Government. One might think that if age 70, for example, were taken as the retiring age your problem would be settled if you could provide the $10,000 in a lump sum and allow the employee to do what he liked with it. At 4 per cent if a male employee took out $100 a month from the original fund of $10,000 he would find out in a little over ten years that he had no fund left on which to live. This example illustrates the use of the life annuity as against the individual trust or endowment fund to provide pension benefits. But no employer who has a pension scheme dares to allow the annuity payments to be commutable into a lump sum. Nor can he afford to allow borrowing privileges to the contributor. For if he does the one or the other, and if the employee loses or spends such money, the employee either falls back on his old employer or is a bad talking advertisement for the employer's business.

Cost of Annuity Schemes

If as time elapses the rate of interest falls, the cost of providing the same set of benefits increases, also the longer the duration in which annual benefits are to be paid the bigger the increased cost will be. A more serious factor however comes in with the lowering of the initial pension age. To illustrate this point we give the following quotations on the present Dominion Government annuity basis.

	Cost of providing at retirement age an annuity of $100. a month for life for a	
Age at retirement	Male	Female
70	$10,160	$11,860
65	12,120	14,020
60	14,050	16,020

Let us for a moment consider a non-contributory pension plan, that is, where the whole cost is borne by the employer. This would be an illustration of an unfunded pension scheme. If pension benefits are set normally about one-half the final year's salary with a normal retirement age of 65 and also if we assume a stationary condition in the number of employees, an employer would probably find after 40 or 50 years that his pension payments would be in the neighbourhood of 20 per cent of the amount payable in annual salaries.

If, on the other hand, such an employer had paid level contributions with or without the aid of his employees from the beginning of service of each employee, the same pension benefits might have been covered by a total annual contribution of 8 to 10 per cent of salaries. His pension plan would now be considered as a funded plan provided he had set up the necessary machinery to accumulate the contributions paid into the fund each year. This investment operation requires great care initially, with continued supervision as time goes on, since the best rate of interest procurable is desired while at the same time there should be no depreciation in the invested funds.

Security of Investment

Some employers have obtained a high rate of interest by investing these moneys in their own business. This is a dangerous course and to overcome it a third party, such as an insurance company or the Annuities Branch at Ottawa, should come into the picture so as to guarantee (if only for a limited period) a definite interest return and to overcome the risk of depreciation of funds and the risk of exceptional longevity among the pensioned persons. These are very desirable things to have covered by a third party. But it has been also found that such plans are not as flexible as those set up and cared for by the employer in conjunction with his employees. Experience has shown that it is very difficult to sell annuities and make a profit, so that the insurance company generally overloads the plan by attaching a number of so-called frills in the nature of insurance benefits, in order to at least break even. The trend of increasing longevity of pensioners and annuitants has been well known for a long time. Over a hundred years ago the poet Byron described the situation in these words:

'Tis said that persons living on annuities
Are longer lived than others,—God knows why,
Unless to plague the grantors,—yet so true it is,
That some, I really think, do never die.

The rates charged by many insurance companies are also loaded to cover in some measure expenses of operation. On the other hand the Annuities Branch at Ottawa does not sell insurance. Their rates for annuities are net, as expenses of operation are borne by the taxpayer in general.

As we have tried to explain in the foregoing notes, the question of providing benefits which may become payable to either the employee or his dependents is a delicate one. Moreover it is not a static problem but changes with the industrial situation. As we have also pointed out above, there are difficulties and drawbacks connected with each of the three methods described, namely, a fund run by the employer, coverage through an insurance company, or a plan purchased through the Annuities Branch of the Dominion Government.

When an attempt is made to take into consideration all the factors bearing on the particular situation for which a pension plan is proposed, it should be easily seen that no one can be dogmatic in his views nor can he prescribe an ideal type of fund which can be adopted to any situation.

Combination Schemes

After stating the above qualifications we venture (with some misgiving) to indicate the procedure needed in handling any Canadian situation, so that a combination of the possible facilities outlined earlier may be used. The level or uniform cost expressed as a percentage of salaries would however have to be estimated for each group of employees after the size and variety of benefits have been fixed. No insurance company in Canada can sell annuities as cheaply as the Dominion Government, but there are two handicaps to be overcome in buying pensions from the Government. The first is that no refund of employee's contributions will be made except upon death, and the second is that the maximum annuity which can be purchased is one for $1,200 per annum on any one life. The first restriction leads us into difficulty, especially where women are employed, because it seems natural for them to demand a return of their contributions as soon as they leave their employment. And the second may become a serious handicap for the executive or higher paid employee of a company, whose pension should exceed $100 a month.

We are convinced that any pension scheme should be contributory in nature and if possible the cost in respect of current service should be divided more or less evenly between the employer and the employee. Further we believe that so-called disability pensions should not be large in amount in comparison with the regular service pension. Otherwise there will be a tendency for employees to quit service on the plea of disablement so as to claim their pensions. Especially will this be true if any such employee can obtain another position and so increase his annual income. We therefore believe that all contributions should be accumulated to the credit of the person for whom they are paid; also in the case of employer's contributions a proper period should elapse before such contributions will vest in the employee.

Methods of Handling Contributions

All contributions can be deposited quarterly with the Dominion Government under a master contract in the case of male employees who have attained say age 25 or have two or three years of continuous service. When the contributions paid in are sufficient to purchase the maximum annuity on the life of the employee arrangements can be made to have a supplementary contract through an insurance company.

With regard to female employees it might be well to adopt the same rule so far as deducting contributions from their wages is concerned, but to withhold the turning over of these moneys to the Government until the woman has reached say age 35, when it might be presumed that there would be a reasonable chance of an ultimate pension. These accumulated sums held by the employer for his female employees might be allowed such interest as could be earned and any employee could of course be given an opportunity to have a contract with the Annuities Branch prior to age 35.

Since accumulation of contributions if only begun in middle life will not produce a very large pension the employer might, out of his current revenue, supplement to some extent the pension purchased. For the older employees in service at the inception of a pension plan it has been customary for the employer to take care of what is called the accrued liability due to their past service. What can be done for such cases will depend on what funds are available for the purpose.

Deferred annuities are generally issued with a normal quinquennial retirement age such as age 60, 65 or 70, but as the contributions are accumulated at interest alone, the Annuities Branch will start a pension on any anniversary before the due date. The due date will not, however, be extended unless such extension is applied for at least five years prior to the normal age stated in the contract. Life annuities may also be issued with a definite number of pension payments guaranteed after the annuity begins. Since the contribution rate is very seldom more than 5 per cent of each individual salary, the contributor will in 40 years time have actually contributed two years average salary, so that if his pension is roughly one-half average salary he will have obtained all his money back in approximately the first four years of his retired life. It has therefore been customary to have such deferred annuity contracts issued on the plan whereby the pension payments are guaranteed for five years after retirement.

Caution and Common Sense Needed

It would be well to round off this rambling record of thoughts and ideas by again appealing for caution and common sense in tackling this pension question. The interest of each person concerned may be different. One man's desires may be directly opposed to another's interests. One item may be unduly stressed or partially ignored. But this much is sure, it takes money to provide for old age and the earlier the age at which contributions are begun the smaller will be the annual cost.

THE ROLE OF THE CONSTRUCTION INDUSTRY IN POST-WAR YEARS

Excerpts from the brief presented on November 25th, 1943, by the Canadian Construction Association to the Special Committee on Reconstruction and Re-establishment of the House of Commons of Canada

There is no certainty as to Canada's postwar future! There are to-day two schools of thought; one is represented by those who see deflation and unemployment ahead, and seek some "New Deal" as a way out. Another group believes planning can assure us full employment once the short period of adjustment is over. They talk of dammed up purchasing power, of the pent-up demand for both consumer and capital goods.

It is only the policy of prudence to go on the assumption that we shall have to create employment to carry our people through the years involved in changing over from war production to peacetime production and in re-absorbing our armed forces into civilian occupations.

Construction is an industry that offers help, without delays and in measurable doses. If properly planned and prepared, it provides a method of creating employment exactly when and where and to the extent required, a method that may be applied almost at will.

Immediate Planning Imperative

The construction industry desires to emphasize the urgent necessity for expediting the preparation of complete plans and specifications for post-war projects of both a private and public nature, ready for calling for tenders at an hour's notice. Even though construction projects in such a reconstruction programme may not be needed for providing employment until well along in the future, much time is required for expropriation of lands at sites, negotiations in connection with purchase of property, materials, machinery and equipment, and for designs, final estimates and lastly financing.

There are many competent architects, engineers and departmental staffs presently short of work who could and should be utilized now for such planning and design. Not to utilize such skills at a time when there is so much to be done is shortsighted indeed.

Private Construction Should Come First

Construction by private enterprise should be given the first chance to create employment. We believe *the government should give every encouragement possible to private industry,* through loans at a low rate of interest, incentive taxation and other means, *to initiate private construction.* Publicly financed construction should supplement this private construction only in the event of the latter failing to provide the required amount of employment. It should not be looked upon as a substitute for private construction, but held in complete readiness for instant use whenever needed.

It is important that such industries should be encouraged to make plans and designs by allowing them to use their own funds up to 3 per cent of the cost of the proposed work, for such projects as are approved or certified by some suitable authority, such funds being deducted from the taxpayers taxable income, sums so deducted automatically lapsing if construction does not proceed within a specified time.

Efficient Methods Preferable to Relief

Our industry should not be obliged to function as a relief agency. It is all too easy to do this, since construction absorbs unemployment so readily. We do not want to see a reversion to the old policies of the depression years, involving relief projects containing a maximum of hand labour. On the other hand we urge that the most efficient methods possible be used, to the end that the greatest value is obtained for every dollar spent.

Post-war construction contracts should be awarded as far as possible on a competitive tender basis, as evidence shows that this is the most efficient and economical way of carrying out work. Advanced planning will make this possible.

Planning a Construction Programme

There are a number of very important phases of this question. No matter how much construction we list and plan for, whether it be public works, or privately financed works, (a) will there be enough funds available ? (b) will there be enough tools and plant ? (c) will there be enough trained men ? (d) will there be enough materials ? (e) will the industry's capacity be sufficient ?

If the available quantity of any of the above items is limited or inadequate, what can be done to bring these shortages of money and plant and men and materials up to the required level ?

The Federal Government, through a commission or board, could examine and pass on the various public construction projects which are proposed, rating them in order of priority and later relating them to proposed private construction, and to reconversion and demobilization plans, timing their start and progress, accelerating or retarding them as the need arises in each region.

Provision for Funds

Wartime corporations under government ownership have proved successful in war years both in Canada and in the United States. While a corporation under government ownership, for the express purpose of giving financial assistance to both private industries and government projects has not yet been attempted in Canada, experience in the United States with the Reconstruction Finance Corporation suggests that something along similar lines would be practical for Canada during the reconstruction period.

It may be that such powers could better be vested in the Bank of Canada, but it is respectfully suggested that some type of organization such as this, in close collaboration with existing financial organizations, would provide more and longer postwar jobs, at less ultimate cost to the Canadian taxpayer than would be possible by any other method.

Through such an agency, financial assistance for both private and public construction could be effected at the same time, stimulating one or the other as the need arises, keeping the proper balance between public and private spending, and dispensing with the necessity for many of the present wartime controls. It is not suggested that controls should be exercised over private construction which does not require Government assistance, other than to record in advance the employment it will furnish.

Working closely with such an agency for providing funds, a Commission or Board, by making advance filing of plans for approval a prerequisite for financial assistance to private or public projects, could forecast employment opportunities more accurately by regions, and time the release of public projects more intelligently.

Equipment, Labour and Materials Supply

Total equipment now on hand is estimated to have a replacement value of close to $100 millions. Since the value of construction equipment required represents about 10 per cent of the value of the construction being done, on an average, provided it is all in use, it would appear that sufficient equipment is on hand for carrying out a construction programme of any volume likely to be undertaken.

It is the opinion of this Association that the supply of construction craftsmen will not be a limiting factor in early postwar years for any volume of construction likely to be reached, so long as the proportion, as between building and engineering projects, remains relatively similar to that obtaining heretofore.

With the return of the lumber industry to peacetime operations after the war, it is not anticipated that the lumber supply will give cause for apprehension, provided encouragement can be given to that industry to attain full capacity.

On the other hand, priorities, if established, for the supply of materials for rebuilding devastated areas abroad, might limit certain domestic supplies on which a postwar construction programme depends.

Will the Industry's Capacity be Adequate

From the volume of work carried out previously and the availability of machinery, labour and materials, the possible construction volume, expressed in millions of dollars, that can be carried out by contractors, governments, the Harbours Board and municipalities is estimated as follows:

Last war year $250 to $350 millions; first postwar year: $450 to $500 millions; second postwar year: $650 millions; and $800 millions for each of the third, fourth and fifth postwar years.

The capacity of the construction industry to give employment for various annual volumes of construction is estimated by us to be as follows:

Gross Construction Volume per year (D.B.S. Index)	Total Number Employed on the job, and in factories, mines, woods, mills, etc., and transportation
$300,000,000	287,000 persons
$400,000,000	383,000 "
$500,000,000	479,000 "
$600,000,000	575,000 "
$700,000,000	671,000 "
$800,000,000	767,000 "

Labour Relations

The good relationship existing between management and labour in the construction industry has developed to the present standard over a long period. Forty years ago or more, employers and labour unions representing the fourteen different trades in the industry began making collective agreements governing wage rates, hours of labour and working conditions.

The National Joint Conference Board, established in 1921 and re-established in February, 1941, has been actively in operation ever since, and is composed of nine representatives of trades unions and nine employers. The chairman is an officer of the Department of Labour, and the secretary is also provided by the Department.

We are desirous that in the future these relations be maintainted and improved. For this reason we believe and respectfully recommend that this National Joint Board be continued in the post-war period under the provisions now made by the Department of Labour and, as in the past, problems affecting our industry be dealt with by this Board, and their recommendations be sent on to the Department of Labour for its serious consideration.

Housing

This Association believes there is need for a maximum of some 300,000 houses in Canada, to be built over the first five postwar years.

The National Housing Act has made it possible for people of fairly low incomes to own their homes, but this can only apply to a small percentage of people. The greater part of these 300,000 homes will be for low-income families, and will involve government ownership and assistance in some form.

Many existing houses are still very useful and only need some assistance to make them available for many years to come. A government policy that would create new housing within the reach of low-income families should bring suitable old housing also within the reach of these families. Any other policy would be a violation of the rights of owners and mortgage investors.

No study of housing conditions and housing requirements in Canada can proceed very far without the necessity of proper town planning becoming apparent. Properly constituted town planning committees, operating under Federal Government direction or regulation, should be a necessary prerequisite to any Federal Government housing assistance.

This Association suggests that a special department, commission or corporation, be placed in charge of this assisted housing which shall be charged with the creation, management and maintenance of these projects. Acting in conjunction therewith will be town planning committees in the larger centres.

Any national housing plan cannot possibly ignore the housing conditions that exist on many of our farms. Provincial commissions would have to be established to pass on the ability of the farm to produce, and the ability of the farmer to pay.

The replanning of cities, the furnishing of homes for low income groups, and the tying-in of the necessary community facilities, are problems we must face after the war. In their solution a very constructive field of employment and rehabilitation may be furnished.

Smoothing of Cyclical Fluctuations Should be Sought

Earliest consideration should be given to the formation of a policy by Dominion, provincial and municipal governments to the deferment of public works during periods of prosperity to those periods of depression which periodically strike the construction industry. The industry has become known as a "peak and valley" one. The smoothing out of these cyclical fluctuations, thereby assuring a more balanced economy for the whole country, can best be accomplished by the proper timing of public works programmes.

(Copies of the complete brief along with appendices may be secured from Mr. J. Clark Reilly, general manager, Canadian Construction Association, 414 Ottawa Electric Building, Ottawa.)

A MESSAGE FROM THE CITY OF QUÉBEC

Cabinet du Maire,
Québec, 3 janvier 1944.

L'institut Canadien des Ingénieurs tiendra à Québec, en février 1944, son Cinquante-huitième Congrès Annuel.

C'est un événement de grande importance dont notre ville peut être fière de devenir le théâtre. Au nom de mes collègues du Conseil de Ville et de la population de Québec, je suis heureux d'offrir dès maintenant nos souhaits de chaleureuse et cordiale bienvenue aux ingénieurs canadiens et aux chefs de la grande industrie de notre pays, qui nous honoreront de leur visite à cette occasion.

L'ingénieur canadien figure au premier rang des techniciens dont la collaboration scientifique a rendu possible l'effort gigantesque du Canada dans le conflit actuel. Grâce à son travail, à ses connaissances et à ses talents, l'industrie canadienne a pu atteindre une production phénoménale, qui restera comme l'un des faits les plus remarquables de l'histoire de la deuxième guerre mondiale.

Ce qu'il a si magnifiquement accompli quand il fallait s'ingénier à produire des engins de destruction et tout l'équipement nécessaire pour écraser l'ennemi, l'ingénieur saura assurément le répéter lorsqu'il s'agira de rebâtir. Il sera demain le grand artisan de la reconstruction économique de l'après-guerre au Canada.

On conçoit facilement la bonne fortune de notre ville de pouvoir être le lieu de réunion du congrès de l'Institut Canadien des Ingénieurs à une heure aussi importante où se joue l'avenir de notre pays. Je souhaite de grand coeur que ce congrès obtienne tout le succès possible, et que les ingénieurs y viennent en très grand nombre. Nous les accueillerons avec joie tout en nous efforçant de rendre leur séjour parmi nous aussi agréable qu'ils sauront le rendre utile et profitable à leur profession et à leur pays.

Le Maire de Québec,

Lucien Borne

Son Honneur le Maire Lucien Borne

Mayor's Office,
Québec, January 3rd, 1944.

The Engineering Institute of Canada will hold, in February, 1944, its Fifty-Eighth Annual Meeting in Québec.

Our city feels justly proud of being made the seat of this very important event. In the name of my colleagues of the City Council and the people of Québec, I am pleased to extend our warm and cordial wishes of welcome to the Canadian engineers and the chiefs of the manufacturing industry of our country, who will honour us with their visit on this occasion.

The Canadian engineer occupies the first rank among the technicians whose scientific collaboration has made possible the gigantic effort of Canada in the present conflict. Thanks to his work, his knowledge and his talent, Canadian industry has achieved a phenomenal production which will remain as one of the most remarkable feats in the history of the Second World War.

This magnificent achievement in the production of destructive machines and all the equipment required for crushing the enemy, the engineer will surely be able to repeat when time comes to rebuild. He will become to-morrow the great artisan of the post-war economic reconstruction in Canada.

We appreciate the good fortune of having our city selected to be the meeting place of The Engineering Institute of Canada at such a crucial time when the future of our country is at stake. I heartily hope that the conference will meet with every possible success and that the engineers will attend it in very great numbers. They will be greeted with joy and nothing will be spared to render their stay amongst us as agreeable to them as it will be useful and profitable to their profession and their Country.

Lucien Borne

Mayor of Quebec.

FIFTY-EIGHTH ANNUAL GENERAL

RENÉ DUPUIS
General Chairman

E. D. GRAY-DONALD
General Vice-Chairman and Chairman of Papers Committee

QUEBEC—

THURSDAY AND FRIDAY,

PROGR

THURSDAY, FEBRUARY 10th

9.00 a.m.—REGISTRATION.

9.30 a.m.—ANNUAL GENERAL BUSINESS MEETING—Announcement of election results. Address of retiring president, K. M. Cameron.

12.30 p.m.—LUNCHEON—Speaker: J. B. Carswell, M.E.I.C.

2.15 p.m.—THE DESIGN OF THE SHIPSHAW POWER DEVELOPMENT, by Dr. H. G. Acres, M.E.I.C., Consulting Engineer, Niagara Falls, Ont.

8.15 p.m.—Special convocation at Laval University for the purpose of conferring honorary degrees upon prominent members of the Institute. All persons registered at the Annual Meeting are invited.

FRIDAY, FEBRUARY 11th

9.30 a.m. (All morning)—POST-WAR PLANNING—A session of five papers with discussions by leading engineers and industrialists which will define the problem in understandable terms; will point out the part to be played by private enterprise, by the government and by labour. The object is to emphasize the part belonging to each group and the necessity of including labour in the planning.

PAUL VINCENT
Secretary

A. EUCLIDE PARÉ
Chairman of Hotel Arrangements Committee

GUSTAVE ST-JACQUES
Chairman of Entertainment and Visits Committee

Plant and other visits will be arranged.

AND PROFESSIONAL MEETING

Château Frontenac

FEBRUARY 10th and 11th, 1944

AMME

MADAME RENÉ DUPUIS
Convenor Ladies' Committee

FRIDAY, FEBRUARY 11th—*Continued*

9.30 a.m.—THE DEVELOPMENT FOR STEAM PRODUCTION AT ARVIDA, by M. G. Saunders, M.E.I.C., Mechanical Superintendent, Aluminum Company of Canada, Limited.

11.00 a.m.—IMPROVED SOIL STABILIZATION, by Guillaume Piette, Jr.E.I.C., Soils Engineer, Department of Highways of the Province of Quebec.

12.30 p.m.—LUNCHEON—Speaker: W. L. Batt, Hon.M.E.I.C., vice-chairman, War Production Board, Washington; and president, SKF Industries, Inc., Philadelphia.

2.15 p.m.—POST-WAR PLANNING—Continued (All afternoon).

2.15 p.m.—SOCIAL SECURITY PLANNING IN THE ENGLISH SPEAKING WORLD, by Mr. Maurice Stack, Technical Advisor on Social Insurance, International Labour Office, Montreal.

3.45 p.m.—ELECTRONICS.

7.30 p.m.—ANNUAL BANQUET—Speaker: The Honourable Adélard Godbout, Prime Minister of the Province of Quebec, on "The Engineer and the Province of Quebec."

10.00 p.m.—DANCE.

ALEX. LARIVIÈRE
Chairman of Reception Committee

Y.-R. TASSÉ
Chairman of Registration Committee

PHILIPPE MÉTHÉ
Chairman of Publicity Committee

STANISLAS PICARD
Chairman of Finance Committee

Special entertainment is being provided for Ladies.

MESSAGE DE L'HONORABLE ADÉLARD GODBOUT

Premier Ministre de la Province de Québec

CABINET DU PREMIER MINISTRE
QUÉBEC

Je suis très heureux que la ville de Québec ait été choisie comme siège du congrès de l'Institut Canadien des Ingénieurs.

La capitale de cette province est le berceau de la civilisation au Canada, le modèle de l'harmonie entre les races, et elle est devenue un centre renommé de culture générale, et particulièrement de culture scientifique, comme en témoignent les Ecoles de Chimie, des Mines et de Génie Electrique groupées sous l'égide de la Faculté des Sciences de l'Université Laval.

En honorant Québec, l'Institut Canadien des Ingénieurs honore la province toute entière, car les sciences ont une part de plus en plus grande dans nos universités et nos collèges. Nous voulons contribuer au développement économique de notre province et du Canada, dans toute la mesure du possible, et aider ainsi généreusement à préparer le brillant avenir qui est réservé à notre pays.

Que les membres de l'Institut Canadien des Ingénieurs soient les bienvenus. Ils trouveront ici la vieille hospitalité québecoise si caractéristique et une ville extrêmement pittoresque, dont l'histoire est intimement liée à celle de tout le Canada et même de toute l'Amérique du Nord.

Je veux féliciter les nouveaux docteurs ès science de l'Université Laval et souhaiter le plus grand succès à tous les congressistes, dans les discussions des divers problèmes qu'ils aborderont, comme aussi dans la carrière où ils tiennent une place si avantageuse.

Que le congrès de Québec fasse époque dans les annales de votre Institut et dans celles du Canada!

MESSAGE FROM THE HONOURABLE ADELARD GODBOUT

Prime Minister of the Province of Québec

CABINET OF THE PRIME MINISTER
QUÉBEC

I am greatly pleased that Québec City has been selected as a meeting place for The Engineering Institute of Canada.

The capital of this ancient province is the cradle of Christian civilization in Canada, the model of racial harmony and friendship, a noted cultural centre, especially in science as evidenced by the Schools of Chemistry, Mines and Electrical Engineering all grouped under the aegis of the Faculty of Science at Laval University.

By honouring Québec, The Engineering Institute of Canada honours the entire province, because science is assuming an increasingly important role in our colleges and universities. We are anxious to promote, to the greatest possible degree, the economic development of our province and of Canada, and to contribute as much as possible in preparing for the brilliant future reserved for our country.

Members of The Engineering Institute of Canada are more than welcome in our province. They will find here the traditionally characteristic Québec hospitality, as well as a picturesque city whose history is closely linked with that of all Canada, and of the whole of North America.

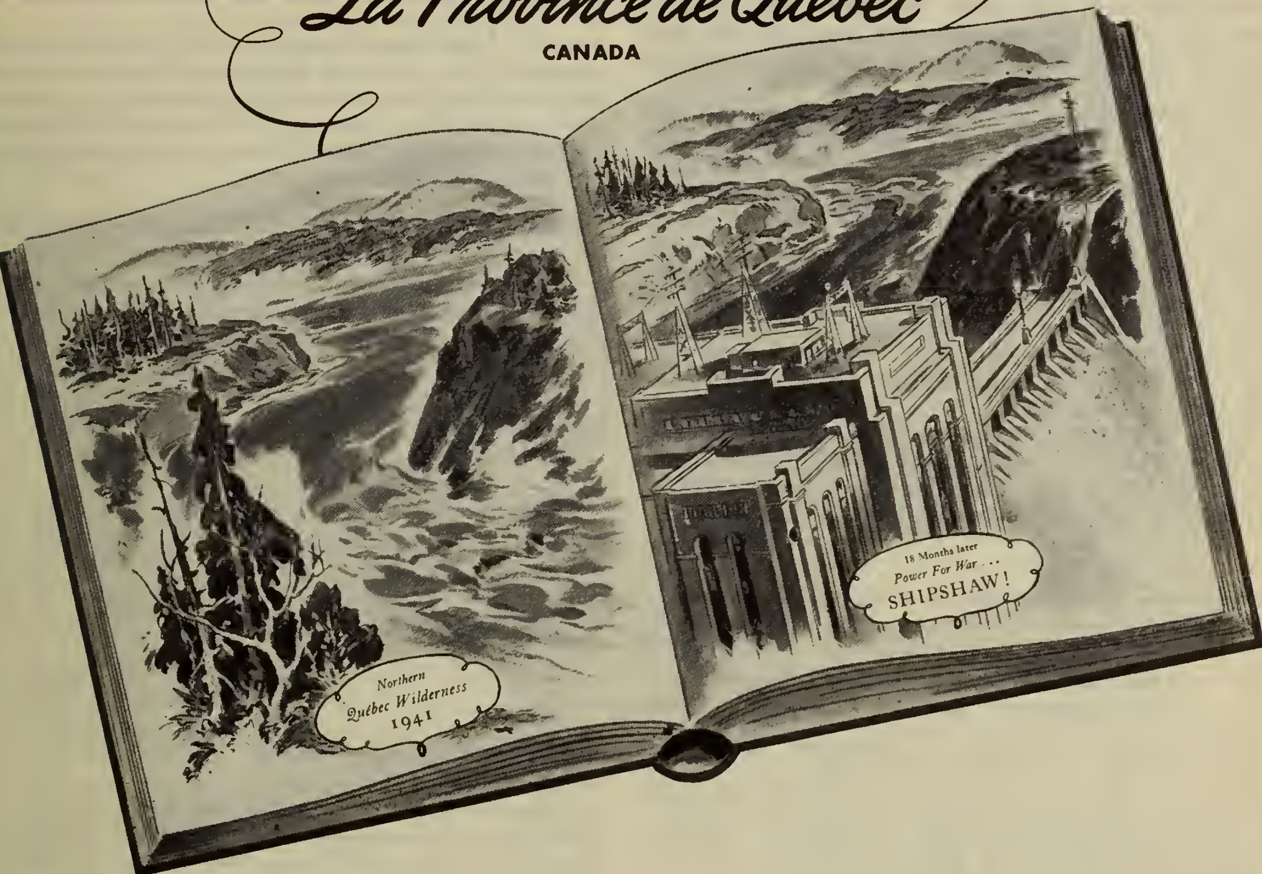
I want to congratulate the new Doctors of Science of Laval University, and I sincerely wish success to all delegates in their discussions of important problems and in their careers where they hold such commanding positions.

May the Québec meeting prove to be a landmark in the annals of your Institute and in those of Canada!

WRITING NEW PAGES IN THE BOOK OF HISTORY OF

La Province de Québec

CANADA



From the deep, untouched wilderness of this famous old Province, a million and a half more white horses are stampeding along the road towards Victory for the Allies.

Big? This new dam—completed by engineers and workers in the record time of 18 months—is the nucleus of a power development greater than Boulder Dam in the U.S.A. or the Dnieper development in Russia. This rugged corner of La Province de Québec is now the greatest hydro-electric centre in the world.

Here's horsepower against Hitler. The electricity generated here will go into producing 80 per cent of the total aluminum required by the British Commonwealth of Nations—approximately 40 per cent of the amount required by all the Allied Nations including the U.S.A.

But let Shipshaw speak!

SHIPSHAW

Ultimate power capacity	1,300,000 H.P.
Cost	$105,700,000
Height of dam	155 feet
Operating head	210 feet
Length of main power house	800 feet
Ultimate number of generators	16
Maximum number of men employed	10,595
Average monthly payroll	$2,101,000
Amount of excavation	7,321,250 cu. yds.
Volume of concrete masonry	1,408,082 cu. yds.
Average amount of cement required daily during height of construction	31 carloads
Total storage capacity of reservoirs, upper water shed	425 billion cu. ft.

TOTAL SAGUENAY DEVELOPMENT

Shipshaw, Chute-à-Caron and Ile-Maligne hydro-electric stations	2,000,000 H.P.

OTHER QUÉBEC WATER POWERS

Beauharnois	705,000 H.P.
Gatineau	238,000 H.P.
Les Cèdres	206,400 H.P.
St-Maurice	529,000 H.P.
Rivière du Lièvre	256,000 H.P.
Outaouais	160,000 H.P.
Baie Comeau (North Shore)	77,000 H.P.

TOTAL PROVINCE OF QUÉBEC DEVELOPMENT

(as to January 1st, 1944)	5,700,000 H.P.
Total possible commercial hydro-electric installations in La Province de Québec	17,000,000 H.P.

Shipshaw is a bright page in this Province's war history. It's only one of our answers to Hitler. Significantly, Shipshaw is located in the same region as the township of Lidice, named by the Québec Government in order to perpetuate the name of the Czech village so ruthlessly destroyed by Hitler's troops. Both Shipshaw and Lidice lie in the famous land of "Maria Chapdelaine," familiar to tourists as the country on which Louis Hémon based his novel of the same name.

Shipshaw is a stirring landmark in Canada's industrial history . . a dramatic concept of the success of man's struggle to turn the forces of nature to his use. Visitors to this Province after the war may well note the Shipshaw dam as a new wonder in Canada . a monument to industry that must be seen to be believed.

Now—Shipshaw joins the battle of production and lends its might to our share of the struggle for freedom. It's pledged to do an all-out war job. But when peace comes back again, the power that is Shipshaw will flow smoothly into production for that brighter, better, world of tomorrow.

LA PROVINCE DE Québec

Tourist and Publicity Bureau
Parliament Buildings, Québec

From Month to Month

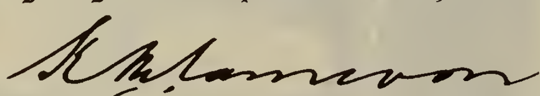
News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

New Year's Greetings

Another year has passed, a year that has seen great accomplishments and great sacrifices. We enter a new year which will demand even more, but we have seen the turning of the tide, and our faces reflect the vision of the final victory.

The achievements of the Institute during the past year have been substantial. We have steadily progressed in the field of service to the young engineer, and to those valiant members who follow their gallant leaders in the theatres of war. We have expanded the spirit of mutual co-operation and goodwill towards our sister societies both at home and abroad. We have done much to meet and solve the problems of the post-war years. There has been no relaxation in the contributions of the Institute or of the individual member to the winning of the war. We must continue to make that our main object and be unceasing in our efforts.

Inspired by the accomplishments of the past, we greet the New Year with its heavy obligations, determined to achieve greater heights from which to see more clearly the challenging obligations and possibilities of the future.



President.

THE JOURNAL CUTS ITS COAT ACCORDING TO ITS CLOTH

This issue of the *Journal* inaugurates the format which has become inevitable as a result of the restrictions on the use of print paper enacted by the Wartime Prices and Trade Board. Like newspapers and most other periodicals *The Engineering Journal* is now on a paper quota based on the 1942 consumption.

The regulations have actually been in effect since early in 1943. However, by resorting to drastic cuts in the circulation list, and the use of lighter paper stock it was possible to avoid changing the format of the *Journal* in the middle of Volume XXVI.

This first number in Volume XXVII and subsequent issues will be trimmed to the new size which has become more or less standardized for publications of similar nature: 8⅛ x 11¼ in. The previous format was 8¾ x 11¾ in.

In order to maintain the space allocated to papers of lasting interest, and thus retain the full value of the *Journal* as a record of Canadian engineering accomplishments, it has been necessary to condense and rearrange the matter in other sections. For the benefit of those readers who retain only the sheets containing articles that have particular application in their field of work, it was the editorial practice in the past to avoid breaking the continuity of technical papers. Under present restrictions it is not possible to continue this policy. It has been thought desirable to omit the Abstracts section at certain times when there is an abundance of technical material awaiting publication. Reports of meetings under the heading News of the Branches will be condensed. Summaries of papers presented at such meetings that are scheduled for publication will be omitted.

These changes in editorial policy have been adopted by the Publication Committee. They were designed to meet the present situation without impairing the *Journal's* usefulness to members. The paper restrictions come at a time when there is much valuable material available both as a result of wartime developments and increased activities within the Institute. In spite of circumstances, an endeavour will be made to maintain the full value of the *Journal*. Comments and suggestions will be appreciated.

REMUNERATION OF ENGINEERS IN THE CIVIL SERVICE

Herewith are reproduced two letters dealing with the salaries of the engineers working for the Federal Government. They are self explanatory.

December 11, 1943.

The Hon. Norman H. McLarty, K.C.,
Secretary of State,
House of Commons, Ottawa.

Dear Mr. McLarty,

Herewith is a copy of a brief which a special committee of The Engineering Institute of Canada presented to the Coon Committee on behalf of the engineers in the Civil Service. Enclosed also is copy of a letter which this committee delivered to Mr. Ilsley on September 17th.

I have been asked by the committee to submit this evidence to you so that it may be easily available to you for the deliberations of your committee when dealing with this same subject of the remuneration of civil servants.

A glance at the chart gives ample evidence of the inadequacy of the salaries paid engineers. We believe this group is one of the most deserving of increases in the entire Civil Service and we sincerely hope that the support of your committee may be added to that already given to the proposal.

Yours sincerely,
(*Signed*) N. B. MacRostie, *Chairman.*
Committee on the Engineer in the Civil Service
The Engineering Institute of Canada.

Dear Mr. MacRostie, December 13, 1943.

I have your letter of the 11th instant enclosing copy of brief presented to the Coon Committee on behalf of the engineers in the Civil Service, together with a copy of a letter written to the Honourable Mr. Ilsley.

This whole matter is, as you know, under consideration. While I cannot promise that any results will accrue along the lines you suggested, I know that your representations will receive consideration. You are, of course, aware of the general policy of the Government in regard to both salaries and wages, and it is pretty difficult to make fish of one and flesh of another in a matter of this kind.

Yours sincerely,
(*Signed*) Norman McLarty.

Readers will note Mr. McLarty's comment about the difficulties of "making fish of one and flesh of another." From the civil servants' point of view this is an interesting quotation. For years they have been "made fish of" and it would seem to be a reasonable expectation that sometime soon they should be "made flesh of."

The legislation establishing wage ceilings made provision for adjustment for those groups that were caught by the freezing order at abnormally low levels. Surely senior engineers getting salaries as low as those paid by the civil service come within this provision, and an adjustment of their scale would not be breaking the ceiling.

The only argument ever given the Institute committee has been the one about breaking the ceiling, and no answer has ever been received to the claim that the legislation provides for such cases. There have been so many flagrant cases of abandoning the ceiling when organized and demonstrative labour groups have been involved that it seems ludicrous to tell this small non-striking professional group that they have to hold the fort for stabilization.

Nobody has denied that their wages are inadequate or that they are not a fair return for services rendered. In fact all these things have been admitted, but the old scale is adhered to, under the cloak of maintaining the ceiling. It seems too bad that an injustice which has existed almost since time immemorial should be continued with no more explanations than that "It is pretty difficult to make fish of one and flesh of another." That is exactly what has been going on for years.

In the United States there is a definite move towards unionizing engineers and technicians. No one wants to see this in Canada, but employers who take advantage of special conditions to hold groups at no more than mere sustenance levels are "asking for it." If the law of the country attempts to perpetuate an injustice, the law of nature will take its course. Such things cannot go on forever.

GENERAL McNAUGHTON RETIRES

Canadians have learned with keen regret of General McNaughton's ill health. Engineers in particular will feel they share with him the disappointment that must be his. They have been proud of his leadership because his work was so well done and because he was an engineer. He is a credit to the profession.

Those who were fortunate enough to see and hear General McNaughton at the annual meeting of the Institute, in 1942, in Montreal, will recall the thrill that his presence and his words imparted to the audience. They may recall also that his appearance gave indications of fatigue and possible disturbances to his health. The earnest wish of everyone that he might be restored quickly to health appears to have been in vain. It is evident that he would not spare himself from his great task and now he pays the price for his zeal and his loyalty.

For Canadians at home the news is not so bad. The Army's loss will be their gain, for the need of great men in Canada now is very pressing. His intelligence, his integrity and his industry should do great things for his homeland. He will be welcomed warmly as a great soldier, and outstanding scientist and a fine gentleman.

Upon receiving the news of General McNaughton's retirement the president of the Institute cabled the following message in which all members of the Institute will wish to join:

> Engineers throughout Canada learned with profound regret that your health necessitates relinquishing your command. They are encouraged to believe you will completely recover and not only will see the accomplishment of your great objectives but will take the leading place in Canada's future for which your outstanding talents so adequately qualify you.

GOOD NEWS FOR SCIENCE STUDENTS

The *Journal* has been informed that word has been sent out to all Canadian universities having faculties of pure or applied science, giving instructions as to the requirements of the armed services for technical graduates and the methods by which selections will be made.

The procedure is that travelling boards representing the three services and the Wartime Bureau of Technical Personnel will travel *together* across Canada, visiting all universities and interviewing all candidates. The boards will be made up of representatives for the Navy, the Air Force and the Army respectively, and representatives of the War Time Bureau of Technical Personnel will also be present. All universities will have been visited by the end of February, so that all students will know by that time whether, after graduation, they will be in the services—and which service, or in civilian occupation.

It is arranged that medical examinations will be completed before the arrival of the boards, so that clear and final decisions can be made without delay, and what is more, these examinations will be accepted by all services as a basis for preliminary selection.

In the event that a student desires to change the service preference which he indicated in his declaration form, arrangements may be made with the representatives of the Wartime Bureau of Technical Personnel when they arrive at the university. Such changes cannot be considered before that time.

In addition to the number of 1944 graduates required, there will be opportunities for members of the 1945 class to arrange for summer training, but for Army and Navy only. These selections will also be made by the travelling boards.

These arrangements are so simple and apparently so complete that one may well wonder why they were not evolved long ago. By such a procedure the student may have this all-important matter thoroughly settled before he has to undertake the grind of preparation and writing final examinations. No doubt all results will be improved greatly thereby.

It is encouraging to see these signs of co-operation between the services.

WHAT IS WRONG WITH C.O.T.C.?

University students always find something about which to grumble, but never has there been so widespread and so common complaint as that about the Canadian Officers Training Corps. A visit with the students in any university reveals that this is the first thing they are ready to talk about.

The Institute's interest in this lies principally in the fact that engineering students from practically every university have brought their questions and complaints to its attention and have asked for assistance in exposing conditions which they claim are unfair, unreasonable, and wasteful of time and energy. The almost unanimous agreement among students of all universities indicates a state of affairs which requires thoughtful consideration by the proper officials. The opinion of members of the staffs seems to support the complaints of the students.

The complaints are these:

(a) The work is very elementary, and the same programme is followed every year for four years. The student in his senior year invariably feels that six hours a week have been totally wasted. He has learned nothing that would be of value in the event of an invasion, or that is of use to him if subsequent to graduation he joins the Army. This repetitive work, of high school cadet grade, bores the student of university calibre. Many claim that their performance is worse at the end of four years than it was when they started.

(b) No credit is given for all this drill when the student enlists in the Army. On the other hand, the Navy and Air Force allow their candidates reasonable credit for the work they do in the University Naval Division and University Air Training Corps. What is even more, since their programmes are much farther advanced than that of the Army, the boys maintain an interest in them and actually get some benefit from them. If the training of the C.O.T.C. is not worth anything to the Army, it is a mild statement to say there would seem to be something wrong with it.

(c) The time taken by drill could be used to better advantage in studies. Every engineer knows that an engineering course is not easy. Most students require all the time they can get to master it. Six hours a week is over 15 per cent of a work-week, and in four years amounts to almost a hundred work-days. That is a lot of time to spend at learning how to shoulder arms.

(d) The regulations are not interpreted uniformly. Some universities have practically eliminated all C.O.T.C. work in the senior year. Others have been allowed to reduce the time requirement and others are still doing six hours. It is possible that the responsibilities for these variations lie with the universities themselves and not with National Defence, but the fact remains that the irregularities exist, to the dissatisfaction of hundreds of students.

At this late date it is not likely that the whole system can be changed for this term, but surely something can be done for the future. Unless the *Journal* has been badly informed, a lot of injury is being done to the morale of this group of useful citizens. Surely it is not necessary.

MORE ABOUT C.O.T.C.

The following is quoted from the annual report of McGill University over the signature of the principal, Dr. F. Cyril James.

> Although there is no student feeling against the idea of military training (which in fact evoked an enthusiastic response from the student body during the early year of the war) it must be confessed that there is a growing resentment against the monotony of the present syllabus and against the attitude of the Army authorities towards the whole scheme. The syllabus now in effect is not sufficiently progressive, especially when it is remembered that the university undergraduates are, on the average, more intelligent than other groups of young men; and the fact that the Department of National Defence does not give any credit for this military training when the student actually enters the Army has tended to create the impression that it is a waste of time. If, on his enlistment, a student who has had three or four years of training is placed in the same category as other recruits who have had no military training whatever, it is hard for him to think that military training at universities serves any useful purpose. . . .
>
> All of these influences upon student morale and *esprit de corps* must, of course, be appraised against the background of the atmosphere that war has created in Canada. Students share the general anxiety during periods when the outlook is dark, and participate in the spiritual exhilaration that follows on the heels of victory. Many of them come from homes where one or more members of the family are on active service, and all of them are troubled from time to time regarding the usefulness to Canada of the work that they are doing.

CO-OPERATION WITH A.S.M.E.

A short time ago an agreement was reached between the governing bodies of The American Society of Mechanical Engineers and The Engineering Institute of Canada whereby the two organizations would endeavour to develop further co-operative activities which would react to the benefit of the profession and the societies.

The principal features of the agreement are the declaration of a desire for closer co-operation, and the appointment of a joint committee to work out a programme. The Institute's representatives on this committee are J. B. Challies, past-president of the Institute and chairman of the Institute's Committee on Professional Interests, John E. Armstrong, councillor and member of the Committee on Professional Interests, and John G. Hall, of Toronto, chairman of the Membership Committee. The A.S.M.E. representatives are James W. Parker, Vice-President, Detroit Edison Company, past-president of the A.S.M.E., A. G. Christie, professor of mechanical engineering, Johns Hopkins University, Baltimore, past-president A.S.M.E., and Albert E. White, director of engineering research, University of Michigan, Ann Arbor.

This is the first document of this type drawn up with an American sister society. A somewhat similar agreement was made some time ago with the Royal Aeronautical Society. Such undertakings are a sign of wholesome progress, and it is to be hoped that these are but a beginning. The usefulness of all technical organizations can be enhanced by a reasonable integration of programmes and policies.

Relationships with American societies have always been close and cordial, and their helpful friendliness has been greatly appreciated by the Institute. This new agreement is the culmination of years of close association and co-operation, and marks the completion of conversations that were started years ago. It is hoped and believed that it also marks the beginning of a new era of sustained international goodwill and mutual aid that will be of great benefit to the profession of engineering. It is a non-commercial "lend-lease" agreement that deals largely with intangibles of great worth.

The agreement is printed on the next page.

WARTIME BUREAU OF TECHNICAL PERSONNEL

Monthly Bulletin

Enquiries are beginning to reach the Bureau covering needs for technical personnel to engage in the planning of various post-war projects. Typical examples are the requirements of the Dominion-Provincial War Emergency Training Programme for supervisors of rehabilitation training and of a civic transportation system for rapid transit planning. The number of men so far involved is very small, and these posts can be filled by men of more mature years without drawing on essential production activities which can more readily absorb men who are younger and more adaptable to varied fields of engineering.

COOPERATION BETWEEN THE ENGINEERING INSTITUTE OF CANADA AND THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

A Report with Recommendations to the Councils of the Two Societies by a Joint Conference of Representatives of Both Sides (subsequently adopted by the two Councils)

I. Introduction

Accredited representatives of The Engineering Institute of Canada and The American Society of Mechanical Engineers met in New York on August 23, 1943, to consider steps to be taken to develop the cordial relationships for over thirty years between the two societies into a programme of active cooperation. This unanimous report, which resulted from the conference is presented to the two councils with the request that its recommendations be adopted as a first step in the development of a tradition for working together that may have far-reaching influence in enhancing the effectiveness of the professions in both nations.

II. Premises

The Engineering Institute of Canada is the only all-embracing, purely engineering national society of Canada, and has a cooperative interchange of memberships and other privileges with four of the eight provincial associations (the licensing bodies) of Canada. It has about 200 members in the United States.

The American Society of Mechanical Engineers, devoting itself to the mechanical specialty of engineering, has about 285 members in Canada, a Local Section, styled the Ontario Section, with headquarters atToronto and three Student Branches—at the University of Toronto, Queen's University and the University of British Columbia.

The relations between the two bodies cover a wide field. A joint meeting is to be held in Toronto September 30 through October 2, 1943. This is the first joint affair in the history of the two bodies—a previous venture, the 1939 British American Engineering Congress having been abandoned because of the war. A.S.M.E. Sections and E.I.C. Branches have held joint meetings in Toronto and at border points. A.S.M.E. has elected two residents of Canada to its Council and has conferred honorary memberships on three distinguished engineers of Canada. A fourth honorary membership is to be conferred at Toronto on October 1, 1943. Both secretaries are members of both bodies. Members of E.I.C. are privileged to purchase A.S.M.E. publications at Member's rates. E.I.C. is a member body of the Engineers' Council for Professional Development which brings its representatives into frequent friendly contact with the A.S.M.E. representatives. From time to time Canadian engineers have participated in the meetings and technical committee work of A.S.M.E. and engineers from the United States have appeared before E.I.C.

During the war, intimate cooperation has prevailed in research between engineers and scientists in Canada and the United States. The technical advances brought about by the war and the possibilities of engineering development after the war provide a fertile field for active cooperation between the two socieites.

The cordial working relations between the two societies and the engineers of the two nations points to the desirability of an active programme of cooperation, keeping in mind that first each society has much to give and gain by cooperation which must be to the mutual interest of both, and second the engineer's first loyalty must be to his own national body.

III. Recommendations

The recommendations of the Joint Conference are in two parts—first those on which immediate action seems wise, and second the establishment of a continuing agency for implementing further cooperation with a list of items this agency may find it expedient to consider.

A. Immediate Action

The Joint Conference recommends that the councils of The Engineering Institute of Canada and The American Society of Mechanical Engineers take the following parallel actions, the actions to be finalized only where both bodies concur and publicity to be withheld until both concur.

1. *Meetings.* Recognizing the importance of the interchange of experience, each society authorize the appointment of representatives to confer at least annually about possible opportunities for useful joint meetings and the invitation of members of each society to meetings of the other.

2. *Local Organizations.* (a) Each society adopt the policy of instituting a local organization of members in the country of the other after conference with the proper body of that country and after painstaking study of alternative cooperative means of providing the service that would normally be given by such a local organization.

(b) Each society express the preference that the officers of a local organization be citizens of the country and members of a national engineering society of the country in which the local organization is located.

(c) Each society encourage joint meetings between contiguous A.S.M.E. Sections and E.I.C. Branches and the formalization of continuing cooperative contacts between them.

3. *Student Organizations.* Each society adopt the policy of establishing a student organization in the country of the other after conference with the proper body of that country and after painstaking study of alternative cooperative means of providing the service that would normally be given by such a student organization.

4. *Secretaries' Memberships.* As a public recognition of the desirability of continued intimate and cordial relations between the secretarial staffs of the two bodies, each society elect the secretary of the other to membership without dues provided he meets the necessary membership qualifications.

B. Continuing Cooperation

Each society appoint three representatives, one if possible from the current membership of each council, to a continuing Joint Conference which shall select its chairman and secretary and shall meet at least annually to review present cooperation, to seek means for further cooperation and specifically to study and report on the following items.

1. Develop a comprehensive plan whereby students in mechanical engineering at all Canadian universities may participate in A.S.M.E. student activities through membership in the student organization of E.I.C.

2. Consider the possibilities of a plan for the interchange of membership privileges with a combined rate of dues.

3. Explore the plans and programmes of the technical and programme making activities of each society to determine (a) whether they may be broadened to be of greater value to members of the other society; (b) whether some form of member participation of one society in the activity of the other may be useful to either or both and, (c) whether new joint research or other technical projects may be developed to be of mutual value to mechanical engineers of Canada and the United States.

IV. Closure

The participants in the Joint Conference report their deep satisfaction in the splendid spirit of their discussions which they know will be continued in the permanent Joint Conference and will develop into a continuing programme and tradition of great mutual value.

Respectfully submitted,

Representatives of
The Engineering Institute of Canada:
(Signed) J. B. Challies
" O. O. Lefebvre
" L. Austin Wright

Representatives of
The American Society of Mechanical Engineers:
(Signed) A. G. Christie
" James W. Parker
" C. B. Peck
" C. E. Davies

Witnesses (Signed) John E. Armstrong
" K. M. Cameron
" R. M. Gates
" deGaspe Beaubien
" Harold V. Coes
" Ernest Hartford

September 30, 1943.

This report was adopted by the council of The American Society of Mechanical Engineers on October 2nd, 1943, and by the council of The Engineering Institute of Canada on October 23rd, 1943.

CORRESPONDENCE

The Danger of Engineers

The Editor,
The Engineering Journal,

Dear Sir:

I read with interest the address by Mr. Flanders entitled "The Engineer as Planner", which was printed in the November issue of the *Journal.* It seems that the minds of our members are fraught with indecision these days. "To be or not to be" an economic planner is the question.

Mr. Flanders' repeated use of the word "danger" recalled dimly to my mind an article which I read many, many years ago, and of which, as nearly as I could remember, I had kept a copy. A thorough search through old boxes and trunks in my storeroom finally unearthed it.

The article appeared in the September issue of *Living Age* in 1933 and is entitled "The Danger of Engineers". As far as I can recall now, it was anonymous. If you should decide that this article is appropriate to the occasion, and cause it to be reprinted, I should not be displeased.

Yours very truly,

W. L. Foss, m.e.i.c.

Calgary, Nov. 24th, 1943.

The article follows:

The success of the Economic Conference is seriously threatened by the World Power Conference which opened at Copenhagen last week. It is dangerous because it consists largely of engineers. By the very nature of their calling, engineers tend to pursue aims that are diametrically opposed to the aims of the Economic Conference, and, (therefore), the true interests of society. Their natural aim is the increase and distribution of wealth.

Engineers seldom have a social conscience. Their outlook on life is entirely materialistic. They aim at increasing the fruits of man's labour, and diminishing the labour, but they never pause to inquire whether it is in the best interests of mankind that wealth should be distributed or labour diminished. A moment's reference to any speech by any statesman, banker or economist will show that it is not.

The good men that represent us at the Economic Conference have far higher motives than distributing wealth and making wheels go round. They are concerned solely with currency and credit; with currency in order to decide by what particular means it shall remain short of requirements; with credit to ensure that it shall be kept unrelated to the community's wealth, and out of the hands of the community. Their purpose is an entirely moral one: to maintain their people in virtuous poverty in spite of the efforts of engineers and other wealth creators.

This lofty purpose is threatened by the Power Conference. I read that the chief British contribution to the discussions will be: "A Summary of the Industrial Power Supply in Great Britain". That is ominous. It means that while the Economic Conference will be deciding how poor we shall pretend to be, the Power Conference will be deciding how rich we really are.

Apart from moral issues these technicians have a sort of argument. They will say that economic science has not kept pace with the advance of technical science. And it is true that while mechanical power has been revolutionized since the war, all the financial and other devices by which our great statesmen propose to revive prosperity date from before the war. But the danger is that, having discovered how much they *could* do, the engineers will start asking what it is that is stopping them from doing it.

II

Already there is evidence of danger. I recently attended a meeting of engineers in London, where they discussed the preparation of a report to show to what extent present resources could raise the standard of living. Several said: "If we do that, people will ask: 'Where will the money come from?' And therefore we had better investigate the money system first."

Now, if the engineers do investigate the money system, they will do so with the same purely practical attitude, the same utter disregard for moral issues, with which they investigate a short circuit or a missing cylinder. And if they find that it is the money system which is holding up their industrial machine, they will regard the financier just as they regard a bit of grit in a feed pipe. So far from regarding British grit and enterprise as twin virtues, they will say that the grit is spoiling the enterprise.

We have so far succeeded in persuading people that the origin of money is mysterious. That although money makes the wheels of industry go round, yet in some mysterious way it is only the turning of those wheels that brings money into existence. Now such an idea can be accepted by almost any kind of man but an engineer. You could not convince an engineer that a machine generates its own power unless it actually did; and if it did, you could not persuade him that the power cannot be analyzed and controlled.

For example, if a motor stops for lack of gas and the driver demands more gas, the correct reply, from the standpoint of sound economics, is: "It is only the running of the engine that creates the gas, therefore you cannot have any more gas until the engine starts again." And the correct thing for the driver to do, if he is a loyal citizen, is to sit down on his running board for the next few years and wait for the tide to turn. But if you talked like that to an engineer he would not even bother to argue. He would just push his way to the gas pump and help himself.

It is, therefore, inevitable that as soon as these engineers discover that their industrial power is held up for lack of the motive power, money, they will find out what money is and where it comes from. They will apply the same purely practical test to it that they do to any other kind of fuel. They will find that money is much easier to create than are most of the things it buys. And, just as they cannot see any reason for withholding fuel from a machine when the fuel is easy to get, so they will say they can't see why the industrial machine should be kept short of money when money is so easy to make. It will be no use talking to them about a gold or any other metal standard. They will say that the only test of a metal is whether it improves the machine, and that the only standard they recognize is efficiency.

I don't say for certain that the engineers will say all this. I say they might. If they do, we shall be faced with a far more dangerous alignment of class antagonisms than the old one of workers versus capitalist employers. We shall be faced with a revolt of bourgeois technicians. This is far worse. Instead of being the natural defence of the financiers against the people, they will have the moneyless people behind them. You can always talk the people out of demanding money, but you can't talk a technician out of being technical. And their revolt will be all the more dangerous because they won't think it is a revolt, but only common sense.

Therefore, I say the Power Conference must be stopped. The police must break it up as they do unemployed processions or gunpowder plots or any other attempts to undermine the basis of the social system. For if the engineers start inquiring into the working of the money system they will do far more damage to the Treasury than Guy Fawkes would have done with his ineffectual fireworks.

Community Planning

The Editor,

The Engineering Journal.

Dear Sir:

I desire to endorse the opinions expressed in the letter from Mr. J. Murchison, M.E.I.C., upon the article on "Housing and Community Planning" appearing in the *Journal* in September.

Some years before the outbreak of the present war, Principal C. Grant Robertson of Birmingham University (Eng.) in an address to the Congress of the Institute of Transport made this prophetic statement:

"The development of transport to-day is throwing our existing society into the crucible; and transport, it is my conviction, stands on the threshold of immense and revolutionary developments.

"No one would be so rash as to predict what in the next five and twenty years or in what precise directions physical science may accomplish in the perfecting of existing methods or the discovery of wholly new ones. Simultaneously a new social structure is in the making. But unless concurrently we develop a new administrative science, and also provide the social and political conditions of an ordered security, the chemist, the physicist, the metallurgist, the mathematician and the engineer will work in vain.

"And of all hard tasks in a world of conflict and carnal appetites, good government is the hardest. The really original administrators are even rarer than the great discoverers; and in a self-governing people, such as ours, the capacity to administer and to create and train the administrative mind and to appreciate the qualities required for working a system of self-government in a dynamic society are not easily grasped.

"A single genius working in the isolation of a laboratory can create a revolution in science; but the remaking of the social structure and the ideas and habits of forty millions of self-governing men and women is a gigantic job, compared with which even a revolutionary achievement in science is easy."

For any interested may I say that the charter of the Town Planning Institute of Canada has been maintained, and re-organization and a new start is possible provided sufficient funds for organization and the necessary services can be secured. For further information address Mr. J. M. Kitchen, 18 Granville Avenue, Ottawa.

Yours truly,

A. G. Dalzell, M.E.I.C.,
Department of City Planning and Surveying,
City of Toronto.

Toronto, December 7th, 1943.

WASHINGTON LETTER

Navy's Model Testing Basin

The managing director of Australia's leading shipbuilding and ship repair concern has been visiting the United States recently and it was arranged for him to inspect shipyards and to meet leading shipbuilding authorities in Washington including the heads of both the Maritime Commission and Navy's Bureau of Ships. He was also particularly interested in visiting the new Model Testing Basin which the Navy is operating in Maryland, not far from Washington. It was my privilege to accompany him on some of his visits and, from an engineering points of view, the trip to the Testing Basin was of outstanding interest. We were taken in hand and shown over this quite extensive institution by Admiral Howard who is in charge. Much of the work which is being done is, of course, of a secret nature but Admiral Howard gave us reprints of an article which recently appeared in *Harper's* describing the work and set up. It will therefore be possible for me to repeat one or two interesting facts about the Basin as they appeared in that article. Primarily, the work consists in running tests on scale models, about 20 ft. long, to determine the frictional and residual resistance characteristics of hull shapes and to establish accurately the required power inputs for varying speeds. The Basin has also done a great deal of work on such matters as vibration, cavitation, manoeuvrability and so on. Scale models of slip-ways and of difficult launching localities are reproduced and models are launched and the necessary data and information for the final operation is obtained. Experimental work is also being done in under-water explosives and in the important field of under-water detection. It was also very interesting to see some of the big gun mock-ups on movable cradles simulating the movement of a ship where tests are run to improve firing and ammunition handling techniques.

Quite as interesting as the work being done was the building itself—particularly the building housing the several testing basins, two of which are about 1,000 ft. long. This building is said to be the only one which conforms to the curvature of the earth. The tracks which carry the towing carriages took over a year to lay and were levelled with almost microscopic accuracy, taking into account the earth's curvature in the over-all length. The towing bridges themselves are also amazing pieces of equipment with interlocking power controls so that a model may actually run under its own power and yet have the bridge itself supply enough extra power to correct for the fact that it is a scale model and in order that direct readings of the required results may be taken. Another fascinating demonstration was the stroboscopic studies being made in respect to propeller cavitation. The whole institution is run with the thoroughness, attention to detail, and shipshapeness which is usual in the Navy.

Post-war Plans Are Well Advanced

As reported in the previous letter, the tempo of the work on the conversion problem is increasing throughout the United States. The main problem to be tackled first, of course, is the problem of an equitable over-all control in war contract cut-backs or cancellations. On the planning side, there is considerable evidence that this country is moving from the general planning stage to the preparation of specific plans. Most of the large corporations have preliminary surveys of probable future markets and probable future trends well under way. In particular, the railroads have been doing a considerable amount of work and there already have appeared several useful publications in this field. The Maritime Commission has in hand extensive post-war plans for the shipbuilding industry and for the U.S. Merchant Marine. The steel industry has worked out an interesting basis upon which their fact finding research and reporting should be done, and the various large corporations are co-ordinating their activities along similar lines. In a large measure, the information collected by the various war agencies will be extremely useful in planning the conversion. This is particularly true in the case of the steel industry because steel was one of the four materials under the Controlled Materials Plan. In the building industry, a number of surveys are going forward, an example of which is the one prepared by the Building Materials and Equipment Association, forecasting a probable nine billion dollars worth of building which could be undertaken in the first year after the war.

In respect to the contribution which American municipalities will make in terms of public works projects, New York City is in the forefront, with Mayor La Guardia and Park Commissioner Robert Moses supplying the driving force. Moses is reputed to have a shelf of projects—right down to the last blueprints and specifications—for the City to undertake at a moment's notice. The total programme is said to aggregate over one billion dollars and is calculated to keep one-quarter of a million men busy for 18 months. Moses has also been instrumental in drawing up similar plans for other American cities and has recently completed a report for the City of Portland. At the time of writing this I have tentative appointments to see both Mr. Paul Hoffman of the Committee for Economic Development and Mr. Stuart Chase of the Twentieth Century Fund, both of whom are in Washington for a day or so for the purpose of addressing the United Nations Forum on the subject of "Toward an Expanding Economy". Canadian engineers will be interested to note that this forum is being chaired by Mr. William L. Batt, vice-chairman, War Production Board, who is to be one of the speakers at the coming Annual Meeting of the Institute.

* * *

Two issues, worldwide in their implications, are being given wide study these days and both are of particular interest to engineers. The first is the whole question of the petroleum position—availability, strategic supply, reserve stocks, the tanker situation and the short haul problem, the advisability of continuing to use petroleum as a base for synthetic rubber, and the possibilities of developing alternate liquid fuels. The second issue is that of global aviation which was touched upon several letters ago. Several of us had lunch at the Capitol recently with two of the five senators who toured the world. These two problems were much on their minds. One of the senators enlarged upon an informative article on these topics in a recent *Colliers* in which he had set forth his views.

* * *

The 40th anniversary of the world's first successful air flight was commemorated the other day in Washington by a series of events which culminated in a testimonial dinner to Mr. Orville Wright. One of the interesting outcomes of the meetings was the announcement that a recent report by the Smithsonian Institute would probably pave the way for the return of Orville and Wilbut Wright's plane from the British Museum to the United States. It will be remembered that the ancient draft was sent by Mr. Wright to England as a result of a controversy which is now some fifteen years old.

E. R. Jacobsen, M.E.I.C.

TAXATION OF PRIVATE ENTERPRISE

ARTHUR SURVEYER, M.E.I.C.
Consulting Engineer, Montreal, Que.

Dr. Arthur Surveyer represents The Engineering Institute on the executive of the Canadian Chamber of Commerce, and while acting in this capacity at the recent annual meeting of the Chamber, participated in the discussion on taxation of private enterprise.

His short paper has been very widely quoted by national Canadian publications, and the *Journal* feels that the material should be made available to the members of the Institute. Accordingly, it is reprinted herewith.—*Ed.*

The most important problem which we have to face is how to secure the revival of private initiative and of private enterprise. Unless this problem is solved, we will not be able to achieve social security; we will have unemployment and we will move faster and faster towards state capitalism; a condition which will eventually bring about a decrease in the production of goods and of wealth together with a general lowering of the standard of living.

To bring about a revival of private initiative, it will be necessary to encourage the launching of new enterprises by risk capital, and to prevent existing companies from going into bankruptcy. Our present form of individual and corporate taxation has the opposite effects:

(a) It tends to prevent the organization of new companies;
(b) It encourages unsound financing; and
(c) It prevents companies from building up the reserves necessary to protect them against bankruptcy.

The launching of new companies is made practically impossible on account of the high corporation taxes and of the high income tax of the people who used to finance new companies. If you assume earnings of the new company equal to 10 per cent of the capital invested, this is immediately decreased to 6 per cent on the payment of the minimum corporation taxes. The individuals who, in the past, supplied the capital for new ventures have incomes of $10,000 a year or more. This means that any increase in their income would now be taxed to the tune of 62 to 92 per cent, leaving a net return to the investor of from 2¼ to ½ of 1 per cent on his money. Obviously, no man is going to make a risky investment in the hope of such a small return. He will undoubtedly prefer to keep his money in the bank. My contention is that corporation taxes should eventually be considerably reduced, if not completely superseded by individual taxes, and that, in the meantime, new companies should be tax exempt for a period of three to five years in order to bring out venturesome capital.

The present form of taxation encourages unsound financing because fixed charges are considered as expenses and deductible before income tax calculation. This provision should also apply to a fixed minimum return on the share capital in order to encourage the financing of companies with stock instead of with bonds, since the existence of a large bond issue endangers the company during bad years.

Our present rate of taxes, and particularly the method adopted to calculate the excess profits tax, prevent the building up of the reserves necessary to enable corporations to face the postwar difficulties with any degree of confidence. The refundable portion of the excess profits tax is not very large. Moreover, it is repayable at an indefinite time and in dollars which will have a much smaller value than the dollars which were originally paid to the government.

Referring to the danger of wholesale bankruptcies after the war, a recent American financial service letter contained the following comments:

> "After World War I the liabilities in commercial failures of the two years 1921 and 1922 zoomed to nearly double any previous record. Among the failures were some of the big money-makers from war contracts. But old-time conservatives, too, were hard hit . . . Yet this was no more than a squall in comparison with the cyclone weather of fluctuating prices, intense but spotty activity and social-political disturbances to be expected after the present war."

Some time ago, Professor Sumner H. Slichter, (Harvard), pointed out that looking back at the tax history of the United States since 1932,

> "One might almost suspect that the tax laws had been written by a Communist Fifth Columnist for the purpose of making private enterprise unworkable. The changes have been remarkably well designed to discourage innovation and experimentation and to reduce the attractiveness of risky ventures."

The same criticism could well apply to the Canadian taxes; and it is a pity that we did not adopt the British taxation philosophy instead of the American New Deal Philosophy. In Canada, no matter how much money a company earns, it is limited to a net of 70 per cent of its standard year, notwithstanding the fact that these earnings may not be all liquid. The method used to calculate the standard year results in keeping the earnings of the standard year very low. In Canada the standard period is the average net earnings for 1936, 1937, 1938 and 1939, whilst in Great Britain the corporations can choose whichever of the four standard years shows the highest earnings, viz., the year 1935 or the year 1936 or the average of 1935-1937 or 1936-1937. It is evident that under Canadian regulations, a company's standard profits are bound to be lower than under the English law, thus increasing the excess profits and reducing the amount available for reserves. I think that the government should, as soon as possible, change the definition of our standard year to that of the English law in order to give Canadian corporations a chance to accumulate the reserves which will be required to meet the postwar difficulties. Another provision of the British excess profits tax which might well be adopted in Canada is that which allows a future tax credit for losses in any one year and even for deficiencies between the actual net earnings and the standard profits.

I am convinced that unless private enterprise is allowed to take the major part in the reconstruction period we will have unemployment on a large scale and that the government will be compelled to take measures which eventually will lead to ever increasing statism, transformation in our ways of life, and a marked reduction in our standard of living.

As Mr. James McGraw, president of McGraw Hill Publishing Company, pointed out, in a recent editorial, the onset of economic perils is not as obvious as a physical attack which unites all citizens in a tremendous effort against a common enemy:

> "No bombs", writes Mr. McGraw, "will signal the deterioration of private enterprise system, the extension of regimentation, the further control of business by government, and the concentration of political power in less and less responsible hands. If these things should befall us, they will come insidiously while we are preoccupied with self interests and ori-

ented by popular misconceptions. If the freedoms of the individual shrivel as the state grows in power, it will be because the individual is too indifferent or complacent to concern himself seriously with economic problems. If our people are misled by false prophets and demagogues, it will be because businessmen did not understand economics, because scholars were too ignorant of practical affairs, and because we failed to produce economic statesman of sufficient stature for the task in hand."

MEETING OF COUNCIL

Minutes of a meeting of the Council of the Institute held at Headquarters on Saturday, December 18th, 1943, at nine thirty a.m.

Present: President K. M. Cameron in the chair; Past-President C. J. Mackenzie; Vice-Presidents L. F. Grant and C. K. McLeod; Councillors J. E. Armstrong, E. V. Gage, E. D. Gray-Donald, R. E. Heartz, J. A. Lalonde, G. M. Pitts and J. W. Ward; Presidential-Nominee deGaspé Beaubien; Secretary Emeritus R. J. Durley and General Secretary L. Austin Wright.

Recognition of Attainments of Engineers in the Armed Forces—Mr. McLeod reported that he and Mr. Pitts had found that sketches and dies could be made for a new medal, but they wanted more direction from Council. For instance, they wanted to know if this recognition had to be in the form of a medal or could it be a certificate or a plaque. Colonel Grant stated that since the last meeting of Council he had given consideration to the advisability of using something other than a medal. He thought that an engrossed certificate or a plaque might be more suitable.

Past-President Mackenzie thought this matter should be given very careful consideration as there were many people in the Institute membership who had attained outstanding distinction in the services.

Mr. Armstrong intimated that it might be better if the Institute's recognition were in the form of an expression of appreciation to the member for the honour which he had brought to the Institute and to the profession rather than an attempt to make the award an honour in itself.

In the light of this discussion, the president asked the committee to consider the matter further and report at the next meeting of Council.

Co-operation with A.I.E.E.: In response to a request from the president, Past-President Challies gave some of the history which led up to the meeting of the committees representing the American Institute of Electrical Engineers and The Engineering Institute of Canada on Friday, December 10th, 1943, in Montreal. He explained that the presidents of the two societies about a year ago had agreed to set up special committees to discuss the possibilities of co-operation in Canada. The committee selected by President Cameron to represent the E.I.C. had been the Committee on Professional Interests. The A.I.E.E. committee was made up of W. J. Gilson, of Toronto, vice-president of District No. 10, as chairman, and Messrs. C. V. Christie and McNeely DuBose, of Montreal, M. J. McHenry, of Toronto, and T. Ingledow, of Vancouver. Of these only Messrs. Gilson, Christie and McHenry were able to attend the meeting.

Mr. Challies stated that the meeting was congenial and the discussions were free, friendly and frank. He pointed out to the meeting that the Council of the Institute realized there was a general demand from members of the Institute in all the provinces for closer functioning of the Institute with other engineering societies, and in particular with the provincial associations; that co-operative agreements had been completed with four of the provincial professional associations; a fifth was drawing to a conclusion, and a sixth was under preliminary discussion, leaving only the provinces of Ontario and British Columbia in abeyance.

He drew the attention of the meeting to the fact that the Council of the Institute was proposing a by-law change whereby associations which had agreements with the Institute would have the right to name a representative on the Council of the Institute, and also that a new by-law was being submitted whereby any voluntary engineering society which had an agreement with the Institute could have the right to place a representative on the Council of the Institute. He expressed the opinion that this procedure would result in the Council of the Institute becoming so representative that it could speak for the bulk of the technically trained engineering personnel in Canada without sacrificing any of the rights or prejudicing any of the privileges of existing organizations. Mr. Challies was hopeful that while no definite conclusions had been reached, the initial discussions would prove helpful.

This interim report was accepted by Council.

Proposal from the Dominion Council—At the president's suggestion Mr. Challies described to Council the meeting which had taken place in Montreal on Saturday, December 11th. This meeting was called by the president of the Dominion Council (W. P. Dobson) and to it were invited representatives of several professional and technical societies including the following:

The Engineering Institute of Canada
The eight provincial professional organizations
The Canadian Institute of Chemistry
The Royal Architectural Institute of Canada
The Canadian Institute of Mining and Metallurgy
The American Society of Mechanical Engineers
The American Institute of Electrical Engineers
The Institute of Radio Engineers
Illuminating Engineering Society

The purpose of the meeting, as explained by the president of the Dominion Council, was to explore the possibilities of creating in Canada one central Committee or Council which could speak for the engineers and associated groups.

Mr. Challies then explained to the meeting the purpose of the proposed new E.I.C. by-law whereby any sister society with which the Institute had a co-operative agreement could have representation upon the Council of the Institute. He thought that this procedure would offer a more desirable means for securing conjoint and co-operative action in the interest of all engineers than the proposal being made by the Dominion Council.

Eventually, it was agreed that in order to hasten the deliberations a small committee should be named by the chairman to go into the matter immediately and to report back to the full meeting at four o'clock in the afternoon. The following persons were chosen by Mr. Dobson to act with himself on the committee: Messrs. R. C. Poulter (I.R.E.), W. J. Gilson (A.I.E.E.), R. A. Elliott (C.I.M. & M.), J. B. Challies (E.I.C.), F. C. Eley (E.I.C.), E. Redpath (B.C. Assn.), and G. M. Pitts (R.A.I.C.).

At the meeting of the committee Mr. Dobson again outlined the proposal of the Dominion Council. Again Mr. Challies explained the proposals of the E.I.C. Council. Finally, it was agreed by the committee that the following procedure be presented to the main group:

(a) The setting up, *as an experiment*, of a council or committee that would represent all the organized engineering and allied societies having members in Canada and upon which each society would have equal representation.

(b) To avoid the setting up of a permanent secretariat and to keep expenses within a minimum, the secretarial responsibility for the new committee would rotate between representatives of the various constituent societies, preferably from their secretarial personnel.

(c) The relation of the new organization to its constituent bodies to be similar to the relation of the Engineers' Council for Professional Development to its member bodies. It was pointed out that the E.C.P.D. can act by and only with the consent of its eight constituent members and only to the extent which these constituent members may, from time to time, permit.

The Institute representatives agreed to this procedure on the distinct understanding that no commitments were being made even as to principle and that a special committee would be set up to prepare an appropriate constitution for the new organization, and that the constitution, when drafted, would have to be submitted for the approval of every society represented at the meeting.

The resolution which was prepared for the main committee read as follows:

"Be it resolved: That the Dominion Council of Professional Engineers and the voluntary engineering and allied societies, represented at this meeting, be asked to consider as promptly as possible the setting up for Canada of an organization similarly constituted to the E.C.P.D. which would consist of a representative to serve on an executive committee and appointed by each constituent association for a term of three years; and the secretary of which would be chosen in rotation annually, preferably from the secretaries of the constituent bodies; and further that the president of the Dominion Council be asked to appoint immediately a small committee to prepare a draft constitution based in principle upon that of the E.C.P.D.; and that this draft constitution, when prepared, be submitted by the president of the Dominion Council to the members of that Council and each voluntary society invited to this meeting."

The above resolution was submitted to the reconvened meeting at four o'clock and agreed to, although the representatives of the Engineering Institute and one other society declined to vote.

Mr. Dobson announced that he had appointed the following committees to draft an appropriate constitution: Messrs. R. C. Poulter (I.R.E.), W. J. Gilson (A.I.E.E.), G. Lorne Wiggs (A.S.M.E.), E. J. Carlyle (C.I.M.M.), W. P. Dobson (Dominion Council), and J. B. Challies (E.I.C.).

In conclusion Mr. Challies emphasized his firm conviction that the proposal for enlarging the Council of the E.I.C. with the various professional engineering societies whose head offices were in Canada or who had members resident in Canada, was from every standpoint the most efficient, economical and satisfactory method of securing co-operative action. He went on to explain, however, that the Institute should always be prepared to consider on its merits any proposal, no matter from what source, it emanated, that may be put forward seriously as a means for fostering co-operation between engineering societies in Canada. For this reason he urged that Council keep an open mind regarding any proposals that may result from the recent meeting.

This report was accepted by Council and Mr. Challies was thanked for the time and attention which he had given to these matters on behalf of Council.

A suggestion that Mr. M. J. McHenry, of Toronto, be added to the membership of the Committee on Professional Interests was approved, and, subject to his acceptance, it was unanimously resolved that Mr. McHenry be appointed a member of this committee.

Collective Bargaining for Engineers: The general secretary presented a memorandum from the Moncton Branch covering a discussion on collective bargaining for engineers which had taken place at a meeting of the branch held on December 6th. The Branch felt that the Institute should be taking some action on this matter, possibly along the lines of the action taken by the American Society of Civil Engineers. Following some discussion, it was unanimously resolved that the memorandum be referred to the Institute's Committee on Professional Interests for consideration and report.

Remuneration of Engineers employed by the City of Montreal: The general secretary reported that a petition had been received from twenty-five engineers employed at the city hall asking the Institute to assist them in the matter of their remuneration.

In view of the strike conditions at the city hall, Council appointed a committee to go into this matter immediately so that the men's interests would be served. The committee consists of deGaspé Beaubien, chairman, C. K. McLeod, G. McL. Pitts (Member of the City Council), and Louis Trudel. (Note: This committee with the Vice-President of the Corp. of Professional Engineers called on the officials immediately and received assurance that the non-striking, non-union members of the engineering organizations would have their interests protected).

Engineers' Council for Professional Development: Past-President Challies having expressed a desire to resign as the Institute's representative on the executive committee of the Engineers' Council for Professional Development, and the consent of Past-President C. R. Young to accept the appointment having been received, it was unanimously resolved that Past-President Young be nominated to replace Mr. Challies.

Elections and Tansfers — A number of applications were considered and the following elections and transfers were effected:

Members

Brierley, John Paul, M.Sc. (Chem.), (Liverpool Univ.), tech. director, Lever Bros. Ltd., Toronto, Ont.

Brownlee, William Daniel, B.A.Sc., (Univ. of Toronto), engr., Electro Metallurgical Co. of Canada, Ltd., Welland, Ont.

Climo, Cecil, B.Sc. (Queen's Univ.), asst. constr'n. engr., Carborundum Co., Niagara Falls, N.Y.

Nickle, Donald Collamer, B.A. (Queen's Univ.), M.Sc. (Mass. Inst. of Technology), sales engr., Gypsum Lime & Alabastine, Canada, Ltd., Toronto, Ont.

Wildwood, Harry Vernon, B.Sc. (Queen's Univ.), field engr., Electro Metallurgical Co. of Canada, Fonthill, Ont.

Juniors

Fairfield, Robert Calvin, B.Arch. (Univ. of Toronto), asst. engr., structural dept., Works & Bldgs. Branch, Naval Services, Ottawa, Ont.

Karn, William Matheson, B.A.Sc. (Univ. of Toronto), asst. research chemist, Electric Reduction Co. of Canada, Ltd., Buckingham, Que.

Rule, Peter Leitch, B.Sc. (Arch.), (Univ. of Alberta), Rule, Wynn & Rule, architects, Birks Bldg., Edmonton, Alta.

Affiliate

Nicholson, Ralph Ardrey Valance, Lieut. Col., O.C., Survey Section, R.C.E., Ottawa, Ont.

Transferred from the class of Junior to that of Member

Cassidy, Stanley Bernard, B.Sc. (Elec.), M.Sc. (Communications), (Univ. of N.B.), chief engineer, Radio Station C.F.N.B., Fredericton, N.B.

McGuire, James Francis, B.Eng. (McGill Univ.), Welding and sales engr., Lincoln Electric Co., Montreal, Que.

Transferred from the class of Student to that of Junior

Demers, Charles Eugene, B.Sc. (Civil), (Queen's Univ.), asst. field engr., Shipshaw Power Development, H. G. Acres & Co.

Marsolais, J. Irenée W., B.A.Sc., C.E. (Ecole Polytechnique), U.S. Army res. inspr. of ordnance material, Dominion Arsenal, Quebec, Que.

Mazur, John T. (Univ. of Manitoba), engrg. supervisor, Plant No. 1, Massey-Harris Aircraft, Weston, Ont.

Poole, John Edward, B.Sc. (Univ. of Alta.), engr., Defence Industries, Ltd., Montreal, Que.

Smith, Arthur Dale, B.A.Sc. (Univ. of Toronto), engrg. dept., Foster Wheeler, Ltd., St. Catharines, Ont.

Wesley, William Grant, B.Eng. (McGill Univ.), P/O R.C.A.F., Montreal, Que.

Admitted as Students

Begg, Robert Arthur, B.Sc. (Mech.), (Queen's Univ.), 50 East Ave. S., Hamilton, Ont.

Blake, Donald Hallewell Robson, 2/Lt., B.A.Sc. (Mech.), (Univ. of B.C.), 605 Victoria Avenue, Victoria, B.C.

Galbraith, George Harshaw (McGill Univ.), 1211 Bishop St., Montreal, Que.

Sanders, George Saunton (Univ. of Manitoba), 26 Oakview Ave., East Kildonan, Man.

Students at Queen's University

Baker, Charles A. N., Queen's Univ., Kingston, Ont.

Burbidge, Harrison Griffin, 295 Alfred St., Kingston, Ont.

Burgess, Bernard Whittaker, 25 Bellwood Ave., Ottawa, Ont.

Campling, Charles Hugh Ramsay, 340 Albert St., Kingston, Ont.

Charlesworth, Edward Frank, Queen's Univ., Kingston, Ont.

Connor, Eric James, 159 Collingwood St., Kingston, Ont.

Denyes, Blake Burley, R.R. No. 1, Napanee, Ont.

Follows, Alan G., Queen's Univ., Kingston, Ont.

Fritsch, Karl Herbert, Queen's Univ., Kingston, Ont.

Gove, Harry Edmund, 486 Johnston St., Kingston, Ont.

Haakonsen, Haakon M., 342 Frontenac St., Kingston, Ont.

Hager, Fritz, Queen's Univ., Kingston, Ont.

Hillgartner, Harry Leonard, 637½ Princess Street, Kingston, Ont.

Holloway, Arthur Francis, 130 Collingwood St., Kingston, Ont.

Hyde, Ernest Charles Garrow, 566 Johnson St., Kingston, Ont.

Johnson, Ivar Conrad, Queen's Univ., Kingston, Ont.

Lappi, Donald Mathew, Queen's Univ., Kingston, Ont.

Mackey, Keith Barker, Queen's Univ., Kingston, Ont.

McLeod, Donald M., 18 William St. W., Kingston, Ont.

McWhirter, Donald Crawford, 39 Division St., Kingston, Ont.

Mosher, Malcolm Charles, 486 Johnson St., Kingston, Ont.

Nelson, Ernest William, 320 Earl St., Kingston, Ont.

Page, Lorne, 4 Birch Ave., Kingston, Ont.

Patzalek, Stanley Philip, Queen's Univ., Kingston, Ont.

Quirk, Raymond Wilfred, 85 Division St., Kingston, Ont.

Ralph, Harold Davidson, Queen's Univ., Kingston, Ont.

Richards, James Leslie, Queen's Univ., Kingston, Ont.

Runge, Walter Arthur, 170 Barrie St., Kingston, Ont.

Rush, Charles Kenneth, 329 Earl St., Kingston, Ont.

Smith, Jack Donald, 153 Alfred St., Kingston, Ont.

Spencer, John Donald, 222 University Ave., Kingston, Ont.

Stevens, John Clement, 62 Nelson St., Kingston, Ont.

Stevenson, William Herbert, 433 Brock St., Kingston, Ont.

Sweet, William Harold, 329 Earl St., Kingston, Ont.

Tomkins, Charles C., Queen's Univ., Kingston, Ont.

Whillans, T. G. Douglas, Queen's Univ., Kingston, Ont.

Williams, Lloyd Stephen, 396 Alfred St., Kingston, Ont.

Wilson, William James F., 214 Alfred St., Kingston, Ont.

Wright, Gordon Maguire, Queen's Univ., Kingston, Ont.

Wrong, James Stuart, 329 Earl St., Kingston, Ont.

Yamanaka, Richard Hiroji, 170 Barrie St., Kingston, Ont.

Young, Kenneth Buchanan, Queen's Univ., Kingston, Ont.

By virtue of the co-operative agreements between the Institute and the provincial associations of professional engineers, the following elections and transfers have become effective:

ALBERTA

Member

Stephens, Hugh James, C.E. (Valparaiso Univ.), Wks. & Bldgs. Engr. Officer, No. 10 Repair Depot, R.C.A.F., Calgary, Alta.

Transferred from Student to Junior

Collier, David Barr, B.Sc. (Univ. of Alberta), field engr., Northwestern Utilities Ltd., Edmonton, Alta.

NEW BRUNSWICK

Member

Redding, John Malcolm, B.Sc. (Elec.), (Univ. of N.B.), F/O, No. 24 R.D., R.C.A.F., Tignish, P.E.I.

NOVA SCOTIA

Members

Byers, John Wilfrid Fisher, B.Sc. (Elec.), (N.S. Tech. Coll.), asst. agricultural engr., N.S. Dept. of Agriculture, Truro, N.S.

Coleman, Frank Reynolds, B.Sc. (Mech.), (N.S. Tech. Coll.), instruction supervisor and asst. training supervisor, Aircraft Overhaul Plant, Clark Ruse Aircraft Ltd., Dartmouth, N.S.

Deane, John, B.A.Sc. (Elec.), (Univ. of B.C.), Lieut. Commander (E) R.C.N.V.R., H.M.C.S. Stadacona, Halifax, N.S.

MacNeil, Donald J., Ph.D. (Princeton Univ.), professor of geology, St. Francis Xavier University, Antigonish, N.S.

Pippy, William D., B.Eng. (Elec.), (N.S. Tech. Coll.), engineer, Nova Scotia Light and Power Co. Ltd., Halifax, N.S.

Weber, Alex. Moritz (Univ. of Sask.), i/c Electrical and instrument dept., Clark Ruse Aircraft Ltd., Dartmouth, N.S.

SASKATCHEWAN

Member

Haberman, John Albert, B.Sc. (Civil), (Queen's Univ.), Lieut., R.C.E., Regina, Sask.

Transferred from the class of Student to that of Junior

Bing-Wo, Reginald, B.Sc. (Civil), (Univ. of Sask.), jr. engr., Dominion Dept. of Agriculture (P.F.R.A.), Regina, Sask.

Staples, William Robert, B.Eng. (Mech.), (Univ. of Sask.), instructor, mech. engrg, (Univ. of Sask.), Saskatoon, Sask.

Students at the University of Saskatchewan

Adams, Jack, 130 Ave. X, S., Saskatoon, Sask.

Bingham, Andrew Thomson, 852 Sask. Cres. E., Saskatoon, Sask.

Birbrager, Jake, 323 Ave. D, S., Saskatoon, Sask.

Blezard, Roy John, 328 Sask. Cres. E., Saskatoon, Sask.

Bobyn, Edward Joseph, 304 4th Ave. N., Saskatoon, Sask.

Boyle, William Eric, 210 Clarence Ave. N., Saskatoon, Sask.

Bradley, Charles Jensen, 318 Clarence Ave., Saskatoon, Sask.

Breslin, William James, 1138 College Drive, Saskatoon, Sask.

Brooks, Eyrle Elwood, 210 Clarence Ave. N., Saskatoon, Sask.

Cherniak, Jack J., 626 Avenue H, S., Saskatoon, Sask.

Chomyn, Michael William, 1201 Elliott St., Saskatoon, Sask.

Clarke, Gerald Wallbridge, 318 Clarence Ave. S., Saskatoon, Sask.

Cramer, David, 206 Ave. E. S., Saskatoon, Sask.

Cummine, William Sturgis, 104 27th St. W., Saskatoon, Sask.

Dokken, Earl Kenneth, 506 5th Ave., Saskatoon, Sask.

Durrant, Morgan Powell, 1167 Henleasc Ave., Moose Jaw, Sask.

Eastwood, George Edmund Peter, Box 99, Spiritwood, Sask.

Elsey, Wilbert Roy, 1036 13th St. E., Saskatoon, Sask.

Ewing, Harlan Thomas, 730 10th St., Saskatoon, Sask.

Farnam, Arlington Bruce, 614 University Drive, Saskatoon, Sask.

Fisher, Earl Holden, 1006 11th St. East, Saskatoon, Sask.

Francis, Joseph Albert, 823 Main St. E., Saskatoon, Sask.

Gawley, Howard Nelson, 726 12th St. E., Saskatoon, Sask.

Gibson, Ronald Franklin, 820 14th St., Saskatoon, Sask.

Grant, Roderick Eugene, 850 University Drive, Saskatoon, Sask.
Green, George Henry, 446 Ave. T. S., Saskatoon, Sask.
Hamilton, Geoffrey Craig, 210 Clarence Ave. N., Saskatoon, Sask.
Hawkeye, Michael, 726 12th St. E., Saskatoon, Sask.
Holmes, Loyde Thomas, 1020 Aird St., Saskatoon, Sask.
Huddleston, William Macdonald, 614 University Drive, Saskatoon, Sask.
Humphrey, Kenneth Floyd, 726 12th St., Saskatoon, Sask.
Iverson, Norman, 301 Bottomley Ave., Saskatoon, Sask.
Jacoby, Max George, 839 University Drive, Saskatoon, Sask.
Kallio, Willard, 719–13th St., Saskatoon, Sask.
Kennett, Douglas Arthur, 111 Albert Ave., Saskatoon, Sask.
Kenney, Ben Dorran, 210 Clarence Ave. N., Saskatoon, Sask.
Larmour, Donald Arthur, 123 Albert Ave., Saskatoon, Sask.
Lavers, Cyril George, 713 Temperance St., Saskatoon, Sask.
Lepp, Henry, 402 26th St. W., Saskatoon, Sask.
L'Heureux, Léon Joseph, 613 10th St. E., Saskatoon, Sask.
Loden, Carl Allan, 1140 Temperance St., Saskatoon, Sask.
Matthews, John Gordon, 721 12th St., Saskatoon, Sask.
Mollard, John Douglas, 210 Clarence Ave. N., Saskatoon, Sask.
Munro, Donald David, 427 Main St., Saskatoon, Sask.
McCrary, John Walter, 614 University Drive, Saskatoon, Sask.
McKay, James Francis, 523 9th St. E., Saskatoon, Sask.
McNally, Reginald John Briar, 725 University Drive, Saskatoon, Sask.
Nixon, Edward Everett, 1118½ College Drive, Saskatoon, Sask.
Ottem, Ray Willard, 1138 College Drive, Saskatoon, Sask.
Payton, Richard Neil, 1001 12th St., Saskatoon, Sask.
Pearson, Roderick Frank, 823 Main St., Saskatoon, Sask.
Purdy, Clayton Charles, 818 10th St. E., Saskatoon, Sask.
Roberts, Howard Stanley, 1035 University Drive, Saskatoon, Sask.
Robertson, Thomas Johnston, 206 31st St. W., Saskatoon, Sask.
Rowbotham, William Redfern, 508 Sask. Cres. E., Saskatoon, Sask.
Sands, Douglas Harold, 518 9th St., Saskatoon, Sask.
Siddall, James Norman, 1018 Victoria Ave., Saskatoon, Sask.
Spencer, Henry A., 915 Temperance St., Saskatoon, Sask.
Tite, Wilfred Allan, 811 Temperance St., Saskatoon, Sask.
Watson, Howard Douglas, 336 6th Ave. N., Saskatoon, Sask.
Wesa, Gustave, Lutheran College, Saskatoon, Sask.
Williams, James Luther, 818 14th St., Saskatoon, Sask.
Wylie, Lewis Hutchinson, 311 Bottomley Ave., Saskatoon, Sask.

Date of Next Council Meeting: President Cameron extended on behalf of the Ottawa Branch, an invitation to Council to hold the next meeting in Ottawa on the afternoon of Saturday, January 15th, 1944. The Ottawa Branch also extends to all out of town councillors an invitation to lunch on that day. On the motion of Mr. McLeod, seconded by Mr. Armstrong, it was unanimously resolved that the invitation of the branch be accepted and that the next meeting of Council be held in Ottawa, on Saturday, January 15th, 1944, convening at two o'clock p.m.

Personals

News of the Personal Activities of members of the Institute, and visitors to Headquarters

Relatives and friends of members in the active forces are invited to inform the Institute of news items, such as locations, promotions, transfers, etc., which would be of interest to other members of the Institute and which should be entered on the member's personal record kept at Headquarters. These would form a basis of personal items in the *Journal*.

T. V. Berry, M.E.I.C., secretary-treasurer of the Vancouver and Districts Joint Sewerage and Drainage Board is the newly elected chairman of the Vancouver Branch of the Institute. Born in England in 1887, he came to Canada at an early age and received his education at the University of British Columbia where he graduated in 1923 as a B.A.Sc. Upon graduation he was engaged for a year in hydro-electric surveys and investigations made by J. G. G. Kerry of Toronto for the City of Vancouver. In 1924, he joined the staff of the City of Vancouver as an assistant in the municipal engineering department and in 1926 he became assistant engineer with the Greater Vancouver Water District. In 1921 he was appointed to the position he now holds.

Mr. Berry was secretary-treasurer of the Vancouver Branch of the Institute for several years.

S. D. Lash, M.E.I.C., assistant professor of civil engineering at Queen's University, Kingston, was recently elected chairman of the Kingston Branch of the Institute. Professor Lash is an honour graduate of the City and Guilds Engineering College, London, England, and a Ph.D. of the University of Birmingham. He came to Canada in 1929 as draughtsman with the Northern Electric Company at Montreal, and later was employed with the Dominion Reinforcing Steel Company, Limited, Montreal. In 1930, he went to Vancouver as a structural detailer with the British Columbia Electric Company, Limited. From 1931 to 1933 he did post-graduate work at the University of Birmingham, and from 1933 to 1935 he worked as a research assistant with the Steel Structures Research Committee in England.

Returning to Canada in 1935, he was instructor in civil engineering at the University of British Columbia until 1938, when he joined the National Research Council at Ottawa as a junior engineer. Later Dr. Lash was acting secretary of the National Building Code project with the National Research Council. In 1941 he joined the teaching staff at Queen's University as a lecturer in civil engineering and in 1942 he became assistant professor of civil engineering. Dr. Lash is a frequent contributor to *The Engineering Journal.*

S. D. Lash, M.E.I.C.

H. F. Barnes, M.E.I.C., returned to Canada last month on the *S.S. Gripsholm* after having been a prisoner of the Japanese in China for the past two years. Mr. Barnes was municipal engineer and secretary of the British Municipal Council at Tientsin, China, since 1924. Born in New Brunswick in 1889, he was educated at the University of New Brunswick where he obtained his degree of B.Sc. in 1912. From 1912 to 1915 he was assistant engineer with the Canadian Pacific Railway in Ontario. From 1915 to 1917 he was professor of railway engineering at the Chinese Government Engineering College at Tangshan, North China. He served overseas during the last war from 1917 to 1919 at which time he returned to China as sewerage engineer with the Public Works Department of the Shanghai Municipal Council. In this capacity he was responsible for the design and construction of the Shanghai sewerage system.

Mr. Barnes was welcomed back to Canada by an old friend, Graham Kearney, M.E.I.C., of Montreal, and he has now proceeded to his native town of Buctouche, N. B., for a well-earned vacation.

Colonel C. B. R. Macdonald, M.E.I.C., called at the Institute headquarters recently en route from England to the British West Indies where he is going on the staff of the comptroller for development and welfare for the British West Indies. Lately he had been with the No. 2 Trans Training Centre, Jullundur Cantonment, Punjab, India.

H. F. Finnemore, M.E.I.C., has been appointed assistant chief electrical engineer of the Canadian National Railways, at Montreal. Mr. Finnemore's new duties will be as collaborator with R. G. Gage, M.E.I.C., chief electrical engineer, in dealing with electrical power and traction activities throughout the National system.

Mr. Finnemore attended Queen's University, Kingston, Ont., where he received the degree of bachelor of science in electrical engineering in 1917. Following three years with the Royal Canadian Engineers during the last war he joined the Canadian Government Railways as a draughtsman at Moncton, N.B. In 1923 he became assistant electrical engineer and in 1938 he was appointed electrical engineer. During his railroading career Mr. Finnemore has been in charge of many important assignments. Among these were the development of Diesel-electric cars, pioneered in Canada by the Canadian National Railways; the introduction of air-conditioning on Canadian National passenger equipment; and the installation of the electrification system for the Montreal Terminal development.

Mr. Finnemore is a member of the Publication Committee of the Institute and a member of the Executive Committee of the Montreal Branch.

Major J. F. C. Wightman, M.E.I.C., was appointed recently chief engineer officer on the Headquarters staff at Camp Borden, Ont. He was previously commanding an Engineers unit in Montreal.

H. F. Finnemore, M.E.I.C.

Lt.-Col. D. Hillman, M.E.I.C.

Drummond Giles, M.E.I.C.

A. F. White, M.E.I.C., was recently appointed chief engineer of the Toronto, Hamilton & Buffalo Railway Company at Hamilton, Ont. He has been with the company since 1912, when he joined as a draughtsman, his latest position having been that of engineer.

Lt.-Col. Alex. K. Robertson, R.C.E., M.E.I.C., is at present executive officer to Major W. W. Foster, special commissioner for defence projects in northwestern Canada.

Drummond Giles, M.E.I.C., former vice-president of Canadian SKF Company Limited has resigned his position and was appointed, on November 1st, executive vice-president of Courtaulds (Canada) Limited, Cornwall, Ont., and a member of the board of directors. In order to take over his new duties which involve important war work, Mr. Giles has had to relinquish his post as special assistant to the co-ordinator of production in the Department of Munitions and Supply, Ottawa.

Captain J. T. Turner, M.E.I.C., of the Directorate of Electrical and Communications Design, Department of National Defence, Ottawa, has recently been promoted from the rank of lieutenant. His position is now that of a Section Head within the Directorate. Before enlisting, Captain Turner was employed by the National Light & Power Company Limited, of Moose Jaw, Sask., as electrical engineer.

Lieutenant V. R. Currie, M.E.I.C., is at present camp engineer officer at Sussex, N.B. He has been in active service with the Royal Canadian Engineers since last May. Previously he was assistant engineer, Rideau Canal office, Department of Transport, Ottawa.

Lt.-Col. D. Hillman, D.S.O., M.E.I.C., for the past ten years district engineer of the Canadian Pacific Railway, Quebec district, retired on November 1st after 42 years service in the engineering department of the company. Entering the company as a chainman in 1901, he was first engaged on location surveys and he raised to the position of assistant engineer in 1905, later becoming division engineer on construction work, at Sudbury, Ont.

He served during the last war from February, 1915, to September, 1919. He went overseas in June, 1915, as a lieutenant and was in France and Belgium from August, 1915 to July, 1919, returning to Canada as lieutenant-colonel. He was mentioned in despatches four times and was awarded the Distinguished Service Order. After the war he became engineer of construction with the company and in this capacity he worked on the entire system of the company from Saint John, N.B., to the Rocky Mountains. More recently when construction work was curtailed he became district engineer for the Quebec district at Montreal.

Robert A. Emerson, M.E.I.C., has been division engineer of the Canadian Pacific Railway Company at Moose Jaw, Sask., since June of last year. He occupied previously the same position at Brandon, Man. Last summer Mr. Emerson spent a few months in the chief engineer's office at Montreal as assistant engineer and has now returned to his post at Moose Jaw.

W. S. Black, M.E.I.C., has joined the staff of Hudson Bay Mining and Smelting Co. Ltd., at Flin Flon, Man. He was previously assistant engineer in the Buildings Construction Department with Trinidad Leasholds, Ltd., Pointe-à-Pierre, B.W.I.

Lucien Allaire, M.E.I.C., previously assistant division engineer of the Department of Highways of Quebec at Metabetchouan, has recently been promoted to the position of division engineer at Cap-de-la-Madeleine, Que.

J. L. Fair, Jr.E.I.C., has returned to the W.C. Wood Co. Ltd., at Guelph, Ont., as electrical engineer after having spent the last four years at Ottawa where he worked in the Patent Office.

H. B. Howe, Jr.E.I.C., has recently been made superintendent of the Canada Cement Company plant at Montreal East. Before joining the company in 1939 he was employed as assistant mechanical engineer with Johns Manville Company at Asbestos, Que.

A. R. Décary, M.E.I.C.

Hector Cimon, M.E.I.C.

Dr. A. R. Décary, M.E.I.C., past president of the Institute, and Hector Cimon, M.E.I.C., vice-president for the province of Quebec, are both acting in an advisory capacity on the Committee of the Quebec Branch in charge of the arrangements for the forthcoming Annual Meeting at the Château Frontenac, February 10th and 11th.

W. G. Reekie, M.E.I.C., was recently transferred from the Quebec North Shore Paper Company at Baie Comeau to the engineering staff of the Ontario Paper Company Limited at Thorold, Ont.

Joachim Fortin, M.E.I.C., has been appointed district engineer at Drummondville, Que., with the Drainage Board of the Province of Quebec.

Lt.-Commander G. H. Desbarats, R.C.N.V.R., M.E.I.C., is base engineer officer, H.M.C.S. Fort Ramsay, at Gaspé, Que. Before enlisting, Commander Desbarats was superintendent of the Paugan power house of the Gatineau Power Company at Low, Que.

E. W. Jeffrey, M.E.I.C., has recently been transferred from the Halifax office to the Montreal office of the Northern Electric Company Limited.

Captain R. E. Kirkpatrick, R.C.A., Jr.E.I.C., who for the past two years had been attached to the United Kingdom Inspection Board, has been seconded to the Director of Artillery in the Department of National Defence and has recently arrived in England to take a course at the Military School of Science.

Leslie Wiebe, Jr.E.I.C., of the Neon Products of Western Canada Ltd. has now gone to Vancouver after having spent a few months in charge of design in the Toronto office of the company.

T. W. Houghton, Jr.E.I.C., of the Canada Paper Company has recently been transferred back to Windsor Mills, Que., after having spent over a year at the Beauharnois mill of the company.

Jean Doucet, Jr.E.I.C., has recently left the employ of Collet & Frères, Montreal, to join the staff of Concrete Construction Limited, Montreal.

Flight-Lieutenant R. D. Doehler, S.E.I.C., was recently honoured with membership in the military division of the Order of the British Empire for the courage and devotion to duty he displayed during a serious fire at an R.C.A.F. station in England. The fire started when the bomb load of an aircraft standing in the dispersal area detonated. Soon a second aircraft caught fire and its bomb load exploded. Flying-Officer Doehler was running to help deal with the first explosion when the second hurled him to the ground. Badly shaken, but still capable of brave and decisive action, he got to his feet and climbed into a third aircraft, which he taxied to safety. In the opinion of those who later considered the scene and the circumstances of the fire his action prevented the destruction of the third aircraft and almost certainly saved the lives of a number of the station personnel. Since the incident in which he won the M.B.E., Flight-Lieutenant Doehler has served for a time in North Africa and the Central Mediterranean area but returned to England in mid-November. His promotion to Flight-Lieutenant was reported at that time.

Walter J. Baylis, S.E.I.C., is now employed with the Hoover Company at Hamilton. He was previously an engineer apprentice with Canadian Westinghouse Company, Hamilton, having graduated from the University of Alberta in 1941.

J. B. Block, S.E.I.C., has been employed as a chemist since June 1st by the St. Clair Processing Corporation at Sarnia, Ont. He graduated from McGill University in the class of 1937.

Lieutenant John G. Horsburgh, S.E.I.C., is now overseas with the Royal Canadian Engineers. He is a graduate of the University of Manitoba, in the class of 1941.

J. Adolphe Martin, S.E.I.C., returned to Montreal recently after having spent a few months at the San Diego plant of the Consolidated Vultee Aircraft Company where he was engineer-representative of Canadian Vickers Limited, of Montreal.

W. A. Pegler, S.E.I.C., has been employed for the past two years with Canadian Industries Limited at Shawinigan Falls, Que., where he now occupies the position of works engineer in the Alkali Division. He is a graduate of the University of Alberta in the class of 1940.

VISITORS TO HEADQUARTERS

E. W. R. Butler, M.E.I.C., Western Canada manager, Bailey Meter Co. Ltd., Winnipeg, Man., on November 25.

Colonel C. B. R. Macdonald, M.E.I.C., London, Eng., en route to take over new post as comptroller, Development and Welfare, Bridgetown, Barbadoes, B.W.I., on November 26.

Sub. Lieut. (A) J. F. Ross, R.N.V.R., S.E.I.C., Naval Air Station, Lewiston, Me., on November 28.

R. H. Robinson, M.E.I.C., sales engineer, Vulcan Iron Works, Winnipeg, Man., on November 30.

H. R. Sills, M.E.I.C., Canadian General Electric Co. Ltd., Peterborough, Ont., and councillor of the Institute, on November 30.

T. L. McManamna, M.E.I.C., manager, International Water Supply, Limited, London, Ont., chairman of the London Branch of the Institute, on December 1.

A. O. Wolff, M.E.I.C., district engineer, Canadian Pacific Railway, Saint John, N.B., chairman of the Saint John Branch of the Institute, on December 2.

Paul E. Buss, M.E.I.C., president, Spun Rock Wool Limited, Thorold, Ont., on December 3.

G. L. Dickson, M.E.I.C., electrical and signal engineer, Canadian National Railways, Moncton, N.B., and councillor of the Institute, on December 3.

Rolland Lemieux, M.E.I.C., city manager and engineer, Arvida, Que., on December 9.

G. G. Murdoch, M.E.I.C., consulting engineer, Saint John, N.B., and vice-president of the Institute, on December 11.

W. A. Pegler, S.E.I.C., works engineer, Alkali Division, Canadian Industries Limited, Shawinigan Falls, Que., on December 11.

Lt.-Colonel H. A. Gauvin, M.E.I.C., superintendent, A. Bélanger Limited, Montmagny, Que., on December 17.

Lucien Letendre, Jr.E.I.C., structural engineer, Marine Industries Ltd., Sorel, Que., on December 18.

H. J. Ward, M.E.I.C., superintendent of property, Shawinigan Water & Power Company, Shawinigan Falls, Que., on December 18.

Major C. Ben Bate, R.C.E., M.E.I.C., senior engineer officer, Canadian Troops, Newfoundland, on December 22.

Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Louis Charles Dupuis, M.E.I.C., died at Lévis, Que., on December 6th, 1943, after several months illness. Born at St-Roch des Aulnaies, Que., on November 8th, 1886, he received his education at Laval Normal School, and Laval University Survey School, Quebec, and by private tuition. He engaged in railway work in 1907 on survey parties with the Transcontinental Railway. In 1911 he joined the Intercolonial Railway as an assistant engineer at Moncton, continuing the following year in the same position at Lévis, Que. He has remained at Lévis practically ever since, occupying successively the positions of resident engineer with the Intercolonial Railway, engineer on double tracking, assistant engineer with the Canadian Government Railways and division engineer of the Saguenay division, Canadian National Railways, and later, in 1924, division engineer of the Lévis division. In 1927 he was transferred for a few months to division engineer, construction department, in charge of the St. Félicien-Mistassini extension. At the time of his death he still occupied the position of division engineer of the Canadian National Railways at Lévis.

Mr. Dupuis joined the Institute as a Junior in 1912 and transferred to Associate Member in 1919. He became a Member in 1940. In 1941 and 1942, he was chairman of the Quebec Branch of the Institute. He had been a member of the Corporation of Professional Engineers of Quebec since 1922.

William Fulton, M.E.I.C., died in the hospital at St. Boniface, Man., on October 23rd, 1943, after a short illness. Born at Ayr, Scotland, on September 12, 1869, he was educated at Leeds Grammar School and Churwell College. Coming to Canada in 1902 he entered the service of the Manitoba Government being first engaged in survey work and later becoming assistant engineer on drainage work. During the first great war he served overseas from 1916 to 1919 when he returned to Canada and resumed his work with the Manitoba government. In 1924 he became district engineer at Winnipeg in the reclamation branch of the Department of Public Works of Manitoba. He had retired from his position a few years ago.

Mr. Fulton joined the Institute as an Associate Member in 1920 and was made a Life Member in 1938.

Harry Molyneux King, M.E.I.C., died at Niagara Falls, Ont., on December 6th, 1943. He was born at Brooklyn, N.Y., on September 12th, 1877, and received his education in East Greenwich and Providence, R.I., U.S.A. From 1903 to 1906 he was engaged in substation construction for the Narrangansett Electric Lighting Company, at Providence, R.I., and from 1906 to 1910 he was employed with Westinghouse Electric and Manufacturing Company, erecting apparatus in the Buffalo district. In 1907 he was sent to the Ontario Power Company at Niagara Falls as the Westinghouse representative to install some of their units. In 1910 he was sent again to the Ontario Power to supervise repairs to Westinghouse generators. On completion of this work he joined the staff as supervisor of electrical maintenance, remaining in this position after the Hydro Electric Power Commission took over the plant in 1917. In 1923 he was appointed operating superintendent of the Ontario Power plant, a position he held until his death.

Mr. King joined the Institute as a Member in 1926.

Robert A. Stewart, M.E.I.C., superintendent of the New Glasgow, N.S., plant of the Eastern Car Company Ltd., died in the hospital at New Glasgow, on December 8th, 1943. Born at New Glasgow, N.S., on November 28th, 1872, he received his education in the local high school. In the early days of his career he was associated with his father in bridge building in Nova Scotia. In 1912 he became superintendent of the Maritime Bridge Company, Ltd., plant at New Glasgow. In 1917 when the company was taken over by the Eastern Car Company, he carried out the same duties with the new company.

Mr. Stewart has been a member of the Association of Professional Engineers of Nova Scotia since 1920 and he became a Member of the Institute in 1940 under the terms of the agreement between the Institute and the Association.

John Bernard Wain, M.E.I.C., assistant chief land surveyor for the Canadian National Railways, died in the hospital at Montreal, on December 5th, 1943, following a brief illness. Born at Bradford, Yorkshire, Eng., on March 11th, 1890, he was educated at Bradford Technical College where he graduated in civil engineering. He came to Canada in 1908 as a draughtsman in the chief engineer's office of the Grand Trunk Pacific Montreal. In 1911 he became field draughtsman, instrumentman and estimator with the Grand Trunk Railway system, at Montreal, becoming senior draughtsman in 1916 and chief draughtsman in the valuation department, in 1919. In 1923 he went to Toronto where he was office engineer in the valuation department of the Canadian National Railways until 1938 when he was appointed assistant chief land surveyor of the company and returned to Montreal.

Mr. Wain joined the Institute as an Associate Member in 1920 and he became a Member in 1940.

Peder Pederson Westbye, M.E.I.C., died at Peterborough, Ont., on November 12th, 1943. He was born at Hedrum-at-Larvik, Norway, on January 21st, 1878. He was educated at Porsgrunds Technical school, Norway, where he graduated as a mechanical engineer in 1897. In 1900 he graduated as a mechanical and electrical engineer from Mittwida and Dresden University, Saxony. He came to this continent in 1906 and he was first employed with William Sellers and Company, Philadelphia, Pa. From the end of 1906 until September, 1910, he was employed first as designer and then chief engineer with Dayton Globe Iron Works at Dayton, Ohio. He then became assistant to the chief engineer of the Platt Iron Works at Dayton and came to Peterborough in 1911 in order to introduce their machines on the market. In 1913 he became consulting engineer with the William Hamilton Company Ltd. of Peterborough and in 1919 he was made vice-president and general manager of the company, later becoming president.

For the past two years he had been in Hamilton, Ont., with the Hamilton Bridge Company engaged in war work.

Mr. Westbye joined the Institute as a Member in 1919. He was chairman of the Peterborough Branch in 1922-23.

L. C. Dupuis, M.E.I.C.

William Fulton, M.E.I.C.

J. B. Wain, M.E.I.C.

News of the Branches

Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

EDMONTON BRANCH

F. R. Burfield, m.e.i.c. - *Secretary-Treasurer*
L. Thorssen, m.e.i.c. - - *Branch News Editor*

The November meeting of the Edmonton Branch was held at the University of Alberta, on November 5th, 1943.

The chairman, C. W. Carry, opened the meeting by asking the members to stand in memory of an esteemed member, the late Professor Cornish, who passed away on November 2nd.

The meeting was addressed by Dr. J. W. Campbell, professor of mathematics, University of Alberta, and honorary president, Royal Astronomical Society of Canada. Dr. Campbell spoke on observatories with particular reference to the new observatory at the University of Alberta. He explained the different types and sizes of telescopes used in Canada and particularly the one now installed at the University. This explanation was followed by a short talk on the stars and then by a film "Exploring the Universe" which showed the position and motions of many stars.

After the chairman had expressed the appreciation of the Branch to the speaker the meeting adjourned to the new observatory, were Dr. Campbell pointed out many interesting phenomena to the members.

HALIFAX BRANCH

S. W. Gray, m.e.i.c. - - *Secretary-Treasurer*
D. C. V. Duff, m.e.i.c. - *Branch News Editor*

The regular monthly dinner meeting of the Halifax Branch of the Institute was held at the Nova Scotian Hotel on Thursday, November 25, 1943. Professor A. E. Flynn, chairman of the branch, presided.

The guest speaker for the evening was Mr. W. D. Outhit, registrar of the Probate Court, Halifax. He gave a very interesting and enlightening talk on different experiences which he had encountered in his legal profession. Mr. Outhit, by various examples, brought an important message to many who do not realize how important it is for a person who possesses property of any kind to make a will.

He pointed out that the law of intestate succession is nothing more or less than a statutory will. It is an effort to provide a substitute for a will that a man himself should have made. In many cases, this statutory will is inadequate, is incomplete, and causes hardship because it is impossible to provide for individual cases.

The address, although not of an engineering nature, was presented in a very interesting manner by the speaker, and was instructive to all members.

Also present as guests of the branch were several students from the Nova Scotia Technical College.

HAMILTON BRANCH

W. E. Brown, m.e.i.c. - *Secretary-Treasurer*
L. C. Sentance, m.e.i.c. - *Branch News Editor*

The regular monthly meeting of the Hamilton Branch was held on Monday, December 13th, at McMaster University, with one hundred members and guests in attendance; T. S. Glover, branch chairman, presided.

Varied experience gained as test engineer in charge of rectifier and electronic equipment for the Canadian Westinghouse Company, enabled the speaker of the evening, H. W. Blackett, to discuss with authority the subject of **Electronics.**

Mr. Blackett reviewed the development of scientific thought which has made possible the state of refinement of present day electronic devices and he further discussed the fundamental concepts relating to the electron theory as a prelude to the showing of a Westinghouse sound film entitled "Electronics at Work".

The six fundamental functions performed by electronic devices, namely, rectification, amplification, control, generation, conversion of light to electrical energy, and vice versa, were well illustrated both as to theory and practical applications.

By means of an oscilloscope, the speaker gave a practical demonstration of the operation and control of electronic tubes, comparing three forms of rectifiers: the diode, high vacuum triode and gas filled triode, the last two with grid control. The advantages of the ignitron, a mercury arc rectifier with synchronized firing control, were discussed and numerous slides of typical applications in the electro-chemical industries, transportation and welding control, were shown.

Further illustrations of electronics at work were evident in photo-electric control of industrial inspection operations, high frequency reflowing of tinplate, high frequency tinplate brazing, heating and welding, radio, television, radar, the automatic pilot, frequency conversion, and D.C. transmission systems.

After a question period, refreshment were served in the anteroom.

KINGSTON BRANCH

R. A. Low, m.e.i.c. - - *Secretary-Treasurer*
C. E. Craig, s.e.i.c. - *Branch News Editor*

The participation of the young engineer in Institute activities featured the president's annual visit to the Kingston Branch, November 29, 1943. President Cameron, in addressing a joint gathering of local Institute members and engineering students of the Faculty of Applied Science, Queen's University, referred to the younger generation of engineers as worthy successors to the present participants in the profession. Engineers are taking a much larger part in Canadian industrial life, he said, and this necessitates close co-operation of all engineers and the broadening of associations and institutions. The older engineer, stated Mr. Cameron, is always eager to assist the junior engineer and he called upon the students to avail themselves of this wealth of information, gathered through years of practical experience.

A feature of the evening was the presentation of the Institute prize certificate to Jack W. Kirk, Sc. '44, for high academic standing and keen interest in Institute activities during his term at Queen's University. Mr. Kirk previously had received the cash award of $25.00 in conjunction with the prize.

Dr. R. C. Wallace, hon. m.e.i.c. introduced the president, stating that Mr. Cameron had exceptionally broad experience in the engineering field and was most qualified to discuss the subject of the evening. Dean D. S. Ellis, of the Faculty of Science, Queen's University, expressed the vote of thanks.

Mr. Cameron chose as his theme, his favourite subject, **Post-War Reconstruction,** focusing his attention particularly to post-war planning, as related to the construction industry. He outlined the complex prob-

Dr. R. C. Wallace introduces President Cameron. On the president's left chairman S. D. Lash and B. J. McColl, president of the Engineering Undergraduates Society of Queen's University.

lems facing Canadians after the cessation of hostilities and urged that plans and specifications for particular projects be started immediately.

Among those attending the meeting were Mayor H. L. Stewart, M.L.A., George H. Ferguson, chairman of the Ottawa Branch, W. E. Bonn, a past-chairman of the Toronto Branch, N. B. MacRostie, councillor for the Ottawa Branch, Dr. P. M. Haenni, director of Aluminium Laboratories, and David Jack, city engineer of Kingston.

Dr. S. D. Lash, chairman of the branch, presided at the meeting. Also present on the speaker's platform were L. Austin Wright and Bruce McColl, Science '44, president of the Engineering Society, Queen's University.

Following the meeting the students entertained members of the local branch at an informal gathering, serving a very tasty lunch. President Cameron welcomed into the Institute a large group of first year students who had previously made applications for admittance.

During his stay in Kingston, Mr. Cameron and party visited plants of the Nylon Division of C.I.L. and also Aluminium Laboratories Limited.

MONCTON BRANCH

V. C. Blackett, m.e.i.c. - *Secretary-Treasurer*

Locomotives, Large and Small, was the subject of an address delivered at a meeting of the Branch, held on October 18th, by Winsby Walker, superintendent of shops, Canadian National Railways, Moncton. J. A. Godfrey, chairman of the branch, presided and introduced the speaker.

Even the ancients, said Mr. Walker, seemed to have been imbued with a conception of the value of steam as motive power. Thus, in the city founded by Alexander the Great, Hero was said to have demonstrated its power about 130 B.C. He wrote a treatise on the subject, explaining its force and how it might be utilized by the use of cylinders, pistons, valves, etc.

England was the birthplace of the steam locomotive and Robert Trevithick, a Cornish engine enthusiast, was the first to operate an engine on rails. Most of the early locomotives operated with a rack rail, and full steam pressure was used throughout the piston stroke. Real progress came with Stephenson, who obtained increased power with a multi-tubed boiler and a separate fire box. The valve gear, which he invented is still in use, although in this country, it has been largely superseded by American designs. Around 1830, locomotives were built that could travel from 30 to 35 miles per hour. Since then a speed of 127 miles per hour has been attained.

The heart of the locomotive is its valve gear and this is a subject upon which designers hold sharply divided opinions. Mr. Walker made use of a large scale model of the Baker valve gear, the property of the branch chairman, to illustrate how operating efficiency was affected by changes in valve settings.

As a hobby, Mr. Walker said, he is interested in small scale locomotives and is a member of the Montreal Society of Model Engineers. These miniature locomotives vary in length from 9 inches to 6 or 7 feet in length. They burn coal and are wonderfully complete as to detail. The society has a test track at Lachine, 485 feet around, where members try out their models.

MONTREAL BRANCH

L. A. Duchastel, m.e.i.c. - *Secretary-Treasurer*
H. H. Schwartz, s.e.i.c. - *Branch News Editor*

Soil Engineering as Applied to Modern Highway Construction was the subject of the talk delivered on November 11th, by Dr. Norman W. McLeod to the Montreal Branch.

One of the principal proposed methods of alleviating post-war unemployment is the construction of a modern highway network all over the country. To keep the costs of construction down, and yet to maintain a good quality of road requires a sound knowledge of soil technology.

There are three separate sub-divisions of a road that must be considered in design. The first is the sub-grade. This must be built on solid ground that is not subject to frost heave. The grade line must be from four to five feet above the ground water line. Proper compaction must be used to obtain maximum soil density and thus minimum soil settlement. Any muskeg or peat must be removed.

The second element of a road is the grade course, built on top of the sub-grade. This is usually a stabilized soil mixture consisting of gravel, sand and a clay binder. However this mixture absorbs water and loses strength. The addition of a small quantity of liquid asphalt, from one to two per cent by weight of the mixture, makes the stabilized mixture water resistant. Grade courses of this type have been built since 1939 and so far have stood up very well to the weather.

The third element of a road is the surface. This may be either cement or bitumen depending upon the traffic the road is required to bear.

At the end of the meeting a film was shown which illustrated clearly all the points raised in Mr. McLeod's talk.

Paul Lebel was chairman of the meeting and Henri Gaudefroy moved the vote of thanks.

* * *

On November 18th, the Montreal Branch held its Annual Student Night.

Four students—two from Ecole Polytechnique, and two from McGill University delivered papers before the members.

The first prize for the best paper was won by Mr. André Prud'homme of Ecole Polytechnique for his paper on **Toll-Office Circuits and Equipment,** dealing with one phase of telephone work.

The second prize went to G. H. Galbraith of McGill University for his paper on **Northern Pipe Line Construction.**

The two other papers were as follows: **Supercharging Aircraft Engines** by Albert Clément of Ecole Polytechnique; and **Sportwelding Aluminum** by D. R. Brown of McGill University.

The judges were Messrs. M. V. Sauer, H. Massue and R. H. Findlay.

Mr. Robert Baillargeon was chairman of the meeting.

* * *

On Thursday, November 25th, Mr. W. A. Irvine spoke to the Montreal Branch on **Post-war Planning by Industry.** As a practical example, Mr. Irvine discussed the planning methods used by the Canadian General Electric Co. and the expected results. The paper appears elsewhere in this issue.

* * *

"At the cost of equipping three army armoured divisions Montreal can become the best city on the North American continent" stated Mr. P. E. Nobbs in the course of his address on **Montreal Housing and Planning Problems** to the Montreal Branch on December 2nd.

At present Montreal is laid out on a grid-iron plan. This creates long blocks of houses with narrow frontage, and small yards. Large sewers and many paved streets are required to service the dwellings. However, if Montreal were rebuilt—at a cost small in comparison to the benefit that would be derived—into small community sections, the number of sewers and streets could be drastically reduced. Paved streets would be used only between communities. Within the community itself, small roads would suffice, since each road would carry only the traffic generated by the community. Main sewers would be needed only between communities.

A new housing plan for Montreal is essential. From a long term point of view, the investment would be profitable. The monetary saving effected by the clearance of the slums, due to the reduced incidence of tuberculosis, would pay for the entire development within a few years. If to this saving is added that due to the reduction in infant mortality, juvenile delinquency and crime, the investment appears quite sound.

The indirect benefits due to the better health and general welfare of the community cannot be estimated readily, but are very large nevertheless.

Mr. Pepperman moved the vote of thanks, and Mr. Aimé Cousineau was chairman of the meeting.

NIAGARA PENINSULA BRANCH

J. H. Ings, M.E.I.C. - - *Secretary-Treasurer*
J. W. Brooks, Jr.E.I.C. - *Branch News Editor*

The October meeting of the Branch was held at the DeCew Falls construction camp, near St. Catharines. An afternoon inspection trip of the DeCew Falls hydro-electric power development was followed by dinner at camp headquarters. Mr. John Dibblee, assistant chief engineer of the Hydro-Electric Power Commission of Ontario, presented an excellent illustrated lecture on the development.

The technical aspects of the DeCew Falls plant were described in detail in a paper, "DeCew Falls Development", by Mr. Otto Holden, published in the October issue of the *Journal.* The local Branch would like to take this opportunity of expressing its appreciation to the Hydro men at DeCew Falls for both the sumptuous repast enjoyed by its members after their tour of inspection, and also for the courtesy extended to them throughout the entire visit.

In the absence of the Branch News Editor, the following report on the November meeting is presented by Past Chairman C. G. Cline:

The Niagara Peninsula Branch held a dinner meeting at the General Brock Hotel on November 25th. The Branch chairman, G. E. Griffiths, presided and there was an attendance of 35. C. G. Moon introduced the speaker, Dr. M. Rosten, chemical engineer at the Ontario Paper Company, who spoke on the subject **A New Age in Agriculture and Forestry.** Dr. Rosten is a graduate of the University of Lwow, Poland, and before the war he was engaged in the production of industrial alcohol in Poland. His argument is that many sources of raw material that might be used for the production of alcohol are being wasted, or at least neglected, in Canada and the United States at present, and that we could, with advantage, introduce on this continent processes that have been in use in Europe for many years. As an instance, he mentioned the plant recently completed for the Ontario Paper Company for the manufacture of alcohol from the sulphite liquor that is a by-product in the manufacture of paper, and which previously went to waste. He mentioned also a process whereby protein could be extracted from low grade grain and used for cattle feed, while the remaining starch could be used for making alcohol.

Large quantities of alcohol are required in industry and its use has increased enormously during the war. It forms the raw material in one process for producing synthetic rubber. It could be used as motor fuel. Present automobile and aeroplane engines could use 10 or even 15 per cent of alcohol mixed with the gasoline. Engines with higher compression ratios, which are probable in the near future, could use larger percentages. In fact, as our available oil reserves decrease, it may be necessary to design engines that will use alcohol alone. In this way, we would have an unfailing source of motor fuel which would be produced as required from the products of our farms and forests.

After replying to a number of questions relating to his paper, Dr. Rosten told how he and his wife escaped from Poland to Rumania during the war, and finally reached Canada. The vote of thanks to the speaker was moved by G. F. Vollmer.

OTTAWA BRANCH

A. A. Swinnerton, M.E.I.C. - *Secretary-Treasurer*
R. C. Purser, M.E.I.C. - - *Branch News Editor*

Members of the Ottawa Branch, at a noon luncheon at the Chateau Laurier on November 25, listened to an address on **Signal Communication in the Field** and viewed a motion picture illustrating some of the devices and methods used. The speaker was Major S. O. Roberts, R.C.C.S.

Major Roberts outlined briefly the system under which a modern army division operates, with co-ordinate action between assault and supporting troops. In order that each may function at precisely the right time, it is imperative that there be an efficient system of communications. This is supplied by the signal corps.

There are several types of field communication, ranging from the telephone to the "walkie-talkie", a simple device weighing not more than 15 lb. which may be carried on the chest and which is good for communication up to a distance of two miles. The nerve centre for these devices is the signal office which is established quickly and easily in a protected, central part of field headquarters.

These devices and methods, as explained by the speaker, have been greatly simplified in the past 25 years. Whereas formerly, for instance, in setting up a wireless set it was necessary to have a gasoline engine now power may be obtained from batteries and the whole set complete may weigh not more than 70 or 80 lb.

To avoid confusion of messages coming from various parts and sections of the army, each commanding officer is supplied with a frequency or wave length. Instruments are calibrated with extreme precision, and so fine are the adjustments that noises of internal combustion engines are entirely eliminated.

PETERBOROUGH BRANCH

A. J. Girdwood, m.e.i.c. - *Secretary-Treasurer*
J. F. Osborn, m.e.i.c. - *Branch News Editor*

The guest speaker at the annual dinner on November 18th was Professor Jocelyn Rogers, provincial analyst and professor of chemistry, at the University of Toronto. The topic, **Scientific Crime Detection**, was developed by the relation of fascinating episodes in the speakers colourful career.

Certain cases are to some extent predictable since they stem from known physical or social conditions. For example, extremely depressing heat waves tend to cause some women to do away with their husbands. Prohibition or an acute shortage of good liquor stimulate production of swamp whiskey with the associated deaths from poison. Traffic accidents are constantly "happening", due to the effect of liquor on the judgments of drivers. This is partially due to the present empirical methods of determining the degree of intoxication since convictions are difficult to obtain and therefore the deterrent to driving under the influence of liquor slight.

A great deal can be learned about a case by studying the background of those involved, that is, their temperament, taste, position in society, etc. Such information enables the investigator to relate more effectively the technical data to the human factors. For example, it is known that murders committed by men are usually violent, messy affairs. Women on the other hand are inclined to be subtle in planning and neat in the execution of a murder. For the proper functioning of scientific methods, Professor Rogers stressed the necessity of a police force chosen for intelligence instead of brawn.

The speaker admitted a preference for the strictly scientific function of securing and presenting facts, but must frequently make deductions from the evidence to translate facts into legally effective instruments.

President K. M. Cameron spoke briefly as well as a number of other prominent guests. Branch Chairman A. R. Jones presided.

* * *

The December 9th meeting was addressed by Mr. J. S. Fullerton of Handy and Harman on the subject **Silver Brazing as a Machine Tool.** The advantages and limitations of alloy brazing were described and illustrated with samples and slides. A large number of guests were present to take advantage of a highly practical paper presented in a form useful to those applying alloy brazing.

SASKATCHEWAN BRANCH

Stewart Young, m.e.i.c. - *Secretary-Treasurer*

The regular monthly meeting of the Saskatchewan Branch with the Association of Professional Engineers was held in the Saskatchewan Hotel, Regina, on Thursday evening, November 18. The meeting was preceded by dinner, at which the attendance was 34.

N. B. Hutcheon, Ph.D., assistant professor of mechanical engineering, University of Saskatchewan, addressed the meeting on **Recent Developments in Building Insulation Practice**, illustrating his subject by lantern slides and sound film.

Explaining the theory of insulation, Dr. Hutcheon informed his audience of the recent findings in respect of condensation in exterior walls of buildings and stated that, through insulation, condensation in walls is accelerated. The remedy lies in the sealing of the interior surfaces of walls against the transmission of the vapor content within a building to the exterior sides of walls.

The address caused considerable discussion after which a hearty vote of thanks was tendered the speaker.

The regular monthly meeting of the Saskatchewan Branch with the Association of Professional Engineers was held in the Kitchener Hotel, Regina, on Friday evening, December 11. J. McD. Patton, vice-chairman, was in charge of the meeting.

The speaker was W. Lloyd Bunting, who took as his subject, **Waterfowl Conservation.** Mr. Bunting, being Saskatchewan Manager for Ducks Unlimited, is an authority on this subject.

A century ago the duck population of North America is estimated to have been 400,000,000. By 1934 this had dwindled to 30,000,000, and conditions had so deteriorated that the governments of the United States and Canada decided that something must be done to prevent further disappearance of the wild fowl population. Previous to this (1916) Migratory Birds Acts, having in view the protection of wildfowl had been enacted in Canada and the United States but, with continued waterfowl disappearance, it was decided in 1934 to place further restrictions on bag limits and hunting methods.

In 1935, a general survey of the duck population indicated that the greatest cause of depletion was brought. Arising out of this finding, Ducks Unlimited (U.S.) was formed to raise funds in the United States for expenditure in Canada by Ducks Unlimited (Canada) for waterfowl protection through maintenance of constant water areas which theretofore had been subject to season drying. Various methods are employed, damming of watercourses, raising of water levels in marsh lands, combining smaller water ponds into one large pond, conversion of poor hay land to first class duck and muskrat areas.

Other cause of depletion of waterfowl population in order of greatest destruction are: crows and magpies; uncontrolled burning of hay lands; jackfish.

Approximately 1,000,000 crows and magpies have been destroyed in Saskatchewan; farmers have been taught to control the burning of hay land; jackfish are, in many areas, prevented by screens from getting into marsh areas. As a result of these measures the present estimated duck population in Saskatchewan is 120,-000,000, an increase of 400 per cent in a period of ten years—much of which may be credited to the activities of Ducks Unlimited, and not a little to the works carried out under The Prairie Farm Rehabilitation Act, (P.F.R.A.).

Following his address Mr. Bunting presented a series of three films showing the habits of waterfowl and the nature of conservation methods. After a period of interested discussion a hearty vote of thanks was tendered the speaker.

SAULT STE. MARIE BRANCH

O. A. Evans, Jr.E.I.C. - *Secretary-Treasurer*

The eighth general meeting for the year 1943 was held at the Windsor Hotel on November 26th, 1943, at 6.45 p.m., when twenty-two members and guests sat down to dinner.

The guest speaker, Mr. J. P. Bendt, had for his topic **Construction Experiences in Russia During the Five Year Plan.**

The speaker said that Russia, while being the largest country in the world was, before the revolution, chiefly a producer of primary products. Most machine tools and manufactured goods had to be imported.

The Economic Council after the revolution decided to establish some 500 necessary industries to give the country a basic industrial set up. A number of these were established at far inland points so that they would be safe from attack.

One of these industries was the now famous steel plant at Magnitogorsk which is situated on the Kirghiz Steppe, east of the Urals which has an altitude of 1,100 ft. above sea level and a latitude of the neighbourhood of James Bay.

He said that Magnitogorsk is near a huge magnetic ore deposit but the coal had to be hauled some 800 miles by rail.

On his arrival in February, 1931, the temperature was near 20 degrees below zero. The village was experiencing the pangs of rapid growth and accommodations were crowded.

There were many difficulties to be overcome such as the training of unskilled labour which was shipped in by car loads. Quite frequently the whole family would accompany the labourer and this tended to make things congested. There were few technicians and progress was slow. He said that the people all tried and were eager to learn. The few skilled technicians came from around Kharkov.

Most of the excavation for the steel plant was done by pick and shovel and the earth was carted away in ¾ cu. yd. wagons by a single horse.

He related many of his experiences and afterwards showed many slides which depicted the progress of the work and the habits of the people.

TORONTO BRANCH

S. H. de Jong, m.e.i.c. - *Secretary-Treasurer*
G. L. White, affil.e.i.c. - *Branch News Editor*

Modern Timber Engineering was the subject of an address by Professor C. F. Morrison, associate professor of civil engineering, University of Toronto, before a general meeting of the Toronto Branch, in the Debates Room at Hart House on Thursday, October 21st.

The paper was published in the October issue of the *Journal.*

W. H. M. Laughlin, chairman of the Branch, presided at the meeting at which 95 were present. A lively discussion followed the paper and the vote of thanks to the speaker was moved by D. C. Tennant.

* * *

The Engineer in the Armed Forces was the subject of an address by Col. G. W. Beecroft, liaison officer between the Wartime Bureau of Technical Personnel and the Armed Forces, at the meeting of the Branch, on Thursday, November 4th.

Col. Beecroft outlined the development and work of the Wartime Bureau of Technical Personnel, pointing out that technical people were the only class with special facilities in wartime labour organizations.

The speaker outlined the types of engineers in demand for the Army, for the Royal Canadian Engineers, the Royal Canadian Ordnance Corps, Royal Canadian Artillery, Signals, and chemical warfare. The Navy has required numbers of mechanical and electrical engineers and has been able to utilize some technically trained people of a less specialized type who have taken special courses in torpedoes, gunnery, anti-torpedo devices, etc. The Air Force has required a variety of engineers, although the only demand at present is for aeronautical engineers or mechanical or electrical engineers with aircraft experience.

Col. Beecroft discussed some of the phases of his work in collaboration with the Wartime Bureau of Technical Personnel. Important results have been achieved in cutting down the time from application to acceptance in the Armed Forces for technical personnel, and many special requests for scientific people with special knowledge have been met successfully.

Attention has been given to technical personnel enlisted or drafted in the ranks with a view to their better utilization and in advising men in plants who wish to go into active service. At the present time, in the Army, direct appointments are being given only to those with special valuable qualifications.

Col. Beecroft referred to the freezing of university science students and dealt with the number of those from the classes of 1943 who have gone into the Armed Forces. In addition, the general situation in regard to requirements for engineers in civilian service and in the Armed Forces was discussed.

A vote of thanks was moved by Prof. M. W. Huggins, University of Toronto.

Junior Section

The Junior Section of the Toronto Branch held their second meeting of the season in the Debates Room at Hart House on November 1st at 8 o'clock p.m., with Mr. W. Fotheringham in the Chair and approximately 150 persons present.

The speaker, Wing Commander T. R. Louden who was recently appointed Professor of Civil Engineering and Aeronautics at the University of Toronto gave un illustrated address on **Aviation—Past, Present and Future.** The gradual evolution of the elliptical form of wing was shown and the extraordinary progress made during the last ten years was very forcibly illustrated by slides of the Imperial Airways plane, the Hannibal, built about 1932. Prof. Louden stressed the critical importance of maintenance costs in the operation of both commercial and military planes. It was stated that the helicopter might be used for handling mails in due course.

Following the lecture a salary survey was conducted by means of a questionnaire under the guidance of Mr. J. Powerland. A report on this survey will be submitted to the December meeting.

VANCOUVER BRANCH

P. B. Stroyan, m.e.i.c. - *Secretary-Treasurer*
J. G. D'Aoust, m.e.i.c. - *Branch News Editor*

The annual dinner and business meeting of the branch took place on Saturday, November 27th, at the Hotel Georgia. Sixty-two members and guests attended. Branch Chairman W. N. Kelly presided.

Following dinner, the annual business of the branch was conducted. The selection of the nominating committee for next year's executive was presented by Mr. C. E. Webb, the slate being elected by acclamation and as appearing on page 3 of this issue.

The retiring chairman, W. N. Kelly, presented his report showing that the branch had enjoyed a particularly successful year. Meetings were held monthly and subjects were widely diversified. An event of great significance was the formation of a student chapter by the civil engineering students at the University of British Columbia, of whom twenty-seven have joined the Institute. This took place immediately after President K. M. Cameron's visit to Vancouver, during which he addressed the engineering students at the University. Mr. Kelly thanked the members of the executive who had attended meetings regularly and carried on the affairs of the branch efficiently and successfully. Special tribute was paid to the secretary, Mr. P. B. Stroyan.

At the conclusion of business the chairman called upon Group Captain Bennett, attached to the Western Air Command of the R.C.A.F. to introduce the speakers of the evening. These were Squadron Leader Donaldson and Flying Officer Lee, both of the R.C.A.F. who spoke on **Flying Control and Air Sea Rescue.** The first speaker, S. L. Donaldson, dealt with flying control as developed in Great Britain, and described the methods used to locate and guide aircraft which are in distress as a result of enemy action or mechanical breakdown, when they are returning from bombing sorties over Europe. He told of the vast organization and the enormous amount of detailed work required in plotting the position of each plane and in safely landing these in large numbers, often under very difficult weather conditions. This work involves liaison with both the army and the navy, the former operating searchlight batteries and the latter providing fast vessels for sea rescue.

The Observer Corps, a volunteer organization, also plays a major part in locating distressed aircraft and transmitting information to airdromes.

The second speaker, F. O. Lee, described the training and equipment used to enable air crews to survive and to be rescued when they are forced to abandon their planes in the sea. This part of the programme was illustrated by two reels of sound film and by a display of some of the equipment furnished for the protection of air crew under such circumstances. This included a radio transmitter, with its balloon or kite raised aerial, a supply cannister, and other items. The self-inflated rubber dinghies, and the carefully selected and packed supplies which are provided, were all described in detail by the speaker.

While space here will not permit a more detailed summary of the subject matter, it can be said that the audience was treated to a well presented and informative description of this phase of air force operations. A hearty vote of thanks was proposed by Col. W. G. Swan and seconded by Dean J. N. Finlayson. The meeting was adjourned at 11.20 p.m.

Library Notes

Book notes, Additions to the Library of The Engineering Institute, Reviews of New Books and Publications

ADDITIONS TO THE LIBRARY

TECHNICAL BOOKS

Intermediate Differential Equations:
Earl D. Rainville. N.Y., John Wiley and Sons, Inc., 1943. 5¼ x 8¼ in. $2.75.

Workshop Sense:
W. A. J. Chapman. Toronto, Longmans Green and Co., 1941. 4¾ x 7¼ in. $0.50.

Electrical Technology for Telecommunications:
W. H. Date. Toronto, Longmans Green and Co., 1943. 5 x 7½ in. $1.50.

Mechanism and the Kinematics of Machines:
W. Steeds. Toronto, Longmans Green and Co., 1940. 5½ x 8¾ in. $5.50.

Elementary Surveying:
Arthur Lovat Higgins. Toronto, Longmans Green and Co., 1943. 5½ x 8¾ in. $1.80.

Kinematics and Machine Design:
Louis J. Bradford and George L. Guillet. N.Y., John Wiley and Sons, Inc., 1943. 5¼ x 8 in. $3.00.

Mellor's Modern Inorganic Chemistry:
9th ed. G. D. Parkes and J. W. Mellor. Toronto, Longmans Green and Co., 1939. 5½ x 8¼ in. $5.00.

Engineering Mechanics:
Bevis Brunel Low. Toronto, Longmans Green and Co., 1942. 5½ x 8½ in. $5.00.

Public Works Engineers' Yearbook, 1943:
Chicago, American Public Works Association, 1943. 5½ x 8¾ in. $3.75.

The 1943 Public Works Engineers' Yearbook is an authoritative reference text on current techniques and practices in the field of public services. It includes information on a number of topics including employee relations, financial programming, public works in civilian defence, substitutes and salvage, traffic, airports, wartime operation of sewerage systems and developments in refuse collection and disposal.

Air Navigation for Beginners:
Scott G. Lamb. N.Y., Norman Henley Publishing Co., 1942. 5 x 8 in. $1.50.

A ground school primer for the aerial navigator with questions and answers in each chapter. Written in clear, simple language so that it is readily understandable. Designed as an introductory text for those who have not previously studied navigation. Valuable to the student wishing to prepare himself for service in the air.

Industrial Fire Brigades Training Manual:
Ed. by Emmett T. Cox, W. Fred Heisler and Horatio Bond. Boston, National Fire Protection Association. 8½ x 11 in. $1.50.

This volume answers three demands; 1. As a training manual for employees assigned to carry out fire fighting duties under direction of the chief of the private brigade. 2. As a reference book in those plants where a fire brigade is already organized. 3. As a guide to those plants which need the essentials but not the details of large plant fire protection organization. It is profusely illustrated with drawings and photographs.

PROCEEDINGS, TRANSACTIONS

American Institute of Steel Construction, Inc.:
Proceedings of the twenty-first annual convention held October 19-21, 1943.

North East Coast Institution of Engineers and Shipbuilders:
Transactions of the fifty-ninth session, 1942-1943, volume 59. London, The Institution, 1943.

The Smithsonian Institution:
Annual report of the board of regents for the year ended June 30, 1942.

REPORTS

British Standards Institution:
Handbook No. 1, 1943.

N.Y., Division of Commerce:
War agencies of United States and New York State, 1943 edition.

Ontario—Department of Mines:
Fifty-second annual report. Mineral occurrences in the North Hastings area, by James E. Thomson.

Edison Electric Institute:
Publication No. K7; Turbines, condensers, feedwater heaters, 1942—a report by the Turbine Subcommittee of the Prime Movers Committee, October, 1943. Publication No. K8; Pole Top resuscitation—prepared by the Accident Prevention Committee, October, 1943.

National Fire Protection Association—Boston:
Venting of tanks exposed to fire, by James J. Duggan, C. H. Gilmour and P. F. Fisher.

Harvard University—Graduate School of Engineering—Publications:

No. 372; Liner-plate tunnels on the Chicago (Ill.) subway, by Karl Terzaghi. No. 373; The numerical solution of heat-conduction problems, by H. W. Emmons. No. 375; Applications of the operational calculus to the theory of structures, by Louis A. Pipes.

Electrochemical Society—Preprints:

No. 84-18; Electrolytic tin plate from the can maker's point of view. No. 84-19; The development of the crucible steel electrolytic tin plate process. No. 84-20; Pure tungsten direct from tungsten ore. No. 84-21; The electrolysis of the nitro-paraffins. No. 84-22; Continuous plating of fine steel wire with nickel. No. 84-23; Corrosion on tin-nickel alloy coating on steel in canned foodstuffs. No. 84-24; The molecular complexity of some gases in the high frequency discharge. No. 84-25; A sulfate-chloride solution for iron electroplating and electroforming. No. 84-26; Characteristics of electric apparatus used on electro-tinning lines.

BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet all of these books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

THE A.B.C.'s OF MOTION ECONOMY

By A. R. Kosma. Institute of Motion Analysis and Human Relations, P.O. Box 116, Newark, New Jersey, 1943. 133 pp., illus., diagrs., tables, 8½ x 5½ in., cloth, $3.25.

This small book outlines in simple and direct language the elements of motion, principles of motion economy, body members and their weights, and the pertinent principles of human relations. It is profusely illustrated by photographs and descriptive cartoon sketches. The material is arranged for ready reference.

A.S.T.M. METHODS OF CHEMICAL ANALYSIS OF METALS, 1943

Recommended Practices for Apparatus and Reagents, Analytical Procedures for Ferrous and Non-Ferrous Metals, Spectrochemical Analysis Methods. American Society for Testing Materials, Philadelphia, Pa., 323 pp., diagrs., tables, 9½ x 6 in., cloth, $2.50; paper, $2.00.

This volume contains adopted and tentative standards for apparatus and reagents, for sampling and for the analysis of commercial metals and alloys. The methods are intended for use in the buying and selling of materials according to specifications.

AIRCRAFT ELECTRICAL ENGINEERING

By R. Matson. McGraw-Hill Book Co., New York and London, 1943. 372 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $3.50.

This text is intended for courses in aircraft electrical engineering which prepare the student as directly as possible for such work in the engineering departments of aircraft factories. An acquaintance with electrical theory is assumed, and the theory of design is omitted. Emphasis is on the practical problems that confront the engineer.

CELLULOSE AND CELLULOSE DERIVATIVES. (HIGH POLYMERS, Vol. 5)

Edited by E. Ott. Interscience Publishers, New York, 1943. 1176 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $15.00.

Thirty-six well-known workers have contributed to this monograph, which is intended to present "the most important modern scientific and technical information concerning cellulose and its derivatives and to have this information in such form that it becomes a thorough introduction for work on any cellulose problem by any person having reasonably wide general technical training." The book will be indispensable to all workers in the field.

CLEAR THE TRACKS! — the Story of an Old-Time Locomotive Engineer as Told to Page Cooper

By J. Bromley. McGraw-Hill Book Co. (Whittlesey House Division), 1943. 288 pp., woodcuts, 8½ x 5½ in., cloth, $2.75.

This autobiographical work is a humorous and nostalgic story of the good old days when railroading was a personalized affair. Along with the personal narrative of the author's experiences, runs a background of detail showing the growth of the railroads from the early wood-burning days to the present.

COPPER CAMP—Stories of the World's Greatest Mining Town, Butte, Montana

Compiled by Workers of the Writers' Program of the Work Projects Administration in the State of Montana, sponsored by the Montana State Department of Agriculture, Labor and Industry, Albert H. Kruse, Commissioner. Publ. by Hastings House, New York, 1943. 308 pp., illus., woodcuts, 8½ x 5½ in. cloth, $2.75.

Little is said in this book about the wealthy mine owners of Butte. On the other hand, there is a wealth of stories about the common citizens, their life and amusements, and about the queer characters who have been on the scene at various times. Strikes, parades and politics are discussed. The book is lively reading which will be appreciated by former residents.

DESCRIPTIVE GEOMETRY FOR ENGINEERS

By H. C. Bradley and E. H. Uhler. 2 ed. International Textbook Co., Scranton, Pa., 1943. 266 pp., diagrs., charts, tables, 9 x 6 in., cloth, $2.50.

MECHANICAL LOADING OF COAL UNDERGROUND

By I. A. Given. McGraw-Hill Book Co., New York and London, 1943. 397 pp., illus., diagrs., charts, maps, tables, 9½ x 6 in., cloth, $4.00.

Theory and practice are both covered in this manual. Many mining plans for all types of equipment and all seam conditions are given. The varieties of equipment are described. Face preparation, power supply and the maintenance of equipment are also discussed.

(The) MINERAL RESOURCES OF AFRICA. (African Handbooks: 2)

By A. W. Postel. University of Pennsylvania Press, The University Museum, Philadelphia, 1943. 105 pp., maps, charts, tables, 8½ x 5½ in., paper, $1.50.

The available data on the mineral resources of Africa and current production, reserves, etc., are concisely summarized in this pamphlet. In each case, the annual world production and the annual production of the chief world producer are given for comparison. The work affords a convenient survey of Africa's position in the mineral industry.

MODERN TIMBER DESIGN

By H. J. Hansen. John Wiley and Sons, New York; Chapman and Hall, London, 1943. 232 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $3.00.

The principles of timber design and timber mechanics are discussed, including formulas for use in design and design examples. Timber connectors and glued laminated construction are emphasized. There are chapters on preservatives, on plywood, and on the characteristics and properties of wood.

PRINCIPLES OF PHYSICAL METALLURGY

By F. L. Coonan. Harper & Brothers, New York and London, 1943. 238 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $3.25.

The fundamentals necessary for a general appreciation of the properties of metals and alloys are presented in this brief elementary text, intended for students who require a knowledge of the nature and characteristics of the metals and alloys of commercial importance. The first section presents the physical principles. The succeeding two sections deal, respectively, with non-ferrous alloys and alloys of iron and carbon.

RADIOGRAPHIC INSPECTION OF METALS

By O. Zmeskal. Harper & Brothers, New York and London, 1943. 150 pp., illus., diagrs., charts, tables, 7¾ x 5 in., cloth, $2.75.

This introductory manual gives a clear, practical account of methods of radiographic inspection of metals. The equipment used, the fundamentals of radiographic practice and the applications are discussed.

PRELIMINARY NOTICE

of Applications for Admission and for Transfer

December 31st, 1943.

The By-laws provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described at the February meeting.

L. Austin Wright, General Secretary.

*The professional requirements are as follows:—

A Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science or engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainment or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

ANTENBRING—GORDON ARTHUR, of 147 Burma St., Arvida, Que. Born at Winnipeg, Man., Nov. 11th, 1912; Educ.: B.Sc. (Civil), Univ. of Man., 1934. B.Sc. (Mining), Queen's Univ., 1937; 1932-35, bldg. inspr., 1935-36, underground eurveyor, Noranda Mines; 1936, asst. chief engr., Paymaster Mines; 1937-39, senior underground shift boss, Sladen Malartic Mines; 1939-42, sales engr., Nordberg Mfg. Co.; 1942 to date, No. 3 ore plant supervisor, Aluminum Company of Canada, Arvida, Que.

References: C. A. Anterbring, G. B. Moxon, D. D. Reeve, A. T. Cairncross, C. Miller, G. H. Herriot.

BRIERE—ROGER, of 332 Mousseau St., Montreal, Que. Born at Trois-Rivières, Que., July 8th, 1916; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1942; Summers—1940, surveying, Dept. of Roads, Quebec. 1941, inspection on constrn. of airport runways, Milton Hersey Co.; May 1942 to date, junior engr., Dept. of Transport, Montreal, Que.

References: J. A. Lalonde, A. Circé, H. Gaudefroy, M. F. Macnaughton, L. Trudel.

BROCHU—BLAISE, of Montreal, Que. Born at East Broughton, Que., July 17th, 1914; Educ.: B.A.Sc., Laval Univ., Quebec, 1941; R.P.E. of Que.; 1938-41, summer work at Candn. Malartic Gold Mines, Asbestos Corpn., Thetford Mines, Noranda Mines, and Quebec Dept. of Mines; 1941-42, surveying, instr'man., Noranda Mines Ltd.; 1942-43, asst. engr., highway engrg., in British Columbia for Dept. of Mines & Resources, Ottawa; 1943 (July-Nov.), supervisor on airport constrn. in Nova Scotia for Milton Hersey Co. Ltd.; at present, sales engr., LaSalle Builders Supply, Montreal, Que.

References: A. Pouliot, G. W. Waddington, P. E. Gagnon, T. S. Mills, S. A. Picard, M. F. Macnaughton.

COVERDALE—HAROLD MILTON, of Halifax, N.S. Born at Boston, Mass., Dec. 9th, 1919; Educ.: B.A.Sc., Univ. of B.C., 1943; 1939-42 (summers), machine and foundry—research, Cons. Mining & Smelting Co. of Canada Ltd., Trail, B.C.; at present, Sub-Lieut. (E), R.C.N.V.R., on mech'l. design, Exp. Section, National Research Council, Halifax, N.S. (Naval Service—Engineering).

References: H. J. MacLeod, J. N. Finlayson, A. Jackson, L. M. Arkley, L. A. Campbell.

FAIRFIELD—HERBERT H., of 15 Pansy St., Ottawa, Ont. Born at St. Catharines, Ont., April 20th, 1915; Educ.: 1933-37, industrial engrg., General Motors Institute. Metallurgical engrg., Statistical Methods of Quality Control; with McKinnon Industries, St. Catharines, Ont. as follows: 1933, tool die making, 1934, elect'l. mtce., 1935-37, foundry ap'tice., 1937-40, asst. metallurgist, setting up chemical testing, metallographical, and sand testing laboratories, training and supervising technicians, development work, etc.; 1940 to date, research engr., Bureau of Mines, Ottawa, Ont.

References: R. E. Gilmore, A. A. Swinnerton, C. E. Baltzer, W. R. McClelland, E. S. Martindale.

FLEMING—DONALD CORBETT, of 1228-15th Ave. West, Calgary, Alta. Born at Medicine Hat, Alta., Sept. 4th, 1907; Educ.: B.Sc. (E.E.), Univ. of Alta., 1933; 1932 (summer), surveying, City of Calgary; 1933-35, head of radio dept., Taylor, Pearson & Carson Ltd., Calgary; 1935 to date, instructor in (a) radio theory and shop practice, (b) mathematics, (c) physics, (d) commercial wireless operating, Institute of Technology and Art, Calgary, Alta.

References: A. Higgins, F. N. Rhodes, W. J. Gold, J. B. deHart, A. Geddes, H. J. McEwen.

FONTAINE—ROLAND, of Ormstown, Que. Born at Montreal, Nov. 12th, 1913; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1937; 1937-39, res. engr., 1939-42, asst. engr., and at present asst. divnl. engr., Dept. of Roads, Prov. of Quebec, Ormstown, Que.

References: E. Gohier, A. Gratton, J. A. Lalonde, L. Trudel, J. O. Martineau.

GORMAN—JOHN ALVIN, of Minto, N.B. Born at Chatham, N.B. Educ.: B.Sc., Univ. of N.B., 1933; 1934-36, constrn. foreman, Havelock Airport; 1936-37, concrete inspr., Musquash Power Co.; 1937-40, rural electrification, field work, 1940-42, switchboard operator, 1942, dftsman., and at present, dftsman and res. engr., Grand Lake power station, New Brunswick Electric Power Commission.

References: J. Stephens, W. D. MacDonald, G. A. Vandervoort, J. N. Flood, A. F. Baird.

HENDERSON—JOHN DALGETY, of 376 Redfern Ave., Westmount, Que. Born at Montrose, Scotland, April 6th, 1882; Educ.: 1904-06, Manchester School of Technology—works and textile engrg. (No degrees given—Honours Medallist 1903 and 1904. King's Prize 1906). Cert. Member of Cert. Public Accountants & General Accountants. 1917-39, industrial engrg. and accountancy. Supervised constrn. and installed machy.—1906-07, Smart Bag Co., Montreal, 1913-14, Empire Cotton Mills, Welland. 1924-25, installed additional machines and managed Canadian Manhasset Cotton Co., St. Hyacinthe, Que.; up to Nov. 1943, comptroller, Clark Ruse Aircraft Ltd., Dartmouth, N.S.

References: A. Surveyer, J. G. Chênevert, E. Nenniger, C. M. McKergow, J. T. R. Steeves.

KRASSOV—CHARLES, of 177 McKay Ave., Windsor, Ont. Born at Krukov, Russia, Feb. 15th, 1903: Educ.: B.Sc. (Civil), B.Sc. (Chem. Engrg)., Tri-State College, Angola, Ind., 1929; 1929-30, struct'l. steel design and detailing, Dominion Bridge Co. Ltd., Winnipeg; 1931-32, chief chem. engr. i/c of testing, control, and research, Radio Oil Refineries Ltd., Winnipeg; 1933-37, consultant to a number of food mfg. firms in western Canada—design and installn. of food processing machy. and research on food production; 1937-41, chief chemist i/c production, National Drug Ltd., London, Ont.; 1930-42, registered and practiced as U.S. and Candn. Patent Attorney; 1942 to date, design and detailing of foundry equipment, patent research on foundry machy. and processes of centrifugal casting, Ford Motor Co. of Canada Ltd., Windsor, Ont.

References: E. Chorolsky, J. B. Candlish, W. D. Donnelly, H. Little, G. W. Lusby.

LAMOUREUX—GEORGES, of 1254 Bishop St., Montreal, Que. Born at Montreal, May 1904; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1929; R.P.E. of Que.; 1929-30, trussed concrete work, for E. Cormier; 1930-33, technical service, City of Montreal; 1933-36, drainage office, Dept. of Agriculture; 1936 to date, junior engr., Dept. of Public Works of Canada, Montreal, Que.

References: K. M. Cameron, A. Circé, J. E. Bonaventure, L. Trudel, H. Gaudefroy.

LATREILLE—RAYMOND, of Quebec, Que. Born at Montreal, January 12th, 1898; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1922; 1923: engr. i/c constrn., for Arthur Surveyer & Co., Montreal; 1923-24, engr. with Beaubien, Busfield & Co., Montreal; 1924 to date, with the Hydraulic Service, Dept. of Lands and Forests, Prov. of Quebec, senior engr., assistant chief engr., and from 1940, chief engineer. 1940 to date, chief engr.,hydraulic service, Dept. of Lands and Forests, Prov. of Quebec, Quebec, Que.

References: A. B. Normandin, R. Dupuis, A. E. Paré, H. Cimon, P. Vincent, Y. deGuise.

LONGPRE—ARPHILE, of 9 Raymond-Casgrain, Quebec, Que. Born at Montreal, April 7th, 1903; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1927. R.P.E. of Que.; 1927, surveying, Dept. of Public Works of Canada; 1928, asst. engr., bridge design and constrn., Dept. of Public Works of Quebec; 1928-30, engr., bldg. design and constrn., Laurentide Constrn. Co. Ltd.; 1930-31, asst. engr., City of Montreal Waterworks; 1931-32, engr., bldg. and constrn., Héroux et Robert; 1932-38, engr., bldg. constrn., J. L. Guay & Frère; 1938, asst. divn. engr., Dept. of Roads, Prov. of Quebec; 1938 to date, asst. engr., City of Quebec.

References: L. Gagnon, S. A. Picard, J. L. Bizier, P. Vincent, G. St. Jacques.

LYNCH—JAMES ALLAN, of 567 Broadview Ave., Ottawa, Ont. Born at Winnipeg, Man., July 15th, 1909; Educ.: B.Sc. (E.E.), Univ. of Man., 1933; 1930-31-32 (summers), survey work in Sask., meter repair and installn., light and power dept., City of Regina; 1935-40, process control engr., Imperial Oil Limited, Regina Refinery; 1940 to date, Engineer Officer, Divn. of Aeronautical Engrg., R.C.A.F. Headquarters, Ottawa, Ont.

References: E. P. Fetherstonhaugh, N. M. Hall, W. O. Longworthy, T. A. Lindsay, A. Ferrier, I. J. Gould.

MILLMAN—ROBERT NOVERRE, of 265 Laurier Ave., Ottawa, Ont. Born at Toyohashi, Japan, May 8th, 1918; Educ.: B.Sc. (M.E.), Univ. of Sask., 1940; 1939, gen. carpentering and woodworking; 1940 (May-Nov.), asst. in mach. shop and engrg. office, Dunlop Tire & Rubber Co. Ltd., Toronto; 1940-43, design and dftng., field layout work, Gore & Storrie, consltg. engrs., Toronto; June 1943 to date, Sub.-Lieut. (Special Br.), R.C.N.V.R., Works & Bldg. Dept., Naval Service, Ottawa, Ont.

References: N. B. Hutcheon, I. M. Fraser, J. G. Powell, N. G. McDonald, C. F. Morrison, R. H. Self.

MORGAN—JOHN WILLIS, of 212 St. George St., Toronto, Ont. Born at Lethbridge, Alta., April 1st, 1917; Educ.: B.Sc. (Chem. Engrg,). Univ. of Alta., 1939; 1937-38 (summers), geophysical and mine surveying, cyanidation plant operator; with the British American Oil Co. Ltd., as follows: 1939-41, asst. chemist, Calgary refinery, 1941-42, asst. chemist, Toronto refinery, 1942-43, design of lab. and equipment and electl. installn. for new refinery at Clarkson, Ont., 1943, operation and production engrg. for new alkylation plant at Calgary, and at present, production engr. for alkylation plants of the company.

References: E. R. Graydon, T. Dembie, I. S. Widdifield, R. S. Wilson, F. Noakes.

MORISSETTE—EMILE, of 4037 Melrose Ave., Montreal, Que. Born at Ste. Marie de Beauce, Que., Feb. 28th, 1907; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1931. R.P.E. of Que.; 1931-40, Montreal Water Board, City of Montreal; 1940-41, engr., and 1941 to date, engr. i/c east section, Roads Dept., City of Montreal, and associate professor on roads, Ecole Polytechnique, Montreal, Que.

References: C. J. Desbaillets, F. Y. Dorrance, H. A. Gibeau, C. J. LeBlanc, A. Circé.

PATTERSON—SAMUEL MORSE, of 218-21st St., Arvida, Que. Born at Toronto, Ont., May 2nd, 1918; Educ.: B.Sc., Univ. of Toronto, 1941; with Aluminum Company of Canada as follows: 1941-42, asst. supervisor, Bayer ore plant (hydrate dept.), 1942-43, supervisor of hydrate dept., Jan. 1943 to date, supervisor of process control, Bayer ore plant No. 2.

References: A. C. Johnston, P. E. Radley, A. T. Cairncross, D. D. Reeve, B. E. Bauman, G. B. Moxon, M. J. Waite.

ROYER—MAURICE, of 239 Laurier Ave., Quebec, Que. Born at New York, N.Y., March 2nd, 1902; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1925. S.B. in C.E., Mass. Inst. Tech., 1926; R.P.E. of Que.; 1918-24 (summers), precise levelling, Public Works Dept., topography, Quebec Streams Commn., constrn., Shawinigan Engrg. Co.; 1925-28, field work and design of waterworks, filtration plants, hydro-electric plants, etc., for Z. Langlais, C.E., consltg. engr; 1928-29, partner, Langlais, Ricard & Royer, consltg. engrs.; 1929-39, partner, Ricard & Royer, consltg. engrs.; 1939 to date, consltg. engr., and professor of strength of materials, applied maths., spherical trigonometry and astronomy, Faculty of Science, Laval University, Quebec, Que.

References: A. R. Décary, A. B. Normandin, A. Frigon, A. Pouliot, R. Dupuis, A. Larivière, G. E. Sarault, P. Vincent.

SCOTT—H. MELVILLE, of 32 Victor Ave., Mimico, Ont. Born at Port Elgin, Ont., March 12th, 1917; Educ.: B.A.Sc., Univ. of Toronto, 1939; 1939-41, engr. i/c of mtce. and installn. Ayerst McKenna & Harrison Ltd., Montreal; at present, technologist, Campbell Soup Co. Ltd., New Toronto, Ont.

References: H. Irwin, E. R. Graydon, T. Dembie, W. Fotheringham, I. S. Widdifield.

SPROULE—STANLEY M., of Montreal, Que. Born at Montreal, Jan. 15th, 1889; Educ.: B.Sc. (Engrg.), 1910. B.Arch., 1912, McGill Univ., 1910, topog'l., dfting and instrument work, C.P.R. irrig. dept.; 1912-14 and 1919-25, structl. and archtl. design and field supervn., Brown & Vallance, Montreal; 1914-19, with Candn. Engrs., i/c bridge work, etc.,; 1925-27, structl. and archtl. design., Andrew J. Thomas, New York City; 1927-29, structl. design and field supervn., Lafayette A. Goldstone, New York City; 1929-31, strctl. design and field supervn., Chas. A. Platt, New York City; 1936, strctl. design and plant survey, General Foods Ltd., Montreal; 1936-38, strctl. and archtl. design, Canadian Industries Ltd., Montreal; 1938-39, i/c plant design, International Foils Ltd., Montreal; 1939 to date, i/c archtl. design and co-ordination of industrial process layouts, incl. mech. and elec. services, Robert A. Rankin & Co., Montreal, Que.

References: G. M. Pitts, F. Peden, A. B. McEwen, E. A. Ryan, C. E. Herd.

VINCE—EDWARD RABAN, of Woodstock, N.B. Born at Woodstock, April 14th, 1887; 1904-08, 3 years civil engr., Univ. of N.B.; 1905-07, surveying and constrn., C.P.R.; 1909-10, mine surveying, Cape Breton; 1910-14, in business; 1914-19, overseas, Major, Candn. Engrs.; Military Service as follows: 1919-20, Works Officer, Toronto; 1920-21, D.E.O., Halifax; 1922-26, D.E.O., Saint John; 1926-30, chief instructor, Royal Candn. School of Engrg., Halifax; 1930-33, D.E.O., London; 1933, D.E.O., Toronto; 1933-35, D.E.O., London; 1935-41, D.E.O., Halifax; 1935-39, Commandant, R. C. School of Military Engrg., Halifax; 1941-42, Commanding, 5th Candn. (Armoured) Divn., R.C.E.; 1942-43, D.E.O., Halifax; at present, town engr. and manager, Woodstock, N.B. (Colonel, R.C.E. (P.F.) Retired).

References: J. B. Stirling, H. S. Dunn, H. W. L. Doane, F. C. Wightman, H. L. Trotter, W. H. Noonan.

WATSON—NORMAN STEWART BAIN, of 307 Green St., St. Lambert, Que. Born at Charlottetown, P.E.I., April 15th, 1898; Educ.: B.Sc. (Elec.), N.S. Tech. Coll., 1922; 1916-18, instructor, evening technical schools, Halifax; 1918-19, engine room artificer, R.C.N.V.R.; 1919-20, instructor in motor mechs. and elem. electricity, D.S.C.R., Halifax and Charlottetown; 1922-26, partner in elec. contracting business at Charlottetown; 1926-27, elec. dftsman., C.N.R., Moncton; 1927-28, inspecting engr., C.N.R., Halifax; 1928, elec. engr., Town of Truro, N.S.; 1928-29, inspecting engr. and maintainer unit cars, C.N.R., Moncton; 1929-38, elec. engr., chief architect's dept., C.N.R., Montreal; 1938 to date, elec. engr., chief architect' dept., C.N.R. and Trans-Canada Air Lines, Montreal, Que.

References: C. B. Brown, H. L. Currie, R. G. Gage, H. F. Finnemore, A. G. Moore, R. O. Stewart.

WOODS—GEORGE MAITLAND, of 681 Godin Ave., Verdun, Que. Born at Lang, Sask., June 1st, 1913; Educ.: B.Sc. (Mech.), Univ. of Sask., 1941; 1931-33, electrician's asst., Woods Electric, Rosetown, Sask.; 1933-37, boilerman & stillman, Hi-way Oil Refinery, Rosetown; 1937-38, survey rodman, 1938-39, instr'man., 1939-40, acting dist. engr., N.W. of Sask., Water Rights Br., Dept. of Natural Resources; 1940, constrn. engr. on airports, Dept. of Transport, Regina; 1941-42, foreman and senior foreman, Verdun Works, 1942-43, supervisor, bldg. services, Westmount tool works, and May 1943 to date, equipment and supplies engr., Westmount tool works, Defence Industries Ltd., Westmount, Que.

References: C. J. McGavin, I. M. Fraser, F. H. Barnes, H. C. Karn, H. R. Carscallen.

ZIRUL—MELVIN LEE, of 1009 West 10th Ave., Vancouver, B.C. Born at North Vancouver, Jan. 4th, 1915; Educ.: B.A.Sc. (Civil), Univ. of B.C., 1941; 1941 to date, field and office engr., Dominion Water & Power Bureau, Dept. of Mines & Resources, Vancouver, B.C.

References: C. E. Webb, J. N. Finlayson, A. Peebles, H. N. Macpherson, W. H. Powell.

FOR TRANSFER FROM JUNIOR

CLARKSON—ARTHUR GRANT, of Edmonton, Alta. Born at Dixie, Ont., Nov. 7th, 1915. Educ.: B.A.Sc., Univ. of Toronto, 1938. 1938-40, engr. dftsmn.; 1940-41, examiner and chief examiner, Douglas Aircraft Co., Santa Monica, Calif.; 1941-43, res. B.A.C. inspr. and acting regional technical office (i/c inspn. and engrg. for British Air Commission, at Douglas Aircraft plant at Long Beach, Calif.); at present aeronautical engr., i/c Canadian Pacific Airlines' Engrg. Dept. for Canada, Edmonton, Alta. (Jr. 1938).

References: J. L. Lang, A. E. Pickering, C. Stenbol, F. Smallwood, C. R. Young.

MARTIN—GERALD N., of Woodlands, Que. Born at Lachine, Que., April 1st, 1913; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1934; 1935-43, designer, Dominion Bridge Co. Ltd.; 1938-40, on loan to International Combustion Ltd.; London and Derby, England, and to Central Electricity Board, London, Eng.; 1941-43, on loan as designer to Aluminum Co. of Canada, Montreal; at present combustion sales engr., Dominion Bridge Co., Lachine. (Jr. 1937).

References: F. Newell, R. S. Eadie, M. E. Hornback, A. Circé, J. A. Lalonde.

WOERMKE—ORVILLE REUBEN, of Buckingham, Que. Born at Arnprior, Ont., Oct. 25, 1916; Educ.: B.Sc. (Chem.) 1939; R.P.E., Quebec. 1934 (winter) road bldg. at Dacre, Ont., with Dept. of Northern Development; 1934-35, Gillies Bros. Lumber Mills, Braeside, Ont.; 1937 (summer) International Nickel Co., Creighton Mine, Ont.; 1939 (five months) soap maker at United Chemical Co., Montreal; 1940 (Jan.-May) instr. in draughting, and instr. in Metallurgical Assay Lab., Queen's Univ., Kingston; 1940 to date, with Electric Reduction Co. of Canada, Ltd., Buckingham, Que., engaged as dftsmn. in May 1940, became chief dftsmn. in Nov. 1940, and is now plant designing engr. i/c all drawing, steel and concrete design, pumping and ventilating design, surveying and layout work. (Jr. 1943).

References: R. M. Prendergast, H. Burri, A. N. Ball, D. Anderson, S. E. Farley.

FOR TRANSFER FROM STUDENT

BINKS—WYMAN RODGER, of Vancouver, B.C. Born at Ottawa, Ont., June 26th, 1915; Educ.: B.Sc. (Civil), Queen's Univ., 1940; 1939 (summer), surveying, 1940 (summer), Fraser Brace Constrn. Co.; 1940-41, Spruce Falls Power & Paper Co.; May 1941 to date, Armament Branch, R.C.A.F., with rank of Flight Lieutenant. (St. 1940).

References: J. K. Wyman, C. W. Boast, W. H. Munro, A. Jackson, R. A. Low.

BROSSEAU—JOSEPH ERNEST GERARD, of 8439 Drolet, Montreal, Que. Born at Montreal, Dec. 15th, 1913; Educ.: 1936-38 (evenings) Montreal Tech. Sch.; private study and correspondence courses: 1938-40, dftng., bill of material scheduling, and i/c Salonge Dept., tools inspn. and approval of test pieces, Canadian Car & Foundry, aircraft division; 1940-42, supervising inspr. (A.I.D.) aircraft, Dept. of National Defence; 1942, engrg. superviser, Sorel Industries, Ltd., Sorel; 1942 to date, checker on tool design, and superviser machine loading and Time Study Dept., Canadian Power Boat Co., Montreal. (St. 1940).

References: J. A. Lalonde, D. Boyd, J. M. Laforest, L. Trudel.

COLBY—ALAN RUTHERFORD, of 3240 West 37th Ave., Vancouver, B.C. Born at Ottawa, Ont., Nov. 20th, 1914. Educ.: B.Sc. (Civil), Univ. of N.B., 1939; summers, 1937, chainman, Fraser Lumber Co., 1938 rodman, City of Fredericton, Engrg. Dept.; 1939 (May-Dec.) levelman, N.B. Highway Dept.; 1940-41, dftsman, 1941-42, instr'mn., 1942-43, instr'mn. i/c of constrn., Dept. of Transport; 1943 (Apr. to Sept.) asst. res. engr., U.S.P.R.A., Alaska Highway; Sept. 1943 to date, water and power engr., Dept. of Mines & Resources, Vancouver, B.C. (St. 1939).

References: F. B. Whiteley, C. E. Webb, F. T. Brown, E. O. Turner, H. C. Moore.

DODD—GEOFFREY JOHNSTON, Jr., of 5959 Kenmore Ave., Chicago, 40, Ill. Born at London, England, May 9, 1918; Educ.: B.Eng. (Mech.), McGill Univ., 1940; summers, 1936-37, tech. asst., model turbine testing plant, Shawinigan Engrg. Co., Shawinigan Falls, 1938-39, jr. field engr., St. Maurice Power Corp., LaTuque, Que., dftng. and surveying; 1940-41, foreman, shot-shell dept., Canadian Industries Ltd., Brownsburg, Que.; 1941 to date, asst. inspr.' of Naval Ordnance, British Admiralty Technical Mission, at present i/c of Western Area Office, Chicago. (St. 1939).

References: E. Brown, C. M. McKergow, F. M. Wood, R. E. Heartz, E. L. Johnson.

Employment Service Bureau

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.

NOTICE

Technical personnel should not reply to any of the advertisements for situations vacant unless—

1. **They are registered with the Wartime Bureau of Technical Personnel.**
2. **Their services are available.**

A person's services are considered available only if he is—

(a) unemployed;
(b) engaged in work other than of an engineering or scientific nature;
(c) has given notice as of a definite date; or
(d) has permission from his present employer to negotiate for work elsewhere while still in the service of that employer.

Applicants will help to expedite negotiations by stating in their application whether or not they have complied with the above regulations.

SITUATIONS VACANT

MECHANICAL ENGINEER, graduate of about one year's standing required by stable industry essential to war work, for draughting, design and study work on mechanical and other maintenance problems. Location southwestern Ontario. Apply to Box No. 2682-V.

MECHANICAL ENGINEER for a large pulp and paper company in the province of Quebec. Mill located near Ottawa. Applicant should have good knowledge of paper mill design and layout. Do not apply if a technical person within the meaning of P.C. 246, Part III (Jan. 19-43) unless your services are available under the regulations administered by the Wartime Bureau of Technical Personnel. Reply stating age, experience, and salary expected to Box No. 2687-V.

EXPERIENCED MECHANICAL DRAUGHTSMAN for design of jigs, fixtures and light manufacturing machinery. Location—Eastern Ontario. Good opportunity. Apply to Box No. 2690-V.

YOUNG MECHANICAL ENGINEER, able draughtsman, required by 76-year old firm in Quebec district, operating cast iron foundry and metal working departments. Firm "designated" by Selective Service but this position not dependent on war work. Good opportunity for advancement to right party. Applicant must be bilingual. State experience and salary expected in writing to Box No. 2695-V.

WANTED—We have an opening in our filtration department for a mechanical, metallurgical or chemical engineer or a man with equivalent technical training or qualifications. This job requires the services of a man to handle test work, sales and servicing of Oliver paper mill filters, deckers, bleach washers, savealls, etc. Knowledge of and experience in the pulp and paper industry along with an engineering background enabling applicants to solve filtration problems is required. This is a permanent position. Do not apply unless your services are available under regulations P.C. 246 Part III (Jan. 19-43) administered by the Wartime Bureau of Technical Personnel. Apply to E. LONG LIMITED, Orillia, Canada.

SITUATIONS WANTED

GRADUATE CIVIL ENGINEER, age 55, over thirty years' experience as engineer and construction executive in charge railway, highway, bridge and foundations and general heavy construction projects. Capable of taking charge organization and management. Wishes to make permanent connection with view to immediate and post-war developments. Apply to Box No. 279-W.

CIVIL ENGINEER, age 39, experience in charge of light and heavy construction, all types surveying, airfield work, machinery installation, light steelwork. Apply to Box 741-W.

GRADUATE CIVIL ENGINEER, age 44, married, bilingual, over twenty years' experience; eight years as laboratory technician in pulp and paper and twelve years as inspecting engineer on various construction jobs including two years in charge of concrete laboratory on large hydroelectric project recently completed. Presently unemployed, desires permanent position. Apply to Box No. 1485-W.

GRADUATE ELECTRICAL ENGINEER, B.Sc.E.E., 1933, University of Manitoba. Experience in design, layout, installation, supervision of industrial electrical power, distribution systems; high tension overhead and underground transmission systems; outdoor and indoor substations. Design and layout of commercial and industrial lighting systems, covering incandescent, fluorescent and cold cathode installations. Available on short notice. Apply to Box 2099-W.

PLANNING ENGINEER—Available March 1st. Graduated in civil engineering, McGill '37. Age 30 years. Married. Home in Montreal. Five years shop experience in structural, boiler and mechanical supervision and inspection. 1½ years experience as supervisor of scheduling and planning of tool and gauge shop in small arms ammunition production tool works (Montreal). Resigning due to curtailment, which limits necessity of further planning. Intent on continuing in specializing in planning in any sphere of industry, any municipality or any country. Will also consider production control as introductory work where prospect of future planning is offered. Will also consider work related to industrial conversion to peacetime occupation, as planning. Salary and location considered secondary to type of work offered. Apply to Box No. 2441-W.

GRADUATE B.Sc., Jr.E.I.C., age 27, executive and administrative ability, keenly interested in fields of industrial engineering and chemistry. Engineering office and laboratory experience, all around technical training. Bilingual. Presently employed, but war conditions necessitate change. Apply to Box No. 2445-W.

CIVIL ENGINEER, 45 years old, married, experienced in all types of industrial and heavy construction, railways bridges, water supply, etc., desired permanent position. Available December first. Apply to Box No. 2458-W.

CIVIL ENGINEER, M.E.I.C., age 28, married. Experienced in highway and airdrome construction, sewer and waterwork, construction of buildings, steam and hot air heating. Desires position with consulting engineer, municipal engineer or general contractor in prairie provinces or western Ontario. Available January 1st, 1944. Apply to Box No. 2459-W.

FOR SALE OR RENT

TRANSITS, levels and accessories. Apply to Ralph Kendall, C.E., P.L.S. 13 Queen's Building, Halifax, N.S.

Mechanical and Electrical Engineer Wanted

For the position of assistant superintendent of the Department of Buildings and Grounds, with the ultimate view of assuming the office of superintendent, for a large educational institution in the province of Quebec. Preferred age, 30 to 35 years. The duties involve, among other things, the inspection of buildings and attached services so that an annual budget can be prepared for the operation and maintenance of two light, heat and power plants and some fifty buildings and their adjacent campuses; the consultation with deans of faculties, wardens of dormitories and heads of departments for the provision of such information as they may require. Applicants must give age, nationality, education, training experience and references, indicate availability, include recent photo, and mail before February 28th, 1944, to Box No. 2688-V.

Mechanical Engineer Wanted

Large pulp and paper mill requires services of graduate civil or mechanical engineer with three or more years' experience in mechanical engineering. When applying state age, education, experience, salary, marital status and when available. Do not apply unless your services are available under regulation P.C. 246, Part III, administered by Wartime Bureau of Technical Personnel. Apply to Box No. 2706-V.

MARTEL—PIERRE, of 67 Prince-Albert, Overbrooke, Ottawa. Born at Shawinigan Falls, Que., Aug. 13th, 1917. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1941; summers, 1937-40, surveying and asst. operator, Shawinigan Water & Power Co., 1941, machine design, Canada Iron Foundries, 1941, inspr., Federal Aircraft Co.; Jan. 1942 to date, Lieut., R.C.A., N.D.H.Q., Ottawa. (St. 1937).

References: J. G. Spotton, J. H. Fregeau, L. Trudel, A. Circé, H. Gaudefroy.

URUSKI—FRANK WILLIAM, of Guayaquil, Ecuador, S.A. Born at Yorkton, Sask., Nov. 20th, 1915; Educ.: B.E. (Civil), Univ. of Sask., 1941; summers, 1939, instr., Univ. of Sask. Summer survey camp, 1936-39, rodman, instr'mn. Dept. of Highways, Sask., 1940, inspr., airport constrn., Dept. of Transport; 1939-40, lab. asst. in surveying and dftng., Univ. of Sask.; 1941, instr'mn., Dept. of Highways, Sask.; at present, seismograph engr., International Petroleum Co., Guayaquil, Ecuador, S.A. (St. 1940).

References: W. E. Crossley, R. Thistlethwaite, C. J. Mackenzie, R. A. Spencer, E. K. Phillips.

Industrial News

Industrial development — new products — changes in personnel — special events — trade literature

ELECTED A DIRECTOR

P. B. Wickware was elected a director of The Imperial Varnish & Color Co. Ltd., Toronto, at the recent annual meeting of the shareholders. Mr. Wickware was appointed sales manager in 1934, a title which he still retains. It is his twenty-fifth year with the company.

PLUMBING & HEATING POINTERS

Crane Ltd., Montreal, Que., have for distribution a French edition of "Plumbing and Heating Pointers." A complete duplication of the English edition, it contains 24 supplementary pages of text describing ways and means of keeping domestic plumbing and heating installations in first-class operating condition.

EXCAVATING SHOVEL

Dominion Hoist & Shovel Co. Ltd., Lachine, Que., have prepared a 4-page bulletin, which gives a full description and complete specifications of the company's combination shovel-crane-dragline, known as "Dominion 358." Dimensional drawings and corresponding tables provide all necessary information required for safe and efficient operation for all three purposes for which this shovel is adapted to be used.

PLASTICS

Peckovers Ltd., Toronto, Ont., have issued a folder discussing the characteristics and uses of a number of plastic products including pipes, tubes, rods, strips, sheets, plates, cords, mouldings, fabrics and mesh. Included is a table which compares the properties of a number of basic plastics in terms of their chemical and physical properties.

INDUSTRIAL INSTRUMENTATION

The Foxboro Co., represented by Peacock Bros. Ltd., Montreal, Que., have for distribution catalogue 95A, 48 pages. This catalogue is a classification of the company's products on a functional basis under ten main headings such as temperature, flow, pressure, liquid level, humidity, etc. The catalogue is so arranged that by a study of the functional requirements of a job the reader is led through a cross-reference directly to the type of instrument required to meet each situation.

Frank C. O'Brien

J. M. S. Carroll

DECEASED

Business executives and technical men in the rubber industry throughout Canada mourn the death of J. M. S. Carroll, who was manager of mechanical sales department, Dominion Rubber Co. Ltd., Montreal, Que.

Mr. Carroll joined Dominion Rubber in 1903 as secretary to the general manager and 1905 was appointed sales manager of the company's eastern division. In 1905 he became division manager, and some years later was named mechanical goods sales manager at head office in Montreal.

Prior to entering the rubber industry, Mr. Carroll was connected with important mining enterprises in Australia and later with the construction department of the Canadian Pacific Railway at Winnipeg, Man.

"STELCO" AT WAR

The Steel Co. of Canada Ltd., Montreal, Que., have issued a 4-page folder and letter showing that practically every phase of war activity and war equipment have made demands on this company's products. This is also shown in a tabulation of the features of the company's war achievements as given in terms of a list of the company's products and the service equipment to which they are applied. The letter gives facts and figures covering production increases and plant expansion necessitated by the demands of war.

RECENT APPOINTMENTS

Burlington Steel Co. Ltd., through its president, H. J. Stambaugh, has announced the promotion of Frank C. O'Brien to general manager, and of Norman A. Eager to sales manager of the company.

Mr. O'Brien joined the company in 1919, was appointed sales manager in 1937, and has served on the board of directors since 1939.

Mr. Eager, formerly design engineer for Shawinigan Engineering Company, has served as assistant sales manager since joining the company in 1940.

Since assuming the presidency of the company in 1939, Mr. Stambaugh has occupied the dual position of president and general manager.

CARBON BRUSHES

Canadian National Carbon Co. Ltd., Toronto, Ont., have issued three bulletins under the caption "Modern Pyramids", containing information on practical subjects relating to brushes and commutation including new developments in carbon and metal graphite brushes, performance characteristics and suggestions on brush application and operation. Bulletin No. 1 describes a test that measures the commutating performance of a brush; No. 2 is a reprint, "The Measurement of the Frictional Characteristics of Brushes"; No. 3 is a technical discussion of "Brush Angle."

NEW ASSOCIATION

On December 3, 1943, there was organized the Canadian Fan Manufacturers' Association by Canadian Blower & Forge Co. Ltd.; Canadian Sirocco Co. Ltd.; Sheldons Ltd., and B. F. Sturtevant Co. of Canada Ltd.

For the past ten years these manufacturers, acting through a joint engineering committee, have promoted and developed the science and art of fan engineering. There has been distributed to the public without cost bulletin X-14 entitled "Standard Methods Adopted for Centrifugal Fans and Blowers." This bulletin contains valuable information, such as comparison charts for various types of fans, operating limits for classes of fans, standards for air and flues gas densities, standards for arrangement of drives and rotation and discharge, as well as information on abrasion and field tests of fans.

For identification to the buying public that air deliveries of fans and blowers have been obtained in accordance with the "Standard Test Code for Centrifugal and Axial Fans," there has been designated a "certified rating sticker" which is attached to or printed in the catalogues published by the companies mentioned above.

Mail for the Association may be addressed to P.O. Box 275, Windsor, Ont.

Norman A. Eager

THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 27 MONTREAL, FEBRUARY 1944 NUMBER 2

"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

★ ★ ★

PUBLISHED MONTHLY BY
THE ENGINEERING INSTITUTE
OF CANADA
2050 MANSFIELD STREET - MONTREAL

Price 50 cents a copy, $3.00 a year: in Canada, British Possessions, United States and Mexico. $4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, $2.00 a year. —Entered at the Post Office, Montreal, as Second Class Matter.

CONTENTS

Banks of transformers with disconnectors overhead at the Arvida plant of the Aluminum Company . . . . . . Cover
(Photo National Film Board)

PLASTICS IN ENGINEERING 72
Wilfred Gallay

STRETCHING OUR RESOURCES 78
C. B. Stenning

Discussion 82

JOB EVALUATION 85
D. W. Weed

REPORT OF COUNCIL FOR THE YEAR 1943 86

FROM MONTH TO MONTH 104

NEWLY ELECTED OFFICERS 112

PERSONALS 117

Obituaries 119

NEWS OF THE BRANCHES 123

LIBRARY NOTES 126

PRELIMINARY NOTICE 129

EMPLOYMENT SERVICE 131

INDUSTRIAL NEWS 132

THE ENGINEERING INSTITUTE OF CANADA

MEMBERS OF COUNCIL - 1943

PRESIDENT
K. M. CAMERON, Ottawa, Ont.

VICE-PRESIDENTS
†W. P. BRERETON, Winnipeg, Man.
*H. CIMON, Quebec, Que.
†L. F. GRANT, Kingston, Ont.
*J. L. LANG, Sault Ste. Marie, Ont.
†C. K. McLEOD, Montreal, Que
*G. G. MURDOCH, Saint John, N.B.

PAST-PRESIDENTS
*T. H. HOGG, Toronto, Ont.
†C. J. MACKENZIE, Ottawa, Ont.
‡C. R. YOUNG, Toronto, Ont.

COUNCILLORS
†J. E. ARMSTRONG, Montreal, Que.
†H. E. BRANDON, Toronto, Ont.
*S. G. COULTIS, Calgary, Alta.
*G. L. DICKSON, Moncton, N.B.
‡E. V. GAGE, Montreal, Que.
*F. W. GRAY, Sydney, N.S.
*E. D. GRAY-DONALD, Quebec, Que
*J. HAIMES, Lethbridge, Alta.
†R. E. HEARTZ, Montreal, Que.
*W. G. HUNT, Montreal, Que.
*E. W. IZARD, Victoria, B.C.
†A. JACKSON, Kingston, Ont.
*J. R. KAYE, Halifax, N.S.
‡J. A. LALONDE, Sorel, Que.
†A. M. MACGILLIVRAY, Saskatoon, Sask.
*N. MacNICOL, Toronto, Ont.
†N. B. MacROSTIE, Ottawa, Ont.
*T. A. McELHANNEY, Ottawa, Ont.
*A. W. F. McQUEEN, Niagara Falls, Ont
†G. E. MEDLAR, Windsor, Ont.
†J. P. MOONEY, Saint John, N.B.
†E. NELSON, Edmonton, Alta.
†H. G. O'LEARY, Fort William, Ont.
*A. E. PICKERING, Sault Ste. Marie, Ont.
*G. MacL. PITTS, Montreal, Que.
*W. J. W. REID, Hamilton, Ont.
*J. W. SANGER, Winnipeg, Man.
†C. SCRYMGEOUR, Dartmouth, N.S.
*H. R. SILLS, Peterborough, Ont.
†J. A. VANCE, Woodstock, Ont.
†H. J. WARD, Shawinigan Falls, Que.
†J. W. WARD, Beauharnois, Que.
†C. E. WEBB, Vancouver, B.C.

* For 1943. † For 1943-44 ‡ For 1943-44-45

TREASURER
C. V. CHRISTIE, Montreal, Que.

GENERAL SECRETARY
L. AUSTIN WRIGHT, Montreal, Que.

SECRETARY-EMERITUS
R. J. DURLEY, Montreal, Que.

ASSISTANT GENERAL SECRETARY
LOUIS TRUDEL, Montreal, Que.

STANDING COMMITTEES

FINANCE
C. K. McLEOD, *Chairman*
J. E. ARMSTRONG
deG. BEAUBIEN
C. V. CHRISTIE
G. A. GAHERTY

LEGISLATION
J. L. LANG, *Chairman*
R. L. DOBBIN
R. J. DURLEY

PAPERS
L. F. GRANT, *Chairman*

LIBRARY AND HOUSE
E. V. GAGE, *Chairman*
A. T. BONE
J. S. HEWSON
M. S. NELSON
G. V. RONEY

PUBLICATION
J. A. LALONDE, *Chairman*
R. DeL. FRENCH, *Vice-Chairman*
A. C. D. BLANCHARD
H. F. FINNEMORE
T. J. LAFRENIERE

SPECIAL COMMITTEES

MEMBERSHIP
J. G. HALL, *Chairman*
S. R. FROST
N. MacNICOL

PROFESSIONAL INTERESTS
J. B. CHALLIES, *Chairman*
O. O. LEFEBVRE, *Vice-Chairman*
J. E. ARMSTRONG
G. A. GAHERTY.
M. J. McHENRY
H. W. McKIEL
J. A. VANCE

INTERNATIONAL RELATIONS
M. J. McHENRY, *Chairman*
R. W. ANGUS
E. A. ALLCUT
A. E. BERRY
C. CAMSELL
J. B. CHALLIES
J. M. R. FAIRBAIRN
O. O. LEFEBVRE
W. H. MUNRO
C. E. WEBB
C. R. YOUNG

THE YOUNG ENGINEER
H. F. BENNETT, *Chairman*
J. BENOIT
D. S. ELLIS
J. N. FINLAYSON
R. DeL. FRENCH
R. F. LEGGET
A. E. MACDONALD
H. W. McKIEL

WESTERN WATER PROBLEMS
G. A. GAHERTY, *Chairman*
C. H. ATTWOOD
L. C. CHARLESWORTH
A. GRIFFIN
D. W. HAYS
G. N. HOUSTON
T. H. HOGG
O. O. LEFEBVRE
C. J. MACKENZIE
H. J. McLEAN
F. H. PETERS
S. G. PORTER
P. M. SAUDER
J. M. WARDLE

ENGINEERING FEATURES OF CIVIL DEFENCE
J. E. ARMSTRONG, *Chairman*
P. E. ADAMS
J. N. ANDERSON
S. R. BANKS
H. F. BENNETT
W. D. BRACKEN
W. P. BRERETON
J. M. DAVIDSON
R. S. EADIE
E. V. GAGE
G. A. GAHERTY
R. J. GIBB
A. GRAY
J. GRIEVE
J. L. LANG
R. F. LEGGET
I. P. MACNAB
J. A. McCRORY
H. J. McEWEN
C. B. MUIR
W. H. MUNRO
J. A. A. PICHÉ
G. MacL. PITTS
C. J. PORTER
M. G. SAUNDERS
W. O. SCOTT
T. G. TYRER
H. K. WYMAN

POST-WAR PROBLEMS
W. C. MILLER, *Chairman*
F. ALPORT
J. S. BATES
deGASPE BEAUBIEN
A. L. CARRUTHERS
J. M. FLEMING
E. R. JACOBSEN
G. R. LANGLEY
H. MASSUE
G. L. MacKENZIE
D. A. R. McCANNEL
A. W. F. McQUEEN
G. MacL. PITTS
P. M. SAUDER
D. C. TENNANT
H. G. WELSFORD

DETERIORATION OF CONCRETE STRUCTURES
R. B. YOUNG, *Chairman*
E. VIENS, *Vice-Chairman*
G. P. F. BOESE
A. G. FLEMING
W. G. C. GLIDDON
O. O. LEFEBVRE
J. A. McCRORY
C. J. MACKENZIE
J. H. McKINNEY
R. M. SMITH

INDUSTRIAL RELATIONS
WILLS MACLACHLAN, *Chairman*
E. A. ALLCUT
D. BOYD
J. P. BRIERLEY
J. C. CAMERON
E. R. COMPLIN
J. A. COOTE
R. DUPUIS
S. M. GOSSAGE
F. W. GRAY
E. G. HEWSON
I. F. McRAE
A. M. REID
W. J. W. REID

LIST OF INSTITUTE MEDALS AND PRIZES

Sir John Kennedy Medal		For outstanding merit or noteworthy contribution to science of engineering, or to benefit of the Institute.
Julian C. Smith Medal		For achievement in the development of Canada.
Duggan Medal and Prize	Medal and cash to value of $100.	For paper on constructional engineering involving the use of metals for structural or mechanical purposes.
Gzowski Medal	Gold medal	For a paper contributing to the literature of the profession of civil engineering.
Plummer Medal	Gold medal	For a paper on chemical and metallurgical subjects.
Leonard Medal	Gold medal	For a paper on a mining subject, open to members of the Canadian Institute of Mining and Metallurgy as well as The Engineering Institute.
Students and Juniors	Books to the value of $25 (5 prizes).	For papers on any subject presented by Student or Junior members.
University Students	$25 in cash (11 prizes)	For the third year student in each college, making the best showing in college work and activities in student or local branch of engineering society.

THE ENGINEERING INSTITUTE OF CANADA

OFFICERS OF BRANCHES

BORDER CITIES
Chairman, J. B. DOWLER
Vice-Chair., A. H. MacQUARRIE
Executive, G. W. LUSBY J. M. WYLLIE
J. F. G. BLOWEY
(Ex-Officio), G. E. MEDLAR
G. G. HENDERSON
Sec.-Treas., W. R. STICKNEY,
1614 Ontario Street,
Walkerville, Ont.

CALGARY
Chairman, J. G. MacGREGOR
Executive, F. A. BROWNIE
H. R. HAYES
A. HIGGINS
W. E. ROBINSON
(Ex-Officio), S. G. COULTIS
G. P. F. BOESE
H. J. McEWEN
Sec.-Treas., K. W. MITCHELL,
803-17th Ave. N.W.,
Calgary, Alta.

CAPE BRETON
Chairman, J. A. MacLEOD
Executive, J. A. RUSSELL M. F. COSSITT
(Ex-Officio), F. W. GRAY
Sec.-Treas., S. C. MIFFLEN,
60 Whitney Ave., Sydney, N.S.

EDMONTON
Chairman, C. W. CARRY
Vice-Chair., B. W. PITFIELD
Executive, J. A. ALLAN
J. W. JUDGE
E. D. ROBERTSON
J. D. A. MACDONALD
I. F. MORRISON
H. W. TYE
(Ex-Officio), D. HUTCHISON
E. NELSON
Sec.-Treas., F. R. BURFIELD,
Water Resources Office,
Provincial Government,
Edmonton, Alta.

HALIFAX
Chairman, G. J. CURRIE
Executive, R. J. BETHUNE J. W. MARCH
J. E. CLARKE C. D. MARTIN
K. L. DAWSON L. E. MITCHELL
D. C. V. DUFF H. A. RIPLEY
J. H. M. JONES R. B. STEWART
(Ex-Officio), A. E. FLYNN
C. SCRYMGEOUR
P. A. LOVETT
Sec.-Treas., S. W. GRAY,
Wartime Bureau of Technical,
Personnel, 84 Hollis Street,
Halifax, N.S.

HAMILTON
Chairman, H. A. COOCH
Vice-Chair., NORMAN EAGER
Executive, C. H. HUTTON
H. J. A. CHAMBERS
R. J. G. SCHOFIELD
A. R. HANNAFORD
(Ex-Officio), ALEX. LOVE
T. S. GLOVER
Sec.-Treas., W. E. BROWN,
91 Barnsdale Blvd.,
Hamilton, Ont.

KINGSTON
Chairman, S. D. LASH
Vice-Chair., H. W. HARKNESS
Executive, R. J. CARTER
D. C. MACPHERSON
H. R. ROGERS F. A. ATHEY
(Ex-Officio), L. F. GRANT
A. JACKSON K. M. WINSLOW
Sec.-Treas., R. A. LOW,
Dept. of Civil Engineering,
Queen's University,
Kingston, Ont.

LAKEHEAD
Chairman, R. B. CHANDLER
Vice-Chair., S. T. McCAVOUR
Executive, S. E. FLOOK
O. J. KOREEN
E. L. GOODALL
J. I. CARMICHAEL
W. H. SMALL
A. D. NORTON
E. A. KELLY
J. S. WILSON
(Ex-Officio), E. M. G. MacGILL
(Mrs. E. J. Soulsby)
E. J. DAVIES H. G. O'LEARY
Sec.-Treas., W. C. BYERS,
c/o C. D. Howe Co. Ltd.,
Port Arthur, Ont.

LETHBRIDGE
Chairman, A. L. H. SOMERVILLE
Executive, J. M. CAMPBELL
A. G. DONALDSON
P. E. KIRKPATRICK
R. S. LAWRENCE
(Ex-Officio), W. MELDRUM
Sec.-Treas., T. O. NEUMANN
Dept. of Transport,
Post Office Building,
Lethbridge, Alta.

LONDON
Chairman, R. S. CHARLES
Vice-Chair., H. G. STEAD
Executive, E. B. ALLEN
F. C. BALL
H. F. BENNETT
V. A. McKILLOP
G. M. SPRAGUE
(Ex-Officio), T. L. McMANAMNA
J. A. VANCE
Sec.-Treas, A. L. FURANNA,
732 Wellington Street,
London, Ont.

MONCTON
Chairman, J. A. GODFREY
Vice-Chair., A. S. DONALD
Executive, E. R. EVANS H. W. HOLE
A. GORDON G. C. TORRENS
G. E. SMITH
(Ex-Officio), H. J. CRUDGE
G. L. DICKSON
Sec.-Treas., V. C. BLACKETT,
Engrg. Dept., C.N.R.
Moncton, N.B.

MONTREAL
Chairman, R. S. EADIE
Vice-Chair., C. C. LINDSAY
Executive, H. F. FINNEMORE
R. C. FLITTON
G. D. HULME
C. E. GELINAS
K. G. CAMERON
G. H. MIDGLEY
(Ex-Officio), C. K. McLEOD
J. E. ARMSTRONG
R. E. HEARTZ
W. G. HUNT
J. A. LALONDE
G. MacL. PITTS
E. V. GAGE
Sec.-Treas., L. A. DUCHASTEL,
40 Kelvin Avenue,
Outremont, Que.

NIAGARA PENINSULA
Chairman, G. E. GRIFFITHS
Vice-Chair., W. D. BRACKEN
Executive, A. G. HERR
C. G. MOON
G. F. VOLLMER
H. E. BARNETT
J. W. BROOKS
G. MORRISON
D. S. SCRYMGEOUR
(Ex-Officio), C. G. CLINE
A. W. F. McQUEEN
Sec.-Treas., J. H. INGS,
2135 Culp Street,
Niagara Falls, Ont.

OTTAWA
Chairman, W. L. SAUNDERS
Executive, W. H. B. BEVAN
J. H. BYRNE
D. G. KILBURN
J. M. WARDLE
C. D. WIGHT
(Ex-Officio), K. M. CAMERON
G. H. FERGUSON
N. B. MacROSTIE
Sec.-Treas., A. A. SWINNERTON,
Dept. of Mines & Resources,
Ottawa, Ont.

PETERBOROUGH
Chairman, A. R. JONES
Executive, R. L. DOBBIN
A. L. MALBY
F. R. POPE
C. R. WHITTEMORE
(Ex-Officio), D. J. EMERY
H. R. SILLS
Sec.-Treas., A. J. GIRDWOOD,
308 Monaghan Road,
Peterborough, Ont.

QUEBEC
Life Hon.-Chair., A. R. DÉCARY
Chairman, RENÉ DUPUIS
Vice-Chair., E. D. GRAY-DONALD
Executive, S. PICARD G. ST-JACQUES
L. GAGNON A. E. PARÉ
G. W. WADDINGTON Y. R. TASSÉ
(Ex-Officio), H. CIMON
R. B. McDUNNOUGH
P. MÉTHÉ
Sec.-Treas., PAUL VINCENT,
Colonization Department,
Room 333-A, Parliament Bldgs.,
Quebec, Que.

SAGUENAY
Chairman, CHAS. MILLER
Vice-Chair., G. B. MOXON
Executive, J. FRISCH W. E. COOPER
F. T. BOUTILIER
(Ex-Officio), R. H. RIMMER J. W. WARD
ALEX. T. CAIRNCROSS
Sec.-Treas., ALEX. T. CAIRNCROSS,
8-C Brittany Row,
Arvida, Que.

SAINT JOHN
Chairman, A. O. WOLFF
Vice-Chair., C. D. McALLISTER
Executive, G. M. BROWN
C. C. KIRBY
(Ex-Officio), G. G. MURDOCH
J. P. MOONEY
D. R. SMITH
G. W. GRIFFIN
Sec.-Treas., F. A. PATRIQUEN,
P. O. Box 1417
Saint John, N.B.

ST. MAURICE VALLEY
Chairman, J. H. FREGEAU
Vice-Chair., R. DORION
Executive, G. B. BAXTER
E. BUTLER
A. G. JACQUES
R. D. PACKARD M. EATON
E. T. BUCHANAN J. JOYAL
W. E. A. McLEISH H. G. TIMMIS
(Ex-Officio), VIGGO JEPSEN
H. J. WARD
Sec.-Treas., DAVID E. ELLIS,
Shawinigan Water & Power
Company,
P.O. Box 190,
Three Rivers, Que.

SASKATCHEWAN
Chairman, A. M. MACGILLIVRAY
Vice-Chair., J. McD. PATTON
Executive, F. E. ESTLIN
E. K. PHILLIPS
J. I. STRONG
F. C. DEMPSEY
N. B. HUTCHEON
J. G. SCHAEFFER
R. A. SPENCER
(Ex-Officio), A. P. LINTON
Sec. Treas., STEWART YOUNG,
P.O. Box 101, Regina, Sask.

SAULT STE. MARIE
Chairman, N. C. COWIE
Vice-Chair., A. M. WILSON
Executive, C. O. MADDOCK
C. R. MURDOCK
G. W. MacLEOD
K. G. ROSS
H. W. SUTCLIFFE
(Ex-Officio), J. L. LANG
A. E. PICKERING
L. R. BROWN
Sec. Treas., O. A. EVANS,
159 Upton Road.
Sault Ste. Marie

TORONTO
Chairman, W. H. M. LAUGHLIN
Vice-Chair., S. R. FROST
Executive, F. J. BLAIR R. F. LEGGET
E. G. HEWSON A. H. HULL
C. F. MORRISON E. A. CROSS
(Ex-Officio), H. E. BRANDON W. S. WILSON
T. H. HOGG C. R. YOUNG
N. MacNICOL
J. M. VAN WINCKLE
Sec.-Treas., S. H. deJONG,
Dept. of Civil Engineering,
University of Toronto,
Toronto, Ont.

VANCOUVER
Chairman, T. V. BERRY
Vice-Chair., A. PEEBLES
Executive, J. P. FRASER F. H. BALLOU
E. S. JONES R. C. PYBUS
G. W. ALLAN J. A. TAMES
(Ex-Officio), C. E. WEBB
W. N. KELLY
Sec.-Treas., P. B. STROYAN,
2099 Beach Avenue,
Vancouver, B.C.

VICTORIA
Chairman, H. L. SHERWOOD
Vice-Chair., A. L. FORD
Executive, P. B. HUGHES
C. M. TRIPP
S. R. WESTON
J. N. ANDERSON
(Ex-Officio), A. S. G. MUSGRAVE
KENNETH REID
Sec.-Treas., R. BOWERING,
41 Gorge Road West,
Victoria, B.C.

WINNIPEG
Chairman, J. T. DYMENT
Vice-Chair., T. H. KIRBY
Executive, C. V. ANTENBRING
N. M. HALL
B. B. HOGARTH
R. H. ROBINSON
R. A. SARA
(Ex-Officio), W. P. BRERETON
J. W. SANGER
D. M. STEPHENS
Sec.-Treas., T. E. STOREY,
55 Princess Street,
Winnipeg, Man.

PLASTICS IN ENGINEERING

WILFRED GALLAY
Division of Chemistry, National Research Council, Ottawa, Ont.

Revised version of paper presented before the Montreal Branch of The Engineering Institute of Canada on November 4th, 1943.

No technical development in all our industrial history has been as highly glamorized as the subject of plastics. It has shown an amazing degree of popular appeal for several reasons, including probably the idea of synthesis from "coal, air and water," the beauty of colour and finish in decorative effects, and the fact that the objects of early manufacture were those of common use by the general public. Feature writers have regrettably enjoyed a general field-day revelling in the subject, and unfortunately there has been a tendency towards certain misconceptions and exaggerations in such writings. Plastic aeroplanes now flying, plastic automobiles and plastic homes of the future have been described. Actually there is no such thing to-day as the plastic aeroplane. The plywood airframe has attained great importance owing to the advent of plastic glues, and what might be termed a "plywood plastic" aircraft is still actually a high-grade plywood. The plastic automobile bodies envisaged to-day are secondary structures to be built over a metal framework. The post-war homes will undoubtedly have dozens of items in which plastics will play a part, but primary load-carrying structures are not among these components as yet. The plastic industry itself has recently become somewhat concerned about the dangers attendant on over-glamorization and some remedial action has been studied.

On the other hand, the plastics industry is on a solid foundation and does show tremendous possibilities for the future in many technical fields. The industry is in its infancy, the great period of growth having been during the past ten years. Particularly as a result of the present emergency, with its attendant shortages and search for replacements, it is no exaggeration to say that each month has seen important advances made in the field of plastics, both in discovery of new materials and formulation, and in new applications.

DEFINITION

The question is often asked—"What is a plastic ?"—and a specific unqualified definition is not a simple matter. Chemically speaking, important plastics represent a number of family groups of quite different chemical character and behaviour. Physically, the plastics range in properties very widely. They may be hard and brittle, or soft and extensible or even elastic, with any number of intermediate gradations. Many plastics are not plastic at all, in the strict sense of the word, so that the designation itself, as far as the finished article is concerned, is a misnomer. The only physical similarity among this highly heterogeneous group is the common property of sufficient fluidity at some stage of manufacture so that flow can take place to assume a given shape. Thus, plastics are essentially materials which at some stage of their processing are amenable to moulding to a desired shape. The moulding procedure varies with the type of material, and the finished products may differ enormously in chemical and physical properties. The chemist recognizes also certain combinations of amorphous and crystalline properties in plastics, and particularly the fact that a plastic must consist of large molecules, very long in one dimension. There is a difference only of degree, rather than of kind, between plastics and rubbers, both natural and synthetic, and also between plastics and many common natural fibres.

Furthermore, the matter of formulation of a plastic is of importance. Just as in an automobile tire, rubber constitutes the minority of the compound by weight, so in many important plastics added materials of the nature of reinforcements constitute the greater part of the material. These added materials provide certain physical properties, e.g., strength or abrasive resistance, not available in the basic rubber or plastic itself.

PROPERTIES

Plastics possess certain basic advantages on which the great extension of their utilization depends. It is of importance therefore to examine briefly their advantages for general use. Plastics are mouldable to a definite size and shape within a very close tolerance. This is a great advantage in the saving of man-hours of machining and the setting-up of machine tools. Production is rapid and production costs are low. The density ranges from less than 1 to about 1.4, except for certain laminates with inorganic fillers, which may have densities up to 1.8. The strength/weight ratio is thus very high, as will be shown below. Many of the plastics are very highly resistant to chemical action and corrosion. They require in general no protective coating, because of this inherent property. The finish is thus built into the material. Since plastics are mainly of synthetic or partially synthetic origin, they may be adapted or "tailor-made" to suit a specific purpose. This is in contrast to many natural materials, such as wood, where the deficiencies as supplied by nature are difficult to remedy. The variability of properties obtainable lends itself well, therefore, to application in a great variety of technical fields. Certain of the disadvantages of plastics, in comparison with such materials as metals, wood and glass, will appear in the more detailed discussions below.

Plastics may be conveniently classified in application into four sections, viz.:

1. Moulded plastics.
2. Laminated plastics.
3. Coatings.
4. Adhesives.

It is obvious that the field is a very large one and the present discussion must be limited to a few salient facts of particular interest to engineers.

MOULDED PLASTICS

The moulded plastics present an extremely wide range in properties of interest to the engineer. Even those of one chemical type may be put out by one manufacturer in dozens of grades and sub-grades, all of which differ in properties and which are applicable to various purposes. It is apparent therefore that for efficient use the engineer should develop specifications for his purpose and choose a plastic, the properties of which fall within the limits of that specification. Authoritative standardization bodies, e.g., American Society for Testing Materials, have been and are very active in designing test methods on which specifications for plastics can be based.

Two general types of moulded plastics are reasonably well differentiated. One of these is irreversible hardened during the moulding, and such materials are comparatively resistant to high temperatures. These thermosetting plastics are characterized also by rigidity, good water and general chemical resistance, good machining properties and good electrical properties. The strength properties, with the exception of impact, are good. Many of the physical properties depend on the type of filler which is used. The thermosetting resins by themselves are brittle. With fillers of increasing fibre length, the impact strength and other properties improve considerably. Thus, cord and sisal filled resins show impact strengths nearly 100 times greater than the resins alone or with a short filler such as wood flour. Tensile strengths range in general from about 5,000 to 12,000 lb. per sq. in., compressive strengths from 10,000 to about 30,000 lb. per sq. in. and flexural strengths from about 8,000 to 20,000 lb. per sq. in. The specific gravities are commonly from 1.3 to 1.5, with a rise in values up to two where a mineral filler is used. These materials are non-inflammable and will resist higher temperatures, e.g., 300 deg. F., for considerable periods depending on the stress applied during heating. Thermosetting moulded plastics are used in many hundreds of applications. The resins themselves find many interesting specialized applications, e.g., resin solutions for sealing porous castings, ion exchange resins for softening water, resins for improving greatly the wet strength of paper, etc.

The second general type of moulded plastic is termed thermoplastic, since it can be reversibly softened by heat. All strength properties are therefore connected with flow at lower temperatures under stress, and hence the thermoplastics are never used where continuous stresses are of any degree of magnitude. However, in general such materials are much tougher than the ordinary thermosetting resins, and the higher impact strength is of considerable importance. The injection moulding process used for such materials is very rapid and production costs are low. Most of these resins are obtainable in many grades of hardness and flexibility, with specialized properties such as high impact strength at low temperatures, high resistance to corrosive acids and alkalis, and specially good electrical properties. The dependence of properties on temperature in this class is to be specially emphasized. Some types are obtained in colourless sheets with very high light transmission characteristics, and their use in aircraft cockpit enclosures, gun turrets and bomb noses is well known. Unfortunately the low surface hardness and resultant ease of scratching makes their use as windows in general difficult. The low dielectric constant and loss factor of polystyrene at higher frequencies has made it a particularly valuable material in electrical work. The good electrical and ageing properties of polyvinyl chloride has led to its extensive use in place of rubber as a cable coating material, although the low temperature toughness still leaves something to be desired. The thermoplastic resins may also be continuously extruded to any desired cross-sectional shape and these are finding many uses. Sheet material may be formed to complicated curvatures, and the joining of sections by glueing or direct heat sealing is generally not difficult.

LAMINATED RESINS

It was noted above that, as the fibre length of the filler in the thermosetting resins increased, the strength properties of the plastic increased also. If this filler is extended to pre-woven sheets, which are laminated together, bound by a thermosetting plastic, then it is apparent that further strength should be attained. The laminated plastics are of particular interest to engineers as structural materials, combining high strength with low density. The fillers may be paper, cotton, asbestos, glass fibre or thin wood veneers, and rapid strides have been made in the last three years particularly in the formulation and use of these materials. They are manufactured in flat sheets, in the form of rods and tubes, and they can also be moulded to compound curvatures.

These materials are specially formulated for specific uses. Some have very low moisture absorption and good electrical properties. Others are formulated to have good punching qualities. Extra strengths are obtainable, for example, by the use of heavy weave fabrics, and higher heat resistance by the inclusion of asbestos cloth.

It is difficult to give specific strength figures since the development is progressing continuously and varying data have been reported by different laboratories and plants carrying out assembly under different procedures. In general, however, it may be said that on a weight basis some of the laminated plastics compare well with aluminium alloys. The specific tensile and compressive strengths are high, but the plastics are considerably lower in stiffness and ductility. Aside from the glass-fibre laminates, which show remarkably high impact strengths, the values in this property are in general rather low in the laminates, especially those measured across the edges of the material. The resistance to buckling is particularly noteworthy, as a result of low density.

The special properties of these plastic laminates, including outstanding resistance to water and chemicals, have led to important engineering applications for the material. Laminated bearings, with which oil or water lubrication may be used, have shown outstanding life and quality in service. Compressor rings in refrigeration, suction box components in the paper industry, doctor blades, plating barrels in electro-plating, hold-down rolls in pickling tanks, rayon spinning buckets, re-inforcements of various types in wooden aircraft, various electrical applications, fan-blades for water-cooling towers, air-deflectors for air-cooled aircraft engines, aircraft flooring, push-rod housings for air-cooled engines, jettison tanks, are a few examples of some of the various uses of the material.

It should be clearly understood that this field is at a very early stage of development, and that extensive improvements may be looked for in the near future in the properties of laminated plastics. Further research is required in the proper use of the fibres in the plastic matrix and in the bonding of these two dissimilar components. It would appear also that design engineers have only to a very small extent examined the potential uses and advantages of these materials. Obviously, in this field as in plastics generally, direct substitution of the new materials for metal should not be made. The design of the structure or component should be basically altered to take full advantage of the properties of the newer material. Extensive design data have now been accumulated for this purpose.

COATINGS

The past four or five years has seen tremendous advances in the field of protective coatings on various surfaces. A great variety of chemical types of plastics materials have been modified and formulated to yield coatings of unusual quality. A detailed account of these advances and even of the classes of coatings developed lies outside the scope of this paper.

Of particular interest to the engineer are the qualities now obtainable with plastic coatings of various types. They are used on a great variety of substrates, including paper, fabric, wood, plaster, iron, steel, aluminium, zinc, galvanized surfaces, etc. Excellent adherence to metal is shown, even following severe deformations such as deep drawing and crimping. Many are available in water-emulsion form. The coatings are very resistant to water and chemical agencies, and show outstanding resistance in prolonged exposure tests. They may be modified in various ways in order to incorporate toughness and flexibility, and consequent durability. Baking finishes of unusual hardness and abrasion resistance have been developed, which are also remarkably corrosion resistant. Very good electrical properties may be obtained.

Civilian use of many of these plastics has been totally restricted during the war, and post-war production of many items incorporating these modern finishes is planned. Plastic coatings for containers up to tank car size, and various types of closures, have been greatly improved. The application extends to most of the processing industries in one form or another. Special corrosion-resistant metals may often be replaced by suitable coatings. The well-known baked finishes for refrigerators, kitchenware, washing machines, etc., have been further improved. Protective and decorative plastic coatings or paints for interior and exterior use in homes have been vastly improved in ease of application, drying time and durability.

The application of thermoplastic resins to fabrics has been of particular importance for a number of essential war uses.

ADHESIVES

The fundamental mechanism of adhesion is not understood, and therefore all advances have been essentially empirical in nature. New developments of the past two or three years are of particular interest to engineers. Adhesives have been developed capable of bonding various metals, wood, rubber, plastics, in various combinations. Good strengths are shown and the bond is very resistant to exposure. The possibility of substitution of a glued joint in place of rivets and the like is obviously of great importance and further developments in this field should be carefully noted in their engineering applications.

In wood to wood bonding, the modern plastic glues are very greatly superior to the protein and starch glues commonly used at present. The older glues show great inferiority in resistance to water, to the action of organisms and general exposure conditions. The modern wooden aircraft was made possible by the development and application of synthetic resin glues, and there is every likelihood that these modern adhesives will rapidly displace other glues for general purposes after the war.

LAMINATED WOOD AND PLYWOOD

Wood is one of our oldest structrual materials, and is still one of the most important. Indeed, from the point of view of volume and generalized applicability, it still holds a premier position in the field. The outstanding physical properties of wood, combined with low density, and the ease of construction in the field are not yet as matched by any rival material for general application. The well-known shortcomings of solid wood have been overcome in admirable fashion through the use of wood in relatively thin layers, glued together to form either plywood or laminated wood. The latter term is generally applied to describe assemblies of wood layers in which the grain of adjacent layers is parallel, as distinguished from plywood, in which the grain of adjacent layers of wood is usually at right angles, or at other angles for specialized uses. The advantages of plywood and laminated wood, particularly the former, are well known and require no extensive elaboration here, but some salient points might be briefly mentioned for emphasis.

In plywood, the distribution of strength factors, and the adjustment of assembly designs according to stresses calculated for a structure, are outstanding factors. The dimensional stability, particularly with regard to ambient moisture conditions, has extended greatly the satisfactory application of wood under severe exposure cycles. The large areas available in plywood, limited only by press dimensions and shipping facilities, are of particular importance in pre-fabrication and ease of subsequent construction. Laminated wood also has outstanding advantages over solid wood, particularly in timber construction. Solid timbers are commonly limited in size in both length and cross-section. The necessity for mechanical joints in order to obtain greater lengths constitutes a weakness, in that the weight of the assembly must be greatly increased in order to maintain adequate strength and rigidity. Laminated timbers may be constructed to any dimensions, by lapping the ends of individual layers in suitably staggered fashion. Solid timbers of larger size offer great difficulty in adjustment of moisture content, and cracking and checking of such solid members constitute a serious difficulty. Individual thinner laminae, on the other hand, are readily dried to a desired moisture content by conventional means, and cracking and checking in laminated timbers are very greatly reduced. Solid timbers show a large percentage of rejection on account of various flaws, and control of quality is difficult on dimentional grounds. Individual laminae, on the other hand, permit of ready inspection and control of quality. It is apparent further that, in these individual layers, certain types of defects are permissible without appreciable loss in quality, since lamination allows of the spacing of such defects in such a manner that the severely localized faults are negligible in a consideration of the overall strength properties. For dominance of strength in one direction, it is obvious that laminated timbers are greatly superior to solid timbers and, furthermore, opportunity is afforded to effect a matching and balancing of grain effects for optimum results. The assembly of layers to curvatures is readily accomplished, and the advantage here over the steaming of solid timbers is apparent. The reinforcing effect of the glue lines is probably also of some importance in considerations of stiffness and dimensional stability.

In his calculations of structural design features, the engineer must necessarily treat such layered wood as an entity, without regard for the fact that the layers are joined together by an adhesive totally different from the wood. In other words, he must tacitly assume that the lines of juncture of the layers are as strong as the wood medium itself, and he must assume further that the durability of such glue lines is equal to that of the wood. It is furthermore not feasible to make any allowance for a degradation of the wood in contact with the glue such as would constitute a zone having a lesser strength than the main body of the wood. The glue line in layered wood should therefore be at least as strong as the wood itself, should yield adequate durability against any extremes of exposure conditions which may be met, should be totally resistant to the action of organisms of various types, and must show no appreciable deteriorating action on the wood adjacent to it, as a result of pH or other chemical or physicochemical action.

SYNTHETIC RESIN GLUES

Synthetic resin glues for use with wood are almost entirely of the thermosetting type, owing to various considerations, including questions of cost and flow under stress. They may be based on phenol-formaldehyde, urea-formaldehyde or melamine-formaldehyde, the latter being somewhat newer than the other two, or mixtures of these substances. They are marketed in the form of an aqueous or organic dispersion, as a dry powder for dispersion by the user, or in the form of a finished glue film on a paper carrier to avoid the necessity of spreading. As thermosetting resins, these glues under certain conditions become sufficiently chemically active to set to a hard infusible state, by chemical condensation. By means of formulation of the resin itself, or by the incorporation of suitable proportions of a catalyst, this chemical activity can be arranged to become rapid over a wide range of temperatures. From the practical standpoint, this range is from about 70 to 300 deg. F. Each type of resin differs considerably in such temperature intervals. For example, urea resin adhesives now in common use are hardened in practice from 70 to about 240 deg. F. These are commonly divided into two sub-types, viz., (1) hot-setting, where the hardening temperatures for convenient use may lie in the range of 200-240 deg. F., and (2) cold-setting, where the adhesive hardens at a minimum temperature of 70 deg. F. Urea resin glues might also be formulated of course to be used at any temperature intermediate between these limits. The hot-setting glues harden within several minutes at the temperature prescribed for them, and this time of hardening increases rapidly as the temperature is lowered. The cold-setting glues require several hours for what might be termed initial hardening, and this time decreases rapidly as the temperature is increased. The earlier phenolic adhesives required a temperature of 280-300 deg. F., but some hot-setting phenolic glues are commonly used to-day at a temperature of about 240 deg. F. Recently, so-called intermediate-temperature phenolics have been successfully introduced, which harden within a reasonable press time at about 150 deg. F. At present, extensive experimentation is proceeding with cold-setting phenolics, which are designed to set in preliminary fashion within several hours at 70 deg. F., similar to cold-setting urea glues. Melamine adhesives are also formulated to harden over a range of temperatures.

It is obvious that a reduction in temperature, consistent with a reasonable pressing time, is an important factor. A further factor which enters into consideration is the assembly time, i.e., the time interval between the application of the glue and the time when pressure becomes effective. The cold-setting resins, owing to their reactivity, will obviously have a limited assembly life, which may militate against their use where more time is demanded in operation.

A further important factor is the durability of the glue in service. Although the synthetic resin glues as a class constitute an enormous improvement over the older resins, they differ markedly within that class. Urea resins must be considered as showing more susceptibility to hydrolysis than phenolic resins and under severe conditions, e.g., under-water use, evidence has been accumulated to show that phenolics possess a superior durability. Other factors, such as tendency to craze in thick glue lines, must also be taken into account.

PRESENT GLUING PROCEDURES

For the gluing of thin plywood, or thin laminated wood, hot-setting resins are exclusively used in order to attain rapid production schedules. The heat necessary to set the glue in the various glue lines is transmitted by thermal conduction from the hot platens of the press through the various wood layers under pressure. Plywood of thickness over ½ in. is relatively uncommon, and plywood over 1 or possibly 1¼ in. in thickness is not stocked. It is difficult to estimate the practicable limit of thickness of plywood which can be manufactured with hot-setting resins in a hot-plate press. The deteriorating effect on the wood, the moisture loss from the wood, and cost considerations all enter into the picture. A total thickness of 1½ in., i.e., a distance of ¾ in. from platen to innermost glue line, would certainly be a liberal estimate of what could practically be manufactured in this way. For such or greater thicknesses of assembly, either cold-setting resins must be used, with the attendant very slow production, or a different mode of introduction of heat into the glue line must be employed.

Essentially the same holds true for thick laminated wood sections. The manufacture of propeller blanks, aircraft spars, laminated arches and trusses from laminae ½ to ¾ in. in thickness to a total thickness of from 4 in. to about 16 in., has recently grown to considerable importance. It is obviously entirely impossible to assemble these structures with hot setting glues in a press, with heat transfer from hot platens. One alternative, viz., the use of cold-setting glues, involves a lengthy time schedule and, in some instances also, a lessening in quality of the glue line. For example, the assembly of a propeller blank consisting of, say, 8 birch laminae, each ¾ in. thick, involves the following. Using casein as glue, some 18-24 hrs. in the press is required, depending on specifications, and then the structure must be conditioned for about a week in order to allow for an equilibrium in moisture distribution. Using cold-setting urea resin as adhesive, from 4 to 6 hrs. in the press is required, depending on specifications, following which the structure must be conditioned for about a week in order to allow for a high degree of condensation of the resin. The initial condensation during the first few hours is not sufficient to withstand the stresses of machining or exposure to variable moisture conditions. It is noted therefore that presses are tied up for considerable periods, and about a week must elapse prior to the time the assembly can be put into further production process. For very large or possibly more complicated assemblies, the very brief assembly life of the cold-setting resins, 15-30 min., may involve difficulties. Since they are reactive at room temperature, condensation proceeds rapidly after spreading. Even the pot-life is relatively short, since condensation proceeds in

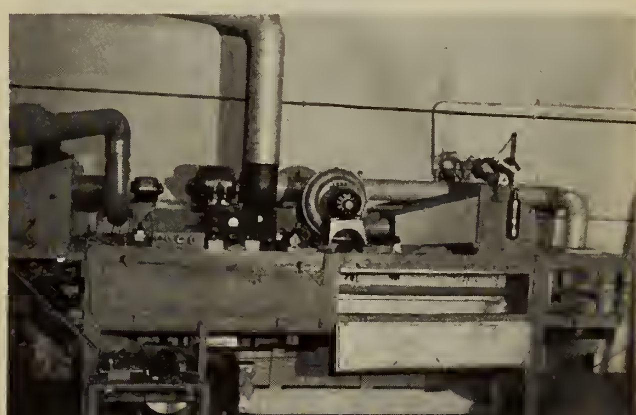


Fig. 1—Pilot scale apparatus for the resin impregnation of fabric, under strictly controlled conditions.

Fig. 2—Shows multi-ply laminated wood being assembled by the new process in the laboratory. A laboratory hydraulic press with 14 by 14 in. platens is shown, and the arrangement of glue lines in parallel is noted.

the mixing vessel in which the resin is dispersed in the water.

It is apparent that both the press-time and the subsequent hardening time with cold-setting resins may both be radically reduced by raising the temperature in the glue line subsequent to lay-up. In order to accomplish this, the whole assembly must be heated. Various methods of heat transfer have been attempted, e.g., immersion of the assembly in hot or boiling water, or subjecting the assembly to an atmosphere of steam. Such methods are cumbersome, and the difficulties involved in an assembly 50 ft. long and 15 in. in cross-section can well be imagined. Assemblies of relatively small cross-section, e.g., ski blanks, have however been subjected to heat in an oven with reasonably good results.

The urea cold-setting adhesives, the only ones commercially available at the moment, must be regarded as inferior to the hot-setting resins from the point of view of durability under severe conditions. This quality factor makes it further desirable to develop a method for the utilization of hot-setting resins in thick assemblies.

HIGH FREQUENCY HEATING

An alternative means of supplying heat to the glue lines of a thick assembly, viz., high-frequency heating, has recently been introduced and has been widely noted. In this method, the whole assembly acts as the dielectric of a condenser in a high-frequency circuit. The material is thus heated in the high frequency electrostatic field by dielectric loss, or heat energy produced by molecular distortion in the very rapidly alternating field.

High-frequency heating, as applied to the gluing of wood, acts not only on the glue line but on the whole assembly. Calculations of power requirements involve the physical properties and dimensions of the wood. Heat requirements are based not on the weight of glue to be heated, or total area of glue line, but rather on the total weight and specific heat of the assembly. The glue line becomes a negligible factor in such calculations in thick assemblies. The whole of the wood must therefore be heated, and the attendant direct disadvantages are power losses in heat uselessly applied, and moisture losses from the wood. If however the plane of the glue line is set parallel to the electrostatic field and perpendicular to the electrodes, the power and time requirements are greatly reduced. Godfrey and Bilhuber ([1]) have recently noted the various factors which enter into the application of this method. The dimensions of the electrodes in relation to the frequency and the tuning of the circuit with regard to the capacity introduced must be considered. Variation in moisture content of the laminae results in variation in temperatures produced. The electrodes must be thermally insulated for higher temperatures to avoid temperature differentials. Certain difficulties have arisen with regard to flash-over in the squeeze-out, and safety precautions must be rigidly adhered to in view of the power used. The applicability of the method to very large assemblies, e.g., 50-60 ft. length and 10 glue lines to a total thickness of 15-18 in., is apparently not immediately visualized in present descriptions. The cost of the high frequency generating units of large power output is an important consideration.

It is apparent that this method of introducing heat into relatively remote glue lines is a promising one. Some of the difficulties apparent at present will, no doubt be ironed out as further experience is gained with the method.

NEW GLUING DEVELOPMENT

In the present work, a method was sought by which the glue line could be heated directly. Electrical means appeared most feasible, and a number of experiments were carried out using the glue line as a resistor. Synthetic resin glues in aqueous dispersion show a low conductivity, which decreases to nil as the glue dries. The addition of inorganic salts to increase ionic conductivity is of little assistance in this regard. The incorporation of finely powdered metallic conductors showed that conduction and heating effects were produced only at such high concentrations as to render the wood to wood bonding action of the glue impossible. Furthermore metallic inserts expand with heat and contract after the adhesive has set and the source of heat has been removed, thus setting up serious stresses in the glue line. Various carbon blacks, including finely divided reinforcing blacks, were incorporated into glue dispersions. It was found, however, that the conductivity attained for a usable concentration of black was low, and the heating effect produced in the glue line was correspondingly low. Graphite yielded results which showed little improvement.

Results were then obtained with acetylene black which were of quite a different order. Acetylene black ([2]) is manufactured by the controlled combustion of acetylene and shows quite remarkable electrical properties when dispersed in non-conducting materials. This action in rubber is well known and the so-called conductive rubber is an article of commerce. The specific reason for the special behaviour of acetylene black in comparison with other blacks is not understood. It is quite possible that this is linked with specialized surface

[1] W. Godfrey and P. H. Bilhuber, *Modern Plastics*, September, 1943.

[2] Manufactured by Shawinigan Chemicals Ltd., Shawinigan Falls, Que., Canada.

properties on each particle, which may bring about a sticking and chain formation between the particles. Such chain formations, branched to form a scaffolding structure, would explain the high conductivity of relatively dilute dispersions of acetylene black in a non-conducting medium. Streptococci-like chains would provide a number of paths for electrical conductivity, with most of the surface left free for the action of the medium as desired. Further evidence for this structure is provided by viscosity considerations.

In general then, the gluing development described in the present study consists essentially of the use of a synthetic resin adhesive in conjunction with acetylene black or other highly conductive black, the glue line thus being rendered conductive. Electrodes of suitable type are placed at the edges of the glue line and a low voltage current of ordinary characteristics, e.g., direct current or 60-cycle a.c., is passed through the glue line. Rapid heating is obtained directly in the adhesive, and the latter is thus conveniently and efficiently hardened. The various factors involved are discussed individually in the following sections.

The development thus far has taken several chief forms of application, as follows:

1. *Glue-black dispersion*—In this form, the black is added directly to the liquid glue and the mixture is spread on the wood. Electrodes are placed in position, and the glue is set by resistance heating.

2. *Carrier for the black*—In this form, the black is coated on the threads of a fabric mesh under controlled conditions in order to provide for uniformity. The normal glue is spread on the wood surface, the conductive carrier is inserted in the glue line, electrodes are added, and the glue is set rapidly by resistance heating.

3. *Carrier for the black and the glue*—In this form, the fabric mesh carrier is successively coated with (1) the black on the threads of the fabric, and (2) the glue as a continuous film over the whole area of the fabric. In this form, the user avoids the spreading of glue entirely. The conductive glue film is placed between the wood surfaces to be joined, electrodes are added, and the glue fuses and sets rapidly by resistance heating.

Figure 1 shows a pilot plant scale laboratory unit used in coating fabric mesh with such materials.

The current used is that directly obtainable in ordinary lighting and power circuits, either d.c., 60-cycle a.c. or the like. The voltage used will obviously depend on the width of the glue line, i.e., the dimension in the direction of current flow. In general, laminated wood is not used in widths greater than 18 in. and 220 volts is sufficient for this dimension. 110 volts has been found ample for widths ranging up to 6 in. and may be satisfactorily used up to about 12 in. It is apparent that the use of higher voltage will increase the power input accordingly, and consequently decrease the time necessary to reach a given temperature in the glue line. For any purpose involving much greater widths, it is apparent that the distance may be effectively reduced, and the necessary potential lowered, by the addition of a third electrode in the glue line acting as a ground for the outside electrode. The current drawn in the process for a given voltage will vary directly as the total area of glue line. This will vary not only as the voltage, but also with the concentration of conductive black per unit area, but a typical example might be about 12 amps. per 1,000 sq. in. at 220 volts, using fabric mesh carrier. Glue lines are all attached in parallel, and the total current consumption is additive.

The process is essentially independent of the dimensions of the assembly being glued. The time necessary to reach a given temperature in the glue line is independent of the length of the assembly, the thickness of each layer, and of the number of glue lines being heated in parallel. These dimensions affect merely the amount of current which will be drawn by the circuit. The time of gluing is also essentially independent of the width of the assembly, so long as the potential used is increased with wider assemblies. The method lends itself well particularly to large scale work.

The time necessary to bring the glue line up to the required temperature may obviously be varied almost at will. Using a high voltage, the power input may be made so large that the whole operation is completed in a matter of seconds. Generally, there is no reason for any excessive speed, and using voltages from 110-220, with a normal concentration of black as noted above, the time under pressure may range from about 2 min. to 15 min. depending on conditions. This obviously constitutes a tremendous reduction in time from the week or more now required using a cold-setting glue at room temperature.

The electrodes generally used are fine copper wire, of sufficient gauge to handle the current drawn. Very long assemblies may entail an appreciable voltage drop and, in such cases, the potential may be fed in at more than one point. The electrodes may be readily recovered for repeated use by trimming off the outside edges of the completed assemblies. Figure 2 shows an experimental assembly in a laboratory hydraulic press. The pressure required is that normally used in wood gluing, i.e., from 150 to 300 lb. per sq. in., and pressure may be applied in any convenient manner, e.g., by clamps, jigs, hydraulic press, screw press, hydraulic hose press, etc.

The process has the advantage of being essentially independent of variations in moisture content of adjacent layers, and of the absolute moisture content of the wood. The wood is heated to only a relatively small extent by thermal conductivity from the glue lines.

The equipment needed for this gluing process is virtually negligible. A circuit leading to bus bars in proximity to the work, accompanying switches and meters, complete the list. The end-point required can be readily calculated on the basis of the work done or It at a given voltage, and therefore the indicator may be either a watt-hour meter or an ammeter in conjunction with a stop-watch. The efficiency of the process is obviously 100 per cent. It may be of interest to give one average figure which we have observed by way of power requirements; viz., 0.4 watt-hrs. per sq. in. of glue line area, to an end-point of 250 deg. F.

(*Continued on page 103*)

Fig. 3—Shows wood failure obtained in standard shear test specimens and also in breaking into glue lines of larger areas.

STRETCHING OUR RESOURCES

C. B. STENNING

Chairman, Conservation Committee, Department of Munitions and Supply, Ottawa, and Chairman, Conservation Sub-Committee, Joint War Production Committee, U.S. and Canada.

Paper presented at a joint meeting of The American Society of Mechanical Engineers and The Engineering Institute of Canada at Toronto, Ont., on October 1st, 1943.

SUMMARY—The paper deals with the organization of the Conservation Committee of the Department of Munitions and Supply and gives illustrated examples of improvements in tools and methods adopted by some Canadian firms in order to conserve materials and manpower.

Conservation is a word with many meanings, but for our purposes to-day it means any project initiated in a manufacturer's plant, which results in the production of more war stores by the men and machines, and with the materials available to them.

CONTROL OF MUNITIONS AND SUPPLY IN CANADA

For the benefit of our American friends, I think I should point out that we have here in Canada an integrated set-up, known as the Department of Munitions and Supply, which places and supervises all contracts and orders for all supplies and munitions of war of whatever character. This same Department includes the controllers of most of the raw materials and of machine tools.

It will be seen, therefore, that this one Department controls the orders, the raw materials and the machine tools. The man-power supply is the problem of the Department of Labour.

It is evident that the staggering responsibility laid upon this Department could not be carried out by any one group of men. The policy, therefore, is to transfer a part of this responsibility to the manufacturer with his contract.

It becomes the contractor's job to produce the goods, subject only to the limitations imposed by the inspection and design authorities and by the controllers of raw materials and machine tools. This is done in the belief that you cannot pass on responsibility for the accomplishment of a nearly impossible job, and then insist on directing the manner in which the job will be done.

I have outlined this chain of authority to explain why practically all of the successful conservation projects in Canada's war effort stem from the manufacturers and their employees and not the Government.

INFORMATION DISTRIBUTED TO MANUFACTURERS

The Government has, however, taken a hand in the distribution of information regarding successful conservation projects. On October 17th, 1942, a meeting of 1300 war contractors was held in Toronto. Its purpose was to link together all of the hundreds of conservation projects in Canada's war industries. At that meeting over a thousand samples of successful projects were exhibited. This exhibit has been shown to several thousand manufacturers and their employees in Toronto, Montreal and Ottawa. It will shortly be transferred to Washington at the request of the Combined Conservation Committee. This educational work has been under the direction of the Conservation Committee of the Department of Munitions and Supply. Monthly mailings are made by the Committee to six hundred war contractors. These mailings have contained thousands of valuable leads about ways in which savings have been made in Canada and the United States. The Conservation Sub-Committee of the Joint War Production Committee, U. S. and Canada, has arranged a steady flow of information between Canada and the United States.

The Department maintains a permanent representative in the Conservation Division of the War Production Board in Washington. This representative also maintains close contact with the U.S. Army, U.S. Navy and Air officials, and the Maritime Commission. He is Canada's member on the Combined Conservation Committee, which co-ordinates conservation efforts between Great Britain, United States and Canada.

CONTROL OF BASIC WAR MATERIALS

The foregoing statements outline the machinery which exists for co-ordinating the conservation efforts in Canada and between Canada and other countries. Back of this effort, of course, lies another picture. The foundation of any programme for the conservation of raw materials in war time must be government stock piles and government controls. Only by use of such devices can a frantic hoarding of raw materials be prevented. The control system is ideal for maintaining steady pressure in selected fields where substitutions must be made if the raw materials are to go around, and supplies required for war needs are to be where they are needed, when they are needed.

It became evident in 1941 that the demand for raw materials in this war would be without precedent, and that the war would have to be organized on a global basis. Among the results of that realization were the formation of the Material Co-ordinating Committee, United States and Canada, in May, 1941, and the setting up of the Combined Raw Materials Board in the fall of that year. Excellent co-ordination in the distribution of "policy and consumption data" between Britain, United States and Canada was obtained. A good practical job of controlling Canada's basic war materials has been done through the various sub-committees and through friendly and whole-hearted co-operation betwen the officers of our controls in Ottawa and the material branches of the War Production Board in Washington. Although geographic and other differences existing between Canada, Great Britain and the United States have necessitated differences in control measures in certain instances, yet, generally speaking, the control measures in the three countries are parallel.

To-day, we are feeling the good effects of the anti-submarine campaign in the North Atlantic and of the opening of the Mediterranean's shorter shipping lanes. Some of the pressure on the supply situation which was so heavy during 1942 and the early part of 1943 has been lifted.

CRITICAL SHORTAGES OF SOME MATERIALS

No good purpose could be achieved by hiding these facts, but let us not think that we are out of the woods *yet.*

The supply of nickel is just meeting the demand, and any increase in demand or decrease in production could be very serious. Cadmium is critical. A substitute should be found wherever possible. Tin is a wasting asset and must be protected by strict conservation measures. Supplies of other non-ferrous metals seem fairly adequate for the moment, but any large demand for any of them, caused by a shift in a munitions programme, could radically change the picture. In the ferrous field the situation on sheets is very tight, as is the situation on malleable castings.

In the rubber field we have another wasting asset. If any of you have in your plant an order for some part that requires the use of crude rubber I urge upon everyone concerned to take immediate and drastic action to find a substitute, either in the synthetic group or the plastic group. If you are entertaining the idea that you will continue to get crude rubber, other than a certain amount for blending purposes, for any product regardless of how urgent it may be, you are labouring under a misapprehension. If, on the other hand, you are trying to get rid of the use of crude in some product and are not satisfied with the progress that your rubber manufacturer is making, I suggest that you ask him to place the problem before the Rubber Technical and Conservation Committee for an opinion. This body operates under the Office of the Rubber Controller, but should be approached through your rubber manufacturer.

COMMITTEES DEALING WITH SUPPLY PROBLEMS

The Rubber Committee is one of the many committees serving the Department of Munitions and Supply. This device for dealing with difficult problems has been used freely by the Department. It would be impossible to tell adequately of all the excellent work done by these groups, but I should like to touch briefly on a few committees that deal directly with production problems and operate under the Co-ordinator of Production. It is my hope that some of this audience will be able to benefit from this information.

MACHINE TOOLS

I will mention first the committee whose affairs are so capably directed by the chairman of this meeting (J. G. Notman).

The efforts of management throughout Canada have resulted in the freeing of a large number of machine tools for other work either in the manufacturer's plant or in some *other* plant on urgent war work. Changes in programme have also contributed to releasing a certain number of machine tools for other work. In order that the best possible use might be made of Canada's machine tools and equipment, a central organization was set up known as the Machine Tool War Service Committee under the joint direction of the Co-ordinator of Production and the Machine Tools Controller. This committee keeps up-to-date records of all the government-owned machine tools released by various contractors and also receives requests from the various Production Branches for machine tools and equipment required to balance out operations or increase production. Carrying out the main function of the committee, namely, to see that the best possible use is made of Canada's machine tools and equipment, the committee allots machine tools to the various contractors on the basis of the programme priority established from time to time by the Production Board of Munitions and Supply.

The committee is a particularly active one and through its efforts considerable savings have been effected. When it was decided some months ago that Canada should fill an order for a certain type of 20 mm. gun, the original estimate for the cost of machine tools required for the job was $1,800,000. The committee

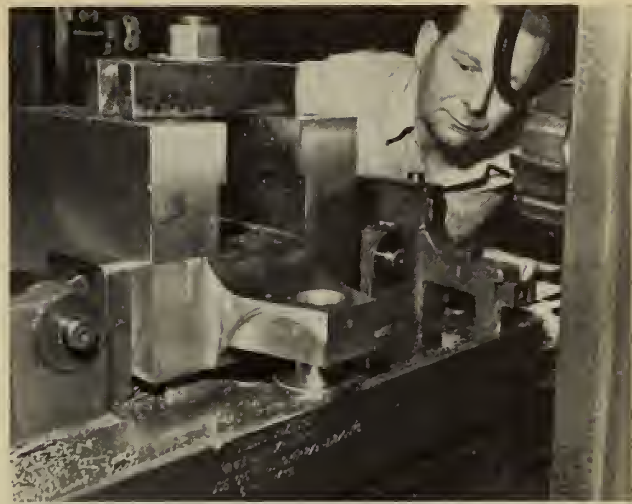


Fig. 1—Milling fixture for breech ring, showing hardened blocks affixed for easy adjustment of milling cutter position.

Fig. 2—Adjusting position of cutter to finish top face of breech ring and back of pintle lug at the same time.

was able to place in the particular shop selected for the job $1,300,000 worth of the type of tools required. An urgent request a few weeks ago for increased aircraft propeller production resulted in the transfer of $300,000 worth of machine tools to a particular plant within ten days time. With the ever-changing requirements of the war it is obvious that this committee can continue to serve a very useful purpose in connection with our war effort.

OTHER COMMITTEES

The Bolt and Screw War Service Committee is doing a good job of organizing for the best use of automatic screw machines and heading machines in Canadian industry.

The Drop Forge War Service Committee performs the same service in relation to our drop forge capacity.

The Plastics Technical Committee, cooperating with the Chemicals Controller, stands ready to give expert assistance to those in war industries who are designing new plastic parts, or who are having trouble with production.

CONSERVATION OF MAN-HOURS

So much for material shortages and the steps that have been taken to relieve them. You do not *need* to be told that we have a labour shortage in Canada. Labour is our *most critical* shortage. In fact, if we could

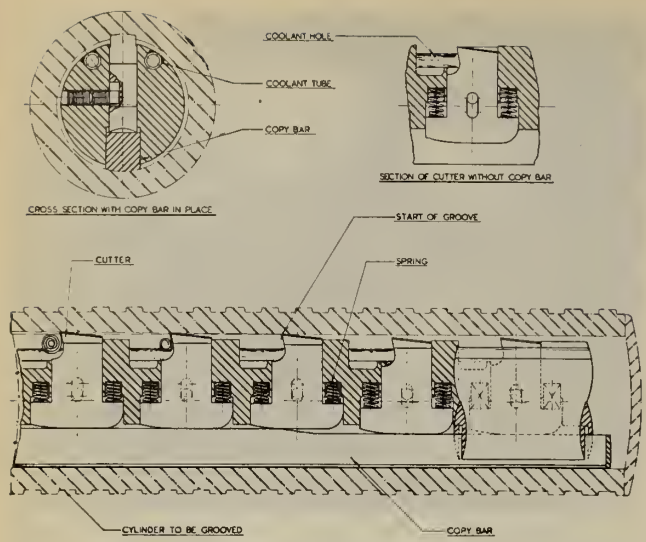


Fig. 3—Cross sections and longitudinal section of cylinder and broaching bar, showing cutting tools and copy bar in position.

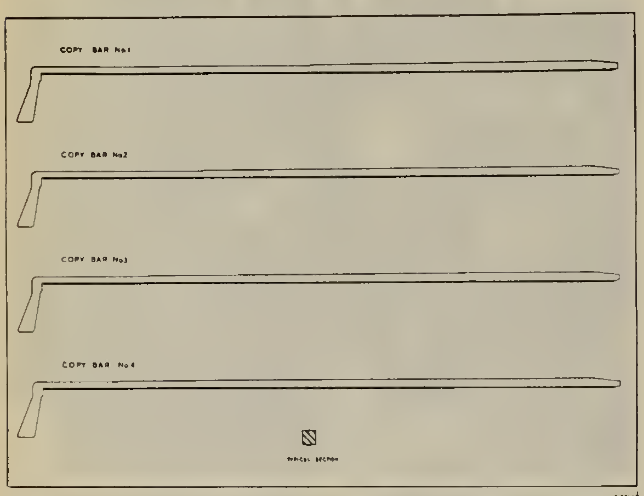


Fig. 4—Copy bars for the four passes needed to finish each groove.

get the labour we could relieve some of our critical material shortages very satisfactorily. The conservation of man-hours is one of the most serious of the immediate tasks that face us.

About two years ago Mr. Howe said "What we make with what we have will be the measure of our greatness in this war." Circumstances have sharpened that remark. It might well read now: "What we make with the men and the women we have will be the measure of our greatness in this war."

THE EMPLOYEE SUGGESTION PLAN SYSTEM

I will not touch here upon such matters as incentive pay, planning, or any other such methods for reducing man-hours required, for these things will be covered adequately by other speakers, but I do want to cover one subject which might be considered to come in this group.

Some manufacturing organizations have persuaded large numbers of employees to contribute to the saving of man-hours by offering them an incentive through Employee Suggestion Plans. The Canadian Government has recognized the possibilities of Suggestion Plans, by allowing the awards made under these plans to be charged to expense for income tax purposes when employed in war contractors' plants. It is also the practice to exempt the employee from income tax on his or her awards. It is only necessary to have the Suggestion Plan approved by the Minister or Deputy Minister of Munitions and Supply. The Department has issued a booklet on this subject, and it is yours for the asking.

Some remarkable results have been obtained by the John Inglis Company plant in Toronto. In a little over a year 7,500 suggestions have been received and nearly 1,000 of these have been accepted, with awards granted to the amount of $40,000. Over 600,000 machine-hours were saved, in addition to substantial savings of material and machine tools. Altogether in this plant during the past twelve months changes in process have resulted in a projected annual saving of 4,000,000 man-hours.

Similar and equally praise-worthy results are being secured in other plants, but in my opinion, more general interest should be taken in the Employee Suggestion Plan idea, because it can be used to get each employee interested in his own job, and to encourage him to find a way to get more work out of each hour. This is one avenue that may well be explored by manufacturers—particularly those whose work involves repetitive operations.

That much has been accomplished by way of conserving labour in war industries has, I believe, been proved by the fact that in practically every instance our most optimistic production expectations have been realized, and in a lot of cases, performance has been two, three or four times what was originally expected. Time will not permit me to go into the detail which would be necessary to do justice to management and labour for what has been accomplished in this country, but no paper on the subject of conservation would be complete unless it gave at least a few examples of what has been done and what is being done in this line by engineers in this country responsible for the prosecution of the war.

USE OF IMPROVED TOOLS, JIGS AND FIXTURES

A noteworthy instance of this is to be found in action in the 6-pounder programme at Dominion Engineering Works, Ordnance Plant. This plant was one of the first in the country to be set up for the production of tank and anti-tank guns. It was equipped on the basis of British manuals which recorded the experience of producing similar guns in United Kingdom arsenals. In order to get the plant into operation in the shortest possible time, a comparable list of machine tools was purchased from United States and Canadian sources. Realizing that it would be impossible to staff the plant with experienced mechanics, the engineering staff decided that it would be essential to build into the jigs, tools and fixtures for the job extreme accuracy and means of *simplifying* the various operations. Results have proved that for a moderate cost of tooling of between $40 and $60 per gun that the production hours per gun in the United Kingdom of around 1,600 man-hours have been reduced to something less than 350 man-hours in Canada. This reduction in man-hours enabled the plant to produce four times the rated capacity with the result that Canada has been able to build up her supply of this particular item in a far shorter time than was originally anticipated. With the cut-back to the original planned rate of production, machine tools and labour have been diverted to the production of anti-aircraft gun mounts, anti-aircraft controls, anti-aircraft guns, aircraft undercarriages and numerous other places in our war effort where machine tools were required.

USE OF TOOL-SETTING AND GAUGING BLOCKS

One of the main contributing factors to the success of this operation was the application of tool setting and gauging blocks to the various production fixtures. The application and use of these tool setting and gauging blocks are shown in the accompanying photographs—

Figure 1 shows a typical milling fixture for an operation on the breech ring, which includes (a) facing the back of the pintle lug to a definite height in relation to the muzzle face of the ring, (b) facing the top face of the ring in relation to the pintle hole, (c) facing the top face of the pintle lug to size in relation to both the hole and the top face of the ring. On the right hand side of the picture, near the operator's hand, are shown three hardened setting and gauging blocks these are attached to the fixture, and establish the three dimensions in question.

Figure 2 shows the operator setting the milling cutter to the vertical hardened block which establishes the dimension of the top face of the ring (item a) (using a fifteen thousandths feeler). In this particular case, the one cutter not only faces the top of the ring but at the same time faces the back of the pintle lug to size. (item b) For this purpose the cutter has to be adjusted vertically to the horizontal hardened block (using a fifteen thousandths feeler) which establishes the height of the back of the pintle lug. The lower vertical setting block controls item (c), the facing of the pintle lug top.

It can be seen that use of these hardened tool-setting and gauging blocks reduces the actual performance of the operation to a matter of being able to operate the controls of the machine and to set the cutters to the gauge blocks using a feeler. The fifteen thousandths feeler is standard throughout the plant so that errors from picking up the wrong thickness of feeler are eliminated. Close to ten million man hours have been saved in this particular plant.

USE OF IMPROVED BROACHING TOOLS

The next example relates to the cutting of the grooves in the cylinder of the 6-pounder recuperator, where General Motors' engineers developed a very efficient and outstanding broaching tool for this operation. The cutting time on this job was reduced to 45 minutes, as compared to 4½ hours at one other source, and we understand that in another plant the time was 6 hrs per job.

A cross section of the cylinder shows five grooves whose depth increases from zero at one end to 73 one-thousandths at the other. These five grooves have to be broached, and the tolerance for the variation in depth at any point in the groove is plus or minus 2 one-thousandths.

The principle adopted in this improved method of broaching requires the use of a round broaching bar carrying ten cutting tools as shown in Fig. 3, each cutting tool removing 2 one-thousandths. Thus one pass of this broach through the cylinder removes a total depth of 20 one-thousandths, and four passes will complete one groove to the required depth. Therefore, twenty passes will complete all five grooves in the cylinder. This operation, including the indexing of the part after every four passes and the necessary cleaning of broaching tools before the return stroke after every pass, also the clamping and removing of the part, entails an average time of 45 minutes.

It will be noted from the figure that the cylinder to be broached and the copy bar are stationary, while the broach carrying the ten cutting tools is moving through the cylinder. The copy bars then control the depth of cut as the tools slide over them.

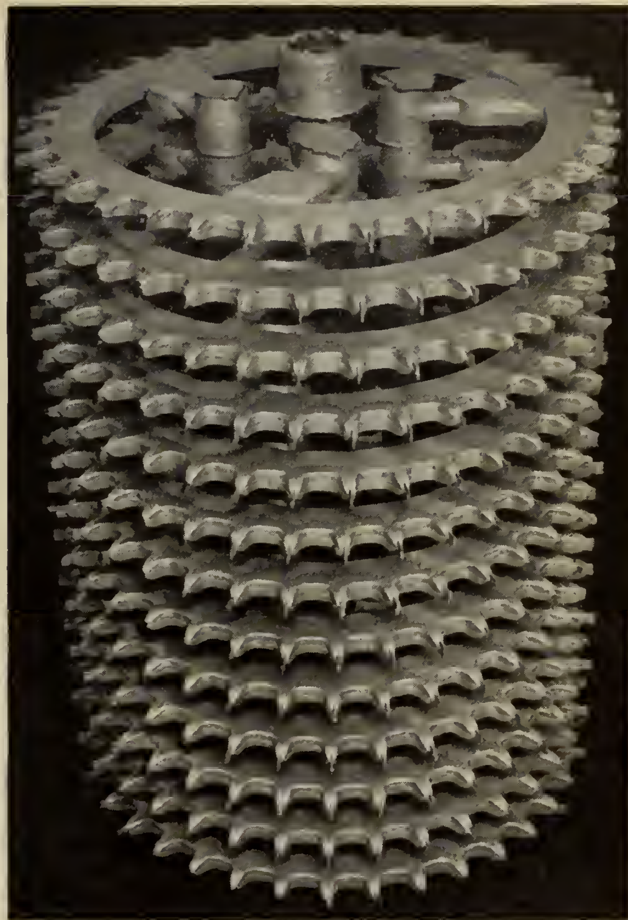


Fig. 5—Universal carrier drive sprockets produced in "christmas-tree" mould.

Four different copy bars are used, one for each pass, as shown in Fig. 4. For the first pass, the lowest copy bar is inserted, so that the cutting of the groove does not start until the cutters are well to the centre of the cylinder. The copy bar for the second pass is shaped so that the cutting starts sooner, and at the last pass the correct shape and depth of the last copy bar is reproduced in the groove. Only the last copy bar needs to be 100 per cent accurate, since it is the one which determines the finished dimensions.

It will be of interest to you to know that approximately 400 or 500 jobs were produced before resharpening was necessary. When resharpening became necessary, only the highest cutting tool was replaced by a new one, as in regrinding each tool, they were used on the next lower stage. In other words, only one cutting tool was discarded at each sharpening, and even these tools were reclaimed by a building up on the sliding surface with Ampco metal.

FORGINGS REPLACED BY CENTRIFUGAL CASTINGS

Another valuable contribution to production engineering in Canada since the outbreak of war has been the development of a centrifugal casting technique by the Ford Motor Company of Canada.

Centrifugal casting is, in many instances, an alternative for forging. It is a process of pouring metal at a given temperature while spinning the mould at a certain predetermined speed. Under ideal conditions centrifugal castings can be produced possessing physical properties even better than those of forgings. This is

Fig. 6—Illustrating the saving of material effected by the centrifugal method of casting.

explained on comparison of the two methods. In forging, bar stock is heated to a given temperature, around a bright cherry red, and hammered into shape, consequently perfect cohesion in the molecular structure cannot be obtained, whereas with a spun castings, poured at a given temperature, the metal being liquid gives perfect cohesion *as the molecules take their set.*

The value of centrifugal casting in war production has been amply demonstrated in the Ford foundry. As an example, take the drive sprockets for the universal carrier which are now produced as a centrifugal casting. In the original British design these sprockets were flame-cut from a solid rolled plate about two feet square. All that was obtained from the first operation was a ring approximately four inches wide into which the sprocket teeth had to be gashed and the part was finished machined all over. Now cast as a "spinner" the rough casting obtained is approximately the size and shape of the finished sprocket complete with teeth. Only minor machining is required. The drive sprockets are cast in a dry sand "Christmas tree" and are produced 13 to a mould. In use the cast sprockets have been found to outwear the original flame-cut type by a wide margin. It is estimated that on this one part alone the adoption of centrifugal casting has enabled Ford of Canada to substitute approximately 1,800,000 lb. of scrap for the 8,860,000 lb. of virgin rolled stock needed for a year's production. In addition centrifugal casting of this part has resulted in a saving of 725,000 man-hours a year and a total of $1,720,000 in cost.

DISCUSSION

Following presentation of the paper "The Continuing Need for the Conservation of Resources" by Mr. Howard Coonley (published in the November 1943 *Journal*), and presentation of the above paper, the following discussion took place at the meeting.

Thornton Lewis[1]

Mr. Howard Coonley's excellent paper has given an overall picture of the conservation measure set in motion by the War Production Board. This programme provides for comprehensive action to determine the raw material resources available, the current requirements for such material and an attempt through conservation and conversion to bring into balance the demands and the supplies available. By determining the relative importance of the various needs and controlling the distribution of the supply of materials, the vital demands for the war effort have been satisfied.

Mr. Coonley has cited many cases of substitution, conversion and down grading which have resulted in the conservation of critical materials.

It may be of interest in connection with Mr. Coonley's paper, handling the broader application of the subject, to extend the discussion and get a picture of conservation work in one of the operating agencies.

The Ordnance Department of the United States Army Service Forces is directly responsible for the development, design, procurement, supply and maintenance of all weapons, ammunition, tanks and combat and transport vehicles used by the Army and supplied to our Allies through Lend-Lease.

In no branch of the Government was the need for conservation more keenly appreciated than in the Ordnance Department. Accordingly a Conservation Branch was established in the Technical Division, and a Suggestion and Conversion Section was created in the Industrial Division, in order to effect conservation in new or existing designs already in production. Further, Conversion Engineering Sections were established in each of the Ordnance Department's district offices. In functioning through these thirteen field offices as well as at headquarters in Washington, the Ordnance Department conservation organization is unique among the armed forces, and to this field contact we attribute much of our success.

Thus, the problem of conservation was tackled from two angles: first, new ordnance designs, and second, the much greater field of ordnance material already being manufactured. The problem was so large it was realized that the Army alone could not do the whole job, but by means of a promotional campaign, the brains and ingenuity of engineers in private industry were mobilized.

Here in the Dominion of Canada a similar campaign was implemented. Also, after the United States Ordnance Department had organized its efforts, full information on its methods was furnished to Great Britain through the Ministry of Production in Washington. One of its members, Mr. A. J. T. Taylor, a member of The Engineering Institute of Canada, flew to London carrying photographs, samples, directives, etc., which were all exhibited in London to some of the highest officials of the British Government.

From the United States Army Ordnance Department's programme, truly remarkable results have accrued.

As so often happens when a development is undertaken to secure a specific saving, other benefits are also realized. This has been the experience in our Conversion Engineering Programme. When a conversion study was finally completed, not only was a saving in critical materials accomplished but in most cases there was also a reduction of machine hours and overall cost. In many instances fewer critical machine tools were also required.

Some few illustrations may be in order. It was found that fragmentation bombs were doubly effective and safe to use if dropped at low altitudes by parachutes. Present procurement created a demand for over 44 million yards of parachute cloth which, in the past,

[1] Deputy Chief, Production Service Branch, Office of the Chief of Ordnance, War Department, Washington, D.C.

had been made from high tenacity rayon 36 in. wide. This rayon was no longer available because it was required for war vehicle tires. Here we literally "cut the chutes to fit the cloth." Semi-high tenacity rayon was substituted and the width changed from 36 to 28 in., all waste being eliminated. Over 12 million sq. yds. of this critical material were saved, and over 13 million lb. of high tension rayon made available for military tires.

The shipping band for 250-lb. bombs was formerly made with two circular steel strips formed into U-shaped sections, each weighing five pounds. These have now been replaced by laminated, impregnated paper bands secured by a light steel strip. On the next million bombs shipped, this idea saved more than nine million pounds of steel. This design has now been adopted on the 500-lb. and 1000-lb. bombs with even greater unit savings.

The new mechanical solderless method of crimping windshields on armor piercing shot not only has proved superior, but will save 1,873,000 lb. of solder on the production in the last seven months of 1943 of shot ranging in size from 37mm. to 3-in. Most important, however, is that slightly more than half of this weight is bismuth, which is vitally needed in pharmaceuticals for medical treatment. Bismuth has become increasingly critical as production for war has advanced.

Plastics have replaced critical non-ferrous metals for many uses. In 1943 we will use over 8,250,000 lb. of resin.

Our greatest savings were accomplished in the non-ferrous and ferrous group of metals, particularly where carbon and low alloy steels were substituted for high alloy steels.

The demand for many critical production tools was eliminated, idle machines put to work, and 44,000 tons of steel alone have been saved, on 1943 production, through the introduction of steel stampings.

These substitutions not only saved critical materials but allowed, in many instances, an enormous increase of production.

A case of conservation, in which two separate Army services have co-operated, recently came to my attention. In making air field landing mats from SAE 1010 steel plate, holes are punched, creating millions of 10 gage discs approximately 2¼ in. in diameter. Formerly the Engineer Corps sent these discs back to the steel mills as scrap. The Ordnance Department has found a half-dozen uses for these discs in the manufacture of ammunition components. Even these uses will not completely consume the entire supply, but we will continue our search to find additional places where these discs may be employed.

Savings of the following critical materials, based on 1943 procurement, will be effected by the Ordnance Department Conservation Programme:

Aluminum	Enough to build 25,000 fighter planes
Copper	Over 200,000 tons
Crude Rubber	Over 115,000 tons
Steel	Over 622,000 tons
Zinc	Over 100,000,000 lb.
Nickel	Over 50,000,000 lb.
Molybdenum	Over 5,000,000 lb.
Chromium	Over 12,000,000 lb.
Tin	Over 5,200,000 lb.
Tungsten	Over 9,000,000 lb.

Our constant aim has been to "down grade" from critical materials to materials less critical and therefore easier to obtain.

Suggestions received by our Conversion Sections in 13 months total over 3300. About 800 have not yet been acted upon, 1200 have been rejected, and over 1300 accepted for production. Over 50 per cent of all suggestions considered have been adopted. This high percentage is a tribute to the fine intelligence and ingenuity of the industrial engineers who have co-operated with the Ordnance Department in this programme.

G. R. Langley, m.e.i.c.[2]

Ways of economizing in the use of materials, are *very* important and a short description of some of those adopted at our Peterborough Works during the last three years may be interesting.

In flame cutting irregular-shaped pieces from steel plate, a little planning yields big results. We use junior draftsmen to make full size layouts of the pieces on heavy template paper. These are cut out and shuffled around on pressboard sheets the same size as standard steel plate, until the most economical cutting positions are found. The cutouts are then pasted down on the pressboard. The flame cutting department scribes around the cutouts and uses the resulting scribed grooves to guide the flame cutters. This scheme also permits the Stores and Purchasing Departments to arrange for exact requirements with confidence and the overall savings more than offset the small cost of producing the cutting plan.

Even though the best cutting plan is followed there are always many small pieces of scrap plate left. In normal times it is customary and probably economical to save only the largest pieces and sell the balance as scrap. Under wartime conditions it is necessary to minimize the load on rolling mills by saving quite small pieces. We find that the utilization of these small pieces is greatly facilitated by tables. Which show the small parts in common use that can be made from the small odds and ends left over from the cutting. New plate is never used for any part shown on one of the indices unless no scrap pieces are available. The plan works so well that it has been extended to other sheet materials.

In connection with certain punched parts, waste is frequently involved through the careless assumption that small nicks or flats cannot be tolerated. For example investigation showed a surprising number of cases where it was quite unnecessary to allow the customary margins between punchings and at the side when punching circles or segments from magnetic sheet steel. On one single job over 35 tons of sheet was saved by allowing small flats on the side, together with the small nicks that are the inevitable result if there is no allowance between punchings. It is incorrect to call these flats and nicks, imperfections, in cases where they have no effect on the appearance or performance of the finished machine.

An article was published in the *Engineering Journal*, January 1943, on an extremely simple scheme developed at Peterborough for eliminating *all* waste in the use of welding electrodes. This is in use in a number of plants, but in view of the shortage of electrode producing capacity it is regrettable that it is not yet in general use.

H. Thomasson, m.e.i.c.[3]

An important phase in any conservation programme is the reclamation of used, broken or damaged items. This is particularly true in the case of special tools such as drills, reamers, taps, dies, milling cutters, and form tools. All of which are both scarce and subject to abuse

[2]Engineer, Peterborough Works, Canadian General Electric Company, Limited, Peterborough, Ont.
[3]Welding Engineer, Canadian Westinghouse Company Limited Hamilton, Ont.

by relatively untrained help, now of necessity using them.

Reclamation of tools breaks down into two major divisions, first, those which only require sharpening or repairs that can best be made by modern grinding equipment, and, second, those repairs that involve the use of welding processes to add metal or join parts.

Broken tools of relatively small cross section are repaired by the use of special low temperature silver soldiers; the essential requirements in this work are cleanliness and patience, while the major pitfall is that of alignment, and special attention should be given to this point.

This method of tool repair is very successful on high speed steel tools which are not reduced in hardness by the process, though appreciable softening occurs if it is used on tools made of plain carbon tool steels.

The second type of repair is where a non cutting portion of a tool such as the tang or shank of drills, reamers, end mills, and similar tools has been broken or damaged to the point where metal must be added. In such a case a new piece is arc-welded on to the broken end. Such welding though strong in itself embrittles the material near the weld, but this is overcome by a stress relief tempering treatment which toughens both the weld and adjacent metal. This method is quite successful, and is also used to repair carbon steel tools when they are of sufficient value to warrant it.

The third type of repair is when portions are broken on or off the cutting edges of valuable tools, such as milling cutters. Here we use arc welding with electrodes of high speed steel to replace the broken portion or to build up worn teeth. The same method is also used to build up punches and dies, and we have found that the use of carbon blocks as an aid to controlling the shape of the deposit has a double value in that it results in sounder metal than is the case when carbon is not used.

The most recently developed repair method is to use the atomic-hydrogen process of welding in the repair of chipped dies, form punches, and similar items. This method has the advantage of being able to deposit metal of any desired analysis, due to the fact that every element is transferred from the filler metal into the weld without loss except carbon, and carbon loss can be controlled to some extent. Another factor is that filler rod can be forged from any odd piece stock that is of the desired analysis which is—all elements except carbon as desired in the weld and carbon approximately 0.40 per cent excess. This method involves annealing and re-heattreating the part and is at its best on very expensive dies. As an example, some time ago we repaired a die-casting die, saving 75 per cent of the replacement cost. The repaired die has been in service for several months and has produced over ten thousand castings.

The problems involved in this work are not welding problems, but are problems of metallurgy and associated heat treatment due to the heat effects from the welding. It is certainly not advisable to throw problems of this type into a welding shop unless they have the necessary technical assistance.

William A. Duncan, m.e.i.c.[4]

One of the most urgent war requirements has been armoured vehicles of all kinds. Welding procedures were established for bulletproof plate for scout cars, after a great deal of painstaking development. Then the introduction of automatic welding greatly accelerated production, for one automatic electric welding head will do as much welding as ten to twelve manual arc welding operators.

The original welding rod used for this application was an austenitic rod containing high percentages of chromium and nickel—both critical materials. Further development, with the co-operation of the manufacturers of these vehicles, finally resulted in a ferritic rod for automatic electric welding. This met all physical requirements and passed the ballistic tests of the Inspection Board of the United Kingdom and Canada. It has resulted in an estimated annual saving of 81,000 man-hours and 25,000 lb. of critical alloys (mostly nickel and chromium).

Practically all bronze welding rods for the production, maintenance, and repair of machinery and equipment contained about one per cent of tin—a most critical material. At the urgent request of the Metals Controller the welding industry developed a substitute bronze rod containing no tin whatever and thereby saved approximately 8,750 lb. of tin annually.

Another highly important development by the welding industry is the increased use of automatic welding in shipbuilding. Because of the need for speed in shipbuilding and for large amounts of welding of all kinds, and because of the difficulty of obtaining a sufficient number of qualified manual arc welders, the introduction of automatic welding was a godsend. This can be realised when we consider that a single automatic welding unit in a shipyard, operated by only two men (operator and helper) has welded more than 600 lin. ft. in a day—a job that would normally require ten to fourteen men for manual arc welding.

We could cite from our own records innumerable instances where bronze-welding has put damaged machinery back into service in a matter of hours, thus avoiding production delays of weeks and even months. Two examples will suffice:

A 500-lb. cast iron slide of a hot nut making machine in a steel plant cracked. It was repaired by bronze-welding and put back into service in nine hours. The replacement part could not have been obtained in less than three months.

A large press gear from a machine essential to production of war materials in a shell plant was broken. Again a replacement could not be obtained in less than three months. It was bronze-welded and returned to service in thirteen hours.

[4]Manager, Process Service, Dominion Oxygen Company Limited, Toronto, Ont.

JOB EVALUATION

D. W. WEED

Wages Payment Division, Personnel Department, General Electric Company, Schenectady, N.Y.

An article written at the request of the Institute Committee on Industrial Relations, being one of a series prepared for the *Journal*.

There is nothing particularly new in the principle of job evaluation. We have been evaluating jobs since the beginning of industrial organization. The president of the company has always received more than the office boy, and the tool and die maker has always received more than the sweeper. The only point at issue is how much more should the president receive than the office boy and how much more should the tool and die maker receive than the sweeper. After all, an employee views his rate of pay and compares it with the rates of pay on other jobs. If the rate of pay that he is receiving cannot be proved to be a correct one as compared with other jobs with which he is familiar, a potential industrial relation situation exists.

It must be borne in mind that in any plan for determining rates of pay there are two different phases: first, evaluating the job, and second, evaluating the contribution the employee makes on the job. These are two separate and distinct things and must not be confused. The discussion of this paper will be confined to job evaluation.

The principal purposes of job evaluation are:

1. To establish proper differentials between jobs in the same factory.
2. To establish proper wage levels.
3. To establish proper rates on new jobs.
4. To establish promotional sequence.

Unless a plan of job evaluation is so simple, so easily understood, that any employee, after having been given proper instructions, can evaluate his job, it will probably be unsatisfactory.

There are two schools of thought in job evaluation plans. The first is by the grading method, which is usually done by a committee which considers jobs as a whole and puts them in grades with like jobs. The chief objections are: first, it is difficult to prove to an employee that his job has been put in the proper grade, as the grading, after all, is only the opinion of a group; second, as time goes on, the personnel of the committee changes and there may be differences of opinion about jobs, particularly on border-line cases.

The second system is the numerical point rating system which is in use at the General Electric Company. There are several variations to this system, most of which are workable and are in the main, satisfactory. The system which I will now describe has been in use in the General Electric Company for over ten years.

In factory jobs we concluded, after long study, that the compensatory characteristics were: mentality, skill, responsibility, mental application, physical application, working conditions.

MENTALITY

Our definition of mentality is mental capacity, that is, the mental capacity required to do the job. Such mental capacity is gained usually in the ordinary sense through schooling. It does not make any difference whether the knowledge is gained in a formal or an informal way, but it is the mental development that an employee must have before he is qualified to do the job in question.

SKILL

After consulting many authorities, and checking with many superintendents, we arrived at the conclusion that skill could best be defined as "learning time." By learning time we mean the total time required on previous jobs plus the time required on the job in question so that the employee can perform the job in an expeditious manner.

RESPONSIBILITY

In evaluating the responsibility required on a job, we measured the chance of hazard or error and its probable cost in material or machinery. If a man is operating an expensive piece of equipment, which is practically fool-proof, the job responsibility is low. If, on the other hand, he is working with very expensive materials, or with expensive equipment, which he can wreck, through an error in judgment, the job responsibility is high.

MENTAL AND PHYSICAL APPLICATION

The definition of these two characteristics is the same and, therefore, we classify them together. It is the degree and continuity of application. If the job requires constant physical effort, the physical application is high. If it requires constant mental effort, the mental application is high.

WORKING CONDITIONS

We do not believe that working conditions are a very serious thing. The modern shop of to-day is a good place in which to work. Large amounts of money have been expended in making work places safe, clean, light, and wholesome, but there are certain jobs which have hazards to clothing or health for which the employee working on such jobs should be compensated.

In setting up this system of job evaluation no attempt was made to prove or disprove any theory of wages. A survey of many firms was made to find the ideas of industry as to the worth between different jobs, and with this information on hand we weighted the characteristics so as to arrive at a wage scale, which was in agreement with what industry was accustomed to pay. We felt that all jobs had something in common and that we should evaluate only those parts of the jobs which differed from other jobs. We, therefore, adopted a base of 400 points which would apply to all jobs. The reason we chose 400 points was that at the time we installed the system the National Labour Relations Board had just come into being and they had decided that 40c per hour was the minimum pay for most industrial establishments and as we wanted to have a large number of points we chose a multiplier of 10.

To set up a job evaluation system such as has been outlined, it is necessary to select some fifty jobs ranging from the highest to the lowest, making very detailed analysis of each job and ranging them from high to low in each characteristic. After the key list is developed, evaluating any job becomes very simple. It really becomes a comparison of jobs rather than an evaluation system. Every job should be analyzed in each characteristic in respect to some job close to it. As an example—in evaluating skill, does it take longer to learn to do this new job than it does some job already evaluated ?

(Continued on page 103)

REPORT OF THE COUNCIL FOR THE YEAR 1943

Together with Committee and Branch Reports

In the history of a society such as the Institute, it is difficult to pick out any one year and say it was the best or the most outstanding. Doubtless each year as it goes by seems to qualify for these titles. Certainly this is true of 1943, and the report which follows will give some indication of the reasons for making that statement.

Size is not necessarily an indication of greatness. Nevertheless, it is important and has a definite bearing on the success and activities of an organization. Last year saw the Institute membership reach a new level of 6,073, with an increase much greater than has occurred in previous years.

Finances, too, are used as a gauge in appraising an organization and its work. As the reports of the Finance Committee and the treasurer indicate, the Institute's finances for the year have been very satisfactory. There is a substantial balance, in spite of the fact that the cost of doing business has increased and that fees of all members overseas and members in combatant areas have been remitted. An expansion in activities has also brought about certain additional expenses, but in spite of these reductions in income and increases in expenditures, the net balance is quite satisfactory.

The best medium by which to judge of the work of a society is the work of its committees. It is doubtful if the Institute has ever had more special committees than it has had in the last year. All these have been active and have made considerable progress, although in every instance the objective has not yet been attained. In such instances, the committee is continuing in 1944.

Visits to Branches

President K. M. Cameron, during his term of office, visited every branch of the Institute and attended every Council meeting. In addition he held Institute meetings in three other places where branches are not yet established. He visited and spoke to the students at every university but one, where engineering degrees are given. During his tour of the western branches he also spoke to several sections of the McGill Graduates' Society.

Council Meetings

Council held many of its meetings away from headquarters. Such meetings were held in Winnipeg, London, Toronto, Quebec and Saint John. In all, there were 12 meetings of Council held throughout the year, with an average attendance of 13. Out of a total of 43 councillors, 36 attended at least one meeting and represented 20 out of 25 branches. The practice of holding these regional meetings of Council has been fully justified.

Finances

The financial statement very largely follows that of 1942. One noticeable difference is that the large amount of arrears of fees which were collected the previous year has not been repeated last year. Doubtless this is due to the fact that the arrears have been very largely cleaned up. There is a substantial increase in the amount of current fees received. Members will find the reports of the treasurer and the Finance Committee both interesting and illuminating.

Annual Meeting

The Annual Meeting at Toronto set some new records. Registration was approximately 750, which is the largest number ever registered for an annual meeting in that city. A splendid programme was arranged by the local papers committee, and every detail of a full meeting was carried out by the local committee to the pleasure and satisfaction of everyone present.

Members in Active Service

It is difficult to secure up to date information about members in the services. Such persons change quickly from place to place; sometimes their location is a matter for secrecy; usually they are too busy in matters of greater urgency to keep Headquarters informed. Nevertheless, some information has been received, and more is being sought as a basis of a permanent record. In the last war 36 per cent of the entire membership was in the services.

While it is difficult to render much useful service to the members overseas, the Institute is more than ever interested in them and would be glad of opportunities to assist. It is proud of their record of honours won for gallantry, and of promotion through merit. Engineers at home acknowledge their indebtedness to their overseas associates, and are grateful for the prestige which is being added to the word "engineer" in all the four corners of the earth.

Collective Bargaining

Another activity which was carried out in co-operation with several other technical organizations was the presentation of a brief to the McTague Commission. It had to do with the possible inclusion of engineers in compulsory collective bargaining, a procedure which the brief insisted must not be established.

Engineering Students

There has been a great increase in interest and activity shown towards the Institute by the students in engineering in many of the universities. Requests for Student Sections have been received from four universities, and negotiations are under way for the completion of agreements. In the meantime there have been substantial increases in the number of students who have joined the Institute in the regular way.

Special Assignments

The Institute accepted an assignment from the Army Technical Development Board with reference to land mines, which developed into a nation-wide activity. Six other societies were asked by the Institute to join in the work so that the endeavour could be carried out co-operatively and therefore more comprehensively. All those members who participated will be glad to know that the Board was very appreciative of the way the project was handled, and was quite pleased with the final results.

International Relations

It is a real pleasure to report that relationships with sister societies in other countries have developed considerably throughout the year. There have been several matters of joint interest and concern with both British and American organizations, and the indications are that the future holds considerable promise of greater opportunities for joint effort on behalf of the profession.

An interesting feature of every annual meeting is the presence of officers of American societies. Institute members look forward to these visits as opportunities to make or renew friendships of great value. In turn the officers of the Institute attend the meetings of several societies in the States, and are given a very warm welcome.

Among last year's events of international importance were the joint meeting with The American Society of Mechanical Engineers in Toronto, the completion of a co-operative agreement with the A.S.M.E., the meeting of the Engineer's Council for Professional Development in New York, and discussions of co-operation with the American Institute of Electrical Engineers carried out by committees appointed by the presidents of the two societies.

Joint Meeting with A.S.M.E.

One of the highlights of the year was the meeting held in Toronto on September 30th and October 1st and 2nd with The American Society of Mechanical Engineers. The executive of the Toronto section of the A.S.M.E. and the branch of the Institute formed a joint local committee to carry out the meeting. There was a registration of 800, with a large group coming from the United States. Three days and nights of professional sessions provided an unusually full programme of great value.

In addition to the professional and technical features, the meeting afforded special opportunities for the development of international contacts and goodwill. It was a pleasant and profitable experience, which it is hoped may be repeated frequently in the future.

Co-operative Agreement with A.S.M.E.

New ground was broken in an expanding programme when the members of a joint committee signed a co-operative agreement in October at Toronto between the A.S.M.E. and the E.I.C. The relationships with this society have always been cordial and friendly, but it was the opinion of officers of both organizations that more progress could be made on behalf of the profession if an organized basis of co-operation could be established. It is expected that the committee established by the agreement will shortly report on endeavours which may be undertaken jointly, to the advantage of both groups and of the profession at large.

Engineers' Council for Professional Development

The E.C.P.D. is one channel through which definite progress has been made towards the improvement of international relations. The co-operative efforts of members of the Institute and members of the seven American societies, working on committees that are grappling with the problems of the profession, have brought American and Canadian engineers appreciably closer together. This association is a rare privilege for Canadians, and at the same time should be the most effective means for establishing professional recognition on both sides of the border.

Roll of the Institute

The membership of all classifications now totals 6,073, which is again a record. New names added to the roll for the year 1943 amounted to 562, but deaths, resignations and removals reduce the net figure to a gain of 421.

During the year 1943, 546 candidates were elected to various grades in the Institute. These were classified as follows: Honorary Member, 1; Members, 162; Juniors, 32; Students, 340; Affiliates, 11. The elections for the previous year totalled 469. Sixteen reinstatements were effected, and 13 life memberships were granted.

Transfers from one grade to another were as follows: Junior to Member, 72; Student to Member, 23; Student to Junior, 95; Student to Affiliate, 2; a total of 192.

The names of those elected or transferred are published in the *Journal* each month immediately following the election.

Removals from the Roll

There have been removed from the roll during the year 1943, for non-payment of fees and by resignation, 41 Members; 2 Juniors; 26 Students; and 7 Affiliates; a total of 96.

Deceased Members

During the year 1943 the deaths of forty-five members of the Institute have been reported as follows:

Members

Allison, John Logie....Montreal, Que.
Baker, James Davidson....Edmonton, Alta.
Burnett, Francis Charles Edward....Montreal West, Que.
Campbell, John George William....Halifax, N.S.
Clark, George Silas....Montreal, Que.
Colhoun, George A....Hamilton, Ont.
Condon, Frederick Oxley....Moncton, N.B.
Cornish, Wilfred Ernest....Edmonton, Alta.
Crowley, Charles James....Toronto, Ont.
Dupuis, Louis Charles....Lévis, Que.
Farquharson, Stanley....Montreal, Que.
Fetterly, Philip Austin....Calgary, Alta.
Fulton, William....Norwood, Man.
Gibbs, Charles Richard....Kalamazoo, Mich., U.S.A.
Harkness, Andrew Harkness....Toronto, Ont.
Harrington, Conrad Dawson....Montreal, Que.
Harrington, John Lyle....Kansas City, Mo., U.S.A.
Hole, John....Toronto, Ont.
Howse, George Wesley....Hamilton, Ont.
Kennedy, William....Montreal, Que.
King, Harry Molyneux....Niagara Falls, Ont.
Kugel, Emil....Montreal, Que.
Larner, Chester Waters....Philadelphia, Pa., U.S.A.
Libby, Philip Nason....Kingsport, Tenn., U.S.A.
Livingstone, Robert....Lethbridge, Alta.
MacKenzie, Charles Edward....Springhill, N.S.
Main, Daniel Todd....Montreal, Que.
Matheson, Arthur John....Toronto, Ont.
McBride, Wilbert George....Montreal, Que.
Nicholson, John B....New York, N.Y., U.S.A.
Nowlan, Brete Cassius....Montreal, Que.
Ord, Lewis Redman....Toronto, Ont.
Pacy, Ernest Harold....Pittsburgh, Pa., U.S.A.
Paine, Nathan Deane....Montreal, Que.
Stead, Geoffrey....Saint John, N.B.
Stevenson, Charles Lester....Ottawa, Ont.
Stewart, Robert A....New Glasgow, N.S.
Sutherland, Alexander....Wolfville, N.S.
Symes, Cyril Barron....Fort William, Ont.
Wain, John Bernard....Montreal, Que.
Westbye, Peder Pederson....Hamilton, Ont.
Wilson, LeRoy Z....Sydney, Australia
Wingfield, Harold Ernest....Stratford, Ont.

Junior

Flahault, Jean E....Arvida, Que.

Student

Polley, Edward Victor....Toronto, Ont.

Total Membership

The membership of the Institute as at December 31st, 1943, totals 6,073. The corresponding number for the year 1942 was 5,652.

	1942	1943
Honorary Members	16	17
Members	3,727	3,820
Juniors	655	665
Students	1,158	1,471
Affiliates	96	100
	5,652	6,073

Respectfully submitted on behalf of the Council,

K. M. Cameron, m.e.i.c., *President.*
L. Austin Wright, m.e.i.c., *General Secretary.*

TREASURER'S REPORT

The report of the Finance Committee shows that from a financial point of view the Institute has had a satisfactory year.

The securities as shown in the auditor's statement have been checked and found in order. The market value of these at to-day's date is approximately $27,250 as against $26,558, the cost of the Institute.

Respectfully submitted,

C. V. Christie, m.e.i.c., *Treasurer.*

FINANCE COMMITTEE

Your Finance Committee is pleased to again report a satisfactory year for the Institute.

The balance sheet prepared by the auditors shows a surplus of approximately $2,600 for the year's operation. You will notice that additional reserves have been set aside for the building reserve fund, thus making the total in that fund $5,000.

Your attention is called to the bank overdraft. This is due to two things. (1) The Institute paid out in advance for the Army Technical Development Board approximately $2,000 in accounts, return for which will not be made until January. (2) During the year $10,000 of Victory Loan bonds were purchased which exceeded the surplus of last year. Consequently the working capital has been reduced, but the Finance Committee has thought it better to use the bank accommodation than to sell any of the bonds.

The special fund known as the Past Presidents' Fund has been examined and approved by the Finance Committee. This fund does not appear among the other accounts of the Institute.

The committee would also like to comment on the fact that the cost of a great many supplies and services which are used by the Institute have increased materially through the year, and contribute to the increase in expenditures. The committee feels that in view of the remission of fees to members overseas and in combatant areas, and the increase in costs, the statement for the year makes a very satisfactory showing.

Respectfully submitted,

C. K. McLeod, m.e.i.c., *Chairman.*

SIR JOHN KENNEDY MEDAL

The Sir John Kennedy Medal has been awarded by the Council of the Institute to Chalmers Jack Mackenzie, c.m.g., ll.d., d.sc., m.e.i.c., acting president of the National Construction Council, at Ottawa, and dean of engineering at the University of Saskatchewan.

COMMITTEE ON INDUSTRIAL RELATIONS

Since the last annual report, seven meetings of your Committee on Industrial Relations have been held, viz.: April 9th, May 7th, June 21st, September 30, November 5th and December 3rd, 1943.

The papers arranged by Professor Viteles and Dr. Bryce M. Stewart for presentation at the Annual Meeting held in February, 1943, were published in the *Journal* together with the discussion.

The University Syllabus on Industrial Relations which was under preparation was brought to a completion and at the request of the committee, was sent out by letter from the president of the Institute to the universities and colleges. The syllabus is under consideration by committees in most of the universities and colleges and from information presently in the hands of the committee, it is being well received.

Speakers on standards pertaining to industrial relations have been provided to the Branches on request and from the experience so far obtained, it is felt that a wider dissemination of information can be obtained by this means than by almost any other available.

The reports commonly known as the Beveridge, the Marsh, the Haegerty and Whitton have been received by the committee and have been given very careful study and discussed at a number of the meetings.

Papers on specific subjects pertaining to industrial relations have been prepared, at the request of the Committee, by Professor M. A. MacKenzie, Mr. Weed, Dr. Dowd and Professor Panabaker and forwarded to Headquarters for publication in the *Journal.* These were papers by international authorities on the problems before them and of vital interest to members of the Institute. Because of a crowded publication programme and the shortage of paper none of these papers appeared during the year, but the first two are scheduled for the January and February, 1944, issues.

The subject of collective bargaining has received very serious consideration at almost every meeting of your committee. Certain fundamentals have been developed, but as yet your committee is not prepared to report on this most important subject.

Your committee requested Headquarters to state if the matter of demobilization and retraining of personnel from the armed forces, came within the purview of this committee or if it was being placed in the hands of some other committee. We were assured that it should come within the purview of the Committee on Industrial Relations. Acting on this premise, the responsible officers of the various sections of the armed forces and of the Department of Pensions and National Health have been interviewed and rather complete reports of the present status of the situation have been presented to the committee. Arrangements have also been made whereby your committee will officially be kept in touch with the developments in the methods to be used by the armed forces and the Department of Pensions and National Health pertaining to this subject.

At the request of the committee in charge of the joint meeting of The American Society of Mechanical Engineers and The Engineering Institute of Canada, held in Toronto early in October, 1943, your committee arranged to have Professor J. C. Cameron, a member of the Committee on Industrial Relations and on the faculty of Queen's University, present a paper at a luncheon on the subject of industrial relations. This paper was broadcast and was extremely well received and has been published in the *Journal*.

One of the most important subjects receiving the attention of members of the Institute in industry during the past few years has been that of job classification and wage schedules. This matter has received the careful consideration and study of your committee at different times and possibly at a later date, a report may be presented but some of the essentials of this subject were prepared by Mr. Weed in the form of a paper which will appear in the February, 1944, issue.

While the interest of any such committee as the Committee on Industrial Relations in the work of the International Labour Office is important, yet the fact that this office due to war conditions has been transferred from Geneva to Montreal, makes it all the more important for Canadians and particularly Canadian engineers to be more conversant with the operations of this most important body. Your committee has been made aware of the work being carried on by the International Labour Office and intends to keep abreast with the problems before that organization.

A request was made for a paper to be presented at the Annual Meeting to be held at Quebec. It was thought that such a paper should be a broad subject of general interest. Arrangements have therefore been made to have Mr. Maurice Stack of the staff of the International Labour Office present a report on the Beveridge, Marsh, Haegerty and Whitton plans.

Respectfully submitted,

Wills Maclachlan, m.e.i.c., *Chairman.*

COMMITTEE ON INTERNATIONAL RELATIONS

During the year 1943, members of your committee have individually and collectively, where possible, furthered contact of members of the Institute and of Canadian engineers generally, with engineers of other countries. Due to the conditions imposed by the war, such contact has not been made as frequently and readily as might have occurred under normal conditions.

Participation of the Institute in the deliberations of the Engineers' Council for Professional Development in the United States has continued, and meetings of their committees in the United States have been attended by members of the Institute. These representations from Canada have been accorded a cordial and very gratifying reception, and the mutual contribution of engineers on both sides of the line has been very worthwhile.

The work of the Committee of the Institute on Professional Interests in establishing an agreement with The American Society of Mechanical Engineers has contributed in considerable measure to a better understanding and a cordial relationship between the mechanical engineers of Canada and the United States. While this has not been a direct activity of the Committee on International Relations, that committee desires to express its appreciation for an effort which promises to contribute to their work, materially.

Individual members of your committee have endeavoured to carry forward the work of international relations, wherever possible. This has been accomplished by participation of members of the Institute in conventions of engineering bodies in the United States, and particularly during the joint meeting in Toronto with The American Society of Mechanical Engineers in September.

American associations which have been contacted in this manner include the American Society of Civil Engineers, the American Institute of Electrical Engineers, the American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers, the American Society of Chemical Engineers, and the American Waterworks Association.

One of the outstanding contributions to international relationship during the course of the year, has been the unanimous election of Mr. W. L. Batt of the United States to honorary membership in The Engineering Institute of Canada. This recognition by Canadian engineers of the ability and merit of an American engineer, for the first time, has added to international relations and understanding.

Your committee desires to acknowledge the gracious and cordial good wishes expressed to the engineers of Canada on Dominion Day, by the engineers of the Argentine, South America. This expression of good wishes and greetings on the part of the Argentine engineers has been suitably acknowledged on behalf of the Institute, and it is hoped the relations will be further promoted and carried forward in the future.

M. J. McHenry, m.e.i.c., *Chairman.*

COMMITTEE ON WESTERN WATER PROBLEMS

Your Committee on Western Water Problems has been inactive during the year 1943 and has little to report. As interest grows in post-war reconstruction other opportunities will no doubt present themselves for your committee to point out the merits of the construction of works to utilize Canada's share of the waters of the St. Mary and Milk rivers in Alberta as a means of providing employment and also of bringing about a permanent increase in the productive resources of our country.

We therefore suggest that your committee be continued so as to be in readiness to resume its activities as soon as the occasion arises.

Respectfully submitted,

G. A. Gaherty, m.e.i.c., *Chairman.*

COMMITTEE ON PROFESSIONAL INTERESTS

During 1943, the terms of an agreement between the Institute and the Association of Professional Engineers of Manitoba were completed and approved by the Institute. Negotiations for a similar agreement with the Corporation of Professional Engineers of Quebec are still in progress. So far as is known, the existing agreements for the provinces of Saskatchewan, Nova Scotia, New Brunswick and Alberta are working out to the satisfaction of everyone concerned.

During the year, the committee was asked to confer with a special committee appointed by the president of the American Institute of Electrical Engineers to consider ways and means for promoting co-operation between the two societies. To this end, the two committees met in Montreal on December 10, 1943, for an exploratory conference. Satisfactory progress was made.

As a result of conferences between members of the committee and representatives of the American Society of Mechanical Engineers in New York on August 23rd, 1943, and in Toronto on October 1st, 1943, a co-operative agreement between the two societies was completed, which clarifies and codifies the close friendly relations which have existed for many years. Preliminary discussions indicate that a similar agreement can be effected with at least one other of the Founder Societies of the United States.

At the request of the president, two members of the committee attended a meeting in Montreal on December 11th, 1943, of representatives of several engineering and technical societies called to consider ways and means for promoting co-operation between such bodies in Canada. As a result of this meeting, a committee was set up to prepare a constitution for an organization which could be set up primarily to enable conjoint action, particularly during the post-war period, should it be necessary for the engineers of Canada to speak with one voice. It is a moot question whether such a committee can be set up, even as an experiment, on a basis satisfactory to the majority of the engineering organizations of the Dominion without the danger of adding another organization to the many which now exist which may well infringe in the fields already covered by existing organizations and which may add substantially to the total of dues already required of Canadian engineers.

J. B. Challies, M.E.I.C., *Chairman.*

LEGISLATION COMMITTEE

No legislation affecting the interests of the Institute or of the engineering profession in general, came to the attention of the committee during the year 1943. There is consequently nothing to report.

Respectfully submitted,

John L. Lang, M.E.I.C., *Chairman.*

PUBLICATION COMMITTEE

During the year, your committee has held several meetings to direct the editorial policy of the Journal and to judge the papers submitted for publication.

The May issue of the Journal marked the 25th anniversary of its foundation. The event was acknowledged by the publication of 23 short articles describing the achievements of the past quarter-century in the various fields of engineering. Other articles in the back section constituted a retrospect into the first numbers. Comments from various sources indicate that this number was well received.

The wartime restrictions on the use of paper made it necessary to adopt, last September, a lighter stock for the text section of the Journal. For the same reasons, the format was reduced, starting with the January 1944 issue.

Your committee wishes to acknowledge the valuable source of Journal material provided by the papers presented at joint meetings with sister American societies, such as were held at Niagara Falls with the American Society of Civil Engineers in October, 1942, and with The American Society of Mechanical Engineers at Toronto in October, 1943.

Respectfully submitted,

J. A. Lalonde, M.E.I.C., *Chairman.*

COMMITTEE ON POST-WAR PROBLEMS

Your committee was not assigned any new duties during the year 1943 until September. At the Council meeting held in London on September 11th, the committee was directed to prepare a submission to the House of Commons Committee on Reconstruction directing its attention to the urgency of having engineering studies and plans started at once so that selected construction projects would be available on very short notice as required by any post-war situation that might develop.

The brief on this subject is now under preparation and the final draft should be in Council's hands in January.

Respectfully submitted,

W. C. Miller, M.E.I.C., *Chairman.*

MEMBERSHIP COMMITTEE

The Membership Committee for 1943 consisted of the two 1942 members with one new member. All were resident in Toronto, so that meetings could be held on short notice as required.

During the year, your committee continued its studies relating to membership classifications and methods of judging qualifications of applicants. This was in accordance with the discussion which took place at the meeting of Council in Toronto in February, 1943.

The work has now been completed and the report is in your hands.

Respectfully submitted,

John G. Hall, M.E.I.C., *Chairman.*

EMPLOYMENT SERVICE

During 1943 as in the previous year, the activities of the Employment Service have been limited on account of the regulations governing the placement of engineers.

The following table gives comparative figures of the work done:

	1942	1943
Registered members	34	59
Registered non-members	45	46
Number of members advertising for a position	19	21
Replies received from employers	48	30
Vacant positions registered	134	113
Vacancies advertised in the Journal	58	36
Replies received to advertised positions	101	93
Men's records forwarded to prospective employers	35	13
Men notified of vacancies	117	91
Placements definitely known	30	19

Close co-operation has been continued with the Wartime Bureau of Technical Personnel. Members who have visited Headquarters with a view to discussing employment problems have been properly instructed with regards to the Wartime Bureau regulations.

The completion of large war construction projects towards the end of the year and the proposed slowing up of production in munitions factories has resulted in several of our members contacting the Employment Service for re-location. This would indicate that the Service will become very active again in the near future.

L. Austin Wright, *General Secretary.*

COMMITTEE ON THE ENGINEER IN THE ACTIVE SERVICES

It is difficult for this committee to make any detailed report at this stage of its work. There have been communications and interviews with interested officers and officials, but the culmination of the efforts of the committee will not be apparent until early in 1944. Considerable encouragement has been received from influential sources, and there is reason to believe that some, if not all, of the points raised will be settled along the lines recommended.

The committee's final brief lays stress on three important matters, of which strong complaint has been and is still being made:

1. Failure of the Royal Canadian Ordnance Corps to give senior appointments to engineers, whereby they might administer the work being done by engineers. To this end it is urged that electrical and mechanical engi-

neering work be removed from the Ordnance Corps and assigned to a special corps established for this purpose, similar to the Royal Electrical and Mechanical Engineers.

2. The appointment of non-technical persons to positions of definite engineering character.

3. The failure to give to engineers, for professional services, rank or pay on a basis similar to that established for other professions.

At this stage, the committee does not want to make any recommendations to Council, but believes that further action should be withheld until the Department of National Defence has given some reply to the latest representations. However, the committee still feels that these matters should be attacked constantly until satisfactory results are obtained. It is hoped that some real progress can be reported early in the year.

Respectfully submitted,

D. S. ELLIS, M.E.I.C., *Chairman.*

COMMITTEE ON PROFESSIONAL ETHICS

The question referred to your committee is a broad and deep one and while opinion is not unanimous there seems to be a majority agreement that the Canons of Ethics for Engineers as prepared by the Engineers' Council for Professional Development are not just right and that there should be a separation between Canons of Ethics and a Code of Practice.

A correct definition of the phrase "Canons of Ethics" appears to be "fundamental laws of moral problems". It is felt these should be few in number.

But the young engineer, and all engineers, require something more than this to guide them in carrying on the practice of their profession and involving things which cross the border-line of morals and expand into the field of public practice and possibly civil and criminal law. These things it is felt should be included in a Code of Practice which should be sectionized and even-

COMPARATIVE STATEMENT OF REVENUE AND EXPENDITURE

FOR THE YEAR ENDED 31ST DECEMBER, 1943

REVENUE

MEMBERSHIP FEES:	1943	1942
Arrears	$ 4,219.28	$ 5,049.11
Current	29,614.40	27,563.49
Advance	618.55	527.80
Entrance	2,514.00	2,581.87
	$36,966.23	$35,722.27
PUBLICATIONS:		
Journal Subscriptions	$ 8,909.31	$ 8,263.77
Journal Sales	76.50	74.41
Journal Advertising	23,126.45	18,645.42
	$32,112.26	$26,983.60
INCOME FROM INVESTMENTS	$ 848.31	$ 545.49
REFUND OF HALL EXPENSE	505.00	500.00
SUNDRY REVENUE		39.17
TOTAL REVENUE FOR YEAR	$70,431.80	$63,790.53

EXPENDITURE

BUILDING EXPENSE:	1943	1942
Property and Water Taxes	$ 1,326.79	$ 1,328.98
Fuel	636.92	592.53
Insurance	175.00	177.85
Light, Gas and Power	360.88	363.82
Caretaker's Wages and Services	1,068.00	1,031.00
House Expense and Repairs	1,096.96	847.43
Building Fund Reserve	1,500.00	3,500.00
	$ 6,164.55	$ 7,841.61
PUBLICATIONS:		
Journal Salaries and Expense	$24,537.31	$20,298.76
Provincial Sales Tax	*3.44*	33.36
Sundry Printing	891.52	650.29
	$25,425.39	$20,982.41
OFFICE EXPENSE:		
Salaries	$16,865.59	$12,912.59
Telegrams, Postage and Excise Stamps	1,420.65	1,152.42
Telephones	646.59	667.75
Office Supplies and Stationery	1,536.12	1,353.25
Audit and Legal Fees	255.00	325.00
Messenger and Express	141.93	119.39
Miscellaneous	646.54	408.23
Depreciation—Furniture and Fixtures	364.48	364.48
	$21,876.90	$17,303.11
GENERAL EXPENSE:		
Annual and Professional Meetings	$ 1,371.86	$ 1,689.73
Meetings of Council	747.89	719.25
Travelling	1,540.67	734.49
Branch Stationery	122.25	146.33
Prizes	357.05	407.80
Library Salary and Expense	1,900.54	2,021.62
Interest, Discount and Exchange	176.55	168.92
Examinations and Certificates	27.68	*40.36*
Webster Lectures—net	......	996.20
Committee Expenses	1,095.22	590.38
Advances *re* Overseas Children	......	225.00
National Construction Council	150.00	100.00
Sundry Expense	161.41	169.28
	$ 7,651.12	$ 7,928.64
REBATES TO BRANCHES	6,712.40	6,526.20
TOTAL EXPENDITURES	67,830.36	60,581.97
SURPLUS FOR YEAR	2,601.44	3,208.56
	$70,431.80	$63,790.53

tually expanded to cover the widely different needs of, for example, the construction engineer, the mechanical engineer, the chemical engineer and the surveyor, it being remarked in this latter connection that the proposed E.C.P.D. canons bear the imprint of undue reference to problems relating especially to construction and contracting work.

As regards Canons of Ethics the following which cover the engineer's duties to the state, to the profession, to employer or client, to fellow engineers, to himself, are suggested:

Canons of Ethics

1. The engineer owes a duty to the state that sound engineering practice be employed in all its physical developments. He shall interest himself in the public welfare and be ready to apply his special knowledge, skill and training for the benefit of mankind.

2. He shall ever uphold the honour and dignity of his profession and co-operate in upbuilding it by imparting information and experience to other engineers or students and by contributing to the work of engineering societies, schools and the scientific press.

3. The keystone of professional conduct is integrity; and the engineer shall discharge his professional duties with fidelity to employers and clients and with fairness and impartiality to employees and contractors.

4. In his dealings with his fellow engineers he shall be friendly, fair and tolerant and shall not injure another's reputation falsely or attempt to supplant him or compete unfairly.

5. He shall not, in any respect, act in a manner which may bring discredit on his profession; he shall strictly respect all confidence imparted to him;

COMPARATIVE STATEMENT OF ASSETS AND LIABILITIES

As at 31st December, 1943

Assets

		1943	1942
Current:			
Cash on hand and in bank		$ 871.36	$ 1,204.97
Accounts Receivable less Reserve		5,087.96	4,418.49
Arrears of Fees—Estimated		2,500.00	2,500.00
Army Technical Development Board		1,767.65	......
		$10,226.97	$ 8,123.46
Special Funds—Investment Account:			
Investments—At cost	$5,988.89		
Cash in Savings Accounts	1,115.72		
		7,104.61	7,522.33
Investments—At Cost:			
Bonds—			
Dominion of Canada			
3% 1951	2,500.00		
3% 1956	5,500.00		
3% 1957	10,000.00		
4½% 1946	96.50		
4½% 1958	180.00		
4½% 1959	4,090.71		
Montreal Tramways			
5% 1951	950.30		
5% 1955	2,199.00		
Province of Saskatchewan			
5% 1959	502.50		
Shares—			
Canada Permanent Mortgage Corporation—2 shares	215.00		
Montreal Light, Heat & Power Cons.—40 shares N.P.V.	324.50	$26,558.51	$16,558.51
(Estimated market value—$27,250.00)			
Sundry Advances		250.00	400.00
Deposit with Postmaster		100.00	100.00
Prepaid Insurance		78.50	200.00
Gold Medal		45.00	45.00
Library—At cost less depreciation		1,448.13	1,448.13
Furniture and Fixtures—At cost less depreciation		2,915.85	3,280.33
Land and Buildings—Cost less depreciation		36,000.00	36,000.00
		$84,727.57	$73,677.76

Liabilities

		1943	1942
Current:			
Secured Overdraft		$ 6,507.44	
Accounts Payable		2,976.67	$ 2,674.23
Rebates to Branches		376.63	507.30
		$ 9,860.74	$ 3,181.53
Special Funds:			
As per Statement attached		$ 7,092.61	$ 6,823.45
Reserves:			
Building Fund		5,000.00	3,500.00
Building Maintenance		2,000.00	2,000.00
Surplus Account:			
Balance as at 31st December, 1942	$58,172.78		
Add:			
Excess of Revenue over Expenditure for year as per Statement attached	2,601.44		
		60,774.22	58,172.78
		$84,727.57	$73,677.76

We have audited the books and vouchers of The Engineering Institute of Canada for the year ended 31st December, 1943, and have received all the information we required. In our opinion the above Statement of Assets and Liabilities and attached Statement of Revenue and Expenditure for 1943 are properly drawn up so as to exhibit a true and correct view of the Institute's affairs as at 31st December, 1943, and of its operations for the year ended that date, according to the best of our information and the explanations given to us and as shown by the books.

(Sgd.) Ritchie, Brown & Co.,
Chartered Accountants.

Montreal, 20th January, 1944.

he shall avoid association with any enterprise of questionable character and shall advertise only in a dignified manner.

As regards the Code of Practice it is considered that the 31 sections proposed by the E.C.P.D. as Canons of Ethics might be adopted with the change in name after slight changes in wording, some combination of what are now separate sections and understanding that the whole in future may be expended to cover the entire field of engineering.

Submitted on behalf of the Committee,

F. H. PETERS, M.E.I.C., *Chairman.*

COMMITTEE ON ENGINEERING FEATURES OF CIVIL DEFENCE

The organization of this committee has remained the same as it was at the close of last year.

In connection with engineering features of civil defence this committee has continued its co-operation with the Director of Civil Air Raid Precautions, (Hon. Dr. R. J. Manion, until his death on July 2, 1943, and subsequently Brig. Gen. Alex Ross), and with the Canadian Engineering Standards Association. The Branch Committees have continued their co-operation with provincial and local A.R.P. organizations. In the provinces of Ontario and Quebec special arrangements have been made for technical personnel of The Engineering Institute of Canada, the Royal Architectural Institute of Canada, and the Canadian Construction Association, to be readily and quickly available locally to A.R.P. organizations for consultation purposes.

Meetings with Dr. Manion and with the Hon. C. D. Howe early in the year seemed to give promise of action on the joint submission of The Engineering Institute of Canada, the Royal Architectural Institute of Canada, and the Canadian Construction Association, to the Prime Minister under date of November 3, 1942, but no action by the Government has yet been reported.

The committee has issued specifications and instructions relative to the engineering features of civil defence in connection with the protection of existing and proposed hotel, apartment, office, store, plant and other buildings, and dwellings, and of the personnel and equipment in them. This report was issued in incomplete form as some of the information ultimately to be appended to it is secret and confidential and not yet available for general distribution.

Because of changing conditions it has been considered undesirable to issue specifications for detached air raid shelters, and this assignment is being held in abeyance.

Because of improvement in the war situation, and because the special assignments to this committee have been substantially fulfilled, this committee is now less active than heretofore. It is endeavouring, however, to maintain its organization, including that of the Branch Committees, so as to permit of promptly taking up further assignments should that become necessary.

JOHN E. ARMSTRONG, M.E.I.C., *Chairman*

PAPERS COMMITTEE

The report of the Papers Committee for 1943 is practically nil. This is not because efforts have not been made to assist the Branches, but because the Branches have shown complete ability to stand on their own feet and to provide what seemed to be very excellent programmes without asking for assistance from the Papers Committee.

A letter was circulated to Branch Secretaries early in the year asking whether the Papers Committee could render assistance and, if so, along what lines, and later a further circular was sent to certain Branches which it was thought would have some difficulty in getting speakers because of their geographical location. In no case, however, was any request for assistance received.

Through Headquarters, a catalogue was prepared and sent to all Branches and to Engineering Undergraduates Societies, containing a descriptive list of films available to such groups as our Branches from industrial firms in Canada.

At the present time, the Papers Committee is negotiating with the Director of Public Relations (Army) with a view to obtaining a film showing the work of Canadian Engineers overseas, which could be sent to all the Branches from coast to coast, and it is hoped that this may be ready early in the new year.

Respectfully submitted,

L. F. GRANT, M.E.I.C., *Chairman.*

LIBRARY AND HOUSE COMMITTEE

During the summer months, headquarters were gone over and given a general cleanup and interior painting, with very good results, including miscellaneous repairs to windows, pipe covering, etc. Three fluorescent fixtures were placed in the reading room, first floor, to the satisfaction of many. Repairs to the front steps were completed and should give service for a few years, although the ironwork is badly corroded.

Venetian blinds would be very desirable for the reading room, especially when the reading room is being used at night. War conditions make it impossible to get them. It is recommended that this item be kept in mind for the future.

The staff is to be complimented on its efficiency and economy.

LIBRARY

Tabulated below is a summary of the accessions to the library in the past year, together with the number of requests for information addressed to the librarian:

Books presented by the publishers for review in *The Engineering Journal*	88
Books presented to the library	1
Proceedings and Transactions	22
Reports (including Standards and Tentative Standards)	256
ARP and Civilian Defence	14
We also acquired material published by the Office of Civilian Defence, Washinton, D.C.	
Requests for information	2,272
Divided as follows:	
By phone	984
By letter	955
In person	333
Books borrowed	476
Bibliographies made	23, a total of 27 pages
Photostats made	70 negatives 30 positives 1 figure 1 enlargement
Books borrowed on inter-library loan	20

Following the recommendation of this Committee of 1942, more publishers have been contacted, and the presentations to the library of technical books for review in the Engineering Journal have increased.

At the request of this Committee, your Finance Committee has agreed to make available annually a sum of $200.00 for the upkeep and purchase of up-to-date technical books for the Library.

It is urged that members interested in the Library should send in suggestions and recommendations on the best technical books published, so that a few of the best in each branch of engineering may be acquired.

Respectfully submitted,

E. V. GAGE, M.E.I.C., *Chairman.*

COMMITTEE ON THE ENGINEER IN THE CIVIL SERVICE

The reference to this subject in the January *Journal* brings Council pretty well up to date on the work of this committee. So far the actual progress made in terms of objectives accomplished amounts to absolutely nothing. The committee presented a strong brief to the Coon Committee which was studying civil service rates of pay, and was greatly encouraged by that committee, but in the recommendations made subsequently by the Treasury Board, supposedly based on the report of the Coon Committee, no mention was made of the engineers.

Later, the committee waited on the Hon. Mr. Ilsley, and again urged that something be done for this low salary group. Mr. Ilsley seemed of the opinion that nothing could be done at that time, but promised to give the matter full consideration.

Again later, the committee wrote the Hon. Mr. McLarty, who has been appointed chairman of a Sub-Committee of the Cabinet to look into the matter. This correspondence appears in the January *Journal*

The committee proposes to maintain its interest and to seize every opportunity to emphasize to the proper officials the inadequacy of the wage schedule, and the serious effects that will accrue to the services, particularly in the post-war period, from such conditions.

Respectfully submitted,

N. B. MacRostie, m.e.i.c., *Chairman.*

COMMITTEE ON THE TRAINING AND WELFARE OF THE YOUNG ENGINEER

Your committee asks leave to make its fifth annual report.

STUDENT SELECTION AND GUIDANCE

Requests for further copies of the booklet "The Profession of Engineering in Canada" have continued, especially from the universities. These requests have been filled until there remain not more than 600 copies of the first edition. Your committee will request authority to print a second edition in 1944. The brochure "La Profession d'Ingénieur au Canada" has been used to excellent purpose in Quebec, and it is being distributed by our committees and by the universities.

BRANCH STUDENT GUIDANCE COMMITTEES

The several branch committees have continued their activities; some functioning much more energetically than others. It now appears that where a counsellor is named for each high school, the co-operation with the school authorities becomes more personal and active. This method is recommended.

The committee wishes to thank those members of the local committees who have helped so materially.

RELATIONSHIP WITH THE ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT

The Institute has continued its very active participation with the E.C.P.D. The E.C.P.D. is now examining the efficacy of certain aptitude tests and has the substantial assistance of the Carnegie Foundation for the Advancement of Teaching in this study. About 4,500 first year engineering students from several universities are being given the tests, and it is expected that much valuable information will be available when they are completed. This work includes the design of tests to determine the probability that a prospective student will satisfactorily complete an engineering curriculum, and a plan to determine the validity of such tests. This will be of material assistance to your committee in its future activities.

A Manual for Junior Engineers is now being prepared under the editorship of Dr. W. E. Wickenden. It is expected that this will give many helpful aids to the young men of our profession.

CO-OPERATION WITH OTHER ORGANIZATIONS

Your committee was asked to assist the Wartime Bureau of Technical Personnel in encouraging students to enter science courses as a war measure. Some progress was made, but owing to the fact that all schools had closed when the programme was announced, it was not as successful as was hoped. It is not known whether this programme will be followed in 1944.

Discussions with the Canadian Legion Educational Services indicate that your Committee may be able to give some assistance to their programme of post-war rehabilitation. The Legion have requested permission to use the booklet "The Profession of Engineering in Canada" in their series of occupational manuals "Let's Discuss Jobs," for the guidance of men in the services who are planning for their return to civilian life. The booklet is at present being printed with special cover design to fit in the Canadian Legion series.

The Student Engineering Societies of several of our universities are interested in a closer relationship with the Institute. It is expected that further progress will be made during 1944.

JUNIOR ACTIVITIES

Copies of Dr. D. W. Mead's booklet on "Standards of Professional Relations and Conduct" were distributed to all members of the graduating classes of 1943. A programme of further distributions of timely articles is now being worked out. We are anxious that Institute members prepare some of these articles.

The Junior Sections of the Montreal and Toronto Branches have been very active. Members of your committee have addressed each of these sections, and we are encouraged by the enthusiasm of the younger members. It is probable that our student guidance contacts will be reflected in the interest of students and of the younger graduates in the affairs of the Institute. During the year, a Junior Section of the Saguenay Branch was formed and is operating successfully.

RECOMMENDATIONS

Your committee recommends:

(1) That all branches be urged to continue their Student Guidance Committees, and that these committees make definite contacts with educational authorities;

(2) That the closest possible relationships be developed and maintained with engineering students generally, and with organized student engineering societies at the universities;

(3) That the sum of $400.00 be authorized for the printing of 10,000 copies of a second edition of "The Profession of Engineering in Canada," and its distribution, and for the printing of articles for issue to university students and others.

Respectfully submitted on behalf of the committee,

Harry F. Bennett, m.e.i.c., *Chairman.*

COMMITTEE ON DETERIORATION OF CONCRETE STRUCTURES

In presenting our report for the year 1943, I can only repeat the statement that I made last year, viz., there is plenty of work for the committee to do in more favourable times which present pressure on its members will not permit undertaking now; and I therefore recommend we should maintain the committee in its present form ready to work actively when the war is over, for at that time there will be much deferred maintenance work to be carried out on concrete structures and the work of the committee will be of interest to a great many of the Institute's members.

Respectfully submitted,

R. B. YOUNG, M.E.I.C., *Chairman.*

BOARD OF EXAMINERS AND EDUCATION

Your Board of Examiners and Education for the year 1943 has had prepared and read the following examination papers with the results as indicated:

	Number of Candidates	Number Passing
SCHEDULE A		
Arithmetic, Algebra, Geometry, Trigonometry, Chemistry, Geography, History	1	1
SCHEDULE B		
Elementary Physics and Mechanics	1	1
Strength and Elasticity of Materials	1	1
SCHEDULE C		
Electrical Engineering—		
III A. General Paper	3	3
III B. Utilization of Electric Power	3	3
Structural Engineering—		
VII A. General Paper	1	0
Mechanical Engineering—		
IV A. General Paper	2	0
IV B.(2) Steam Power	2	0

Respectfully submitted,

R. A. SPENCER, M.E.I.C., *Chairman.*

STUDENTS' AND JUNIORS' PRIZES

The reports of the examiners appointed in the various zones to judge the papers submitted for the prizes for Students and Juniors of the Institute were submitted to Council at its meeting on December 18th, 1943, and the following awards were made:

H. N. Ruttan Prize (Western Provinces), to N. Safran, Jr.E.I.C., for his paper "Synthetic Rubber".

John Galbraith Prize (Province of Ontario), to A. C. Northover, Jr.E.I.C., for his paper "New Methods and Substitute Materials in Wartime Construction".

Phelps Johnson Prize (Province of Quebec—English), to B. Mroz, S.E.I.C., for his paper "Portland-Montreal Pipe Line".

Ernest Marceau Prize (Province of Quebec—French), to Henri Audet, S.E.I.C., for his paper "Locomotive de manoeuvre Diesel-electrique 660 B.h.p.".

Martin Murphy Prize (Maritime Provinces), to James L. Belyea, S.E.I.C., for his paper "Simplification in the Design of Automatic Weapons".

GZOWSKI MEDAL COMMITTEE

It is the unanimous recommendation of your committee that the Gzowski Medal for the year 1943 be awarded to Frank E. Sterns, M.E.I.C., for his paper "Transit Shed with Concrete Roof Arches," as published in the June, 1943, issue of the *Journal.*

Respectfully submitted,

W. H. POWELL, M.E.I.C., *Chairman.*

JULIAN C. SMITH MEDAL COMMITTEE

Carrying out the instructions pertaining to the award of the Julian C. Smith Medal for 1943, the special committee consisting of Past-President C. J. Mackenzie, C. R. Young and myself has made a selection of two names, which have been submitted by letter ballot to all councillors.

As a result, Julian C. Smith Medals for 1943 are being awarded to:

Mr. George Joseph Desbarats, C.M.G., Ottawa, Ont.

Dr. Frederic Henry Sexton, President, Nova Scotia Technical College, Halifax, N.S.

Respectfully submitted,

K. M. CAMERON, M.E.I.C., *Chairman.*

DUGGAN MEDAL AND PRIZE

The Duggan Medal and Prize Committee has examined carefully the papers presented to the Institute during the prize year which appear to meet the conditions for this award.

The committee has reached a unanimous decision that the most meritorious one is that by W. R. Stickney, M.E.I.C., on "Electrical Arc Welding," as published in the February 1943 issue of the *Journal*, and therefore recommends that the Duggan Medal and Prize be awarded to Mr. Stickney.

Respectfully submitted,

J. M. FLEMING, M.E.I.C., *Chairman.*

NOMINATING COMMITTEE

Chairman: H. C. FITZ-JAMES

Branch	*Representative*
Border Cities	C. G. R. Armstrong
Calgary	F. K. Beach
Cape Breton	J. R. Morrison
Edmonton	J. Garrett
Halifax	J. R. Kaye
Hamilton	W. J. W. Reid
Kingston	J. R. Carter
Lakehead	E. L. Goodall
Lethbridge	A. J. Branch
London	F. T. Julian
Moncton	A. Gordon
Montreal	J. M. Crawford
Niagara Peninsula	C. G. Cline
Ottawa	N. B. MacRostie
Peterborough	W. T. Fanjoy
Quebec	E. D. Gray-Donald
Saguenay	N. F. McCaghey
Saint John	D. R. Smith
Saskatchewan	E. K. Phillips
St. Maurice Valley	M. Eaton
Sault Ste. Marie	E. M. MacQuarrie
Toronto	A. E. Berry
Vancouver	H. N. Macpherson
Victoria	S. H. Frame
Winnipeg	D. M. Stephens

LEONARD MEDAL COMMITTEE

Your committee considers that none of the papers submitted was of sufficient merit in the field for which the Leonard Medal was intended, and accordingly recommends that no award be made this year.

Respectfully submitted,

ALAN E. CAMERON, M.E.I.C., *Chairman.*

PLUMMER MEDAL COMMITTEE

Your Committee considers that none of the papers submitted is eligible for the Plummer Medal and accordingly recommends that no award be made this year.

Respectfully submitted,

O. W. ELLIS, M.E.I.C., *Chairman.*

Abstracts of Reports from Branches

Note—For Membership and Financial Statements see pages 100 and 101

BORDER CITIES BRANCH

The Executive Committee held eight meetings during the year for the transaction of Branch business.

The Executive appointed Mr. A. H. MacQuarrie as chairman of two sub-committees on post-war planning; one was a sub-committee to the Windsor Chamber of Commerce Committee on local post-war plans, and the other was as regional representative of the National Construction Council of Canada to act as chairman of a sub-committee on post-war planning.

Nine Branch meetings were held during the year, as follows, the attendance being shown in brackets.

Jan. 22—G. H. Strickland, Superintendent of Filtration, Windsor Utilities Commission, spoke on **Water Purification.** (30.)

Feb. 19—A. G. Turnbull, Commercial Engineer in charge of Industrial Control, Canadian General Electric Company, spoke on **Electronics in Industry.** (39.)

Mar. 19—R. B. Young, Assistant Chief Testing Engineer for the Hydro-Electric Power Commission of Ontario, gave a paper on **Recent Developments in Concrete Technology.** (42.)

Apr. 16—W. C. Krug, of the firm of Draper, Dobie & Company, members of the Toronto Stock Exchange, talked on **Revolutionary Changes in Money.** (41.)

May 21—M. J. Ackroyd, Outside Plant Engineer of the western Ontario area, Bell Telephone Company of Canada, and Vice-President of the Association of Professional Engineers of Ontario, outlined the work of the Association and gave a paper entitled **Blue Reels Turning.** (39.)

Sep. 10—This dinner was held in honour of the president of the Institute, K. M. Cameron, who talked on **Post-war Plans.** The general secretary, Dr. L. Austin Wright, accompanied the president and spoke on the activities of the Institute. (46.)

Oct. 15—W. Moffat, of the Canadian Westinghouse Company Limited, Hamilton, gave an illustrated lecture on **Cleaning Air Electrically.** (32.)

Nov. 19—H. Mabson, Chief Inspector for the Industrial Accident Prevention Association Incorporated, gave a paper on **Some Engineering Aspects of Industrial Safety.** (25.)

Dec. 17—Annual meeting and election of officers. C. M. Goodrich, Consulting Engineer for the Canadian Bridge Company Limited, related **Some Experiences—1917-1919.** (27.)

CALGARY BRANCH

The following report covers the activities of the Branch for the year 1943:

Jan. 14—**Synthetic Rubber** and **Radio Service, Yesterday, To-day and Tomorrow,** by N. Safran and A. Ainlay (57.)

Feb. 12—**Some Modern Aspects of Physics,** by W. K. Allan, B.A. (43.)

Feb. 25—**The Influence of Disease on History,** by W. A. Lincoln, M.D. (38.)

Mar. 13—Annual meeting, followed by dinner. (60.)

June 14—**Welding,** by H. Thomasson. (200.)

Oct. 8—Dinner meeting, followed by president's address. (124.)

Oct. 22—**Water Development Possibilities in the Post-war Period,** by W. L. Foss. (39.)

Nov. 18—**The Shipshaw Development,** by L. A. Thorssen. (62.)

Nov. 27—Annual joint dinner meeting of Alberta Association of Professional Engineers, The Rocky Mountain Branch of the Canadian Institute of Mining and Metallurgy, and the Calgary Branch of The Engineering Institute of Canada.

Dec. 9—**Lights and Shadows in the Agricultural Picture,** by J. E. Brownlee. (31.)

CAPE BRETON BRANCH

The Branch was pleased to receive a visit from the president and general secretary in April, on which occasion there was a dinner meeting at the Y.M.C.A., following which the president and others spoke.

In November, a very large meeting under the auspices of the Branch was held at St. George's Hall, at which Prof. A. E. Flynn gave an illustrated talk soliciting active co-operation of all technical personnel in the solution of a war problem.

EDMONTON BRANCH

During the year the Branch held seven general meetings and, in addition, two meetings were held in conjunction with other societies. As in 1942, the attendance of American engineers has been a welcome feature at most of our meetings. The following is a summary of our regular meetings with attendances shown in brackets. Except for the two meetings in November, these were all preceded by an informal dinner.

Jan. 14—**The Alaska Highway,** by Col. Theodore Wyman, Jr., in command of the United States Engineer Forces, North West Service Command. (58.)

Feb. 23—**Alternative Fuels for Motor Vehicles,** by W. A. Lang, Research Chemist, Research Council of Alberta. (56.)

Mar. 20—Joint meeting with Alberta Association of Professional Engineers and Canadian Institute of Mining and Metallurgy. The dinner was followed by an illustrated lecture on **Canada Moves North,** by R. H. Finnie, which included a new reel of pictures on the Alaska Highway. (167.)

Apr. 29—**The Shipshaw Development,** by L. A. Thorssen of the Department of Civil Engineering, University of Alberta. (67.)

May 25—**Adapt to New Changes Quickly,** by R. V. Carey of Messrs. Bechtel, Price, Callahan's Canol staff. (37.)

Oct. 19—**Post-war Planning,** by the president of the E.I.C., K. M. Cameron, on the occasion of his annual visit to the west. A special invitation was given to McGill graduates to attend this meeting. (86.)

Nov. 3—Special joint meeting with other engineering and chemical societies addressed by Mr. Stacey of Vancouver. (190.)

Nov. 5—**Astronomy,** by Dr. J. W. Campbell, Professor of Mathematics at the University of Alberta. This was followed by an inspection of the observatory and reflecting telescope recently installed on the University campus. (17.)

Dec. 7—**Elements of Design of Family Aircraft,** by D. D. Dick, student at the University of Alberta. (30.)

HALIFAX BRANCH

During the year meetings were held as follows:

Jan. 28—Combined annual banquet at Nova Scotian Hotel. (230.)

Feb. 25—H. W. Lea, Director of the Wartime Bureau of Technical Personnel, spoke on the operations and policies of his Bureau. (130.)

Mar. 25—I. P. Macnab, Chairman of the Local Committee on Engineering Features of Civil Defence, introduced and showed a British sound film on bombs, which dealt in particular with the location and treatment of unexploded bombs. (90.)

Apr. 19—K. M. Cameron, president of the Institute, was our guest. He addressed the meeting on **The Present and Post-war Problems of Engineers,** and reviewed in brief the various committees of the Institute that already were active or in a state of organization. Dr. L. Austin Wright, general secretary of the Institute, L. D. Currie, Minister of Mines and Labour, and G. S. Kinley, Deputy Mayor, also addressed the meeting. (140.)

Oct. 28—H. F. Ryan, Canadian General Electric Company, addressed the meeting on the science of **Electronics.** (66.)

Nov. 25—W. D. Outhit, Registrar of Probate, Halifax, addressed the meeting, his topic being **Some Will and Some Won't.** (59.)

Nov. 9—This special meeting of all technical personnel in the vicinity of Halifax was sponsored by the Institute, and was addressed by Dr. Alan E. Cameron. (206.)

HAMILTON BRANCH

The Branch held the following meetings, the attendance figures being given in brackets:

Jan. 13—Annual meeting and dinner. The guest speaker was Dean C. R. Young, who spoke on the subject, **The Engineering Profession in Wartime.** The general secretary, L. Austin Wright, was also present and addressed the meeting briefly. (78.)

Mar. 1—**Synthetic Rubber,** by E. R. Rowzee, Factory Manager of the Canadian Synthetic Rubber Company, Toronto. (80.)

Apr. 7—**Welding—A Conservation, Salvage and Reclamation Tool,** by H. Thomasson, Welding Engineer of the Canadian Westinghouse Company, Hamilton. This was a joint dinner meeting with the American Water Works Association, Canadian Section, on the occasion of their 23rd Annual Convention. (150.)

Apr. 16—**Developments in Materials for Electrical Equipment,** by D. R. Kellogg, Ph.D., Assistant to Manager, Engineering and Standards Department, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., U.S.A. This was our annual joint meeting with the Toronto Section, A.I.E.E. A complimentary supper was provided by the Canadian Westinghouse Company in their cafeteria. (165.)

May 19—Special meeting in honour of K. M. Cameron, president of the Institute. Dinner was served in McMaster University Refectory prior to the meeting. The president spoke on the subject, **The Engineer and Post-war Construction.** Dr. L. A. Wright, general secretary, gave a short talk regarding Institute affairs. Through the courtesy of the Norton Company of Canada, two interesting films on abrasives were shown. (75.)

Oct. 14—**Ogoki Diversion,** by J. R. Montague, Assistant Hydraulic Engineer for the Ontario Hydro-Electric Power Commission. This was a joint meeting with the Hamilton Group of the American Institute of Electrical Engineers at the Westinghouse Auditorium. (110.)

Oct. 28—**Plastics,** by J. A. Palmer, Plastics Development Division, the Dow Chemical Company, Midland, Michigan, U.S.A. (110.)

Nov. 17—**Conservation and the Engineer,** by Professor R. F. Legget of the Department of Civil Engineering of the University of Toronto. (28.)

Dec. 13—**Electronics,** by H. W. Blackett of the Canadian Westinghouse Company, Hamilton. (100.)

The Executive Committee of the Hamilton Branch held seven meetings during the year, with an average attendance of six members.

KINGSTON BRANCH

During the year the following meetings were held by the Branch:

Feb. 3—Special meeting held jointly with the Ontario Association of Professional Engineers and the Engineering Society of Queen's University. Prof. J. A. Van den Broek of the University of Michigan spoke on **Theory of Limit Design.**

Feb. 24—Dr. P. M. Haenni, Director of Research, Aluminum Laboratories Ltd., spoke on **Development of Aluminum as a Construction Metal.**

Nov. 11—Regular meeting held at Queen's University. Dr. A. L. Clark, Hon.M.E.I.C., former dean of the Faculty of Applied Science at Queen's University, gave an account of his trip down the Mackenzie to the Arctic Ocean, illustrated with slides.

Nov. 29—Joint meeting held with members and students of the Faculty of Applied Science, Queen's University, on the occasion of the president's visit. Mr. Cameron spoke on **Post-war Reconstruction.**

LAKEHEAD BRANCH

The Branch held the following meetings during the year:

Apr. 29—Dinner meeting, Fort William. A. D. Norton, chief tool designer and methods supervisor at the Canadian Car and Foundry Co. Ltd., Fort William, spoke on **A General Survey of Aircraft Tooling Problems.**

Oct. 6—Regular meeting, Fort William. Mr. Otto Holden spoke on the **Ogoki Diversion,** illustrated with slides and graphs.

Oct. 25—Special meeting on the occasion of the President's and the assistant general secretary's visit. Mr. Cameron addressed a dinner meeting in the Royal Edward Hotel, at which the presidents and executives of local Chambers of Commerce, also chairman of Civic Rehabilitation Committees, were invited guests. Mr. Cameron spoke on **Some Aspects of the Post-war Problems.**

LONDON BRANCH

During the year, the Executive held six business meetings. Nine regular and special meetings were held as follows: Attendance is given in brackets.

Jan. 27—Annual meeting and election of officers. **Hitler or Mein Kempf, Which Was First,** by Dr. Karel Rybka, of Toronto. (49.)

Feb. 17—**Field of Modern Plastics,** by W. M. Williams, General Sales Manager, Plastics Division, Canadian Industries, Ltd., Toronto. (45.)

Mar. 24—**Reducing the Overhead,** by M. J. Ackroyd, Plant Engineer, Bell Telephone Co. of Canada. (42.)

Apr. 21—**Flood Control and Its Relation to Water Supply and Erosion,** by W. R. Smith, County Engineer, Middlesex County, London. (96.)

May 26—**Modern Engineering in Timber,** by Prof. C. F. Morrison, University of Toronto. (35.)

Sep. 11—Special supper meeting for president K. M. Cameron. (42.)

Oct. —**Modern Highway Construction,** by G. O. Howell, Dept. of Highways, London, and G. May, General Supply Co. of Canada, Toronto. (125.)

Nov. 10—**Synthetic Rubber,** by E. R. Rowzee, Canadian Synthetic Rubber Company, Sarnia. (45.)

Dec. 10—**Electrons and Ignitrons,** by J. T. Thwaites, Canadian Westinghouse, Hamilton. (40.)

LETHBRIDGE BRANCH

The President of the Institute paid a brief visit to the Lethbridge Branch on Saturday, October 9.

Following a luncheon with some of the Executive members, Mr. Sauder drove Mr. Cameron through a portion of the irrigated district. Returning to Lethbridge, Mr. Cameron addressed the members of the Branch on Institute affairs.

MONCTON BRANCH

The Executive Committee held four meetings. Seven meetings of the Branch were held as follows:

Apr. 13—A combined meeting of Moncton Branch and the Engineering Society of Mount Allison was held in the Science Building of the University. A technicolour film dealing with airport construction in Labrador was shown.

Apr. 14—A dinner meeting was held in the Y.M.C.A. in honour of the president of the Institute, K. M. Cameron.

Apr. 20—A meeting was held in the city hall, at which the Labrador airport films were shown.

Apr. 27—A meeting was held in the city hall for the purpose of nominating branch officers for 1943-44.

May 31—Annual Meeting.

Oct. 18—A meeting was held in the city hall. Winsby Walker, Shop Superintendent, Canadian National Railways, Moncton, gave an address on **Locomotives, Large and Small.**

Dec. 16—A meeting was held in the city hall. Films were shown dealing with the life of Dr. Diesel, the Portland to Montreal pipe line, and lubricating oils.

MONTREAL BRANCH

Twenty-five meetings have been held during the year 1943, with an average attendance of around 140. In addition to the regular programme, a special visit was arranged during the summer to the new Canadian National Terminal. Of the regular meetings, one was a joint meeting with the Montreal Section of the Institute of Radio Engineers and two were joint meetings with the Montreal Section of the American Institute of Electrical Engineers. The visit to the Noorduyn Aircraft plant in October was apparently much appreciated as nearly 400 members made the trip.

Following is the list of meetings held during the year, with attendance shown in brackets:

Jan. 15—Annual Meeting of the Branch. (100.)

Jan. 21—**New Methods for the Production of Light Metals,** by Dr. L. M. Pidgeon. (125.)

Jan. 28—**Structural Rubber for Vibration and Shock,** by J. W. Devorss. (90.)

Feb. 4—**Fishway Problems in Quebec Rivers,** by Percy E. Nobbs. (80.)

Feb. 11—**History and Fundamentals of Resin Chemistry and Fabrication Problems of Phenol Formaldehyde Plastics,** by A. E. Byrne. (75.)

Feb. 18—**Post-war Reconstruction,** by K. M. Cameron. (120.)

Feb. 25—Annual Social Evening. (200.)

Mar. 4—**Launching of 10,000-Ton Cargo Vessels,** by P. G. A. Brault. (175.)

Mar. 11—**The Technician at War,** by Dr. H. G. Littler. (150.)

Mar. 18—**Modern Engineering in Timber,** by Carson F. Morrison. (180.)

Mar. 25—**Wartime Chemicals and Explosives Programme,** by H. Crabtree. (150.)

Apr. 1—**Pre-Stressed Concrete,** by A. J. Durelli. (110.)

Apr. 8—Some war films. (150.)

Sep. 30—**The Engineer of Tomorrow,** by H. F. Bennett. (180.)

Oct. 7—**St. Lawrence River Control and Remedial Dams, Soulanges Section,** by M. V. Sauer. (160.)

Oct. 14—Visit to Noorduyn Aircraft plant. (400.)

Oct. 21—**Signalling and Interlocking of Montreal Terminal, C.N.R.,** by J. J. VanHorn. (125.)

Oct. 28—**Ignitron Rectifiers,** by J. T. Thwaites. (210.)

Nov. 4—**Plastics in Engineering,** by Dr. W. Gallay. (210.)

Nov. 11—**Soil Engineering as Applied to Modern Highway Construction,** by Dr. Norman W. McLeod. (120.)

Nov. 18—Annual Student Night. (100.)

Nov. 25—**Post-war Planning by Industry,** by W. A. Irvine. (150.)

Dec. 2—**Montreal Housing and Planning Problems,** by Percy E. Nobbs. (140.)

Dec. 9—**The World's Largest Plate Mill,** by Dr. W. G. Theisinger. (130.)

Dec. 16—**Inductive Co-Ordination Aspects of Mercury Arc Rectifier Installations,** by D. J. McDonald. (70.)

JUNIOR SECTION

As in the previous years, since the beginning of the war, the activities of the Junior Section have been more difficult to maintain. The attendance at meetings showed a decrease compared to the last few years. The number of meetings has, however, been maintained at eight, which compares favourably with the preceding session.

The following is a list of the Junior Section meetings, with the attendance given in brackets:

Feb. 1—Annual Meeting. Mr. J. A. McCrory spoke on the **Professional Activities of the Engineer.** (63.)

Feb. 22—**Pre-Columbian Engineering in America,** by R. Quintal. (14.)

Mar. 8—**Development and Construction of Outdoor Power Substations,** by T. Wildi. (21.)

Mar. 22—Joint meeting at Ecole Polytechnique with the Montreal Branch and Alumni Association of Polytechnique —**The Engineer and the War,** by John Holm.

Apr. 12—**Tool Design,** by M. Conklin. (27.)

Oct. 25—Opening Night. Mr. R. S. Eadie, chairman of the Montreal Branch, addressed the members. Mr. Jacques Benoît, Chairman of the Local Committee on the Welfare of the Young Engineer, spoke on the work and aims of his committee. (14.)

Nov. 8—**Scientific Management and Industrial Administration,** by Captain A. C. Rayment. (12.)

Nov. 18—Annual Student Night. **Spot-Welding Aluminum,** by D. R. Brown (McGill); **Supercharging Aircraft Engines,** by A. Clément (Ecole Polytechnique); **Northern Pipe Line Construction,** by G. H. Galbraith (McGill); **Toll-Office Circuits and Equipment,** by A. A. Prud'homme (Ecole Polytechnique). (60.)

NIAGARA PENINSULA BRANCH

The programme committee arranged and conducted the following general professional meetings:

Feb. 19—Dinner meeting at Niagara Falls. Professor J. L. Synge, of the University of Toronto, spoke on **Mathematics and the Engineer.**

Mar. 23—Joint evening meeting with the Foster-Wheeler Engineering Society, held on the premises of the Foster-Wheeler Company, St. Catharines. First there was an inspection trip through the plant, and then a lecture by Mr. N. I. Battista, of Courtauld's (Canada) Limited, on **Synthetic Fibres.** This evening was also Ladies' Night.

Apr. 29—Dinner meeting at Niagara Falls. Mr. Paul Ackerman, Consulting Electrical Engineer, spoke on **Industrial Democracy and Its Survival.**

May 20—Branch annual meeting, held at St. Catharines. Our guests of honour on this occasion were Mr. K. M. Cameron, E.I.C., president; and Dr. L. A. Wright, E.I.C., general secretary. President Cameron spoke to the Branch on the work of the reconstruction committees and Dr. Wright outlined E.I.C. activities.

Oct. 21—Inspection trip and dinner meeting at the new Decew Falls Development, near St. Catharines. The late afternoon was devoted to a complete inspection of the work, and in the evening Mr. John Dibblee gave an illustrated talk on the design and construction of the Decew Falls plant.

Nov. 25—Dinner meeting at Niagara Falls. Dr. M. Rosten, chemical engineer, Ontario Paper Company, spoke on **A New Age in Agriculture and Forestry.**

OTTAWA BRANCH

The following meetings were held during the year, the attendance being shown in brackets:

Jan. 14—Annual evening meeting. An address entitled **Wardens of Power** was given by Dr. T. H. Hogg, Chairman and Chief Engineer of the Hydro-Electric Power Commission, illustrated with Kodachrome slides and a sound motion picture film in full colour. (102.)

Jan. 21—Evening meeting. **The Engineer and Industrial Relations,** by J. C. Cameron, Associate Professor, Commerce and Administration, Queen's University. Due to the intensely cold weather, the attendance was only 16.

Feb. 25—Evening meeting, with Dr. Walter Clark, of the Research Laboratories of the Eastman Kodak Co., Rochester, N.Y., who was to have spoken on **Colour Photography.** However, owing to transportation difficulties, Dr. Clark was compelled to cancel his engagement at the last moment.

Mar. 18—Luncheon meeting, Chateau Laurier, in honour of Mr. K. M. Cameron upon his election to the presidency of the E.I.C. The Minister of Public Works, the Hon. Mr. A. Fournier, and the Deputy Minister, Mr. Emmett Murphy, also spoke briefly following Mr. Cameron's address. (102.)

Apr. 1—Luncheon meeting, Chateau Laurier, at which two sound colour films, "**Bouncing Molecules,**" and "**Rubber Goes Synthetic,**" were shown. These were presented by P. Lebel, Asphalt Technologist for the Imperial Oil Co. of Canada, Montreal. (110.)

May 27—Luncheon meeting, Chateau Laurier, with a short explanatory address by Lieut.-Col. Erwin, Asst. U.S. Military Attaché for Air, supplemented by a sound colour film entitled "**Hazards of Ice for Airmen.**" This concluded the winter series of Branch meetings.

Oct. 28—Luncheon meeting, Chateau Laurier, with an address entitled **Our Chief Needs (Military and Industrial)**, given by Capt. A. C. Rayment. (110.)

Nov. 25—Luncheon meeting, Chateau Laurier, Major S. O. Roberts, R.C.C.S., speaker, with a sound film entitled **"Signal Communications in the Field."** A complete field "walkie-talkie" was also demonstrated by two non-commissioned officers. (100.)

Dec. 16—Luncheon meeting, Chateau Laurier. An address on **Sanitation** was delivered by Major F. Alport, consulting engineer to the Naval Service Branch. (67.)

PETERBOROUGH BRANCH

The following meetings were held during the year, with attendances shown in brackets:

Jan. 23—Social Evening (Ladies' Night).

Feb. 4—Mr. R. F. Cline of the Norton Company, **Niagara Falls Abrasives.** (33.)

Feb. 18—Mr. R. E. Hayes of the General Supply Co., Ottawa, **Earth Moving Takes Wings.** (33.)

Mar. 4—Mr. Wills Maclachlan—Hydro-Electric Power Commission of Ontario. (26.)

Mar. 25—Dr. L. M. Pidgeon of the National Research Council, **The Metal Magnesium.** (75.)

Apr. 8—Mr. G. R. Langley of the Canadian General Electric Company, Peterborough. (76.)

Apr. 22—Mr. George Rishor of the Canadian General Electric Company, Peterborough, **Synthetic Rubber and Rubber Substitutes.** (29.)

May 6—Student Night. Mr. G. M. McHenry, **Some Aspects of the Boulder Dam Power Development.**
Mr. A. C. Northover, **New Methods of Material Substitution in Wartime.** (44.)

May 20—Annual Business Meeting.

June 19—Annual Picnic.

Oct. 28—Mr. C. Neal, Carboloy Division, Canadian General Electric Company, **Cemented Carbide, the Magic Metal.** (51.)

Nov. 18—Annual Dinner. Speakers: President K. M. Cameron and Dr. L. Jocelyn Rogers. (105.)

Dec. 9—Mr. J. S. Fullerton of Handy & Harman. (47.)

QUEBEC BRANCH

Ten general Branch meetings were held throughout the year, as listed below, the attendance being shown in brackets:

Jan. 25—**Metals in the War,** by H. J. Roast, Vice-President, Canadian Bronze Co., Montreal. (45.)

Feb. 3—**Le Chauffage des Habitations,** by Huet Massue, Shawinigan Water & Power Co., Montreal. (40.)

Feb. 22—**Abris contre les raids aériens et leur degré de sécurité,** by J. A. Piché, Dominion Public Works Dept., Quebec. (25.)

Mar. 22—**Comment doubler l'effet calorifique d'un combustible,** by E. J. Fournier, Quebec. (30.)

Apr. 12—Junior Night. **Applied Soil Mechanics,** by Guillaume Piette, Soils Engineer, Highway Dept., Quebec.
Traffic Survey, by J. P. Lecavalier, Asst. District Engineer, Highway Dept., Quebec. (35.)

Apr. 19—**Steel for the Armed Forces.** Bethlehem Steel Corporation sound film. Remarks by W. Waddington. (40.)

May 3—**Assurance-Chômage: Loi Sociale,** by S. Picard, Director, Unemployment Insurance Office, Quebec. (40.)

June 19—Luncheon and Business Meeting. President K. M. Cameron's visit. (50.)

Sep. 20—Third Annual Golf Tournament, Royal Quebec Golf Club; supper and dance. (35.)

Dec. 20—**A propos d'éducation,** by Adrien Pouliot, Dean, Faculty of Science, Laval University. Films: **"Wright Builds for Air Supremacy"; "Cyclone Combustion."** (50.)

SAGUENAY BRANCH

During the year, the Branch held general meetings as follows:

Jan. 28—**Handicrafts,** by Dr. Ivan H. Crowell, Director of Handicrafts, MacDonald College, Montreal. This was a joint meeting with the Women's Canadian Club of the Saguenay.

Mar. 11—**Fighter Operations Over Britain,** by Flight Lieutenant C. W. Johnston. The subject was illustrated with two combat films taken over Egypt and England.

Mar. 18—**Transite,** by Mr. L. C. Harris, Manager of Power Products and Industrial Division, Canadian Johns-Manville Co. Ltd., Montreal.

June 3—**Modern Incineration of Refuse and Garbage,** by Mr. George R. Nielsen, Vice-President of the F. L. Smidth Company, New York, N.Y. Paper read by Mr. W. R. Hoyer in the absence of Mr. Nielsen.

June 24—**Primary Design and Construction Features of Shipshaw Development,** by Dr. H. G. Acres, Niagara Falls.

June 26—Annual Meeting. Official visit of President Cameron, general secretary and party.

July 29—**Post-war View of the Aluminum Situation,** by Mr. P. M. Haenni of the Aluminum Laboratories Ltd., Kingston, Ont.

Oct. 25—**Recent Engineering Development—Gas Turbines,** by Mr. F. Nagler, Chief Mechanical Engineer, Allis-Chalmers, Milwaukee.
Recent Hydro-Electric Developments in the United States, by Mr. J. F. Roberts, Manager of the Hydraulic Department, Allis-Chalmers, Milwaukee. The lectures were illustrated with slides and, during the coffee hour which followed, Mr. Nagler explained and demonstrated the use of the bow and arrow in big game hunting.

Dec. 9—**Bridges of the Newfoundland Railway,** by S. R. Banks, Aluminum Company of Canada, Ltd., Montreal, Quebec.

SAINT JOHN BRANCH

Five meetings of the Branch were held in the Admiral Beatty Hotel, as noted below, with the attendance at each meeting given in brackets.

Jan. 29—The annual joint dinner meeting of the Branch and the Association of Professional Engineers of the Province of New Brunswick. A programme of varied motion pictures, shown by Mr. J. H. Hoyt, was enjoyed by those present. (50.)

Mar. 19—A coloured film entitled **"The Inside of Arc Welding"** was shown. (67.)

Apr. 16—A supper meeting, on the occasion of a visit from President Cameron, the general secretary and several members of Council. (44.)

May 11—Annual meeting and dinner of the Branch at which the present officers of the Branch were elected. (29.)

Oct. 27—A supper meeting at which the three films, **"The City," "Timber Front"** and **"The Face of Time"** were shown. The subject of "The City" was town planning, "Timber Front" dealt with the forest and the National War Effort, and "The Face of Time" showed the developments and methods used in carrying out geological surveys. (34.)

ST. MAURICE VALLEY BRANCH

Five meetings were held during the year, three at Shawinigan Falls and two at Trois-Rivières. Attendance is given in brackets.

Mar. 18—Dinner and Annual Meeting with installation of new officers, at the Cascade Inn, Shawinigan Falls. A talk was given by Mr. C. S. Kane on **Post-war Planning.** (24.)

June 23—Dinner meeting at St. Maurice Hotel, Trois-Rivières, to welcome President Cameron and party. Before dinner an inspection trip was made to the Trois-Rivières plant of the Canada Iron Foundries, Limited. President Cameron addressed the gathering on **Post-war Reconstruction.** (74.)

Oct. 26—Dinner meeting at the Cascade Inn, Shawinigan Falls. Mr. H. L. Sheen, of the Canadian General Electric Company, Limited, gave an illustrated address on **Electronics.** (85.)

Nov. 2—A meeting was held at the Three Rivers Club, Trois-Rivières, of all Technical men in the district, and a joint committee was formed under the chairmanship of Mr. Horace Freeman. (40.)
A similar meeting was held in Shawinigan Falls, in con-

Branches	Border Cities	Calgary	Cape Breton	Edmonton	Halifax	Hamilton	Kingston	Lakehead	Lethbridge	London
MEMBERSHIP										
Resident										
Hon. Members	..	..	..	..	..	..	2	..	..	..
Members	54	95	30	69	181	96	30	30	27	22
Juniors	8	10	1	17	13	17	6	3	3	1
Students	4	7	..	31	29	17	32	7	2	..
Affiliates	..	1	1	1	1	1	1	6	..	..
Total	66	113	32	118	224	131	71	46	32	23
Non-Resident										
Hon. Members	..	..	..	..	..	..	..	..	..	..
Members	26	18	26	7	76	20	3	12	11	16
Juniors	6	2	3	2	7	3	2	1	7	1
Students	6	5	8	6	20	3	7	3	6	2
Affiliates	..	..	2	..	..	1	..	..	..	1
Total	38	25	39	15	103	27	12	16	24	20
Grand Total December 31st, 1943	104	138	71	133	327	158	83	62	56	43
" December 31st, 1942	80	144	72	101	281	150	81	67	58	50
Branch Affiliates, December 31st, 1943	..	46	..	..	..	14	..	..	..	1
FINANCIAL STATEMENTS										
Balance as of December 31st, 1942	277.77	237.21	424.57	102.32	284.90	137.79	110.84	220.51	189.90	223.70
Income										
Rebates from Institute Headquarters	201.37	78.43	94.57	28.80	80.72	265.56	130.56	133.89	35.88	91.20
Payments by Professional Assns	..	242.20	..	205.05	414.00	..	..	..	54.30	..
Branch Affiliate Dues	..	172.06	..	..	..	34.50	..	..	..	..
Interest	..	46.35	..	..	1.00	59.20	0.48	3.30	1.41	3.00
Miscellaneous	266.70	15.00	17.00	..	60.25	101.18	..	436.60	4.20	..
Total Income	468.07	554.04	111.57	233.85	555.97	460.44	131.04	573.79	95.79	94.20
Disbursements										
Printing, Notices, Postage①	46.76	126.44	4.88	40.84	134.08	119.00	23.13	22.43	3.29	37.19
General Meeting Expense②	367.67	77.30	37.70	34.40	63.99	7.06	6.25	306.08	30.24	38.78
Special Meeting Expense③	..	162.74	..	24.92	60.00	132.63	38.45	177.70	..	133.03
Honorarium for Secretary	..	..	..	50.00	50.00	..	..	10.00	..	..
Stenographic Services	10.00	10.00	..	..	26.40	50.00	19.95	..	..	..
Travelling Expenses④	..	16.45	..	..	..	24.68	..	..	..	20.65
Subscriptions to other organizations	..	..	..	..	..	..	15.00	..	..	..
Subscriptions to *The Journal*	..	33.00	..	..	..	6.45	..	..	..	..
Special Expenses	26.20	32.72	..	15.00	66.37	..	8.78	4.91	..	5.55
Miscellaneous	..	9.83	15.59	3.00	34.73	42.48	..	27.95	.30	0.45
Total Disbursements	450.63	468.48	58.17	168.16	435.57	382.30	111.56	549.07	33.83	235.65
Surplus or *Deficit*	17.44	85.56	53.40	65.69	120.40	78.14	19.48	24.72	61.96	*141.45*
Balance as of December 31, 1943	295.21	322.77	477.97	168.01	405.30	215.93	130.32	245.23	251.86	42.25

①Includes general printing, meeting notices, postage, telegraph, telephone and stationery.
②Includes rental of rooms, lanterns, operators, lantern slides and other expenses.
③Includes dinners, entertainments, social functions, and so forth. ④Includes speakers, councillors or branch officers.

Moncton	Montreal	Niagara Peninsula	Ottawa	Peterborough	Quebec	Saguenay	Saint John	St. Maurice Valley	Saskatchewan	Sault Ste. Marie	Toronto	Vancouver	Victoria	Winnipeg
..	2	..	1	..	..	..	..	..	..	..	1	..	1	4
36	860	73	350	39	93	61	47	39	96	18	391	127	36	120
7	170	15	50	16	20	12	1	16	8	6	66	6	2	23
6	428	11	62	12	19	22	15	18	8	1	102	13	1	75
..	27	2	6	..	1	2	3	1	1	..	15	3	..	3
49	1487	101	469	67	133	97	66	74	113	25	575	149	40	225
..	..	..		1	..	..	..	..	..	..		..	..	..
12	55	5		18	13	5	42	3	57	31	13	53	9	27
2	26	..		3	3	..	3	2	7	4	6	6	2	7
9	43	..		3	3	1	35	9	26	4	38	13	3	7
..	2	..		1	1	1	1	2	1	..	1	1	..	..
23	126	5	121	26	20	7	81	16	91	39	58	73	14	41
72	1613*	106	590	93	153	104	147	90	204	64	633	222	54	266
63	1531	113	477	99	143	114	142	78	190	79	557	189	66	258
4	16	7	21	8	..	..	..	..	..	12	..	1	1	8

*For voting purposes only, there should be added to Montreal Branch, an additional 317 members, 181 being resident in the United States, 94 in British possessions and 30 in Foreign countries.

Moncton	Montreal	Niagara Peninsula	Ottawa	Peterborough	Quebec	Saguenay	Saint John	St. Maurice Valley	Saskatchewan	Sault Ste. Marie	Toronto	Vancouver	Victoria	Winnipeg
102.65	1,709.07	256.75	873.76	198.05	12.23	136.81	280.34	101.56	60.59	498.94	658.46	305.83	57.26	390.08
23.15	2,204.89	232.20	697.81	179.27	294.20	222.95	34.53	149.93	31.05	145.75	742.98	342.25	118.00	336.69
123.15	..	..	..	..	..	..	148.00	..	183.34	..	..	..	..	..
15.00	78.00	43.60	60.00	20.00	..	..	..	..	..	36.00	..	..	3.00	40.00
3.45	11.17	7.50	47.77	0.88	0.07	..	...	..	..	13.62	10.35	0.62	..	22.50
13.50	46.50	3.03	60.17	..	171.80	80.20	184.50	..	..	189.53	625.16	..	107.55	35.14
178.25	2,340.56	286.33	865.75	200.15	466.07	303.15	367.03	149.93	214.39	384.90	1,378.49	342.87	228.55	434.33
19.68	819.41	51.43	95.60	60.44	97.58	10.20	46.56	22.17	59.95	20.45	483.25	91.05	25.04	117.03
14.00	190.00	24.20	132.55	45.00	65.22	50.54	10.00	117.28	92.20	246.75	37.25	45.00	13.60	22.50
33.42	279.65	24.29	..	4.18	178.60	105.43	255.85	..	..	41.88	259.67	85.50	103.05	17.02
25.00	300.00	75.00	..	..	..	..	25.00	..	60.00	25.00	125.00	50.00	35.00	75.00
10.00	120.00	5.00	50.00	..	..	..	10.00	5.00	12.00	1.00	30.00	20.00	..	..
..	39.85	32.65	..	..	..	31.00	..	..	25.97	..	5.70	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
8.15	26.00	19.75	6.00	6.00	..	..	..	..	..	12.00	..	..	..	16.00
..	178.99	50.00	70.00	16.98	..	..	..	..	..	..	178.22	..	..	23.00
29.02	50.10	..	51.40	7.65	10.90	9.48	22.50	..	8.22	7.50	99.86	1.25	..	3.92
139.27	2,004.00	282.32	405.55	140.25	352.30	206.65	369.91	144.45	258.34	354.58	1,218.95	292.80	176.69	274.47
38.98	436.56	4.01	460.20	59.90	113.77	96.50	*2.88*	5.48	*43.95*	30.29	159.54	50.07	51.86	159.86
141.63	2,145.63	260.76	1,333.96	257.95	126.00	233.31	277.46	107.04	16.64	529.23	818.00	355.90	109.12	549.94

junction with the Shawinigan Chemicals Society and a joint committee was formed under the chairmanship of Mr. A. F. G. Cadenhead. Mr. E. Gohier, Chief Engineer of the Roads Department of the Province of Quebec, addressed both meetings.

SASKATCHEWAN BRANCH

All meetings were held jointly with the Association of Professional Engineers, and the respective programmes were as follows:

Jan. 20—Regular meeting, addressed by Charles Eder, Assistant Manufacturing Superintendent, Regina Industries, Ltd., on **Industrial Relations.**

Feb. 19—Annual meeting, addressed by G. N. Griffin, Principal, Normal School, Regina, on **The Challenge of Democracy.**

Mar. 18—Regular meeting; paper by Dean Morrison, University of Alberta, on **The Effect of Aerial Bombing,** read by D. A. R. McCannel; illustrated.

May 20—Special meeting, addressed by W. P. Dobson, President, Dominion Council of Professional Engineers, on **Science in a Changing World.**

Oct. 6—Special meeting, addressed by K. M. Cameron, president, Engineering Institute of Canada, on **Post-war Reconstruction.**

Nov. 18—Regular meeting, addressed by N. B. Hutcheon, Assistant Professor of Mechanical Engineering, University of Saskatchewan, on **Recent Developments in Building Insulation**; illustrated.

Dec. 11—Regular meeting, addressed by W. Lloyd Bunting, Saskatchewan Manager, Ducks Unlimited, on **Waterfowl Conservation**; illustrated.

SAULT STE. MARIE BRANCH

Nine dinner meetings were held during the year. The average attendance was twenty-five members and guests.

Jan. 29—**Design and Construction of Synchronous Machines,** by H. R. Sills.

Feb. 26—**Moving Coal Bridge at the Algoma Steel Corporation and Structural Construction,** by D. C. Tennant.

Mar. 26—Motion picture—"Hydro-Electric Development at La Tuque."

Apr. 30—**Uses of the Oxy-acetelyene Torch,** by W. F. Buller.

June 1—Motion picture films—"Power to Win"; "Railroading," by L. W. Ashcroft.

Sep. 24—**Producer Gas Fuels for Motor Cars,** by H. M. Lake.

Oct. 27—Visit of President K. M. Cameron and Assistant Secretary Louis Trudel.

Nov. 26—**Construction Experiences During Russia's Five-Year Plan,** by J. P. Bendt.

Dec. 17—Annual meeting.

TORONTO BRANCH

The regular meetings held during the year are listed below, with the attendance given in brackets.

Jan. 7—T. M. Moran, **War Industry Problems.** (50.)

Jan. 21—Students' Night: Joint meeting with the University of Toronto Engineering Society.
John M. Dyke, **The Solid Fuel Combustion Engine.**
Ronald Scott, **Electronic Devices.**
R. B. Telford, **Deep Wells.**
J. A. Legris, **The Place of the Engineer in the Post-war World.**
W. E. A. Rispin, **Synthetic Rubber.**
K. Stehling, **Underground Gasification of Coal.**
Two films: "The Wardens of Power" and "The Master Plan," were shown through courtesy of the Hydro-Electric Power Commission of Ontario.

Feb. 18—Professor K. B. Jackson, **Photography in Engineering.** (70.)

Mar. 4—E. L. Durkee, M.Am.Soc.C.E., **The Rainbow Bridge.** (91.)

June 18—Golf tournament.

Oct. 21—C. F. Morrison, **Modern Timber Engineering.** (95.)

Nov. 4—Col. G. W. Beecroft, **The Engineer in the Armed Forces.** (65.)

Nov. 19—A. H. Richardson, **The Ganaraska Survey.** (47.)

Nov. 26—Watkin Samuel, **Steep Rock Iron Mine, Its History, Exploration, and Plans for Development.**
Joint meeting with the American Institute of Electrical Engineers.

Dec. 3—Dean C. R. Young, **Engineers' Council for Professional Development.**
Dr. G. B. Langford, **Engineering Education.** (51.)

At the beginning of the year a Junior Section of the Branch was inaugurated. This Section administers its own affairs and a connection between it and the Branch is maintained by one member of each Executive being, ex-officio, a member of the other. The Junior Section report follows.

JUNIOR SECTION

As this is our first annual report, a review of the formation of the Junior Section might be in order.

In December, 1942, a group of young engineers, with the aid and guidance of Professor R. F. Legget, organized a Junior Section of the Toronto Branch of the Engineering Institute of Canada. It was their desire to supplement existing technical organizations but in no way to supplant any of them.

It was felt by the organizing committee that there was a definite need in Toronto for a group that would unite and strengthen all young engineers. A great number of the recent engineering graduates working in Toronto were not connected with any technical society and had no engineering contacts at all outside of their office work. Some who were members of the senior branch of the Engineering Institute were not attending the meetings principally because of the lack of men of their own age at the meetings. The existing technical societies for young engineers were doing an excellent job in their own fields, but they consisted of several small groups of engineers. So it seemed desirable that these and other young engineers be united for their common benefit. Thus the idea of a Junior Section of the Engineering Institute in Toronto appealed strongly to young engineers and it was widely endorsed.

Seven general meetings were held, four of which were dinner meetings. The speakers, subjects and attendance were as follows:

Jan. 27—Professor Griffith Taylor, **Geopolitics and Canada.** (80.)

Feb. 24—Professor Eric R. Arthur, **Town Planning and Housing.** (65.)

Mar. 24—Dinner meeting at Hart House. Harry F. Bennett, **The Engineer of Tomorrow.** (75.)
Annual elections.

Apr. 22—Dinner meeting at Diana Sweets. Mr. Herb. Smith, **Professional Engineers Association of Ontario.**
Mr. John Layng, **Planning the Small Town.** (90.)

Apr. 22—Dinner meeting at Diana Sweets. Mr. Edmund Ricker. Review of Mr. Paul Ackerman's address, **Industrial Democracy and Its Survival.**

Oct. 4—Dinner meeting at Diana Sweets. Atlas Steel motion picture, "Vision Fulfilled. (110.)

Nov. 1—Professor T. R. Loudon, **Aviation, Its Past, Present and Future.** (160.)

Dec. 6—Dinner meeting at Diana Sweets. Dean C. R. Young, **Humanistic Aspects of Engineering.**
Jack Powlesland, **Salary Survey of Junior Engineers in Toronto.** (110.)

VANCOUVER BRANCH

The Branch held the following meetings during the year:

Feb. 18—Mr. Gerald H. Heller, Personnel Supervisor, Dominion Bridge Co., Ordnance Plant, Vancouver, delivered an address on **Industrial Relations.**

Mar. 25—Mr. C. K. McLeod and his assistant, Mr. Richardson, delivered a paper on **Old Time-Pieces.**

Apr. —Regular meeting of the Branch. Speaker: D. Keith MacBain, chief engineer, Pulp Division, Weyerhaeuser Timber Co., Everett and Longview, Wash., on **The Weyerhaeuser Hydraulic Barker and Log Chipping Unit.**

May 17—Mr. Harry C. Anderson, assistant chief engineer of the Department of Public Works of British Columbia, gave an address on **The Alaska Highway.**

Oct. 12—Dinner meeting on the occasion of the President's visit, Mr. Cameron, after addressing the audience on the Institute affairs, spoke on **Post-war Reconstruction.**

Oct. —Mr. Norman R. Odling, Supervisor of Technical Staff, Western Canada, for the Canadian Broadcasting Corporation, delivered an address on the **Technical Aspects of Broadcasting and Future Trends.**

Nov. 27—Annual dinner and business meeting. Squadron-Leader Donaldson and Flying-Officer Lee, both of the R.C.A.F., spoke on **Flying Control and Air Sea Rescue.**

VICTORIA BRANCH

Due to the difficulty in securing a place to hold evening dinner meetings, on account of the blackout which was in force for a considerable period of the year, most of the general meetings were luncheon meetings. Since the time allowed for such meetings is limited, there were fewer papers presented this year than last year.

Jan. 12—Luncheon meeting. This was the annual meeting.

June 8—Lecture meeting. **Wartime Salvage Welding,** by H. Thomasson, welding engineer for the Canadian Westinghouse Ltd. 175 people were present.

June 24—Luncheon meeting. Mr. Creer, registrar of the Association of Professional Engineers of B.C., spoke to the members on the Association and on the newly-formed British Columbia Engineering Society.

Oct. 15—Joint dinner meeting with the Victoria McGill Graduates Society in honour of the official visit of President and Mrs. Cameron. The dinner was attended by a total of fifty-six members and their ladies.

Dec. 6—Luncheon meeting. This was the annual nomination meeting.

Dec. 21—Luncheon meeting. The annual meeting for 1943. Address of the retiring chairman and of the new chairman, Lt.-Col. H. L. Sherwood.

WINNIPEG BRANCH

The following Branch meetings were held during the year:

Jan. 7—The Hon. Errick F. Willis, Minister of Public Works for the Province of Manitoba, spoke on **The Alaska Highway.**

Feb. 4—Annual meeting of the Branch. Following the business of the meeting, an interesting film dealing with the subject of Town Planning was shown.

Mar. 4—Dinner meeting, at which Major H. G. L. Strange, of the Searle Grain Co., spoke on the **Royal Engineers.**

Apr. 1—Dinner meeting. Mr. L. B. Thompson, Supt. of the Dominion Experimental Farm at Swift Current, Saskatchewan, gave a very interesting talk on **Engineers in Agriculture.**

Apr. 22—A coloured film, entitled "Wings Over the North," depicting the problems of transportation in the north country, was shown through the courtesy of Canadian Pacific Airlines Ltd. A film by Ducks Unlimited of Canada was also shown.

Oct. 7—A very interesting discussion on the report of the Manitoba Electrification Enquiry Commission, led by Mr. E. V. Caton, Mr. J. W. Sanger, Mr. L. McKay, and Mr. J. W. Tomlinson, was held in Theatre B at the University.

Oct. 22—On this date the Branch was honoured by having President K. M. Cameron and other members of his party as guests at a luncheon meeting at the Hudson's Bay Co. dining room. Mr. Cameron gave a very interesting talk on **Post-war Planning.**

Nov. 18—Mr. A. T. McCormick, District Manager, Dominion Sound Equipments Ltd., gave a very interesting illustrated address on **Noise in Industry.**

Dec. 2—Dr. A. R. M. Lower, United College, spoke on **Canada, the War, and the Future.**

PLASTICS IN ENGINEERING

(Continued from page 77)

Tests have shown that the glue line is excellent in quality, i.e., shear strengths are high and the breaks are obtained in the wood rather than in the glue. Figure 3 shows some examples of assemblies made by the new process, and it is noted that the degree of wood failure is excellent.

Large scale trials at an aircraft propeller plant ([3]) showed that the method was readily applicable on a larger scale. The assemblies were in general about 8 ft. in length, 10 in. wide and consisted of from 6 to 9 laminae of ¾ in. birch. Trials included variations in voltage, glues and other factors and many useful data were obtained. It was found that propeller blanks could be glued readily in as short a time as 2 min. using a hot-setting glue, and such blanks could be put into production immediately. This compares with a press time of 6 hrs. and a conditioning period of 7 days in the normal process using cold setting urea resin.

Examples of engineering applications for laminated wood are propellers and spars in aircraft, keels and framing members in ships, engineering booms, trestles, laminated arches and trusses, pre-fabricated housing and farm building construction, timbers for various purposes, flooring, etc.

ACKNOWLEDGMENT

In the development of the new electrical hot gluing technique described above, acknowledgment is made of the very valuable assistance rendered by Mr. G. G. Graham, formerly on the staff of the Division of Chemistry, National Research Laboratories.

[3] S. & S. Aircraft Ltd., Winnipeg, Man.

JOB EVALUATION

(Continued from page 85)

After you have evaluated a certain number of jobs the job in question slips into its proper place without any question. This applies equally to the other characteristics.

SURVEYS

Assuming that the jobs have all been evaluated on the point rating system, we have a proper relationship between different jobs but we have not yet converted the points into money. To do this it is necessary for a company either to adopt an arbitrary value per point which will fit its present wage scale or to make surveys: first, either in the community in which their factory is located, or second, by making comparisons with competitors in the same line of work. It is a general practice to make surveys in the community in which the factory is located as most companies wish to pay the going rate being paid in the community. To make proper surveys it is necessary not only to have good descriptions of the jobs to be surveyed, but to have a range of jobs from the highest to the lowest. For survey purposes it is essential that the surveyor see and analyze the jobs in the factories being surveyed so that he can assure himself that the job descriptions which he has given these factories are thoroughly understood by them.

It is customary to obtain the number of employees on each job with the high, low and average of the earnings of the employees on that job. With this information, weighted averages can be set up for each job and a wage scale can be drawn which will give the proper relationship between points and money so that the factory making the survey can establish a proper wage level consistent with wages paid for work requiring like skills in the community.

From Month to Month

News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

COLLECTIVE BARGAINING AND THE ENGINEER

At the January meeting of Council resolutions from two branches, bearing on this subject, were discussed. Frequent reference was made to the situation in the States, for the double purpose of finding the circumstances that were common to both countries, and the points of contrast. It was decided to have the president appoint a small committee to go into the situation in full detail, and to report at the February meeting in Quebec.

The situation in the States is materially different from that in Canada. Here there is no Wagner Act that provides nationally for compulsory collective bargaining, although some of the provinces are showing an interest in the subject. Ontario has an act that excludes "the learned and scientific professions," and the indications are that Quebec proposes to exclude them also in the legislation now being contemplated but the other provinces have not yet advanced sufficiently in their deliberations to indicate what form of legislation they have in mind.

The action of the American Society of Civil Engineers has precipitated the situation in the United States. There has been a lot of criticism, but the votes taken in the various districts of the Society, so far reporting, indicate an overwhelming majority "in favour." The first fourteen sections that reported showed an average of 94 per cent for and 6 per cent against. One section—Seattle—reported a favourable vote of 97 per cent. The report of the New York or Metropolitan Section was not clear, but a member of the committee that prepared the report indicated at the recent annual meeting of the Society, that the committee did not approve of the Society's method of proceeding, but nevertheless did not entirely disapprove of the principles.

The subject is a serious one. If collective bargaining includes the engineers it doesn't seem reasonable to permit bargaining units of a heterogeneous nature to control them. If they must be organized it is their own organizations that should do it. In fact the experience in the States is that the members are demanding it. They do not want to join the labour unions; and they insist that their societies should serve them instead.

The Council of the Institute will have the benefit of opinions from a large number who will be attending the annual meeting at Quebec. It is hoped that the situation may be revealed fully and that the best solution in the interests of the profession may not be difficult to find.

GENERAL McNAUGHTON SENDS GREETINGS

Upon receipt of the news of General McNaughton's retirement President Cameron sent him a message (*Engineering Journal*, January, 1944) expressing the Institute's concern about his health, and assuring him of a welcome back in Canada. A reply has since been received which is published herewith:

"Dear Mr. Cameron:—

"I most heartily appreciate your kind message. Canadian engineers, both here in the United Kingdom and at home, have given outstanding service in developing the Canadian Army into the fine instrument it is. In all departments, within the Army and without, we have had the greatest benefit from their wide knowledge, vision, perseverance, and devotion to the cause. They have made a contribution of the greatest value in the present task which will endure into the future for the lasting benefit of Canada. I am very grateful for the help so freely given to me personally as well as to the Service, and I look forward to continued association in other fields as the call may come.

"With kindest regards to you and to the members of The Engineering Institute.

"(Signed) A. G. L. McNaughton."

"NAMED FOR ENGINEERS"

Under this heading *Mechanical Engineering* for January prints an editorial about five ships that are to be named for five distinguished American engineers. Such action is most unusual but naturally meets universal approval from engineers. The famous cable ship *Lord Kelvin* is perhaps the only other instance of this type of recognition for engineers and scientists.

The five ships are being built for the United States Maritime Commission. The five engineers in their lifetime were all members of The American Society of Mechanical Engineers. They all contributed substantially to the foundation of better management techniques, and so it is fitting that their names should be perpetuated in those giant products of engineering and management, the modern steam ship.

Of the five engineers, *Mechanical Engineering* has the following to say:

"Frederick W. Taylor, father of scientific management, who laid the foundations of modern management principles and practices and was the first to make a comprehensive study of the art of cutting metals."

"Frank B. Gilbreth, whose work in time and motion study opened new and fruitful fields of increasing production with the reduction of fatigue."

"Harrington Emerson, whose 'twelve principles of Scientific Management,' became household phrases a year ago."

"Henry L. Gantt, the great philosopher and protagonist of modern management and champion of the working man, who, by means of the Gantt chart, brought orderly procedure to production."

"John Edson Sweet, inventor, engine builder, and educator, who had 'to invade the ranks of foremen and machinists' to recruit his staff and whose more lasting honor was 'his influence over men, to cause them to think straight and live honorably'."

"In the ports of the Seven Seas men will read these names and wonder what they signify; Victory first for the United Nations as the result of untiring efforts of obscure workmen who day by day back up the heroic efforts of their brothers in the field—and after victory, the rebuilding of a war-torn world where the principles of sound management, the philosophy of an industrialized civilization that has come to respect human values, the quest for the 'one best way,' and that benign influence that causes men to think straight and live honorably shall inspire men with new courage and a new hope to work out their destinies in accordance with the fundamentals these engineers discovered and put into practice."

THERE ARE NO ASSOCIATE MEMBERS

It is surprising to find that some persons still believe themselves to be Associate Members of the Institute. This classification which was done away with in a by-law amendment in 1940, and, all persons in that group were automatically transferred to Member immediately.

At Headquarters many letters are received in which the writer says he is an Associate Member. Perhaps this shows a lack of interest in the intricacies of Institute affairs, or perhaps over pressure of more weighty matters. There was considerable reference to these changes in the *Journal*, both before and after the ballot, and every member was asked individually to vote on the proposal. But it just goes to show how difficult it is to keep every member informed of the multitude of things that take place in the life of the Institute.

The purpose of this comment is to again inform those who were Associate Members in 1940 that they are now Members.

MAY AN ENGINEER DESIGN A BUILDING?

The Province of Quebec Association of Architects says the answer to that question is "No." To prove its contention it is taking legal action against a Montreal engineer—a member of the Engineering Institute and of the Corporation of Professional Engineers of Quebec—for having designed a building while not a member of the Association. The building was an industrial structure to be used for the manufacture of machine tools.

Aside entirely from the legal considerations, it is most lamentable that members of two professions so closely allied in practice should have to go to court to settle a detail which only they are technically qualified to understand and decide. A fine exhibition it will be, when these two splendid professions permit themselves to be dragged through the courts before the legal profession, a performance from which only the legal profession can profit. The engineers and architects are bound to be losers, no matter who gets the decision.

Injury will be done to every architect and engineer in Canada. A group of people is a profession only as long as the public grants it that distinction. Education, legislation, or registration do not make a profession. It is public respect, and just as soon as that respect is lost the professional status is lost. This washing of dirty linen in the open is a most unprofessional act, and the public will not hesitate to judge accordingly. Years of patient and intelligent upbuilding of the status of each group may well be lost in this unnecessary public show.

Now for the legal considerations. First of all, it is possible that a decision unsatisfactory to both sides will be obtained. It may be that publicity will be the only thing gained; and nobody wants that. Why should this argument be settled by a lawyer or a group of them? Surely the architects and engineers are not at this stage conceding to the lawyers a greater share of wisdom or intelligence. Surely they have the ability to settle the point themselves. Why can't they set up a tribunal of their own, if necessary, and agree to accept its decision as well as one reached by members of another profession? Who would think of asking the engineers and architects to settle a dispute between two groups of lawyers?

It is the architects who have initiated the action. The engineers are going to fight it vigorously because an important section of their accustomed activities is endangered. Since the practice of engineering began, engineers have been designing buildings. They are not likely to abandon the field lightly. In their defence it may be necessary to say things uncomplimentary to the architects. It may be necessary to prove that in the public safety it is essential that engineers be allowed to continue to design buildings. In the prosecution of their case the architects may well introduce evidence that will be no credit to the engineers. What an exhibition this will be! The fact that the case ever gets to court will be an indictment of the architects and perhaps the engineers as well.

This much can be said for the defendant. He did nothing that has not been done by engineers for over a century. He has not started this case. He and his supporters have endeavoured to settle it out of court. He can do nothing now but defend himself. That much he must do for the entire profession. He has been assured of the support of the Corporation of Professional Engineers of Quebec and of the Engineering Institute.

Surely some one or some group can prevent this fratricidal procedure. Are all the architects and all the engineers going to let themselves be dragged down by this unprofessional exhibition? Isn't there someone, somewhere, strong enough and wise enough to save the situation for these two young and vigorous professions, neither one of which can afford the consequences.

The following letter was presented at the last Council meeting of the Institute as a progress report from the committee appointed by the Corporation:

January 11th, 1944.

Dear Mr. Wright:

Re: Architects vs Brian R. Perry

In view of the interest that The Engineering Institute of Canada has taken in the legal action that has been instituted by the Architects' Association of the Province of Quebec against Brian R.Perry, it has been suggested that, as a member of the Committee set up to assist Mr. Perry in his defence, I give you a résumé of the status of the case for the information of the council of the Institute. This Committee is composed of Messrs. G. A. Gaherty, appointed by the E.I.C., C. C. Lindsay and myself, appointed by the C.P.E.Q. and A. D. Ross, appointed by Mr. Perry.

You will recall that the action of the Architects' Association is based on the allegation that Mr. Perry infringed their Act because not being a member of this Association he designed and supervised the construction of a factory building for Harrington Tool and Die Company. In other words, they contend that no one but an architect has the right to do work of that kind in the province of Quebec. Realizing the foolishness of such action on the part of the Architects' Association, the Committee has made a serious attempt to bring about some kind of agreement between the architects and engineers in this province but without receiving any serious consideration by the architects, so that the case is being proceeded with and is listed for trial during the February term of Court.

At a number of meetings attended by all the members of the Committee the question of Mr. Perry's defence has been thoroughly discussed with Mr. Frank Chauvin, attorney for Mr. Perry, and Mr. Roger Brossard, K.C., counsel for the Corporation of Professional Engineers. The line of action has been decided, witnesses have been chosen and we are giving every assistance possible to the lawyers in preparation of their defence.

Although this case has been taken against Mr. Perry for having done a specific job, the engineers of the province recognize it as an attack upon them and appreciate the interest that The Engineering Institute has expressed and the assistance it has given through its representative Mr. Gaherty.

(Signed) J. A. McCrory.

SQUARE PEGS IN ROUND HOLES

In January the *Montreal Gazette* printed a short poignant article under the above heading, which will be received sympathetically by engineers all over Canada. It is reproduced herewith.

"Perhaps you have heard this story before because they tell me it has been going the rounds for some two months now. My informant swears it is true and was sufficiently sure of his facts he gave me the party concerned with full authority to check its veracity.

"It appears that a fairly well-known Montreal engineer was anxious to do his part in the war effort, but because of the nature of his calling had not been able to do much about it. A short time ago he noticed an advertisement by the Federal Government calling for the services of an engineer. He made application to the department concerned and awaited a reply.

"When he did not hear from the government after a reasonable period of time, he decided to make a few inquiries on his own to find out if the position for which he had made application had been filled. He found out that it had been.

"Being of a rather curious turn of mind, he decided to make a few more inquiries to learn just who had been given the position. Government officials being what they are, this took a little more time, but eventually he discovered what had happened. He found out the job had been filled alright, but you can imagine what was his surprise when he discovered that the person who had filled the job was a lawyer.

"Now our friend was not the vindictive type. As a matter of fact, he had not cared very much in the first place whether or not he was given the job. He had made the application because he had honestly felt he might be doing something useful to help his country.

"He had often heard stories of square pegs in round holes in the federal government service, but had always thought these stories had been circulated by opponents of the administration who sought to discredit the Ottawa authorities. But this time he was convinced and a little incensed, so he decided he had better write Ottawa a letter to explain his feelings in the matter.

"This is the gist of the letter he sent the department:

" 'Dear Sirs: I have just heard that the position of engineer for which I made application has been filled, and that the party who has been given the job is a lawyer. Just in case that any time in the future you might be in need of the services of a lawyer I would be glad if you would let me know. I'm an engineer."

WASHINGTON LETTER

One of the interesting events of last week was the appearance of an authoritative book on Lend-Lease by E. R. Stettinius, Jr., former Lend-Lease Administrator and now Under-Secretary of State. Actually, the book is much more than a dissertation on Lend-Lease. It is an excellent and dramatic commentary on the major developments in world events since 1938. It traces all the various factors which eventually lead to the Lend-Lease Act—the repeal of the Neutrality Act—the cash and carry policy—Dunkerque and the fall of France—the destroyers-for-bases deal—and finally H.R. 1776—the Lend-Lease Act. The book also includes a very appreciative treatment of the whole question of Reverse Lend-Lease. In this connection it is clearly implied that Lend-Lease Aid, which the United States has so generously provided to all the United Nations since March 11, 1941, must be viewed against a background which extends back as far as 1938. It is emphasized that the tremendous expenditures made by Britain and France in the United States from 1938 onward alone made possible in time the eventual expansion of American industry into the great arsenal of democracy which it has now become. The point is clearly brought out that not only was British and French money expended in the purchase of munitions, but vast sums were also expended in the building of physical plants, equipment and machine tools throughout the United States. Armies of technicians and workers were trained and designs, drawings and know-how were made available. The book, which runs to some 347 pages, is well illustrated with both pictures and excellent charts. It is extremely well and readably written as a fast moving story. One reads this book as one would read a novel and in many sections one reads with a mounting sense of excitement. One particular chapter has to do with the hectic days and nights of negotiations aimed at taking over the French contracts and the French assets in the United States before the fall of France and the consequent freezing of all French assets and commitments. I was talking to Tom Childs the other day about this period in which he and the late Arthur Purvis figured so prominently. He told me that the chapter only catches a small part of the actual excitement and tension of those days, but even so it makes excellent reading.

The publication of Mr. Stettinius' book at this time is most significant. Since Germany marched into Poland, most of the actions of the United Nations have been taken as the result of urgent and pressing necessities and have been governed largely by the exigencies of the situation at the moment. Policies have been directed to the central and all-important end of winning the war. We are now reaching a turning point. Policies and actions designed to win the war are now bearing fruit and justifying the wisdom and courage of those who put them into effect. From now on, however, policies will have to be shaped with a view to their long term effects and to the maintenance of peace and international co-operation. Many wartime measures will have to be reviewed and amended or abrogated. It is therefore particularly fitting that the public should now be made aware of what actually lay behind the many bold steps which had to be taken and that all of us should become aware of the tremendously complicated character of some of the difficulties. Only on the basis of such an appreciation can adequate and lasting solutions be reached in effecting transition to long term policies which will ensure a durable peace. Mr. Stettinius' book will certainly fill an important role in this kind of public education. The opening sentence of his preface sets the keynote—"The life-blood of our democracy is the free exchange of ideas." At the present time the whole question of Lend-Lease is much to the fore. With changed conditions, Congress is looking askance at some features of Lend-Lease. A return to normal channels of trade is being advocated. In this connection it is well to bear in mind the last paragraph in Mr. Stettinius' book:

"Lend-Lease operations, as we know them now, will some day draw to a close, but we know already that the principle of mutual aid in mutual self-interest that is embodied in the Lend-Lease Act must live on. To-day there is more unity of purpose and of action among freedom-loving peoples than ever before. In that unity we can find the strength to build a peaceful world in which freedom and opportunity will be secure for all."

It is particularly interesting that Mr. Stettinius' book should appear during the same week as the announcement of a complete reorganization of the State Department, of which he is now the Under-Secretary. One of the significant features of this reorganization is the establishment of a special division of post-war planning in the international field. The State Department has also made several important announcements regarding a plan for the organization of an International Education Office to deal with problems of educational reconstruction.

While on the subject of Lend-Lease and international relations, I cannot resist the urge to write into the record, as it were, the significant clauses of the famous Article VII of the Master Lend-Lease Agreement. This article states that the terms and conditions of settlement of benefits provided under Lend-Lease between countries "shall be such as not to burden commerce between the two countries, but to promote mutually advantageous economic relations between them and the betterment of worldwide economic relations. To that end, they shall include provision for agreed action . . . open to participation by all other countries of like mind, directed to the expansion, by appropriate international and domestic measures, of production, employment, and the exchange and consumption of goods, which are the material foundations of the liberty and welfare of all peoples."

* * *

The latest news releases indicate that American war production is still mounting in spite of cutbacks in some phases. Aircraft, shipbuilding and gun production in November showed well-sustained increases over October production. The aircraft goals for 1943 were exceeded and the present rate of production is very considerably higher than the 1943 average. At the same time increasing thought is being given to civilian production and, while officials of the War Production Board have warned that ordinary civilian needs must remain far down on the list behind essential war requirements, an increasing range of civilian goods will probably be permitted for production in order to take care od fluctuations incident to reconversion plans. In this connection, the problems of renegotiation and the problems of termination of war contracts are also looming larger. Mr. Baruch's recommendations regarding contract terminations appear to be receiving general support. Another interesting factor in the production picture is the closure of four aluminum production lines in federally-owned plants. It is expected that these closures are but a forerunner in a fairly sweeping cutback in an aluminum output which has very considerably outstripped consumption. Readjustments in the aluminum programme, the effects on price, and the international implications, particularly as between the U.S. and Canada, will be very interesting to watch. Also significant is the recent presidential directive giving top priority to the landing craft programme. Also much in the news have been the recent experiments being carried out both in England and the United States on various types of jet-propulsion, both for aircraft and missiles. Some authorities believe that the future of aircraft will be based on this principle. Also of interest in the technical field are recent announcements regarding the future of television. It is predicted that a very extensive television industry will be ready to go into operation as soon as peacetime conditions return and that plans are at present under way for the establishment of telecasting networks that will cover the whole country. The announcement by Alfred P. Sloane, Jr., of General Motors Corp., of a "Master Plan" for the reconversion to peacetime activity of General Motors plants calls for an expenditure of half a billion dollars. Another item of interest is that the country's largest war plant —the huge aeroplane engine plant built by the Dodge Division of the Chrysler Corporation—will shortly go into operation. The plant includes nineteen buildings. The main building covers eighty-two acres and has nearly four million square feet of floor space. Some 25,000 persons will be employed.

During a small lunch on Capitol Hill the other day, I met several members of the House Foreign Affairs Committee including the young and personable congressman Fulbright—author of the Resolution which bears his name. There are several new recruits to this most important committee who show great promise.

Jan. 21/44 E. R. Jacobsen, M.E.I.C.

CORRESPONDENCE

Industrial Relations

Dear Sir:

I have read with much interest the paper "Trends in Industrial Relations" by Professor J. C. Cameron in the December issue of the *Journal*. The views expressed seem to me to be progressive and point the way to possible improvements in the field of industrial relations.

With one statement, however, I feel that I must disagree. Professor Cameron says "Their interests (employers and employees) point in the same direction, the success of the undertaking. The idea that there is a necessary and a deep-rooted antagonism among them is fallacious and untenable." It seems to me that under the prevailing system of free enterprise, the "undertakings" of capital and labour in their participation in a commercial enterprise are quite different. It is the purpose of the capital investor to produce a profitable venture—one which will pay dividends on the capital invested. The success of the company, from his point of view, is measured chiefly by the magnitude of these dividends. Should a business or industrial plant cease to pay, it is shut down, except, of course, when a revival is anticipated.

The aim of the labourer is to obtain a livelihood through the wages received. The success of his undertaking is measured chiefly by the magnitude of these wages, although there are other conditioning factors. It appears that these interests are certainly in opposition. The greater the relative sums spent on wages, and services to benefit the workers, the less there remains for profits, and vice versa. It is in fact because of this basic conflict that there are labour troubles. Strikes, lockouts and other evidences of industrial friction have their roots in this issue.

I do not imply that a rapprochement between labour and capital is impossible. Indeed, it is through just such attitudes as outlined by Professor Cameron on the part of both labour and capital that industrial peace can be realized. What must be understood is that in that case opposite interests have been reconciled, and that such a situation always bears seeds of future troubles.

I think it should also be pointed out that the proposals offered deal with only one phase of the labour problem; that is, the elimination of friction within organizations, as evidenced by hard feelings, general dissatisfaction, and ultimately by strikes and lockouts. There are, however, other, and more important problems of labour which should receive the attention of all thinking people, especially engineers. These problems are general unemployment and low wages. It is not my intention to raise here the question of the causes of these conditions. They are inextricably bound up with the economic structure of our free-enterprise system. As a result, the steps required to eliminate them are basically economic in nature. Even the universal adoption by management of responsible policies such as illustrated in the case of "X Manufacturing Company" could not be of much help. Whatever the answer, steps must be taken to insure that the post-war world will not be plagued by these evils as it was in pre-war days. A good deal of the responsibility for clearly thinking out a satisfactory solution to this problem rests with the engineering profession. Let us hope that an increasing number of engineers, busy as they are, will give serious thought to this matter.

Yours faithfully,

Bernard Etkin, s.e.i.c.

Toronto, December 30th, 1943.

MEETING OF COUNCIL

A regional meeting of Council was held at the Chateau Laurier, Ottawa, Ontario, on Saturday, January 15th, 1944, at two o'clock p.m.

Present: President K. M. Cameron (Ottawa) in the chair; Past-President C. J. Mackenzie (Ottawa); Vice-Presidents L. F. Grant (Kingston), and C. K. McLeod (Montreal); Councillors J. E. Armstrong (Montreal), E. V. Gage (Montreal), E. D. Gray-Donald (Quebec), R. E. Heartz (Montreal), N. B. MacRostie (Ottawa), T. A. McElhanney (Ottawa), G. M. Pitts (Montreal), W. J. W. Reid (Hamilton), C. E. Webb (Vancouver) and General Secretary L. Austin Wright.

There were also present by invitation—Past Vice-President E. G. Cameron; Past-Councillors W. F. M. Bryce, O. S. Finnie, A. K. Hay, W. H. Munro, John Murphy, F. H. Peters, J. L. Rannie and E. Viens, all of Ottawa; and the following members of the Ottawa Branch—W. L. Saunders, chairman; G. H. Ferguson, immediate past-chairman, A. A. Swinnerton, secretary-treasurer; J. H. Byrne, W. H. G. Flay, J. M. Wardle and C. D. Wight, members of the executive; W. J. LeClair, a member of the Ottawa Branch, and secretary-treasurer of the Canadian Lumbermen's Association, was also present to submit a proposal from the Association for the establishment of an Institute prize.

President Cameron expressed his personal pleasure and satisfaction in holding a regional meeting of Council under the auspices of his own Branch.

Remuneration of Engineers—City of Montreal—At the last meeting of Council in view of the impending strike among city employees, and at the request of twenty-five engineer employees, Mr. deGaspé Beaubien had been appointed chairman of a committee to aid in protecting the interests of engineers. Immediate action had been taken, and Mr. Beaubien had submitted the following report:

December 22, 1943.

"The engineers, who are employees of the City of Montreal, sent you a petition asking the Institute's protection in the event of a strike of the civil employees of the City should be called and a hasty settlement prejudice their rights.

"At the Council's meeting of Saturday last, you have appointed a Committee to interview the City authorities on behalf of its employees who are members of the Institute. On this Committee were Messrs. C. K. McLeod, Gordon Pitts, Louis Trudel and myself.

"The impending strike was called yesterday morning and, as it was urgent that prompt action be taken before any commitment was made by the City, I took it upon myself to call upon the civic authorities immediately. Mr. Charles Lindsay, vice-president of the Corporation of Professional Engineers, and I visited Mr. Asselin, chairman of the Executive Committee, and Mr. Honoré Parent, Public Works Director, and obtained from both the assurance that the engineering staff of the City Hall, not members of the Union and not on strike, would find themselves, when it comes to a settlement, in no less favourable position than the civic employees who are members of the Union."

Employment Conditions with particular reference to Collective Bargaining and Remuneration—The general secretary presented resolutions from the Moncton and Halifax branches, dealing with remuneration of engineers.

He explained the developments which had taken place in the United States and the part which was being played by the American Society of Civil Engineers. This society has determined that if engineers are to be forced into collective bargaining units by the working of the Wagner Act they would be much better off with units of their own choosing, and accordingly the society has outlined procedures by which each one of its sections can establish if it so chooses a bargaining unit for its area. The situation in Canada is quite different in view of the fact that up to the present there is no Federal compulsory collective bargaining legislation. At the president's request the general secretary reviewed some of the developments that were associated with the collective bargaining legislation enacted in the province of Ontario. The "learned and scientific professions" are excluded from the workings of this legislation although a very definite attempt had been made by organized labour to have them included.

The general secretary also recalled to Council that the Institute, in association with the Canadian Institute of Mining and Metallurgy, the Canadian Institute of Chemistry, the Royal Architectural Institute of Canada, and the Dominion Council, had presented a brief to the McTague Commission asking that if Federal legislation were contemplated the "learned and scientific professions" be not included.

At a previous meeting of Council this whole matter had been referred to the Committee on Professional Interests, but that committee felt that the subject lay somewhat outside of its terms of reference and that a special committee should be appointed. President Cameron thought that the terms of reference for the Committee on Industrial Relations might be wide enough to include this topic, but there was some discussion which indicated that this angle of collective bargaining was not in the field of that committee.

Mr. Pitts stated that the subject needed definite and astute study in order to determine a policy. He thought that the professions should not be included in unions or bargaining units of the usual labour type, but that through their own professional organizations they should seek the assistance which may be required. He thought that all the professional men in Canada should establish one Institute which could speak for the entire professional group in such matters.

Mr. MacRostie supported Mr. Pitts and referred specifically to the engineers employed in the Civil Service.

Mr. Reid agreed that consideration should be given to the question as to where we are going in these collective bargaining matters. He thought there should be some group which could speak for the engineers and for the scientific man. He thought if the engineering organizations failed to meet this need they would not be achieving their objectives. Mr. Wight, Mr. Munro and Mr. Ferguson gave general support to Mr. Pitts' proposal for the professional institute. Mr. Munro emphasized the need of some organization being able to speak for the engineers, particularly in the low salary brackets which are being paid sometimes less than ordinary mechanics.

Dean Mackenzie suggested that it be left to the president to select a small committee which could consider this matter and report to the next meeting. He emphasized that some care should be taken in the selection of this group so that its recommendations would be based on the great volume of material which is available for study. This was carried unanimously.

Canadian Lumbermen's Association—The general secretary read the following letter which had been received from the Canadian Lumbermen's Association:

December 28, 1943.

"Dear Mr. Wright:

"As previously informally discussed with President Cameron, Vice-President Lang and yourself, I have obtained authorization from the Directorate of this Association to offer to the Engineering Institute of Canada a prize of value approximately $100.00 per year to be competed for by your members. This Association wishes to leave the handling of such competition to the Council of the Institute, stipulating only that the prize be awarded for what in the opinion of the Council is the best paper or design dealing with wood structures submitted by its members during the year.

"The undersigned will be very pleased to discuss details of this matter with you at any time which may be arranged.

"Yours very truly,

"(Signed) W. J. LeClair,

"Secretary-Manager."

At the president's request, Mr. LeClair reviewed the activities of his association, pointing out that seven years ago an engineer was engaged by a group of lumbermen to advise on matters of trade promotion. This group endeavoured to prepare information that would develop a more extensive use of wood in building construction. A technical service was made available to engineers and the publication, *Timber of Canada*, was established. A scholarship had also been made available for university students and additional scholarships were being planned.

In offering this prize to be awarded through The Engineering Institute the association was hoping for a further development in the technical knowledge associated with the use of wood in construction. Mr. LeClair had found that there was a considerable lack of knowledge of design and he hoped that this prize might stimulate efforts in that field.

It was moved, seconded and unanimously agreed that the offer of the association be accepted and that the general secretary express to the Association the Institute's appreciation. It was also agreed that a committee should be appointed immediately to draw up the terms and conditions under which the prize would be awarded. This committee was appointed as follows: T. A. McElhanney, Chairman, W. J. LeClair, G. M. Pitts.

It was noted that the next meeting of Council would be held in Quebec City, on February 9th, 1944, the day previous to the annual general meeting.

The Council rose at six thirty p.m.

A number of applications were considered, and the following elections and transfers were effected:

Members

Blaylock, Peter Woodburn, B.Sc., (McGill), development engr., Shawinigan Chemicals, Ltd., Shawinigan Falls, Que.

Czerwinski, Waclaw, Mech. Engr., (Politechnika Lwowska, Poland), chief engr., Canadian Wooden Aircraft, Toronto, Ont.

LaMountain, George William, B.Sc., (U.S. Naval Academy), supt. of properties Aluminum Co. of Canada, Arvida, Que.

Limoges, Jacques, B.A.Sc., C.E., (Ecole Polytechnique), district engr., Dept. of Roads, Prov. of Quebec, Quebec, P.Q.

Little, Elliott Menzies, B.A.Sc., (Univ. of Tor.), gen. mgr., Anglo-Canadian Pulp & Paper Mills Ltd., Quebec, P.Q.

Ross, John Henry, B.Sc., (Mech.), (Queen's), works engr. and security officer, Small Arms Ltd., Long Branch, Ont.

Simson, Fred Thomas, B.A.Sc., (Univ. of Tor.), hydraulic engr., Canadian & General Finance Co., Toronto, Ont.

Theriault, Antonin, Brigadier, C.B.E., B.Sc., (Civil, Mining), (Ecole Polytechnique), chief supt. of Arsenals, Artillery Park, Quebec, P.Q.

Juniors

Carrick, Stanley Mirus, (Univ. of Man.), 365 Selkirk Ave., Winnipeg, Man.

***Germain,** Walter Edgar, struct'l. dftsman., Dept. of Works and Bldgs., Naval Service, Ottawa, Ont.

Hand, Carl Everett, B.A.Sc., (Univ. of B.C.), shift engr., Arvida sub-station Aluminum Co. of Canada, Arvida, Que.

McKeown, Lewis Austin, L.Sc., (Univ. of Montreal), service representative, Aluminate Chemicals, Ltd., Toronto, Ont.

McLean, Glen Roland, B.Sc., (Chem. Eng.), (Univ. of Alta.), tech. service engr., Plastics Divn., Monsanto (Canada), Ltd., Bordeaux, Que.

Woodall, Gordon, B.A.Sc., (Univ. of Toronto), designing struct'l engr., for E. A. Cross, consltg. engr., Toronto, Ont.

Transferred from the class of Student to that of Junior

Codd, Percy, B.Eng., (Univ. of Sask.), U/T Navigator "B", R.C.A.F., Chatham, N.B.

Schwartz, Harry H., B.Eng., (McGill), S.M. (M.I.T.), radio development engr., Northern Electric Co. Ltd., Montreal, Que.

Solomon, Julius Denison, B.A.Sc., (Univ. of Toronto), development engr., Hamilton Bridge Co. Ltd., Hamilton, Ont.

McArthur, Donald Stewart, B.Sc., (Univ. of Alta.), progress engr., c/o J. Gordon Turnbull, Sverdrup & Parcel, Whitehorse, Y.T.

Woodfield, Percy Raymond, B.Sc., (Univ. of Man.), engr. officer (Flight-Lieut.), R.C.A.F., Ottawa, Ont.

Admitted as Students

Burns, Donald Ripley, (Mount Allison Univ.), Sackville, N.B.

Burris, Donald Archibald, (N.S. Tech. Coll.), Pine Hill Residence, Halifax, N.S.

Ewing, Kenneth Harry, (McGill Univ.), Geodetic Service of Canada, Ottawa, Ont.

* Has passed the Institute examinations.

Haig, Douglas Ernest, (Univ. of Man.), 163 Martin Ave., Winnipeg, Man.

Levasseur, J. A. Maurice, (Mtl. Tech. Sch.), technician, dftsman. Electrical Engrg. Dept., Sorel Industries Ltd., Sorel, Que.

MacLean, Duart Alan, (Univ. of Man.), 214 Ashland Ave., Winnipeg, Man.

Perkins, Douglas Harold, (Univ. of Toronto), 364 Victoria Park Ave., Toronto, Ont.

Roy, Léo-Paul, (Ecole Polytechnique), 5517-4th Ave., Rosemount, Montreal, Que.

Steele, Owen Stevenson, (N.S. Tech. Coll.), 107 Walnut St., Halifax, N.S.

Students at Laval University

Beauchesne, Louis-Alfred, Parisville, county Lotbinière, Que.

Bélanger, Cécilien, 312 St. Jean, Quebec, P.Q.

Brulé, Marcel, 69 Maréchal-Foch, Quebec, P.Q.

D'Amours, Maurice, 160 Maisonneuve Ave., Quebec, P.Q.

Dumont, Gilbert, Laval University, Faculty of Science, Quebec, P.Q.

Fournier, Gaston, Laval University, Quebec, P.Q.

Fraser, Daniel Maurice, 69 Maréchal-Foch, Quebec, P.Q.

Gareau, Grégoire, Faculté des Sciences, Laval Univ., Quebec, P.Q.

Hamel, René, 65 Maréchal-Foch., Quebec, P.Q.

Lavallée, Paul, Faculté des Sciences, Laval Univ., Quebec, P.Q.

Legendre, Rosaire, 26 Couillard St., Quebec, P.Q.

Painchaud, Robert, 38 DuBuisson Street, Beauport, P.Q.

Pouliot, Jean-Louis, Faculté des Sciences, Laval Univ., Quebec, P.Q.

Tremblay, Jules, 212 d'Aiguillon, Quebec, P.Q.

Students at McGill University

Cohen, Abbey, 4654 Hutchison St., Montreal, Que.

Collet, Marc Armand, 223 Clarke Ave., Westmount, Que.

Dunne, Gerald Joseph, Gervais Ave., Otterburn Park, Que.

Segal, Perry, 6211 Lennox Ave., Apt. c-115, Montreal, Que.

Slader, Geoffrey Yorke, 3482 Hutchison Street, Montreal, Que.

Students at University of British Columbia

Bentall, Robert Gilmour, 1531 Davie St., Vancouver, B.C.

Ker, Walter Allan, 1556 W. 12th Ave., Vancouver, B.C.

Narod, Alvin Jackson, 105 Cook St., Victoria, B.C.

Scarisbrick, Richard Gilbert, 980 Denman St., Vancouver, B.C.

Wallace, John Merritt, 1757 W. 40th St., Vancouver, B.C.

Engineering class of 1873 at McGill University. Back row, *left to right:* Clement H. McLeod, (secretary of E.I.C. for twenty-five years). Donald A. Stewart, Robert J. Brodie. Front row: Henry K. Wicksteed, George T. Kennedy, John F. Torrance.

REGISTRATION IN ENGINEERING COURSES AT THE UNIVERSITIES

Errata

Through an oversight, the number of students in first year engineering at the University of Alberta was left out of the tabulation showing the registration in engineering courses at Canadian universities, on page 689 of the December *Journal.* This figure is 149.

The corrected totals for the current year are therefore as follows: total registration in engineering at the University of Alberta: 367; total registration in the general course at all universities: 1,722; total number of engineering students at all universities: 4,610.

It should be pointed out that, in certain instances, the registration figures in first year engineering include students of No. 2 Canadian Army course who, if successful, will be given full credit for the first year of the regular course.

Although it was not mentioned in the table, there are at present, at the University of Toronto, seven students taking aeronautical engineering courses.

ENGINEERING STUDENTS' COSTS AT TORONTO

The data contained in the following summary were obtained by a survey conducted by the Engineering Society of the Undergraduates and the Junior Panel of the Engineering Alumni Association, University of Toronto. It represents the actual average costs including tuition fees for average students for the year 1942-1943.

The totals obtained are as follows:

Toronto students	$579.00
Students from outside of Toronto	$805.00

(The cost of transportation to and from home for visits must be added to this cost).

18.4 per cent of the students surveyed belonged to fraternities and their annual average fee of $48.00 must be added to the above totals.

These figures may be broken down as follows:

	Home in Toronto	*Home outside of Toronto*
Fees—tuition, societies and deposits	$291.00	$291.00
Food and shelter—		
(a) living at home includes lunches only	50.00	
(b) students in residence		274.00
students in boarding houses		279.00
students in fraternity residence		303.00
Cooperative res.		218.00
Rooming and eating meals out		280.00
Transportation to and from School	22.00	......
School socials	14.00	14.00
Outside socials	68.00	68.00
School equipment	40.00	40.00
Clothing per 12 months	78.00	79.00
Misc. Laundry, toilet articles, medical expense	15.50	42.00

The costs of some expenditures may be expanded to show the variation obtained in the survey:

	Low	*Weekly Cost Average*	*High*
Room rent	$2.50	$3.30	$ 5.00
Meals for the above	4.00	6.02	7.00
Boarding house	8.00	9.30	14.00
University residence	8.00	9.14	10.00
Fraternity house (board)	8.50	10.00	11.20
Co-operative residence	7.00	7.25	7.50
University socials	1.00	14.00 *per yr.*	75.00
Other socials	.25	2.25	7.00

The students surveyed saved an average of $319.00 during the vacation and 11 per cent of them earned on an average of $113.00 during the term.

DE GASPÉ BEAUBIEN

PRESIDENT OF THE ENGINEERING INSTITUTE OF CANADA, 1944

Nearly three hundred years ago, when Ville-Marie had just been founded, a young Frenchman named Trottier left his native county, le Perche—now part of Normandy—and came to seek his fortune in New France. Prosperity followed, so that a century later one of his descendants, "le père Michel Trottier", was able to leave a substantial estate to each of his sons, who thus became landowners. One of them, Le Sieur Trottier de Beaubien, was the founder of the distinguished family to which our new president belongs, a family whose members have long taken a notable part in Canadian affairs.

de Gaspé Beaubien, C.B.E., M.E.I.C.

President de Gaspé Beaubien was born in 1881 at Outremont, Quebec, a son of the Honourable Louis Beaubien of Montreal. He was educated at the Collège de Montréal and the Collège Ste-Marie; then proceeding to McGill University where he took the engineering course and received the degree of B.Sc. in 1906. He remained at the University for a time as demonstrator, and then went to the works of the Westinghouse Company at East Pittsburgh, having obtained experience with the Montreal Light, Heat & Power Company as early as 1903.

From 1908 until 1922 he practised as a consulting engineer in his own name, then for some years in partnership under the name of Beaubien, Busfield & Company. In 1929 the present consulting firm was established; throughout this period Mr. Beaubien was engaged largely in hydro-electric and power development engineering.

During the earlier years of Mr. Beaubien's career, his clients included cities like St. Jérôme, Drummondville, Farnham, Iberville and Montmagny, as well as commercial concerns like the Frontenac Breweries, the Cie Hydraulique de Portneuf and the Chicoutimi Pulp Company. Since then he has acted as consulting engineer for the cities of Montreal, Quebec, Outremont and Westmount and has been consulted by a number of power companies, such as the Southern Canada Power Company, the Montreal Island Power Company, the Shawinigan Water & Power Company and Montreal Light, Heat and Power Consolidated.

In 1937, at the request of the City of Montreal, he undertook to report upon the tariff of rates charged by the Montreal Light, Heat and Power Consolidated for the supply of electric energy to the city for power, street lighting, etc., and is at the present time retained by the Public Service Board of the Province of Quebec to advise on rates for electric service to the public.

Since June, 1942, Mr. Beaubien has been a member of the committee which is preparing the French version of the National Building Code.

As regards the war effort, his activities have been largely administrative. In 1942 he was appointed a member of No. 4 Rehabilitation Committee and later became joint chairman of a campaign committee for Military District No. 4 on recruiting in Montreal for the Reserve Army. He also served on the Sub-committee on Post-War Construction Projects of the James Advisory Committee on Reconstruction. He is now a director of Defence Communications Limited, an important Crown company. He is past joint chairman of the National War Savings Committee, and is serving as a member of the National War Finance Committee. In the recent Honours List, his work was fittingly recognized by the award of a C.B.E.

Other technical and executive appointments include membership in the Electrical Commission of the City of Montreal, representation of the Canadian Chamber of Commerce on the main committee of the Engineering Standards Association, besides directorships in a number of prominent industrial concerns.

Mr. Beaubien joined the Institute as a Student in 1903, becoming an Associate Member in 1908 and a Member in 1921. He was treasurer in 1938-'39 and '40 and vice-president in 1941-'42, so that he takes the presidential chair with a real working knowledge of the problems of the Institute.

His other technical society memberships include the Corporation of Professional Engineers of the Province of Quebec; the Association of Consulting Engineers; the American Institute of Electrical Engineers; the Canadian Institute of International Affairs.

Notwithstanding the many claims on his time, he has served as president of the Canadian Club of Montreal (1939); the Rotary Club of Montreal (1940); and the Cercle Universitaire (1943). He is vice-president of the Royal Automobile Club of Canada, and for some years has taken an active interest in highway safety problems and the work of the Province of Quebec Safety League.

The diversity of Mr. Beaubien's activities, and the well-merited esteem in which he is held by both French and English-speaking Canadians, effectively support the view that a well-balanced engineering training widens a man's interests, and gives him a broader outlook. His professional standing has been enhanced by his industrial and governmental contacts. The wide circle of his friends who already know and appreciate his personality and achievements will join with the membership of The Engineering Institute of Canada in welcoming his election as our new president.

NEWLY ELECTED OFFICERS OF THE INSTITUTE

G. L. Dickson, M.E.I.C., has been elected vice-president of the Institute representing the maritime provinces. Born at Truro, N.S., he was educated at Acadia University where he received a B.A. in 1900 and an M.A. in 1901. From there he went to McGill University at Montreal, where he studied electrical engineering. From June, 1904, to March, 1910, he was employed as chief electrician by the Pictou County Electric Company. On March 1st, 1910, he joined the Nova Scotia Steel and Coal Company as an engineer at their iron mines at Wabana, Newfoundland. From June 1st, 1916, to October 17th, 1917, he was employed as manager with the Chambers Electric Light and Power Company, Truro, N.S.

Geo. L. Dickson, M.E.I.C.

J. M. Fleming, M.E.I.C.

E. B. Wardle, M.E.I.C.

On October 17th, 1917, he joined the Canadian Government Railways and has worked for that company in various capacities since that time, first as a construction foreman and draughtsman, then as a general power plant inspector, and finally, from March 1st, 1923, to December 31st, 1943, when he retired, as electrical and signal engineer, Atlantic region.

Mr. Dickson joined the Institute as an Associate Member in 1923, becoming a Member in 1940. He was president of the Association of Professional Engineers of New Brunswick in 1941 and, in that capacity, he signed the co-operative agreement between the Association and the Institute, early in 1942.

John M. Fleming, M.E.I.C., president of C. D. Howe Company Limited, Port Arthur, Ont., is the newly elected vice-president of the Institute for the province of Ontario. Born in Winnipeg, Man., he received his engineering education at the University of Manitoba where he graduated in 1921. The following year he did post-graduate work at the University and also acted as demonstrator on the staff.

He joined the engineering staff of the Manitoba Power Company in 1922 working on the design of the Great Falls Power Company plant. In 1923 he was employed by Walbridge Aldinger Company as resident engineer on construction of a temporary railroad for the construction of the aqueduct of the city of Tulsa, Oklahoma. Later in the same year, he was resident engineer for the Winnipeg Electric Railway Company on construction of foundations for Koppers coke plant, Winnipeg.

In 1924 he joined the staff of C. D. Howe & Company, consulting engineers, Port Arthur, on the design of terminal grain elevators and was employed by that company until 1932. From 1933 to 1935 he was associated with Mr. Howe in C. D. Howe and Company following the retirement of his partners. From 1936 to date he has been president of C. D. Howe Company Limited carrying on the business of the former company.

Mr. Fleming joined the Institute as a Student in 1917 transferring to Associate Member in 1928 and to Member in 1938. He was chairman of the Lakehead Branch in 1939-41 and councillor of the Institute in 1941-42.

E. B. Wardle, M.E.I.C., consulting engineer, Consolidated Paper Corporation, Grand'Mère, Que., is the newly elected vice-president of the Institute for the province of Quebec. Born at Slaterville, R.I., he received his education at Dartmouth College, N.S., where he graduated as a B.S. in 1889. Upon graduation he joined the staff of Tower and Wallace, consulting engineers, New York, and later went with George F. Hardy, consulting engineer also of New York. In this capacity he was employed until 1914 in the design and supervision of construction of several pulp and paper mills in the United States and Canada, notably Oxford Paper Company, Rumford Falls, Me., Champion Fibre Company, Canton, N.C.; Champion Coated Paper Company, Hamilton, Ohio; Laurentide Company Limited, Grand'-Mère, Que.; Anglo-Newfoundland Development Company, Grand Falls, Nfld.; Powell River Company Limited, Powell, B.C.; also power station for Laurentide Power Company, Grand'Mère, Que.

In 1914 he joined the staff of the Laurentide Company Limited at Grand'Mère as chief engineer and in 1932 he became chief engineer of Consolidated Paper Corporation with offices at Grand'Mère. Last year he became consulting engineer of the company. Since September, 1942, Mr. Wardle is also acting as consulting engineer to the Newsprint Administrator, Wartime Prices and Trade Board.

Mr. Wardle joined the Institute as a Member in 1929. He was a member of Council in 1939-1940.

A. S. G. Musgrave, M.E.I.C., municipal engineer for the Corporation of the District of Oak Bay, B.C., is the newly elected councillor representing the Victoria Branch. Born at Cork, Ireland, he was educated at Trinity College, Dublin, where he graduated in Arts

A. S. G. Musgrave, M.E.I.C.

James McMillan, M.E.I.C.

William Meldrum, M.E.I.C.

in 1911 and in engineering in 1912. He came to Canada in 1913 and was articled to a B.C. land surveyor until 1914 when he enlisted for military service. From 1915 to 1919 he was overseas in Belgium and in Palestine. In 1917 and 1918 he was G.S.O. 3 at General Allenby's Headquarters. He was awarded an M.B.E. and mentioned in despatches.

Returning to Canada in 1919 he qualified as a British Columbia land surveyor and entered private practice as civil engineer and land surveyor in the firm of Musgrave, Whyte and Moffatt. In 1935 he was appointed to his present position.

Mr. Musgrave joined the Institute as an Associate Member in 1938 and became a Member in 1940. He was chairman of the Victoria Branch of the Institute in 1942 and, in 1943, he was a member of council of the Association of Professional Engineers of British Columbia.

James McMillan, M.E.I.C., has been elected councillor of the Institute representing the Calgary Branch. Born in Glasgow, Scotland, he was educated at the University of Alberta where he graduated in electrical engineering in 1924. Upon graduation he joined the staff of Canadian Westinghouse Company Limited, Calgary, as a sales engineer. He had previously obtained employment with the same company during summer holidays, working on the installation of switching equipment at Edmonton power house. In 1927 he joined the Calgary Power Company and was employed on general engineering work until 1931 when he became purchasing agent of the company, supervising construction of transmission lines, distribution system substations and switching structures, which position he still holds. During the first world war he served with the 49th battalion (Edmonton Regiment) from 1915 to 1919.

Mr. McMillan joined the Institute as an Associate Member in 1934, becoming a Member in 1940. He served as secretary-treasurer of the Calgary Branch from 1935 to 1938, as vice-chairman in 1939-40 and as chairman in 1940-1941. He is a councillor of the Association of Professional Engineers of Alberta.

William Meldrum, M.E.I.C., is the newly elected councillor representing the Lethbridge Branch. Born at Johnstone, Scotland, he was educated at Halifax and Leeds, in England. He entered the coal mining profession at Leeds and in 1909 he came to Canada, engaging in general survey work. He enlisted in the Royal Canadian Engineers in 1916 serving until 1920 when he joined the staff of the Department of Natural Resources, Canadian Pacific Railway Company, as mining engineer and surveyor with the Galt Mines. When the larger mines of the Lethbridge coal field were amalgamated in 1935 he continued in the same capacity for the controlling company, The Lethbridge Collieries Limited.

Mr. Meldrum joined the Institute as an Associate Member in 1925 becoming a Member in 1940. He served as chairman of the Lethbridge Branch in 1932 and again in 1940.

H. L. Briggs, M.E.I.C.

C. Stenbol, M.E.I.C.

W. S. Wilson, M.E.I.C.

Alex. Love, M.E.I.C.

A. W. F. McQueen, M.E.I.C.

H. R. Sills, M.E.I.C.

H. L. Briggs, M.E.I.C., newly elected councillor of the Institute for the Winnipeg Branch, is assistant chief engineer of the City of Winnipeg Hydro-Electric System. He was born in the town of Killarney, Man. After completing his school education at that place, he spent several years with the Union (now the Royal) Bank of Canada, then taught school prior to studying engineering at the University of Manitoba. He obtained his B.S. degree in electrical engineering in 1928, being awarded the University gold medal for general proficiency in the course of studies. Since graduation and prior to his present appointment he has been successively electrical draughtsman, assistant to chief operator, relay engineer, then operating engineer, all with the Winnipeg Hydro.

Mr. Briggs joined the Institute as a Student in 1926. He transferred to Associate Member in 1931 and he became a Member in 1940. After a number of terms on the executive committee of the Winnipeg Branch of the Institute, Mr. Briggs was branch secretary for two years, and branch chairman for the year 1940. During 1940-41, he was president of the Manitoba Electrical Association.

Carl Stenbol, M.E.I.C., chief engineer of the Algoma Steel Corporation Limited, is the newly elected councillor for the Sault Ste. Marie Branch. Born in Norway, he began his engineering career in this country with the Dominion Steel & Coal Company, Sydney, N.S. In 1911 he joined the Algoma Steel Corporation as chief draughtsman. The following year and until 1914 he was smelter engineer and chief draughtsman with Canadian Copper Company. In 1915 he worked as a designer with the Anaconda Copper Company, Montana, and as mechanical engineer with Dome Mines Company. During the first world war he was with the Canada Cement Company, Montreal, as superintendent of their steel and forge plant. He returned to Sault Ste. Marie in 1917 and became assistant to the managing director of the Algoma Steel Corporation. He became mechanical superintendent in 1917 and a few years ago he was appointed chief engineer.

Mr. Stenbol joined the Institute as a Member in 1921.

W. S. Wilson, M.E.I.C., the newly elected councillor of the Institute for the Toronto Branch is secretary and assistant dean of the Faculty of Applied Science and Engineering at the University of Toronto. Born in Gray County, near Hanover, Ont., he studied engineering at the University of Toronto where he graduated in 1921. His course had been interrupted by the war during which he served in France with the 38th Ottawa Battalion. In 1921-1922 he was engaged on estimating and supervising construction work with Wilson and Falconer, and in 1922-1923 was estimator with Dowling-Williams Limited. From 1923 until 1926 he was demonstrator in the Department of Engineering Drawing, University of Toronto, and in the following year was with R.W.H. Binnie, general contractor, as estimator. In 1927 Mr. Wilson was appointed secretary of the Faculty of Applied Science and Engineering of the University of Toronto, which position he still holds, along

G. H. Ferguson, M.E.I.C.

R. S. Eadie, M.E.I.C.

P. E. Poitras, M.E.I.C.

with that of assistant dean. He is at present officer commanding the 2nd Battalion of the University of Toronto C.O.T.C. contingent, with the rank of lieutenant-colonel.

He joined the Institute as a Student in 1921 transferring to Associate Member in 1926 and to Member in 1935. He was chairman of the Toronto Branch in 1942.

Alexander Love, M.E.I.C., mechanical engineer in the structural division of Hamilton Bridge Company, Hamilton, Ont., is the newly elected councillor of the Hamilton Branch. Born at Saltcoats, Ayrshire, Scotland, he was educated at Ardrossan Academy and Glasgow University where he graduated in engineering in 1912. In the same year he came to Canada and joined the Hamilton Bridge Company where he worked from May to September when he went with the Canadian Pacific Railway. He was employed in the division engineer's office at Toronto until 1914 when he enlisted for military service. He served overseas with the 19th Canadian Infantry Battalion until 1916 when he was commissioned with the Royal Canadian Engineers and served until 1919.

Upon returning to Canada he went with the Hamilton Bridge Company where he was employed as detailer. He successively rose to designer, plant engineer and mechanical engineer of the structural division, the position which he now holds.

Mr. Love joined the Institute as an Associate Member in 1920, transferring to Member in 1934. He was secretary of the Hamilton Branch from 1933 to 1937 and chairman in 1940.

A. W. F. McQueen, M.E.I.C., has been re-elected councillor representing the Niagara Peninsula Branch of the Institute. Born at Lowestoft, England, he graduated from the University of Toronto in 1923 and entered the service of the Hydro-Electric Power Commission of Ontario. For three years he was assistant engineer of tests and for another three years he remained with the Commission in charge of various hydrological and hydraulic investigations. In 1927 he became assistant engineer with H. G. Acres and Company, Limited, consulting engineers, Niagara Falls, Ont., and in 1934 hydraulic engineer, which position he holds at the present time. Mr. McQueen has been intimately connected with all the important work carried out by his firm since the beginning of the war, including the Grand Valley dam, the diversion of the Seine river for Steep Rock Iron Mines Limited, the Shipshaw hydro-electric development, the steam plant and facilities for the synthetic rubber plant of the Polymer Corporation at Sarnia.

Mr. McQueen joined the Institute as a Student in 1920. He was transferred to Junior in 1927 and to Associate Member in 1929. He became a Member in 1939. He is the author of several papers that have been published in the *Journal*. In 1932 he was awarded the Past-Presidents' Prize for a paper on "Engineering Education." In 1938 he was the joint author of the paper "The 18-Foot Diameter Steel Pipe Line at Outardes Falls," which was awarded the Gzowski Medal. He was chairman of the Niagara Peninsula Branch of the Institute in 1939.

H. R. Sills, M.E.I.C., has been re-elected councillor representing the Peterborough Branch. He was born at Kingston, Ont., and was educated at Queen's University. Upon his graduation in 1921 he joined the Canadian General Electric Company and has remained with the firm ever since. In 1922 he became engaged in the design of synchronous motor and A.C. generators and has now specialized in the design of such machinery. He has been closely associated with the design of all recent generating equipment manufactured by his firm including that of the LaTuque and Shipshaw power developments.

Mr. Sills joined the Institute as a Student in 1921 transferring to Associate Member in 1936. He became a Member in 1940. He was first elected councillor of the Institute in 1940.

P. A. Lovett, M.E.I.C.

E. B. Martin, M.E.I.C.

P. E. Gagnon, M.E.I.C.

G. H. Ferguson, M.E.I.C., the newly elected councillor for the Ottawa Branch is chief of the Public Health Engineering Division in the Department of Pensions and National Health in Ottawa. Born at Toronto, Ont., he graduated in engineering from the University of Toronto in 1906. Following graduation he was engaged on various work in the service of several consulting engineers, and later joined the staff of the Hydro-Electric Power Commission of Ontario as assistant hydraulic engineer, becoming hydraulic engineer of the Commission of Conservation of Canada in 1911.

He served overseas with the Royal Canadian Engineers during the war 1914-18, returning to duty at Ottawa in January, 1919.

He then joined the staff of the Grand Trunk Arbitration Board in March, 1920, and at the conclusion of that arbitration, served as special engineer to the general manager, Toronto Transportation Commission during the rehabilitation of the Toronto street railway, returning to Ottawa in March, 1923, to develop the Public Health Engineering Division of the newly formed Department of National Health, of which division he is now chief.

Mr. Ferguson joined the Institute as a Student in 1906 transferring to Associate Member in 1919. He was chairman of the Ottawa Branch in 1943.

R. S. Eadie, M.E.I.C., is one of the newly elected councillors of the Institute for the Montreal Branch. Born at Hintonburgh, Ont., he was educated at McGill University where he obtained the degree of B.A.Sc. in civil engineering in 1920 and the degree of M.Sc. in 1922. His course was interrupted in 1916 when he joined the Royal Canadian Engineers as a lieutenant and served in Canada and overseas until the end of the war.

After graduation he accepted a position as lecturer in the Department of Applied Mechanics at McGill and remained in that position until 1924. In that year he severed his connection with McGill and joined the staff of the Dominion Bridge Company, at Montreal. He has been associated with the company since that time. In 1935 he was appointed designing engineer and in October, 1937, was made assistant chief engineer, which position he holds at present.

He has been intimately associated with the design and construction of many of the important structures built by the company during the past few years.

Mr. Eadie joined the Institute as a Student in 1914, transferring to Junior in 1920, to Associate Member in 1926 and to Member in 1936. He was member of the executive committee of the Montreal Branch in 1939-40, vice-chairman in 1942 and chairman in 1943.

Paul-Emile Poitras, M.E.I.C., one of the newly elected councillors of the Institute for the Montreal Branch, was born at Mascouche, Que., and received his engineering education at the Ecole Polytechnique de Montréal where he graduated in 1915. Upon graduation he went with the Inspection Board and was employed on the inspection of war material until he joined the Dominion Bridge Company in Montreal, the following year, as a structural draughtsman, later transferring in the mechanical department. In 1919 he was employed with the Canada Cement Company, Montreal, on construction of a plant extension and machinery layout. The following year he worked on the construction of a cold storage warehouse in the Montreal harbour.

In 1920 he joined the staff of the Steel Company of Canada Limited, Montreal, as an engineer later becoming mechanical engineer in charge of the engineering department, a position which he still holds.

Mr. Poitras joined the Institute as a Member in 1937 and for the past few years has been active in the affairs of the Montreal Branch, serving on the executive committee.

Paul-E. Gagnon, M.E.I.C., director of the department of chemical engineering and president of the Graduate School at Laval University, is the newly elected councillor of the Institute for the Quebec Branch. Born at Kingsey, Que., he was educated at Laval University and did post-graduate work during three years in Paris and obtained a D.Sc. degree with high honours, at the Sorbonne. In 1930 he was engaged in research work in chemistry at the Imperial College of Science and Technology, London, Eng., where he obtained the Diploma of Membership. The same year he was appointed lecturer in chemistry at Laval University, Quebec, and the following year he became assistant professor, becoming professor in 1935. In 1938 he was appointed director of the department of chemistry in 1938 and in 1941 was made director of the department of chemical engineering. Dr. Gagnon is a governor of Laval University and a past-president of the Canadian Chemical Association.

He joined the Institute in 1942.

E. B. Martin, M.E.I.C., city engineer of Moncton, N.B., is the newly elected councillor of the Institute for the Moncton Branch. Born at Moncton, N.B., he was educated at the University of New Brunswick where he graduated in civil engineering in 1912, joining the engineering staff of the city of Moncton the same year. He served overseas with the Royal Canadian Engineers until 1919 when he returned to Canada and became Street Commissioner of the City of Moncton. He served in that capacity until 1932 when he became city engineer.

Mr. Martin joined the Institute as an Associate Member in 1920, becoming a Member in 1940.

P. A. Lovett, M.E.I.C., is the newly elected councillor of the Institute for the Halifax Branch. Born at Liverpool, N.S., he graduated in electrical engineering from the Nova Scotia Technical College, Halifax, in 1938 and during the two years following he took the apprenticeship course at Canadian Westinghouse Company, in Hamilton, Ont. From 1930 to 1933 he was employed as an assistant to the equipment engineer of the Maritime Telegraph and Telephone Company Limited, Halifax, and from 1934 to date, he has been secretary-treasurer of Engineering Service Co., Halifax, a firm doing consulting, operation, designing and public utility work.

Mr. Lovett joined the Institute as a Student in 1928, transferring to Junior in 1931 and to Associate Member in 1935. He became Member in 1940. He was chairman of the Halifax Branch in 1942.

J. A. Russell, M.E.I.C.

J. A. Russell, M.E.I.C., the newly elected councillor of the Institute for the Cape Breton Branch is the chief mechanical engineer for the coal division of the Dominion Steel and Coal Corporation Limited, Sydney, N.S. Born at Birmingham, Eng., he was educated at the Bridge Trust School and Birmingham Technical School. He served his apprenticeship with M. B. Wild and Company, mining machinery manufacturers in Birmingham. From 1925 to 1929 he was employed as a designer on mining machinery. He came to Canada in 1929 and joined the Dominion Coal Company at Sydney, N.S., as a draughtsman. The following year he was appointed to the position which he now holds with the Dominion Steel and Coal Corporation.

Mr. Russell joined the Institute as a Junior in 1930 and transferred to Associate Member in 1937. He became a Member in 1940.

Personals

Relatives and friends of members in the active forces are invited to inform the Institute of news items, such as locations, promotions, transfers, etc., which would be of interest to other members of the Institute and which should be entered on the member's personal record kept at Headquarters. These would form a basis of personal items in the *Journal*.

News of the Personal Activities of members of the Institute, and visitors to Headquarters

ENGINEERS SHARE IN KING'S HONOURS

It will be a matter of interest to all members of the Institute to see the complete list of their fellow members who share in the recent King's Honour List. There are in all seven persons included in the lists printed in the newspapers which we have every reason to believe are complete.

The honours are divided with five going to persons in military posts and two to those in civilian occupations.

The Institute joins with the other citizens of Canada in congratulating the following members for the honours which they have so well deserved.

COMPANION, ORDER OF ST. MICHAEL AND ST. GEORGE (C.M.G.)

Robert Charles Wallace, M.A., PH.D., LL.D., Kingston, Principal, Queen's University.

COMMANDER, ORDER OF THE BRITISH EMPIRE (C.B.E.)

de Gaspé Beaubien, Montreal, consulting engineer.

Major-General Howard Kennedy, M.C., Quebec and Ottawa, quartermaster-general, National Defence Headquarters.

Major-General Harry Farnham Germaine Letson, M.C., E.D., Vancouver and Ottawa, adjutant-general, Department of National Defence.

OFFICER, ORDER OF THE BRITISH EMPIRE (O.B.E.)

Commander Arthur Francis Peers, R.C.N., Halifax and Quesnel, B.C., H.M.C.S. *Cornwallis*.

Lieut.-Colonel Gordon Park Stirrett, E.D., R.C.E., Vancouver, 3rd Divisional Engineers.

MEMBER, ORDER OF THE BRITISH EMPIRE (M.B.E.)

Lieutenant Alastair Duncan Cameron, R.C.A., Fredericton, N.B., Regimental Survey Officer, 21st Field Regiment.

Dr. Thomas H. Hogg, M.E.I.C., chairman and chief engineer of The Hydro-Electric Power Commission of Ontario, and past president of the Institute, has been named to represent Canada on the Public Utilities Committee set up by the Combined Production and Resources Board to survey the utility needs of allied nations and plan procurement of equipment for liberated countries.

Formation of this committee is a sequel to recommendations made at a meeting of the United Nations Relief and Rehabilitation Administration at Atlantic City where it was decided that the requirements of liberated areas should be referred to the Combined Boards. The latter body was asked to consider these requirements in relation to military and civilian demands and to make recommendations on meeting the needs presented by the UNRRA. The Public Utilities Committee has been set up to make the necessary recommendations involving the requirements in its particular field.

J. B. Dowler, M.E.I.C., of the Ford Motor Company, Windsor, Ont., has been elected chairman of the Border Cities Branch of the Institute. Born at Galt, Ont., he is a mechanical engineering graduate from the University of Toronto, in the class of 1931. He joined the Ford Motor Company of Canada upon graduation and has remained with the company ever since.

J. B. Carswell, M.E.I.C.

J. B. Carswell, M.E.I.C., has been appointed president of the War Assets Corporation, the crown company recently formed to deal with surpluses of war equipment without impairing the economy of the country. Mr. Carswell had been representative of the Department of Munitions and Supply of Canada, at Washington, for the past few years. Before the war he was president of the Burlington Steel Company, Limited, Hamilton, Ont.

C. B. Brown, M.E.I.C.

C. B. Brown, M.E.I.C., consulting engineer of the Canadian National Railways, Montreal, retired at the end of 1943. He graduated in civil engineering from Cornell University, in 1911, and after a number of years of experience in railway operation and construction work and in bridge and elevator building in various parts of Canada, he joined the Canadian Government Railways, in 1913, as chief engineer. Later he became assistant general manager with headquarters at Moncton. With the organization and development of the Canadian National Railways he was appointed chief engineer of the system with headquarters at Montreal. In October, 1939, he relinquished the duties of chief engineer to become consulting engineer and devote his entire time to the completion of the Montreal Terminal.

Lt.-Col. J. P. Carrière, R.C.E., M.E.I.C., has been promoted from the rank of major and is now stationed at Canadian Army Headquarters overseas.

G. J. Currie, M.E.I.C., is the newly elected chairman of the Halifax Branch of the Institute. Born at Halifax, he was educated at Dalhousie University and Nova Scotia Technical College where he graduated in 1931. Upon graduation he joined the Nova Scotia Light and Power Company at Halifax and is still with the same company as an engineer.

the east for his work in connection with the Welland canal.

Shortly after the end of the last war, Mr. Scott operated a construction and paving business of his own in Toronto but when the present war broke out he immediately offered his services to the Government and became director of ammunition filling with Allied War Supplies Corporation, Montreal.

Gerald N. Martin, M.E.I.C., has been appointed combustion sales engineer of the Dominion Bridge Company, Montreal. He has been with the company since his graduation from the Ecole Polytechnique, Montreal, in 1934. In 1938, he was granted leave of absence to

H. L. Sherwood, M.E.I.C.

George J. Currie, M.E.I.C.

G. N. Martin, M.E.I.C.

L. P. Cousineau, M.E.I.C., of Dufresne Engineering Company Limited, Montreal, is at present on loan to Quebec Shipyards Limited, Quebec.

R. L. Morrison, M.E.I.C., returned last June with his employers, Messrs. Airspeed (1934) Limited, Portsmouth, Eng., after having been on loan for a year to the Royal Air Force as technical adviser on the maintenance and operation of aircraft.

Lt.-Col. H. L. Sherwood, M.E.I.C., formerly district engineer officer, M.D. 11, Victoria, B.C., is the newly elected chairman of the Victoria Branch of the Institute. Graduating from the Royal Military College, in 1903, he was employed with the construction department of the Canadian Pacific Railway until 1914 when he went overseas with the Canadian Railway Construction Corps. He was promoted to major in 1917. From 1919 to 1923 he was on the staff of the Department of National Defence Headquarters, Ottawa, as a permanent force officer of the Royal Canadian Engineers. He was district engineer officer, M.D. 3, Kingston, Ont., from 1923 to 1929 and he occupied the same position in M.D. 10 at Winnipeg, Man., from 1929 to 1936. At that time he was transferred to the same position with M.D. 11, Victoria, a position he occupied until his retirement in 1941. He was promoted to lieutenant-colonel in September, 1939.

Hew M. Scott, M.E.I.C., has been appointed general manager of the War Assets Corporation, Montreal. Born in Scotland, Mr. Scott started his engineering career in Montreal with the Peter Lyall & Sons Construction Company in 1908 and headed their munitions division during the last war. He is well known in British Columbia for his work on the Esquimalt dock and in

obtain added experience and to study modern combustion engineering under the Central Electricity Board, London, England. While in England, he worked on the design and operation of the highest pressure boilers in use and was stationed for a time at the Brimsdown station of the North Metropolitan Power Supply Company. He returned to Canada in 1940 to resume his position in the boiler department of Dominion Bridge Company.

A. A. Scarlett, M.E.I.C., has recently been promoted by the International Harvester Company of Canada Limited, to the position of vice-president in charge of engineering, having supervision over engineering work carried on at all Canadian plants. Mr. Scarlett, who is a graduate of the University of Toronto, S.P.S., '13, has had long service in engineering work in Canadian and American plants of the company. Previous to his recent promotion he was chief engineer of the company's large Hamilton Works.

C. L. Dewar, M.E.I.C., has been appointed president of Wartime Shipbuilding Limited, a government-owned company. Mr. Dewar whose services have been loaned by Bell Telephone Company, has been with Wartime Merchant Shipping since its inception in 1941, first as comptroller and later as assistant to the president. Mr. Dewar's position with Bell Telephone Company was that of chief engineer of Eastern Area.

Norman A. Eager, M.E.I.C., has been promoted sales manager of Burlington Steel Company, Hamilton, Ont., after having been assistant sales manager since 1940.

G. L. Dickson, M.E.I.C., electrical and signal engineer, Canadian National Railways, Atlantic Region, retired at the end of 1943, after having occupied that position for 20 years. Mr. Dickson is the newly elected vice-president of the Institute for the Maritimes.

Reginald Mudge, M.E.I.C., who has been assistant engineer of track for the Canadian Pacific Railway Company, Montreal, since January, 1939, retired from the company at the end of 1943, completing 36 years service. He joined the Canadian Pacific at Smiths Falls, Ont., at the age of 22. In 1911, he became resident engineer at Silver Creek, B.C. In February, 1912, Mr. Mudge came to Montreal to be assistant engineer, and from December, 1914, until May, 1919, was enlisted as captain in His Majesty's Canadian Forces. In March, 1921, he became transitman in the office of the chief engineer at Montreal, and he later worked as assistant engineer of construction until his appointment in January, 1939, as assistant engineer of track, the position he held when he retired.

Captain S. N. Tremblay, M.E.I.C., is the officer commanding, No. 2, Canadian University Course, at Laval University, Quebec.

E. P. Muntz, M.E.I.C., has established a consulting office in the Royal Bank building, at Montreal.

Mr. Muntz graduated in civil engineering at the University of Toronto in 1914, becoming an assistant engineer on the construction of the Welland Ship Canal. He served overseas from 1916 to 1919, in France and Palestine on railway and bridge construction. From 1923-1940 he was engaged on industrial buildings, bridges and other engineering work, chiefly as president and chief engineer of his own engineering and contracting companies, at the same time doing considerable consulting work both in the United States and Canada. From 1940 to 1943 he has been engaged on special engineering work with the Foundation Company of Canada, Limited, and the Preload Company of Canada, Limited.

Jean Paul Lecavalier, M.E.I.C., who was previously assistant district engineer with the Department of Highways of Quebec, at Quebec, has joined the engineering staff of the Drainage Bureau, Department of Agriculture of the Province of Quebec, at Montreal.

Maurice Ostiguy, Jr.E.I.C., previously assistant divisional engineer of the Department of Roads at Waterloo, Que., has been promoted to the position of assistant district engineer, at Quebec.

A. C. Smith, S.E.I.C., has left the staff of Aluminum Company of Canada Limited at Beauharnois, Que., to join Commonwealth Plywood Company, at Ste. Thérèse, Que.

VISITORS TO HEADQUARTERS

J. D. Lacombe, M.E.I.C., Quebec North Shore Paper Company, Baie Comeau, Que., on December 29.

A. Babin, M.E.I.C., Quebec North Shore Paper Company, Baie Comeau, Que., on December 30.

K. R. Chestnut, M.E.I.C., Gander, Nfld., on December 30.

C. O. P. Klotz, M.E.I.C., Aluminum Company of Canada, Limited, Arvida, Que., on January 5.

L. P. Cousineau, M.E.I.C., Quebec Shipyards Limited, Quebec, on January 6.

R. Boisclair, Jr.E.I.C., St. Hugues-de-Bagot, on January 7.

Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Charles Robert Coutlee, M.E.I.C., died in Toronto on January 1st, 1944. Born near Aylmer, Que., on January 29, 1867, he was educated at the Royal Military College, Kingston, Ont., where he graduated in 1886.

During his long and varied career he was connected with the engineering staffs of the Canadian Pacific Railway Company, the Dominion Department of Railways and Canals, the Provincial Department of Highways of Nova Scotia and, from October, 1904, until his retirement on July 1st, 1932, he was in the Chief Engineer's Branch of the Department of Public Works of Canada.

While with the Canadian Pacific Railway Company, he was engaged on the construction of the "short line" through the state of Maine, and also on the Crow's Nest Pass tunnel at Fernie, B.C. On May 8, 1888, he entered the Department of Railways and Canals of Canada, where he was one of its principal engineers on the design and construction of the Soulanges canal. Later, he entered the service of the Department of Highways of the Province of Nova Scotia where he was very active in the starting of the provincial highway system.

C. R. Coutlee, M.E.I.C.

Early in the present century he was associated with the late Mr. Arthur St. Laurent and Mr. S. J. Chapleau in the survey and preparation of the report on the proposed Georgian Bay canal. Previous to his retirement he was in charge of all work in connection with the Upper Ottawa River storage and was one of the original members of the Board of Engineers of the Department of Public Works of Canada. While with this department, he was consulted on many of the water supply and regulating works, harbour and river improvements.

He joined the Institute as a Student in 1888, transferring to Associate Member in 1894. He transferred to Member in 1901 and he was made a Life Member in 1935. Mr. Coutlee was the first chairman of the Ottawa Branch and during the years of 1909, 1910, 1911 and 1912 he was a councillor of the Institute.

George R. Dalkin, M.E.I.C., died in Montreal on December 24, 1943, after a long illness. Born in the county of Durham, England, on December 4, 1889, he was educated at Darlington Technical College and served an apprenticeship as mechanical engineer from

1905 to 1910 with Teasdale Bros., at Darlington. He came to Canada in 1912 and was employed on the engineering staff of the city of Edmonton, Alta., until 1916. After serving a few months with the Royal Canadian Engineers, in 1916, he went with the Imperial Munitions Board on gauge inspection and later on ship inspection. In 1918 he joined the staff of Jardine and Company, consulting engineers, Montreal, and was engaged for several years on the design and layout of ship machinery. Later he joined the Harbour Commissioners in Montreal as a mechanical engineer and, in 1930, he became assistant chief engineer at the Montreal Harbour, a position he held at the time of his death.

Mr. Dalkin joined the Institute as an Associate Member in 1920 and he became a Member in 1940.

staff of Ryther and Pringle Company as machine shop foreman; he became superintendent in 1919 and engineer in 1922. In 1926 he was appointed plant manager. He later worked as a sales engineer with Bagley and Sewall Company, at Watertown, N.Y.

In 1930 he went with the Kalamazoo Vegetable Parchment Company at Kalamazoo, Mich., later becoming chief engineer of the company a position which he occupied at the time of his death.

Mr. Gibbs joined the Institute as a Student in 1914 and transferred to Associate Member in 1927. He became a Member in 1940.

Major-General C. S. L. Hertzberg, C.B., M.C., V.D., M.E.I.C., died while serving with the British Army in India according to word received last month. Before retiring from the Canadian Army overseas, last June, he was chief engineer of the 1st Canadian Army.

Born at Toronto, Ont., on June 12, 1886, he studied engineering at the University of Toronto where he graduated in 1905 and did some post-graduate work in the following year. During the early years of his career, he was employed with the Trussed Concrete Steel Company becoming branch manager in Toronto, in 1909. The following year and until 1912 he was in charge of engineering for the company. In 1912 and 1913 he was branch manager of the Bishop Construction Company in Toronto. He entered private practice at the end of 1913 as a member of the firm James, Loudon and Hertzberg, consulting engineers, Toronto.

In the fall of 1915 he enlisted for overseas serving as a lieutenant in the 7th Field Company, R.C.E. He was wounded in January of 1917, a month after winning the Military Cross at the Somme, and invalided to Canada. In October, 1918, he joined the Canadian Expeditionary Force to Siberia, serving there until June, 1919, and winning the Czecho-Slovakian war medal for valour.

In 1918 he was placed in command of the 2nd Field Company, Royal Canadian Engineers, with the rank of major, and in 1926 he was made lieutenant-colonel, commanding the non-permanent engineers. At the end of his tenure of command he was transferred to the reserve of officers in 1930.

At the outbreak of this war he went overseas as officer commanding 1st Divisional Engineers and was promoted to the rank of brigadier and made chief engineering officer at Corps Headquarters. Upon formation of the 1st Canadian Army overseas, General Hertzberg was its first chief engineer.

George R. Dalkin, M.E.I.C.

E. G. Evans, M.E.I.C.

Major-General C. S. L. Hertzberg, M.E.I.C.

Edwin George Evans, M.E.I.C., retired right-of-way engineer, Canadian National Railways, Atlantic Region, died at his home in Sussex, N.B., on December 7, 1943. Born at Margate, P.E.I., on June 23, 1865, he received his engineering education at Mount Allison University, afterwards going to Boston to complete his studies. In 1884, Mr. Evans joined the engineering staff on the construction of the Canada Eastern Railway, and in 1886 was assistant engineer on the survey of the Washington Counties Railway, in Maine. He was next appointed engineer on the rehabilitation of the St. Martins Railway and the completion of the construction of the Central Railway, Norton to Chipman. When that work was completed in 1890, he was appointed superintendent and assistant treasurer of the Buctouche and Moncton Railway. When the latter line was reorganized in 1894 Mr. Evans was appointed receiver.

He later engaged in metallurgical research work in New York for four years, and acted as consulting engineer in the supervision of contract work deepening and widening the upper Canadian channel of the St. Lawrence river through the Thousand Islands, for three years. In 1918, he joined the Canadian National Railways as district engineer at Moncton, N.B., and in 1925 was appointed engineer of right-of-way, Atlantic Region. He retired in 1932.

Mr. Evans joined the Institute as a Member in 1908. He was made a Life Member in 1934.

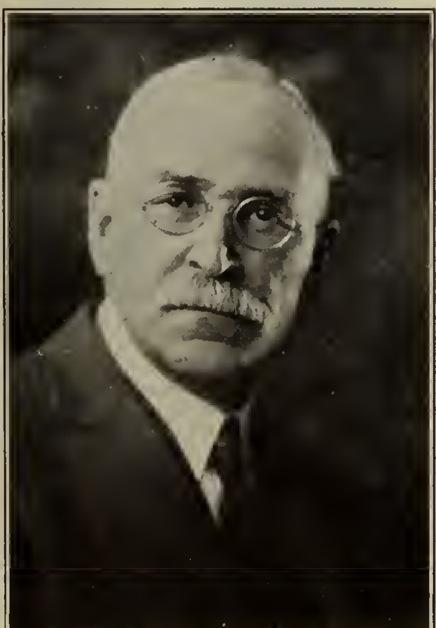
Charles R. Gibbs, M.E.I.C., died at Kalamazoo, Mich., on October 2, 1943, after a few months illness. Born at Carthage, N.Y., on January 27, 1883, he studied engineering at McGill University, Montreal, where he obtained his degree in 1916. Upon graduation he returned to his native town of Carthage where he joined the

In the interval between the two wars he carried out a successful consulting practice in the field of structural engineering and at the time he was recalled on active service in the army he was a member of the firm Harkness and Hertzberg.

Mr. Hertzberg joined the Institute as an Associate Member in 1911 and he transferred to Member in 1917. He was chairman of the Toronto Branch of the Institute in 1931-32 and he was a councillor of the Institute in 1933-34-35.

James H. Hunter, M.E.I.C., died at the hospital in Montreal, on January 8, 1944. He was born at Sorel, Que., on April 29, 1865. He began his engineering career in 1881 with the Canadian Pacific Railway and the following year joined the engineering staff of the Montreal Harbour Commissioners.

From 1885 to 1887 he was with Wood Saxon and Company, hydraulic and electrical engineers, in New York, following which he was engaged on railway construction in connection with electric block signal installation with the Baltimore and Ohio and Staten Island Rapid Transit Railway. In 1893 he was employed with the Danbury Electric Light and Power Company.



James H. Hunter, M.E.I.C.

Returning to Montreal in 1894, Mr. Hunter entered private practice as a consulting engineer and in 1912 became associated in this capacity with the Canada Starch Company Limited. Seven years later he gave up most of his private practice to devote his full time to the position of chief engineer and general superintendent for Canada Starch.

During his years as a consulting engineer, Mr. Hunter was responsible for the design and construction of a large number of projects, many in the province of Quebec, and among which are the Boston Rubber Company plant at St. Jérôme; St. Jérôme Electric Light Company; North River Power Company; Wiarton Binder Twine Company; Waterville Electric and Power Company; plans for the Sault St. Louis Light and Power Company; the unloading plant and coal pockets for the Dominion Coal Company; Cardinal, Ont.; Electric Light and Power Company.

For the Canada Starch Company Limited, he built the Fort William plant and the concrete dock and grain elevator, and directed rebuilding of the plant at Cardinal, Ont. He became vice-president of the Canada Starch Company in the fall of 1942.

Mr. Hunter joined the Institute as an Associate Member in 1908 and transferred to Member in 1923. He was a councillor of the Institute in 1925-26 and vice-president for the province of Quebec in 1927-28. In 1926 he was chairman of the Finance Committee of the Institute.

Charles E. MacKenzie, M.E.I.C., died in the hospital in Springhill, N.S., on December 22, 1943. Born at Port Hawkesbury, N.S., on September 14, 1886, he was educated at Dalhousie University, Halifax, and Nova Scotia Technical College where he received his engineering degree in 1912. Upon graduation he joined the staff of the Dominion Coal Company at Springhill, N.S., and remained with the same firm throughout his career. At the time of his death he was chief engineer of the Cumberland Railway and Coal Company, a subsidiary of the Dominion Coal Company.

Mr. MacKenzie joined the Institute in 1940.

Fred Newell, M.E.I.C., chief engineer of the Dominion Bridge Company, Montreal, died in the Western Division of the Montreal General Hospital on January 19th, 1944.

Mr. Newell was born at Portsmouth, England, on March 12th, 1878. At the age of fifteen he became an apprentice at the Royal Arsenal at Woolwich where he worked until 1899. He received his technical education at Woolwich Polytechnic and Birkbeck Institute, London, from 1900 to 1905. In 1903 he became a "Whitworth Exhibitioner," an award which was a remarkable testimony to his ability. The Polytechnic bronze medal was also awarded to him. In 1900 he was in charge of the erection of field gun mountings at Vickers, Sons and Maxim. From 1901 to 1905 he worked in the erecting department at the Royal Arsenal, Woolwich, and from 1905 to 1907 as an inspector on heavy gun sights. He lectured in applied mechanics and mathematics at Woolwich Polytechnic in 1905 and 1906 and in steam and steam engines at Erith Technical School from 1905 to 1907.

Mr. Newell came to Canada in 1907 and after being employed for seven months as a draughtsman by John McDougall Caledonian Iron Works, Montreal, joined the Dominion Bridge Company, Montreal, in February, 1908, becoming a designing draughtsman and checker in the mechanical and structural departments. He became chief mechanical draughtsman in 1913 and assistant mechanical engineer in 1915. In 1918 he was appointed mechanical engineer and in 1931 became assistant chief engineer and in 1937 chief engineer of his company. During the year between the spring of 1941 and that of 1942 in addition to his duties as chief engineer he was acting manager of the Eastern Division of the Dominion Bridge Company.

In the mechanical field, Mr. Newell was responsible for the design of a large number of important engineering projects. In conjunction with C. D. Howe & Company of Port Arthur, Ont., he designed the unloaders for handling cars of grain with which a number of large elevators in the west are equipped. A great number of cranes were designed under his direction and he pioneered in the use of modern welded construction both for cranes and for other mechanical equipment.

He also handled the design of the machinery for many swing, lift, and bascule bridges but perhaps his most notable work as a mechanical engineer was in the development of hydraulic control gates and similar equipment. A large number of the hydro-electric power

Fred Newell, M.E.I.C.

plants throughout Canada are equipped with gates of his design. In this connection he did much pioneering work on the fixed roller type of gate which is now in general use in this country. He also contributed largely to the design of heating equipment to permit of the operation of gates in freezing temperatures.

The pre-stressing plant used for pre-stressing the cable strands in the Island of Orléans Bridge, Quebec, the Lion's Gate bridge, Vancouver, and other suspension bridges was built under his direction. He also took considerable interest in the design features of the Canadian National Railways lift bridge built over the Lachine canal.

When war broke out Mr. Newell was just recovering from a heart attack and, while he had to be careful, he quickly became engaged in the war work which his company undertook. Probably because of his early experience at Woolwich Arsenal, he took particular interest in the Ordnance Plant which his company established at Vancouver. No effort was spared by him while working on the layout, equipping and placing in operation of this plant. He made periodical visits to it and spent several months there in an endeavour to develop more economical methods in the manufacture of gun parts. Another interest, partly arising from the war and to which he gave considerable time, was in the use and heat treatment of alloy steels for heavy forgings.

In connection with the Canadian Engineering Standards Association, Mr. Newell did a great deal of valuable work as a member of specification making committees. In particular, he had much to do with the specifications for structural welding and for movable bridges.

Mr. Newell joined the Institute as an Associate Member in 1916 and transferred to Member in 1923. He served on the executive committee of the Montreal Branch in 1929 and 1930. In 1932 he was elected to represent the Montreal Branch on Council and served thereon for three years and was re-elected in 1936 for a further term of three years. He was vice-president representing the Province of Quebec in 1939 and 1940. In 1938 and 1939 he was chairman of the Committee on Professional Interests and took a large share in the negotiations with the Associations of Professional Engineers in various provinces. During this period, agreements were signed with the associations in Saskatchewan and Nova Scotia. He was also a member of the Finance Committee from 1938 to 1942 and chairman in 1939 and 1940.

Mr. Newell took a deep interest in the affairs of the Institute and did a great deal of work on the committees on which he sat and on Council. He attended many of the annual and professional meetings and made several journeys across the country in the interests of the Institute.

Amongst his own associates and also by the wide circle of friends he had in the engineering profession throughout Canada, Mr. Newell was held in the highest esteem. His friendly disposition and kindly acts created a warm appreciation of him. Moreover, the helpful consideration which he gave to the problems presented to him by others was so much valued that his loss will be very deeply felt. R.H.F.

Charles Lester Stevenson, M.E.I.C.

Charles L. Stevenson, M.E.I.C., died accidentally on November 29, 1943, at Debert Military Camp, N.S., while serving as a lieutenant with the Royal Canadian Ordnance Corps. Born at Waltham, Mass., U.S.A., on June 5, 1911, he was educated at the University of New Brunswick where he graduated in civil engineering in 1934. Upon graduation he was employed with the Department of Public Works of New Brunswick, at Fredericton, on highway construction. In 1936 he was employed for several months on construction of Ontario Paper Mill at Baie Comeau, Que., and in 1937 he worked on construction of an extension to Howard Smith Paper Mill at Cornwall, Ont. Later, in 1937, he was engineer in charge of the Abrasive Company of Canada plant at Arvida, Que., and upon completion of the work he joined the staff of the Abrasive Company as engineer in charge of installation of equipment. In 1939, he joined the engineering department of the city of Westmount, Que., and in 1942 enlisted for active service with the R.C.O.C. He worked with the Army Engineering Design Branch of the Department of Munitions and Supply at Ottawa until February, 1943, when he resumed his military training in preparation for overseas duty.

Mr. Stevenson joined the Institute as a Student in 1934, transferred to Associate Member in 1938. He became a Member in 1940.

News of the Branches

Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

BORDER CITIES BRANCH

W. R. Stickney, m.e.i.c. - *Secretary-Treasurer*

The Annual Meeting and Election of Officers of the Border Cities Branch was held at the Prince Edward Hotel on Friday, December 19th. Twenty-one members and guests were present for dinner and six other members were present for the meeting.

After the dinner, Mr. S. E. McGorman introduced Mr. C. M. Goodrich, consulting engineer for the Canadian Bridge Company Limited, who related some rather amusing experiences and incidents which he encountered in his term of service with the armed forces during the last war. A vote of thanks to Mr. Goodrich was moved by Mr. T. H. Jenkins after which the secretary-treasurer's report and financial statement was given by W. R. Stickney. The chairmen of the various committees then gave their reports, and after the appointment of scrutineers, the officers listed on page 71 were elected for the coming year.

HALIFAX BRANCH

S. W. Gray, m.e.i.c. - - *Secretary-Treasurer*
D. C. V. Duff, m.e.i.c. - *Branch News Editor*

The annual business and dinner meeting of the Halifax Branch of the Institute was held Dec. 16th, at the Nova Scotian Hotel, when officers were elected for 1944.

During the meeting there was consideration of professional problems after a summary had been given of the Institute's activities of the year

Professor Flynn presented the Institute's congratulations to Dr. F. H. Sexton who has received award of the Julian C. Smith medal for achievement in the development of Canada. The award is made by the Institute.

Professor Flynn introduced the new chairman, G. J. Currie, who said that when he received notification he sought the advice of an older and more experienced engineer and had been told that appointment as chairman of the Halifax Branch of the Institute was a high honour.

C. S. Bennett, chief engineer, National Harbours Board, Halifax, presented a vote of thanks to the outgoing chairman and executive for their excellent work of the year.

Professor Flynn said in his address that the goodwill shown him as chairman was an example of the spirit to be found throughout the profession.

A sound picture "Inside Fighting Russia" was shown during the evening. In lighter vein a comedy talking picture was also shown.

HAMILTON BRANCH

W. E. Brown, m.e.i.c. - *Secretary-Treasurer*
L. C. Sentance, m.e.i.c. - *Branch News Editor*

The Annual Meeting and Dinner of the Hamilton Branch took place on Friday, January 7th, at the Scottish Rite Club, with one hundred members and guests in attendance; the chairman of the outgoing executive, T. S. Glover, presided.

At the conclusion of the dinner, Mr. F. W. Paulin introduced the distinguished guest speaker, Wing Commander T. R. Loudon, m.e.i.c., professor of Civil Engineering and Aeronautics at the University of Toronto. Wing Commander Loudon, who, since 1940, has been engaged in special research work with the R.C.A.F., spoke on **Aviation—Past, Present and Future.**

It is expected that Wing-Commander Loudon's address will be published in an early issue of the *Journal.*

At the Hamilton Branch annual dinner. ***Left to right:*** **W. W. Chadwick, Incoming Chairman H. A. Cooch, Chairman T. S. Glover and the speaker, Wing Commander T. R. Loudon.**

W. E. Brown, secretary-treasurer of the branch, presented the report of the nominating committee, and gave a resume of the activities of the branch throughout the year.

On the motion of H. A. Lumsden, a vote of thanks was tendered the retiring chairman, T. S. Glover. With due ceremony, the reins of office were handed to H. A. Cooch, incoming chairman.

LAKEHEAD BRANCH

W. C. Byers, Jr.E.I.C. - *Secretary-Treasurer*

At a dinner meeting held in Port Arthur on Tuesday, December 14th, some 45 members and guests of the Branch heard Mr. Kalman Segalowitz, engineer on the staff of the Canadian Car & Foundry Co., Fort William, describe the construction of the **Shipshaw Power Development on the Saguenay River, Que.**

R. B. Chandler, chairman of the Branch, presided.

Mr. Segalowitz was employed as engineer on the staff of the Foundation Company, Montreal, General Contractors for the project and his address which was illustrated with diagrams and photo slides depicted the work at various stages.

H. G. O'Leary, in moving a vote of thanks to the speaker, recalled that he had spent his early days as an engineer in the country described by Mr. Segalowitz. The cold weather of that section of Quebec was not exaggerated, he said.

A series of papers describing the various features of this project will appear in the April issue.

MONCTON BRANCH

V. C. Blackett, m.e.i.c. - *Secretary-Treasurer*

The Portland to Montreal oil pipe line was the subject of one of a series of films, dealing with the oil industry, shown at a meeting of the branch on December 16th. Instituted as a war measure, this 236 mile pipe line was completed late in 1941 and carries crude oil from Portland to the Montreal refineries that formerly had to be transported by tanker up the St. Lawrence river, a round trip sea voyage of some two thousand miles. Oil is pumped through the line at the rate of 50,000 barrels per day.

Another film depicted the latter part of the life of the great German scientist, Dr. Rudolph Diesel, inventor of the engine which bears his name. In 1913, Dr. Diesel was invited to confer with the British Armiralty, but he mysteriously disappeared on the steamer taking him from Germany to England. It is suspected that he was murdered and thrown overboard by agents of his own government.

A third film dealt with the technical development of lubricating oils.

J. A. Godfrey, the branch chairman, presided at the meeting.

MONTREAL BRANCH

L. A. Duchastel, M.E.I.C. - *Secretary-Treasurer*
H. H. Schwartz, Jr.E.I.C. - *Branch News Editor*

On December 9th, Dr. W. G. Theisinger delivered an address on **The World's Largest Plate Mill.** This mill is 206 in. wide. It was built during the last war, and was subsequently only partly utilized. However, with to-day's demand for large steel plate, this mill has been used to full capacity. It has permitted considerable savings in cost and welding time since the larger sheets require less welding.

Another place where the large sheets are used to advantage is in the construction of heads for marine boilers. These heads are now cut from a single sheet, rather than from smaller sheets welded together.

At the conclusion of the meeting, a film was shown illustrating the highlights of the lecture.

R. C. Flitton was chairman of the meeting.

* * *

On December 16th D. J. McDonald of Bell Telephone Company of Canada, delivered an address on **Inductive Coordination Aspects of Mercury Arc Rectifier Installations** to the Montreal Branch. The speaker stressed the importance of considering all aspects of interference. Several methods of eliminating the difficulties encountered in operating rectifier units were mentioned. The presence of harmonics causes a distortion of the wave shape. These harmonics are fed back into the power line and, unless prevented, into the communication lines. Two preventative measures are the use of multiphase rectifiers and filters. However, multi-phase rectifiers must be properly balanced or the benefits to be expected from a greater number of phases will not materialize. Filters are expensive and should only be installed where absolutely necessary.

F. King was chairman of the meeting.

* * *

On January 13th, F. L. Lawton spoke on **The Manouan and Passe Dangereuse Water Storage Developments.** The paper covered the design and construction of the recent large water storage developments on the upper tributaries of the Saguenay River which were built to increase the power output of the Saguenay River. This paper will appear in the April issue of the *Journal.*

J. B. D'Aeth was chairman of the meeting.

OTTAWA BRANCH

A. A. Swinnerton, M.E.I.C. - *Secretary-Treasurer*
R. C. Purser, M.E.I.C. - - *Branch News Editor*

A noon luncheon address before the Ottawa Branch at the Chateau Laurier on December 16 was given by Major F. Alport, M.C., consulting engineer to the Naval Service Branch of the Dominion Department of National Defence. A very important aspect of the general subject of sanitation was dealt with, namely, the purity of water and milk supply in relation to sewage disposal.

Diseases transmissible by polluted water either directly by drinking it or indirectly through the agency of the milking cow, or both, are many and varied according to Major Alport. He listed an imposing number, including typhoid, paratyphoid, cholera, dysentery, anthrax, undulent fever, scarlet fever, tuberculosis and also pointed the finger of suspicion at such diseases as poliomyelitis, pneumonia and pneumonic plague. Even the common cold came in for some attention. With regard to these and other diseases he said there was still much investigation to be undertaken before one could speak with certainty.

The purity of water and milk supply in relation to sewage disposal forms a most vital feature of the general subject of sanitation. The pollution of streams and its effect upon water supply, if allowed to continue unabated, Major Alport prophesized, is going to affect adversely the national economy of Canada. In the United States already, action is under way toward the cleaning up of affected streams, and such action is considered a matter of major importance. In regard to tourist traffic alone, he said, which brought in nearly 300 million dollars a year before the war—60 to 70 per cent of it by automobile—adverse effects are liable to be felt unless the drinking water and milk for such tourists can be kept pure.

Investigations, together with modern research, have tended to disprove the theory generally held a generation or so ago that flowing streams purify themselves. Actually there is reason to believe that stagnant water has a greater chance of purifying itself than has flowing water. In the earlier investigations dependence was placed upon chemical analysis and dilution was confused with purification. Bacteriological analysis reveals a different story, however, and therefore the only safe assumption is that "by and large flowing streams do not purify themselves."

For the diseases listed, recognized safeguards to-day are an assured pure water supply and the pasteurization of milk. Filtration plants embodying sedimentation through sand and then the application of chlorine afford the greatest protection where large water supplies are required. Chlorine is really a modern development, its protective qualities having been discovered in 1897 and its universal use dating from 1910 and afterward. "Without this protection the cities of this continent would have been cesspools of contamination," declared the speaker. Chlorination, however, has its limitations for after a certain amount of chlorine has been used the water becomes unattractive for drinking purposes. It is also known that it is not proof against everything but in this connection investigation is still going on all over the world.

Even the pasteurization of milk should be performed with meticulous care. In one large city not long ago the milk supply, although having undergone pasteurization treatment, was found to contain germs of epidemic sore throat. On checking up, however, it was revealed that the pasteurization had not been properly carried on, a temperature of 130 deg. F. only having been reached in many cases.

Regarding the use of rivers as a direct source of drinking water without treatment the speaker maintained that no river should be considered fit for such purpose unless it flows from an "absolutely uninhabited watershed." With the prevalent practice in this country of dumping untreated sewage into flowing streams such a course would be decidedly dangerous in settled areas. The time has come, the speaker said, to give careful consideration to this filthy practice from one coast to the other. It is economically sound to treat sewage, he concluded.

* * *

Annual Meeting

The branch annual meeting was held at the auditorium of the National Research Building on Thursday evening, January 13. Reports presented revealed that six luncheon meetings were held during the year and two evening meetings, including the annual meeting. In accordance with its usual practice, the branch donated two sets of draughting instruments to the Ottawa Technical School for presentation as prizes for proficiency in draughting, as well as a copy of "Technical Methods of Analysis" by Griffin to the Hull Technical School for a similar purpose.

On November 14, 1943, the chairman and the secretary-treasurer of the branch, at the invitation of the Peterborough branch, attended the annual meeting of the latter. Several members were present from Hamilton, Toronto and Montreal as well as some members of Council and the president, K. M. Cameron.

The evening's programme also included a number of moving pictures showing scenes on the Banff-Jasper highway, and logging operations in the Canadian West. A short address was also given by the national president, K. M. Cameron, on institute activities.

At the close of the meeting refreshments were served to the 90 members present.

TORONTO BRANCH

S. H. de Jong, m.e.i.c. - - *Secretary-Treasurer*
G. L. White, affiliate e.i.c. - *Branch News Editor*

Dean C. R. Young and Dr. G. B. Langford addressed a joint meeting of the Toronto Branch and the Association of Professional Engineers of Ontario on December 3rd.

Dean Young, speaking on the **Engineers' Council for Professional Development**, sketched the evolution of engineering societies in Great Britain and on this continent. He stated that E.C.P.D. represents a pooling of the resources of eight engineering organizations in the United States and Canada. The objective of the Council is the enhancement of the professional status of the engineer. To that end, attempts are being made to develop some method of certification for engineers.

The speaker outlined the various committees which have been functioning within the E.C.P.D. The Committee on Student Selection and Guidance attempts to see that young men who enter engineering schools are adapted to the profession. The Committee on Engineering Schools is concerned with accrediting colleges, schools and their curricula. The Committee on Professional Training is designed to take hold of the young man who needs some guidance after leaving college, by preparing a list of books for reading purposes, and the preparation of a manual for the junior engineer.

The Committee on Professional Recognition has been attempting to define the profession, thus far without success. It is now concentrating on developing in the minds of young men a strong professional consciousness —to emphasize the importance of engineering in society. The Committee on Engineering Ethics has been working on a code and has drawn up one which is under consideration by the eight member organizations of E.C.P.D.

Dr. G. B. Langford, professor of mining geology, University of Toronto, discussed **Engineering Education** and told his audience that while there had been a 32 per cent increase in university graduates throughout Canada during the past ten years, graduations in engineering had increased 72 per cent. The reason for this latter fact is that many young men are taking engineering who do not intend to become engineers, but merely want a broadened education and find it in the engineering courses. Dr. Langford stated that these students should be segregated from those who intend to become professional engineers by having two courses: (1) a general educational course with an engineering background; (2) a course leading to an engineering degree.

The speaker deplored the lack of scholarships, research work and post-graduate study in engineering, stating that the lack of interest in post-graduate work has been responsible for the small amount of engineering research in Canada. The engineering schools in Canada are not looked upon as research centres. He said that staffs of schools must be built up as the members are now overworked between teaching and consulting engineering; greater financial aid must be given to post-graduate students; and schools of engineering research should be created in this country. Insufficient finances were responsible for these obvious deficiencies in engineering education, Dr. Langford stated.

Dr. G. R. Lord, assistant professor of mechanical engineering, University of Toronto, was chairman of the meeting.

* * *

Engineering Features of Steep Rock Development were described at the meeting of Toronto Branch of the Institute, on November 26th, by Watkin Samuel, chief engineer, Steep Rock Iron Mines, Ltd. This was a joint meeting with the local section of the American Institute of Electrical Engineers.

Mr. Samuel reviewed the highly diversified and engineering problems associated with the development of the deposits. Engineering interest has undoubtedly centered in the extensive plans for the diversion of the Seine river and the pumping of water from Steep Rock lake in order to lower the water level so that the ore body may be uncovered for mining operations.

However, this is only the most spectacular part of the programme and Mr. Samuel covered many other phases including exploration of the ore body, determination of quantities and grades of ore, treatment of the ore, transportation, and supply of electrical power.

* * *

The Ganaraska Survey was the subject of an address by A. H. Richardson, Department of Lands and Forests, Toronto, before a meeting of the Toronto Branch on Friday, November 19th. The chairman of the meeting was Prof. R. F. Leggett, University of Toronto.

Mr. Richardson reviewed the work that has been done on conservation, including reference to the report of Professor Coventry on the Peel plain and to the King Township survey of four or five years ago. These reports indicated a serious lowering of the water table, increasingly rapid erosion, and other undesirable conditions.

Following the Guelph Conference report of 1941, the Ganaraska area was selected for a typical resources survey in consultation with the James Committee. The investigation included soil, soil erosion, agricultural economics, land use, botanical, entomological, and tree disease surveys. These surveys were carried out by various provincial and federal departments.

The speaker discussed the character of the Ganaraska area, the history of the valley and its present condition, commenting on the disappearance of wild life, the clearing of forests, erosion, and the increase of floods.

The chief recommendatons of the report were as follows:

1. Development of 2,000 acres of forest to be drawn for the most part from agricultural lands.
2. Waste land on farms to be improved and its use controlled.
3. Four dams to be built on the watershed to impound 18,000 ft. of water.
4. The forest fringe along the river to be protected, contour plowing and strip farming to be introduced on farms sloping to the river and the steep slopes to be put back into forest.
5. All gooseberries and black currants to be eradicated, these being hosts to the rust on oats.
6. Tree planting to be done on highways.
7. Most of the work to be improving existing woodlands and not new planting.
8. Establishment of parks and recreational centres.

It was estimated that the project would provide work for 600 men for two years, except for a period of two or three months in the winter.

The speaker emphasized that the survey should be followed by others of the same kind throughout the southern part of the province.

The appreciation of the audience was expressed by S. R. Frost.

A motion was passed asking that Institute headquarters be requested to set up a national committee to deal with conservation of renewable natural resources, the national committee to be so constituted that it may work through regional groups which will be able to meet for discussion of local aspects of conservation.

Pertinent literature on this subject was suggested as follows:

1. Report of the Guelph Conference, 1941.
2. The King Township Survey—Proceedings, Royal Canadian Institute.
3. Dessication of the Peel Plain—Proceedings, Royal Society of Canada, 1931.
4. Vanishing Lands—White and Jacks.
5. Conservation and Sanitation by R. F. Legget—Engineering and Contract Record.

* * *

Junior Section

The December meeting of the Junior Section of the Toronto Branch took the form of a dinner at Diana Sweets, on December 6th. The speaker was Dean C. R. Young, who discussed the **Humanistic Aspects of Engineering** and emphasized the value of a broad intellectual training for engineers and warned of the danger of any engineer concentrating solely on technical matters in the period to come. Following a question period, an interesting booklet describing the results of the November Salary Survey, was discussed.

Library Notes

Book notes, Additions to the Library of The Engineering Institute, Reviews of New Books and Publications

ADDITIONS TO THE LIBRARY

TECHNICAL BOOKS

Applied Mechanics:

Arthur Morley. Toronto, Longmans Green and Co., 1943. 5 x 7½ in. $2.25.

Chemical Process Principles:

Pt. 1; Material and Energy Balances. Olaf A. Hougen and Kenneth M. Watson. N.Y., John Wiley and Sons, Inc., 1943. 5½ x 8½ in. $4.50.

Structural Aluminium Handbook:

Aluminium Company of America, Pittsburgh, 1940. 5½ x 8¼ in. $1.25.

Industrial Chemistry:

3rd ed. William Thornton Read. N.Y., John Wiley and Sons, Inc., (c. 1943). 5½ x 8½ in. $5.00.

An Introduction to Concrete Work:

H. L. Childe. London, Concrete Publications Ltd., (1943). 4¼ x 7 in. 132 pp., illus. 1s. 6d.

Synthetic Resins and Rubbers:

Paul O. Powers. N.Y., John Wiley and Sons, Inc., 1943. 5½ x 8½ in. $3.00.

Science in Britain:

A series of pamphlets published for the British Council by Longmans Green and Co., 1942. 4¾ x 7¼ in. 35c. each. We have in the library;

The Royal Institution—46 pp.

Science lifts the veil; a series of broadcast talks on the conquest of the sub-visible universe. 61 pp.

British Agricultural Research; Rothamsted by Sir E. J. Russell. 32 pp.

The Steam Turbine and other inventions of Sir Charles Parsons by R. H. Parsons. 35 pp.

Diesel Locomotives—Mechanical Equipment:

John Draney. Chicago, American Technical Society, 1943. 5½ x 8½ in., illus., $4.00. (Canadian representative, General Publishing Co., Toronto.)

Diesel Locomotives—Electrical Equipment:

John Draney. Chicago, American Technical Society, 1943. 5½ x 8½ in., illus., $3.75. (Canadian representative, General Publishing Co., Toronto.)

American Standards Association:

Z10.1—1941; Abbreviations for scientific and engineering terms.
Z10.2—1942; Letter symbols for hydraulics.
Z10.3—1942; Letter symbols for mechanics of solid bodies.
Z10.4—1943; Letter symbols for heat and thermodynamics including heat flow.
Z32.2—1941; Graphical symbols for use on drawings in mechanical engineering.

The following books have been presented to the Institute Library by Mr. John E. Armstrong, M.E.I.C., and are here gratefully acknowledged.

Proceedings of the World Engineering Congress, Tokio, 1929:

20 volumes.

REPORTS

Carnegie Corporation of New York:
Annual report for the year ended September 30, 1943.

Connecticut Society of Civil Engineers:
Fifty-ninth annual report for the year ended March 24, 1943.

Canada—Dominion Bureau of Statistics:
Manual of instructions. Balance sheets, revenues and expenditures and other accounting statements of municipal corporations. Ottawa, 1942.

Ontario—Department of Mines:
Fiftieth annual report being Vol. L, Part viii, 1941—Geology of Gauthier Township, East Kirkland Lake area.

Harvard University—Graduate School of Engineering—Bulletins:
No. 374; Anaerobic digestion.—No. 376; Exploration of soil conditions and sampling operations.—No. 377; A note on the mutual impedance of antennas—and—The radiation field of long wires with application to vee antennas.—No. 378; Superheterodyne converter terminology.

Electrochemical Society—Preprints:
No. 84-27; Strip steel electroplating with a sodium stannate bath. No. 85-1; Current efficiency in a series of electrolytic cells.—No. 85-2; Laboratory evaluation of corrosion resistance of bearing alloys.

U.S.—Bureau of Mines—Technical Paper:
No. 655; Carbonizing properties and petrographic composition of thick freeport-bed coal from Harmar mine, Harmarville, Allegheny County, Pa., and the effect of blending this coal with pocahontas No. 3 and No. 4 bed coals.

U.S.—Geological Survey—Water Supply Paper:
No. 917; Summary of records of surface waters of Missouri and St. Mary river basins in Montana 1881-1938. —No. 935; Surface water supply of Hawaii July 1, 1940, to June 30, 1941.—No. 941; Water levels and artesian pressure in observation wells in the United States in 1941.—Pt. 6; Southwestern states and territory of Hawaii.—No. 942; Quality of surface waters of the United States, 1941.—No. 957; Surface water supply of the United States, 1942.—Pt. 7; Lower Mississippi river basin.—No. 959; Surface water supply of the United States, 1942.—Pt. 9; Colorado river basin.—No. 960; Surface water supply of the United States, 1942. —Pt. 10; The Great Basin.

U.S.—Geological Survey—Bulletin:
No. 928-C; Adsorbent clays their distribution properties production and uses.—No. 928-D; Manganiferous and ferruginous chert in Perry and Lewis counties, Tennessee.—No. 931; Strategic minerals investigations, 1941.—No. 939-D; Geophysical abstracts 111, October to December, 1942.—No. 940-B; Manganese deposits of the Elkton area, Virginia.—No. 940-C; Geophysical surveys in the Ochoco quicksilver district, Oregon.

U.S.—Geological Survey—Professional Paper:
No. 196; Geology and biology of North Atlantic deep-sea cores between Newfoundland and Ireland.—No. 215-A; Relative abundance of nickel in the earth's crust.

The Institute of Metals:
The equilibrium diagram of the system aluminium-zinc by G. V. Raynor. (Annotated equilibrium diagram series No. 1.) 11½ x 8¾ in., 4 pp., 1 fig. London, The Institute of Metals, 1943.

Quebec—Department of Mines—Division of Laboratories:
Special report on utilization of the titaniferous magnetites of St. Charles, Bourget township, by Louis Bourgoin. (Presented by the author.)

AIR RAID PRECAUTION AND CIVIL DEFENCE

The following literature has been added to the Institute library since the last published list in the June journal.

Ministry of Home Security—Research and Experiments Department:
Bulletin No. C28; Structural protection of buildings against small incendiary bombs and spread of fire. March 11, 1943.—No. C29; Structural protection of buildings against small incendiary bombs and spread of fire: Pt. 2; Lateral protection (supersedes part of the appendix to Bulletin No. C28).—No. C30; Structural protection of buildings against small incendiary bombs and spread of fire: Pt. 3; Internal compartments.—No. C31; Reinforced concrete for maximum energy absorption under impact. The use of various forms of steel as reinforcement. November 23, 1943.

BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet the books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

A.S.T.M. STANDARDS ON PAPER AND PAPER PRODUCTS

Prepared by A.S.T.M. Committee D-6 on Paper and Paper Products; Methods of Testing, Specifications. November, 1943. American Society for Testing Materials, Philadelphia 2, Pa. 138 pp., illus., diagrs., charts, tables, 9 x 6 in., paper, $1.35. ($1.00 to A.S.T.M. members.)

A.S.T.M. STANDARDS ON PLASTICS

Sponsored by A.S.T.M. Committee D-20 on Plastics. Specifications, Methods of Testing, Nomenclature, Definitions. October, 1943. 431 pp., illus., diagrs., charts, tables, 9 x 6 in., paper, $2.00. ($1.50 to A.S.T.M. members.)

A.S.T.M. STANDARDS ON TEXTILE MATERIALS (with Related Information)

Prepared by A.S.T.M. Committee D-13 on Textile Materials; Specifications, Tolerances, Methods of Testing, Definitions and Terms. October, 1943. 457 pp., illus., diagrs., charts, tables, 9 x 6 in., paper, $2.25. ($1.50 to A.S.T.M. members.)

These three publications are intended primarily to present in convenient form the A.S.T.M. standard and tentative standard methods of test and specifications pertaining to their respective subjects. Glossaries and descriptive nomenclature are included for the plastics and textile materials, and in the textile materials volume abstracts are printed of three papers presented at a recent meeting.

ANALYSIS OF STATICALLY INDETERMINATE STRUCTURES

By C. D. Williams. International Textbook Co., Scranton, Pa., 1943. 265 pp., diagrs., charts, tables, 8½ x 5 in., fabrikoid, $3.50.

Intended primarily as a text for the undergraduate engineering student, this book presents only fundamental methods for general application. The separate chapters deal with beams, trusses, single-span frames and arches, columns and, in considerable detail, with the slope deflection and moment distribution methods of analysis. The problems are designed to impress on the student the most important factors involved.

THE CERAMIC ARTS (Industrial Arts Education Series)

By W. H. Johnson and L. V. Newkirk. The Macmillan Co., New York, 1942. 158 pp., illus., diagrs., charts, tables, 11 x 8 in., paper, $1.20 ($2.50 bound).

Intended as a text for the industrial arts department of high schools, this book presents the basic principles of the five great divisions of ceramics: pottery, plastics, glass, alabaster, and cement and concrete. The use of the tools is explained, and detailed directions are provided for the processes necessary to produce a large number of specific articles.

A DOUBLE-SPEED SYNCHRONOUS GENERATOR (University of California Publications in Engineering, Vol. 4, No. 3, pp. 27-36)

By A. Tilles. University of California Press, Berkeley and Los Angeles, 1943, diagrs., charts, 11 x 8½ in., paper, 25c.

A method is presented of operating a machine as a synchronous machine at twice its ordinary synchronous speed. The basic operating characteristics are given, and the behavior of the machine as a part of a system and in commercial application is indicated in a general way.

THE FUNDAMENTALS OF ELECTROCHEMISTRY AND ELECTRODEPOSITION

By S. Glasstone. American Electroplaters' Society, New York, 1943. 90 pp., tables, 8¼ x 5 in., fabrikoid, $2.00.

The twenty chapters composing this small book are a reprinting of a series of articles which appeared in the Monthly Review of the American Electroplaters' Society. They describe in fairly simple language the fundamentals of electrochemistry as applicable to electroplating. The last chapter deals briefly with the causes and prevention of corrosion.

GAS CHEMISTS' BOOK OF STANDARDS FOR LIGHT OILS AND LIGHT OIL PRODUCTS

By V. J. Altieri. American Gas Association, 420 Lexington Ave., New York, 1943. 352 pp., illus., diagrs., charts, tables, 9¼ x 6 in., fabrikoid, $5.00 to non-members; $3.50 to A.G.A. members.

This volume constitutes an expansion and revision of the light oil chapter of the Gas Chemists' Handbook. It presents the fundamentals concerning specifications, definitions, tests and other standards, and includes a complete account of recent developments in practical fractional distillation analyses. The object of the book is to furnish information that will help to speed up production, avoid unnecessary changes in equipment, facilitate standardization, etc.

HANDBOOK OF TABULAR PRESENTATION, How to Design and Edit Statistical Tables, a Style Manual and Case Book

By R. O. Hall. Ronald Press Co., New York, 1943. 112 pp., charts, tables, 11½ x 8½ in., cloth, $3.50.

The designing and editing of statistical tables are discussed on the basis of broad practical experience in this book which will be found useful by all who have to present matter in tabular form. The principles presented are illustrated by a collection of tables, which are discussed critically.

HYDRAULICS, Parts 1-4

By H. P. Hammond. International Textbook Co., Scranton, Pa., 1942, each part paged separately, illus., diagrs., charts, tables, 7¾ x 5 in., fabrikoid, $3.00.

Part I of this elementary textbook deals with hydrostatics. Part II discusses the discharge of orifices, tubes and weirs, and covers the subject of nozzles. Flow through pipes, including the determination of power delivered by or to water flowing in a pipe, occupies part III. Part IV takes up flow in open channels and covers stream gaging. Numerical examples for practice accompany the various subdivisions of the parts.

INDUSTRIAL SAFETY

By T. O. Armstrong, R. P. Blake, J. J. Bloomfield, C. B. Boulet, M. A. Gimbel, S. W. Homen, W. D. Keefer and R. T. Page, edited by R. P. Blake, foreword by H. T. Heald. Prentice-Hall, Inc., New York, 1943. 435 pp.. illus., diagrs., tables, 9½ x 6 in., cloth, $5.00.

A series of chapters by authorities in the field provides a handbook useful to all industries. Subjects discussed include the history of industrial safety, causes of industrial accidents, accident prevention, inspection, safeguarding machinery, safety training and education, accident hazards, reports and records. Fire prevention, first aid and personal protective equipment are also covered in separate chapters. The book has been written from the viewpoint of the industrial worker on the job.

MACHINERY'S HANDBOOK for Machine Shop and Drafting-Room

By E. Oberg and F. D. Jones. 12th ed. Industrial Press, New York; sole distributors for the British Empire; Machinery Publishing Co., Ltd., war-time address; 17 Marine Parade, Brighton, England, 1943. 1,815 pp., diagrs., charts, tables, 7 x 5 in., fabrikoid, $6.00.

In the thirty years since this work first appeared, it has become established as an almost indispensable work of reference in drafting rooms and machine shops. This new edition contains the same number of pages as the preceding one, but numerous changes have been made in charts and tables which bring them up to date.

MINERALS IN WORLD AFFAIRS

By T. S. Lovering. Prentice-Hall, New York, 1943. 394 pp., illus., diagrs., charts, maps, tables, 9½ x 6 in., cloth, $5.35.

This book provides a general account of the part that minerals have played in world affairs. Their influence on social and economic conditions that breed wars and affect decisions in these wars is discussed broadly for the non-specialists. The reader gets a usable overall picture of the place of minerals in an industrial nation.

PLASTICS

By J. H. DuBois. American Technical Society, Chicago, Ill., 1943. 435 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $3.75.

A simplified presentation of the manufacture and use of the important plastics materials and products, with tables of their properties and the basic information required by engineers and designers. This revised edition contains two new chapters, on synthetic rubber and low-pressure laminates. The book is designed to be used both as a text and as a practical reference handbook.

SHORT WAVE WIRELSSS COMMUNICATION, including Ultra-Short Waves

By A. W. Ladner and C. R. Stoner. 4th ed. rev. and enl. John Wiley & Sons, New York; Chapman & Hall, London, 1943. 573 pp., illus., diagrs., charts, tables, 8¾ x 5½ in., cloth, $6.00.

Although this book deals especially with short wave communication, the principles common to both long and short waves are introduced where necessary in order to achieve a self-contained treatise. The principles and equipment for short and ultra-short wave operation are thoroughly discussed concurrently, instead of having a separate chapter for ultra-short waves as in previous editions. A chapter on high frequency therapeutic apparatus is included.

STEAM TURBINE OPERATION

By W. J. Kearton. 4th ed. Pitman Publishing Corp., New York; Sir Isaac Pitman & Sons, Ltd., London, 1943. 375 pp., illus., diagrs., charts, tables, 9 x 5½ in., cloth, $5.00.

A practical text on the installation, running, maintenance and testing of steam turbines, the popularity of which is shown by four editions in twelve years. In addition to instructions, the author has included descriptive matter which will enable the engineer to understand the construction of the plant and will explain the thermal and mechanical considerations that affect its operation. The chapters on glands and governing have been rewritten for this edition, and a chapter on thrust bearings has been added.

A STEEL MAN IN INDIA

By J. L. Keenan with the collaboration of L. Sorsby, introduction by L. Bromfield. Duell, Sloan and Pearce, New York, 1943. 224 pp., 8½ x 5½ in., cloth, $2.50.

This autobiographical narrative covers the experience of an American steel man during twenty-five years with the largest steel-producing unit in India. Technical details, humorous reminiscence, and social and political discussion are intermixed throughout the book, giving an overall picture of the development of the industrial age in India.

TEACHER'S MANUAL FOR MILITARY, MARINE, VOCATIONAL AND INDUSTRIAL TRAINING

By N. Moseley. Cornell Maritime Press, New York, 1943. 208 pp., illus., diagrs., charts, tables, 7½ x 5 in., cloth, $2.00.

Part I of this manual considers the primary requirements of the instructor and the trainee. It discusses various methods of teaching—lecture, demonstration, recitation, discussion—in the light of actual conditions in the shop, laboratory or field. Part II expands on the practical aspects. Study procedures and the technique of handling students are dealt with. Special problems in industrial training programmes are considered, and there is a final chapter on teaching foreign languages.

THE TECHNIQUE OF HANDLING PEOPLE, the Eleven Secrets of Handling People

By D. A. Laird and E. C. Laird. McGraw-Hill Book Co. (Whittlesey House Div.), New York, 1943. 138 pp., illus., 8½ x 5½ in., cloth, $1.75.

Eleven simple rules are given as the fundamental approach to more pleasant and advantageous relations with other people. Each one is discussed separately, with practical illustrations of its value taken from current conditions and the careers of leading men of the present time.

PROBLEMS IN DESCRIPTIVE GEOMETRY FOR ENGINEERS

By E. H. Uhler. International Textbook Co., Scranton, Pa., 1943, no pagination, diagrs., tables, 9 x 12 in., paper, $1.75.

Part I of this text deals with fundamental principles, covering projections, constructions, surfaces, intersections, methods of revolution and the method of traces. Part II describes the application of these principles to engineering problems: civil, mechanical, chemical, mining and structural geology. The text is supplemented by a separate book of plates in which are problems to be solved by both graphical and mathematical methods. Plates are numbered to refer to chapter and article of the explanatory text.

DIESEL ENGINEERING HANDBOOK, 1943 de Luxe edition

Originally edited by L. H. Morrison, revised by C. F. Fooll. Diesel Publications, 192 Lexington Ave., New York. 966 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth $7.00 in U.S.A.; $8.00 foreign.

Practical, up-to-date information is provided upon the operation and maintenance of Diesel engines, valuable both to the owner and operator. The treatment is exhaustive, and the book is profusely illustrated from actual practice. Two chapters of engineering fundamentals are devoted to brief description of useful general engineering terms and equipment.

PRELIMINARY NOTICE

of Applications for Admission and for Transfer

January 26th, 1944.

The By-laws provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described at the March meeting.

L. Austin Wright, General Secretary.

*The professional requirements are as follows:—

A Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science or engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainment or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

AINLAY—ARTHUR, of 740 Woodland Ave., Verdun, Que. Born at Lomond, Alta., Sept. 18th, 1918; 1937-40, radio technician, Radiocrafts Co. Ltd., Calgary, Alta.; 1940-41, radio and electrical technician, Can. Westinghouse Co. Ltd., Calgary, Alta.; 1941-43, chief wireless instructor, Provincial Institute of Technology and Art, Calgary, Alta.; at present, tech. asst. engr., Inspection Board of U.K. and Canada, c/o Northern Electric Co., Montreal, Que.

References: W. S. Fraser, A. Higgins, F. N. Rhodes, J. H. Ross, K. W. Mitchell, H. J. McEwen.

BRIDEN—LEONARD DUTTON, of Tors Cove, Newfoundland. Born at Haileybury, Ont., June 17th, 1915; Educ.: B.Sc. (Mining Eng.), Michigan College of Mining and Technology, 1940; 1934-36, gen. mining and engrg. asst., Barry-Hollinger Mines, Ltd.; 1940-41, instru'man., H. F. McLean Const. Co., Nitro, Que.; 1941-42, asst. engr., Carter-Halls-Aldinger Co., Moncton, N.B.; with the Newfoundland Light and Power Co. Ltd., as follows: 1942-43, asst. engr., and at present engr. i/c winter operation and the study of winter operating conditions of water supply canals for hydro-electric power developments.

References: J. W. Morris, A. C. D. Blanchard, J. H. McLaren, J. K. Sexton, H. J. McLean, H. Forbes-Roberts.

CHADWICK—WALTER WYBURN, of 368 Wilson St., Hamilton, Ont. Born at Hamilton, Ont., April 13th, 1891; Educ.: B.A.Sc., Univ. of Toronto, 1911; 1908-09, chemist, Steel Co. of Canada; 1909-11, Can. Westinghouse Co. Ltd.; 1912-14, Chadwick Brass, Ltd.; 1914-15, W. W. Chadwick Co.; 1915-18, Chadwick Metal Co.; 1918-21, Canadian Nathan Mfg. Co.; 1921-33, Chadwick-Carroll Brass Co. Ltd.; 1933-43, pres. and gen. mgr., Chadwick-Carroll Brass & Fixtures Ltd.

References: H. A. Cooch, W. L. McFaul, A. R. Hannaford, N. A. Eager, C. H. Hutton, J. C. Nash, H. J. A. Chambers.

CHERNICK—ALEXANDER, of Toronto, Ont. Born at Winnipeg, Man., Oct. 25th, 1910; Educ.: B.Sc. (Civil), Univ. of Manitoba, 1931; 1931-32, Dominion Electric Co., Winnipeg; 1932-33, Good Roads Board of Manitoba; with the Municipal Corp'n. of Tel Avir, Palestine, as follows: 1933-35, road inspr. on constrn., 1935-38, town planning engr., 1938-40, resident engr., on seashore improvement project; 1941-43, Toronto Iron Works, Toronto, on constrn. of equipm't. for the British American Oil Refinery at Clarkson, Ont.; at present, chief expediting engr., British American Oil Co., Toronto, Ont.

References: S. H. deJong, R. O. Paulsen, A. E. MacDonald, G. H. Herriot, J. N. Finlayson.

CHISHOLM—KENNETH GORDON, of Winnipeg, Man. Born at Chelsea, Que., Aug. 6th, 1902; Educ.: B.Eng. (Elec.), McGill Univ., 1929; 1929-31. R. C. C. Signals, radio range install'n, Northern Electric Co., Montreal; 1931, planning and install'n of communication system for forest fire protection (radio), Sask. Govt.; 1932-37 (summers), planning and installing forestry communication system, Laurentian Forest Protective Assoc.; 1932-37 (winters), various technical work as follows: 1933-34, transmitter operator and studio operator, CFCF, Montreal; 1935, specialist radio receiver repairs, R.C.A. Victor Co. Ltd., Montreal; 1936, with the Canadian Marconi Co.; 1937, broadcast station consltg. work; 1938-41, engrg. and install'n. of radio equipment in planes and in ground stations, Trans Canada Air Lines; 1941 to date, sales engr., engrg. products div'n., Western Canada, R.C.A. Victor Co. Ltd., Winnipeg, Man.

References: J. Dyment, C. H. Brereton, J. D. Peart, G. R. Pritchard, A. T. McCormick.

CRAM—JAMES DONALD, of 120 Victoria Ave., Belleville, Ont. Born at Harris, Sask., April 28th, 1918; Educ.: B.Sc. (Agricultural Engrg.), Univ. of Sask. 1943; 1942 (May)—1943 (April), equipm't. engr., D.I.L., Winnipeg, Man.; 1943 (April-July), technical supervisor, D.I.L., Nobel, Ont.; 1943 (July to date), mech. engr., Stewart-Warner-Alemite Corp'n. of Canada, Ltd., Belleville, Ont.

References: G. W. Parkinson, I. M. Fraser, R. A. Spencer.

DALTON—WILLIAM REGINALD, of 30 St. Andrews Terrace, Sault Ste. Marie, Ont. Born at Nelson, Ont., Nov. 23rd, 1898; Educ.: B.Sc., Queen's Univ., 1929; 1926-28 (summers), dfting., English Electric Co., St. Catharines, Ont.; 1929 (summer), dfting., Steel Co. of Canada; 1929-31, tool engrg. and design of jigs and fixtures, Can. Westinghouse Co.; 1936-37, i/c interworks inspec'n., International Harvester Co.; 1938-39, teaching, Dominion Provincial Youth Training group, Galt, Ont.; 1939-40, teaching dfting., Danforth Technical School, Toronto; 1940, design of attachments for shell lathes for John T. Hepburn; 1941-44, teaching dfting., Sault Ste. Marie Technical School and, at present, head of dfting. dept., and maths. instructor at night school.

References: A. M. Wilson, R. S. McCormick, Geo. G. W. MacLeod, J. L. Lang, G. W. Holder.

FINNIE—NORMAN WILLIAM, of 302 Hunter St., Peterborough, Ont. Born at Montreal, Dec. 20th, 1913; Educ.: B.Sc., Queen's Univ., 1939; 1930-36, motor repairs—ampere electric switchgear costs and sales office, English Electric Co.; with the Canadian General Electric Co., Peterborough, as follows: 1936-40, transformer and meter sales office, Packard Electric Test course, 1940-41, switchgear engrg.; 1941, industrial control, 1942 to date, junior engr., designing induction motors.

References: V. S. Foster, A. R. Jones, D. V. Canning, B. E. Burgess, A.L. Malby, D. J. Emery.

HESLER—RONALD JOHN HAROLD, of Sackville, N.B. Born at Montreal, Que., Feb. 26, 1921; Educ.: Ordnance Mech. Engr. (Wireless) 1943; 1937-39, amateur radio operation (VEIKS); 1942-43, technical staff officer (Tele-communication Group) Directorate of Mech. Mtce., Ottawa, Ont.; 1943 to date, officer in charge of army wireless mtce., Atlantic Command, "W" and "G" Forces. (Asks for admission as an Affiliate.)

References: H. W. McKiel, C. A. D. Fowler, I. P. Macnab, LeS. Brodie, H. W. Read.

KENNEDY—TAYLOR JAMES, of 4130 Dorchester St. West, Westmount, Que. Born at Westmount, Que., March 15th, 1916; Educ.: B.Eng. (Mining) 1938, M.Eng. (Mining) 1939, McGill Univ.; 1935-38 (summers), underground mining general, O'Brien Gold Mines, Que., Dome Mines Ltd., South Porcupine, Ont., and Frood Mine, International Nickel Co., Sudbury, Ont.; 1938 (summer), prospecting and diamond drilling work, Mining Products of Canada; 1939-40, mine engr. and night foreman, Morris Kirkland Gold Mines, Ltd., Ont.; with the Canada Cement Co. Ltd., as follows: 1940-43, plant engr., No. 1 plant, and at present, asst. supt., No. 1 Plant, Montreal East, Que.

References: F. B. Kilbourn, W. G. H. Cam, H. C. Kennedy.

KLEMPNER—HAROLD, of 345 College Ave., Winnipeg, Man. Born at Winnipeg, Man., March 11th, 1909; Educ.: B.Sc. (Civil), University of Man., 1930; 1928 (summer), junior dftsmn., Dominion Water Power & Reclamation Service; 1929 (summer) dftsmn. on constrn., C.P.R.; 1930-31, transitman, C.P.R., Kenora, Ont.; 1931, engr., Northern Public Service Corp'n, Ltd., Winnipeg; 1932-33, under instruction, R.C.A.F., Camp Borden; 1933-39, as engr. for Smelter Gold Mines, Ltd., Golden Key Mining Syndicate, Wingold Mines Ltd., Barry Hollinger Mines, Coniaurum Mines, and Delnite Mines; 1940, design and dfting., Malartic Goldfields, Ltd.; 1940-41, senior shift boss, Powell-Rouyn Gold Mines, Ltd.; 1941-42, technical engr. officer, R.C.A.F., 1942, asst. inspecting engr., Dept. of Munitions & Supply, Winnipeg; 1942-43; field engr. and constrn. supt., Carter-Halls-Aldinger Co. Ltd.; at present engr., National Research Council, Winnipeg, Man. (temporary appointment).

References: A. W. Fosness, G. H. Herriot, C. H. Attwood, A. E. MacDonald, E. P. Fetherstonhaugh.

LONGWORTHY—WILLIAM HAROLD, of Esquimalt, B.C. Born at Regina, Sask., Jan. 3rd, 1921; Educ.: B.Sc. (Mech.), Univ. of Sask. 1942; 1942 to date, Sub-Lieut. (E) R.C.N.V.R., c/o F.M.O., Esquimalt, B.C.

References: W. S. E. Morrison, I. M. Fraser, N. B. Hutcheon, R. A. Spencer, G. W. Parkinson.

LOUDEN—JOHN CECIL, of 78 St. Albans St., Toronto, Ont. Born at Birkenhead, England, April 30th, 1896; Educ.: Holt Technical School, Birkenhead, 1912-14; Univ. of Toronto (evening classes) celestial navigation and practical maths., 1939-41; with the Dept. of Highways (Ontario) as follows: 1934-38, rodman and instru'mn. on winter topographical surveys and inspr. on road constrn., 1938-41, office engr. and dftsmn. i/c divn. 6, engrg. office, 1942, traffic engr., main draughting room, Parliament Bldgs., Toronto; 1942-43, works and operations engr., R. Melville Smith Co. Ltd., management contractors, Alaska Highway, on constrn. of headquarters bldgs., at Fort St. John, B.C., and camp, headquarters and hospital at Fort Nelson, B.C., including water and sewage install'ns, mtce. of supply, etc. At present, dftsman., Cloverleaf Design and traffic problems, Ontario Dept. of Highways, Toronto.

References: R. M. Smith, T. F. Francis, R. A. Campbell, H. Rindal, A. Hay.

McCARTHY—DOUGLAS FINDLAY, of 4 Avalon Blvd., Toronto 13, Ont. Born at North Bay, Ont., Aug. 5th, 1907; Educ.: B.A.Sc., University of Toronto, 1929; R.P.E. Ont.; 1925-29 (summers) chainman on rly. location, topographer on storage dam survey, instru'mn on rly. constrn., Temiskaming and Northern Ont. Rly.; 1928, res. engr., rly. constrn., Algoma Central and Hudson Bay Rly.; with Spruce Falls Power and Paper Co. Ltd., Kapuskasing, Ont., as follows: 1929-31, mtce. and layout dfting. and 1931-32, estimator and field engr.; with the Hollinger Consolidated Gold Mines, Ltd., as follows: 1933-39, instru'mn. on underground surveying, responsible for contract tonnage measurements, 1939-42, ore reserve engr., preparation of monthly and annual ore reserve estimates; at present, asst. struct'l. engr. i/c bldg. mtce. and constrn., the General Engineering Co. (Canada) Ltd., Allied War Supply Corp'n. Project 24.

References: C. R. Young, C. T. Anderson, R. S. Segsworth, I. S. Widdifield, K. H. Anderson.

McLAREN—LEO GERARD, of Rimouski, Que. Born at Chicoutimi, Que., Sept. 12th, 1898; Educ.: B.Sc. (Civil), McGill Univ., 1924, R.P.E. Que.; 1918-23 (summers), asst. to field engr.; 1924-31, field engr., Shawinigan Engineering Co.; with the Dept. of Public Works (Canada) at Rimouski, Que., as follows; 1933-42, asst. engr.; 1942 to date, senior asst. engr. to District Engineer.

References: K. M. Cameron, C. R. Lindsay, R. Blais, B. Grandmont, A. R. Decary, J. A. McCrory, R. F. Legget, C. Luscombe.

NEWTON—LESLIE JAMES, of Pont Rouge, Que. Born at Dalkeith, Ont., Sept. 5th, 1914; Educ.: B.Sc., Queen's Univ., 1936; with Phillips Electrical Works, Ltd., as follows: 1936-38, Brockville plant, Ont., 1938-39, Montreal plant; 1939 to date, plant engr., Building Products, Ltd., Pont Rouge, Que.

References: D. S. Ellis, L. T. Rutledge, H. W. Lea, W. D. MacKinnon.

ORR—LESLIE GALLAHER, of 219 Mooregate St., St. James, Man. Born at Franklin, Man., May 7th, 1910; Educ.: B.Sc. (Civil), Univ. of Manitoba, 1943; 1931-35 (summers), rodman, hydrographic survey, Dept. of Marine and Fisheries; 1939 (summer), instru'mn., Dominion Dept. of Agric., P.F.R.A. 1940 (summer), explorer and instru'mn., surveys branch, Manitoba Dept. Mines and Natural Resources; with the Dominion Dept. of Agric., P.F.R.A. as follows: 1941-43, instru'mn., 1943 to date, junior engr. (acting dist. engr.) i/c all surveys and designs for dams, and other water development projects.

References: C. H. Attwood, A. E. MacDonald, B. B. Hogarth, E. Gauer, J. I. Mutchler, D. M. Stephens.

SANKOFF—ABBEY, of 2515 Maplewood Ave., Montreal. Born at Montreal, March 15, 1909; Educ.: B.S. ,University of Pittsburgh, 1934; 1934-42, motion and time study, plant layout, engrg. investigations, production problems, industrial accounting, Canadian Westinghouse Co. Ltd.; 1942 to date, industrial engr., engrg. and plate shops, Canadian Vickers Ltd., Montreal.

References: R. C. Flitton, G. Agar, R. M. Calvin, P. F. Stokes, T. R. McLagan.

STUPPEL—ISAAC, of 541 Rideau St., Ottawa, Ont. Born at Riga, Latvia, Nov. 23rd, 1902; Educ.: Mech. Engr., Polytechnisches Institut, Arnstdat, Germany, 1926; with Hull Iron & Steel Foundries, Hull, Que., as follows: 1928-32, dftsman., 1932-36, chem. lab. on steel analysis, 1936 to date, asst. supt.

References: W. H. G. Flay, D. M. Loomis, R. M. Prendergast, G. M. Pitts.

FOR TRANSFER FROM THE CLASS OF JUNIOR

BENJAFIELD—JOHN FORDYCE, of 4603 Hampton Ave., Montreal. Born at London, Ont., July 20, 1908. Educ.: B.Sc., Queen's Univ., 1933; R.P.E. Ontario; 1928-32 (summers), rodman, C.N.R.; 1933-35, dftsmn., Dept. of Highways, Ontario; 1935-36, instr'mn., City of St. Thomas; 1936, instr'mn., C.N.R.; with Foundation Co. of Canada as follows: 1937-39, field engr., layout of bldgs., lines and levels, estimating, 1939-41, supt., supervision of bldg. of plant constrn., 1941 to date, travelling supt., supervision of a number of jobs as to costs and methods of work. (St. 1933; Jr. 1938.)

References: R. E. Chadwick, W. Griesbach, W. C. Miller, J. Ferguson, F. Bell.

BERGER—BERNARD AVROM, of 5415 Randall Ave., Cote St. Luc, Que. Born at Montreal Dec. 28, 1908. Educ.: B.Sc., (Mech.) McGill Univ., 1930; R.P.E. Quebec; 1930-36, with Ford Motor Co. of Can. Ltd., as follows: 1930-31, tool room app'ntce, 1931-32, asst. production foreman, 1932-36 tool and machine design; 1936-37, tool and machine design, General Motors of Canada, Oshawa; 1937-41, tool and machine design and 1941-43, chief dftsmn., Northern Electric Co., Fire Control; 1943, tool engr. and asst. prodn. mgr. for Electric Tamper and Equipment Co., Montreal; at present, in private practice as consltg. mech. engr., Montreal. (St. 1928; Jr. 1936.)

References: H. Miller, J. J. H. Miller, H. C. Spencer, S. Sillitoe, W. A. Dawson.

CAMPBELL—GERALD ARTHUR, of Petawawa, Ont. Born at Montreal, Que., Aug. 25, 1915; Educ.: B.Sc., (Civil), Univ. of N.B., 1938; Summers, 1936, asst. supt., Bridge Dept., N.B., 1937, surveyer, Fraser Co. Ltd., 1938, inspr. on paving, Milton Hersey Co.; 1937-38, asst. instr. in surveying, Univ. of N.B.; 1938-39, dftsmn., Dept. of Lands and Mines, N.B.; 1939-41, field engr., United British Oilfields of Trinidad, Ltd., i/c earthworks, road constrn., mtce., drainage and industrial rly.; 1941-42, field engr., Walsh and Driscoll Constrn. Co., Edinborough Air Base, Trinidad, i/c engrg. on constrn. of runways, etc.; 1942-43, field engr., with E. G. M. Cape and Co., Dartmouth, N.S., on constrn. of civil wharf.; at present, cadet in Royal Canadian Engineers at A5, C.E.T.C., Petawawa, Ont. (St. 1937; Jr. 1942.)

References: J. Stephens, E. O. Turner, J. R. Scanlan, C. L. Cate.

HOWE—HAROLD BERTRAM, of 4801 Lacombe Ave., Montreal. Born at Inverness, P.Q., Mar. 29th, 1915; Educ.: B.Sc., (Mech.) Queen's Univ., 1936; 1936-39, asst. mech. engr., Canadian Johns-Manville Co. Ltd., Asbestos, Que., design and dftng. of factory, mine, mill and rly. machinery; with Canada Cement Co. Ltd. as follows: 1939-40, plant engr., Plant No. 1, Montreal East, i/c constrn. of bldgs. and machinery, 1940-42, misc. design and dftng., head office, field work supervising all major mtce. jobs throughout company; 1942-43, i/c operation and mtce. of company's ships and precision field machinery constrn.; 1943 to date, Supt., i/c of operation in all phases of the company's plant No. 1, Montreal East. (St. 1935; Jr. 1941)

References: F. B. Kilbourn, W. G. H. Cam, L. Trudel, L. M. Arkley, D. S. Ellis.

MARTIN—ARHUR L., of 2015 University St., Montreal, Que. Born at Winnipeg, Man., Nov. 12, 1909; Educ.: B.Sc., (Civil) Univ. of Man., 1934; 1935 (Oct.-Nov.) junior doing office work, Manitoba Good Roads Dept.; 1936-37, inspr. with C. D. Howe Co., Manitoba Good Roads Dept., Greater Winnipeg Sanitary Dist.; 1937-40, detailing dftsmn., estimator and concrete designer, Truscon Steel Co. of Canada, Ltd., Toronto; 1940 to date, dftsmn on concrete and timber design, General Engrg. Dept., Aluminum Co. of Canada, Montreal. (Jr. 1941.)

References: C. D. Norton, V. Andersen, D. G. Elliott, S. R. Banks, W. B. Korcheski.

PORTEOUS—JOHN WARDLAW, of Edmonton, Alta. Born at Galt, Ont., Jan. 12, 1907; Educ.: B.Sc., 1928, M.Sc., 1932, (Elec.), Univ. of Alta.; R.P.E. Alta.; 1928-29, student course Canadian Westinghouse Co., 1929-30, demonstrator, Syracuse Univ.; 1930, lecturer, 1943, asst. prof., and at present assoc. professor, Univ. of Alberta, Edmonton; 1940, constrn. of C.K.U.A. 1,000 watt transmitter layout. (St. 1929; Jr. 1934.)

References: R. S. L. Wilson, H. J. MacLeod, E. Stansfield, F. R. Burfield, A. M. Allen.

THOMAN—RUSSELL K., of 4382 Vanhorne Ave., Montreal. Born at Hamilton, Ont., July 31, 1910; Educ.: B.Sc., Queen's Univ., 1936; 1926-31, steel erection, Hamilton Bridge Co.; 1936-39, industrial engr. and prodn. mgr., Remington Rand Ltd., Hamilton, Ont.; 1939 to date, supt. engrg. divn., Canadian Vickers, Ltd., Montreal. (St. 1936; Jr. 1938.)

References: G. Agar, R. C. Flitton, R. M. Calvin, P. F. Stokes, H. S. Vanpatter, G. O. Vogan, G. H. Midgley.

FOR TRANSFER FROM THE CLASS OF STUDENT

HART—ERWIN EDWARD, of Toronto. Born at Toronto, July 18, 1915. Educ.: B.A.Sc., Univ. of Toronto, 1940; 1940-41, scheduling at machine shop work, and 1941-43, scheduling of all mtce. dept. work, Dunlop Tire and Rubber Goods Co. Ltd.; 1943 to date, supervisor of material standards, Ordnance Divn., John Inglis Co. Ltd., Toronto. (St. 1940)

References: C. R. Young, C. F. Morrison, R. F. Legget, F. Noakes, R. Graydon.

STAPLETON—DAVID OUTRAM, of 139 Brock Ave. S., Montreal West, Que. Born at Exmouth, Devonshire, England, Mar. 24, 1916; Educ.: B.Eng. (Mech.) McGill Univ., 1938; 1935-36 (summers), gen'l. mtce., Noranda Mines Ltd., Noranda; 1937-40, gen'l. mtce. and operating, Dominion Oxygen Co., Montreal; 1940-43, with the British Air Commission as follows: 1940-42, asst. to inspr. in charge at Canadian Car and Foundry Turcot Aircraft, Montreal, Canadian Associated Aircraft Ltd., St. Hubert Airport, Que., Northorp Aircraft, Inc., Hawthorne, Calif.: 1940-42, asst., to resident British inspr. Lockheed Aircraft Corp., Burbank, Calif., 1943, resident British inspr., No. 9 Modification Centre, Standiford Field, Louisville, Ky.; at present, lab. technician in Test and Experimental Lab., Canadian Car and Foundry Co. Ltd., propellor divn., Montreal, Que. Development engrg. and tests on propellers, governors and pumps, field service on same. Prodn. expediter and coordinator between chief engr. and the shop. (St. 1938.)

References: W. S. Attwood, E. I. Wigdor, G. J. Dodds, W. A. Wood, E. Brown, R. deL. French, A. R. Roberts.

Employment Service Bureau

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.

NOTICE

Technical personnel should not reply to any of the advertisements for situations vacant unless—

1. **They are registered with the Wartime Bureau of Technical Personnel.**
2. **Their services are available.**

A person's services are considered available only if he is—

- **(a) unemployed;**
- **(b) engaged in work other than of an engineering or scientific nature;**
- **(c) has given notice as of a definite date; or**
- **(d) has permission from his present employer to negotiate for work elsewhere while still in the service of that employer.**

Applicants will help to expedite negotiations by stating in their application whether or not they have complied with the above regulations.

SITUATIONS VACANT

MECHANICAL ENGINEER, graduate of about one year's standing required by stable industry essential to war work, for draughting, design and study work on mechanical and other maintenance problems. Location south-western Ontario. Apply to Box No. 2682-V.

MECHANICAL ENGINEER for a large pulp and paper company in the province of Quebec. Mill located near Ottawa. Applicant should have good knowledge of paper mill design and layout. Do not apply if a technical person within the meaning of P.C. 246, Part III (Jan. 19-43) unless your services are available under the regulations administered by the Wartime Bureau of Technical Personnel. Reply stating age, experience, and salary expected to Box No. 2687-V.

EXPERIENCED MECHANICAL DRAUGHTSMAN for design of jigs, fixtures and light manufacturing machinery. Location—Eastern Ontario. Good opportunity. Apply to Box No. 2690-V.

YOUNG MECHANICAL ENGINEER, able draughtsman, required by 76-year old firm in Quebec district, operating cast iron foundry and metal working departments. Firm "designated" by Selective Service but this position not dependent on war work. Good opportunity for advancement to right party. Applicant must be bilingual. State experience and salary expected in writing to Box No. 2695-V.

CHEMIST OR CHEMICAL ENGINEER qualified to formulate and prepare liquid resin and other glues for use in plywood manufacture. Permanent position. State experience and salary expected. Apply to Box No. 2713-V.

SALESMEN, large life insurance company has opening for men, about 35 years of age. Married. Average salary of $2000 a year paid for servicing business plus commissions on all new business. Average yearly earnings $3200. Excellent prospects of advancement in sales executive work for capable men. Professional men have a high record of success in this business. Apply to Box 2715-V.

WANTED—We have an opening in our filtration department for a mechanical, metallurgical or chemical engineer or a man with equivalent technical training or qualifications. This job requires the services of a man to handle test work, sales and servicing of Oliver paper mill filters, deckers, bleach washers, savealls, etc. Knowledge of and experience in the pulp and paper industry along with an engineering background enabling applicants to solve filtration problems is required. This is a permanent position. Do not apply unless your services are available under regulations P.C. 246 Part III (Jan. 19-43) administered by the Wartime Bureau of Technical Personnel. Apply to E. LONG LIMITED, Orillia, Canada.

SITUATIONS WANTED

CIVIL ENGINEER, age 38, experience in charge of light and heavy construction, all types surveying, airfield work, machinery installation, light steelwork. Apply to Box 741-W.

GRADUATE CIVIL ENGINEER, age 44, married, bilingual, over twenty years' experience; eight years as laboratory technician in pulp and paper and twelve years as inspecting engineer on various construction jobs including two years in charge of concrete laboratory on large hydroelectric project recently completed. Presently unemployed, desires permanent position. Apply to Box No. 1485-W.

GRADUATE MECHANICAL ENGINEER, age 31, eight years' experience which includes successful work as plant engineer and plant superintendent in small plant; organization and administrative work in production, process control and design in large war industry. Familiar with latest practice in industrial management on job methods, personnel training, quality control, job evaluation, efficient labour relations programme, etc. Specialized field is methods engineering. Principally interested in organization and administrative work with small or medium-sized industry with post-war possibilities. Apply to Box No. 1500-W.

GRADUATE ELECTRICAL ENGINEER, B.Sc.E.E., 1933, University of Manitoba. Experience in design, layout, installation, supervision of industrial electrical power, distribution systems; high tension overhead and underground transmission systems; outdoor and indoor substations. Design and layout of commercial and industrial lighting systems, covering incandescent, fluorescent and cold cathode installations. Available on short notice. Apply to Box 2099-W.

GRADUATE B.Sc., Jr.E.I.C., age 27, executive and administrative ability, keenly interested in fields of industrial engineering and chemistry. Engineering office and laboratory experience, all around technical training. Bilingual. Presently employed, but war conditions necessitate change. Apply to Box No. 2445-W.

CIVIL ENGINEER, 45 years old, married, experienced in all types of industrial and heavy construction, railways bridges, water supply, etc., desires permanent position. Available December first. Apply to Box No. 2458-W.

CIVIL ENGINEER, M.E.I.C., age 28, married. Experienced in highway and airdrome construction, sewer and waterwork, construction of buildings, steam and hot air heating. Desires position with consulting engineer, municipal engineer or general contractor in prairie provinces or western Ontario. Available January 1st, 1944. Apply to Box No. 2459-W.

FOR SALE OR RENT

TRANSITS, levels and accessories. Apply to Ralph Kendall, C.E., P.L.S. 13 Queen's Building, Halifax, N.S.

Mechanical Engineer Wanted

Large pulp and paper mill requires services of graduate civil or mechanical engineer with three or more years' experience in mechanical engineering. When applying state age, education, experience, salary, marital status and when available. Do not apply unless your services are available under regulation P.C. 246, Part III, administered by Wartime Bureau of Technical Personnel. Apply to Box No. 2706-V.

ASSOCIATION OF PROFESSIONAL ENGINEERS OF TORONTO

M. J. Aykroyd, Outside Plant Engineer, Bell Telephone Co., Toronto, has been elected president of the Association of Professional Engineers of Ontario for the year 1944. He succeeds R. A. Elliott, B.Sc., general manager of the Deloro Smelting & Refining Co. Ltd., Deloro. J. L. Lang, M.E.I.C., Lang & Ross, Sault Ste. Marie has been elected vice-president. Other members elected to the Council of the Association are as follows:

Civil Branch—D. S. Ellis, M.E.I.C., Dean, Faculty of Applied Science, Queen's University, Kingston. M. W. Huggins, M.E.I.C., Asst. Professor of Civil Engineering, University of Toronto, Toronto.

Chemical & Metallurgical Branch—W. J. Cook, Asst. Supt., International Nickel Co. Ltd., Port Colborne. G. L. Macpherson, M.E.I.C., Chief Engineer, Imperial Oil Ltd., Sarnia.

Electrical Branch—E. V. Buchanan, M.E.I.C., General Manager, Public Utilities Commission & London Railway Commission, London. J. H. Smith, Engineer, Electrical Construction Sales, Canadian General Electric Co. Ltd., Toronto.

Mechanical Branch—G. Ross Lord, M.E.I.C., Asst. Professor of Mechanical Engineering, University of Toronto, Toronto. R. M. Robertson, Chief Engineer, Babcock-Wilcox & Goldie-McCulloch Ltd., Galt.

Mining Branch—J. Beattie, Manager, Delnite Mines Ltd., Timmins. G. B. Langford, Professor of Mining Geology, University of Toronto, Toronto.

Industrial News

Industrial development — new products — changes in personnel — special events — trade literature

RECENT APPOINTMENT

B. J. Richards has been appointed sales manager, mechanical and sundries rubber products by Dominion Rubber Co. Ltd., for western Ontario, Manitoba, and Saskatchewan, with headquarters in Winnipeg.

He represented the company in the Maritime provinces and Ontario in the field for thirteen years, and was formerly manager of general products sales, head office, Montreal.

Mr. Richards replaces A. C. McGiverin, who has been appointed sales manager, mechanical and sundries goods, Quebec division, with headquarters in Montreal.

NICKEL AND ALLOYS

The International Nickel Co. of Canada Ltd., Toronto, Ont., have issued an 18-page catalogue containing reviews of forty-five publications being offered by this company dealing with nickel and its alloys. They are classified under the following headings; industrial applications, mechanical properties, physical properties, working instructions, guides and monographs.

C.G.E. APPOINTMENT

Canadian General Electric Co. Ltd., Toronto, Ont., has announced the appointment of D. M. Alcock to the position of arc welding specialist in its head office apparatus sales department.

Mr. Alcock brings to his new position a very extensive and varied experience in the welding field. Between 1917 and 1937 he was employed as a welder by the Thompson Welding Co., Toronto; General Motors Corp., Detroit; Canadian General Electric Co., Toronto, and John Inglis Co., Toronto. During this period he also held the position of foreman welder at Dominion Welding Engineering Co., Toronto and Montreal; Toronto Iron Works, Toronto, and Horton Steel Works, Fort Erie.

Between 1937 and the time he assumed his present position with C.G.E., Mr. Alcock worked on inspection and qualifications of welding procedures and qualifying of welding operators for Chas. Warnock Co., Montreal; Aluminum Co. of Canada Ltd., Arvida; Ontario Paper Co., Outardes Falls; H. G. Acres Co., Niagara Falls, Toronto, Montreal, Fort Erie; Toronto Shipbuilding Co., Toronto, and the Shipshaw project of the Aluminum Company in Québec.

D. M. Alcock

R. M. Robinson

NEW APPOINTMENT

R. M. Robinson, formerly of Canadian General Electric Co. Ltd., lighting division, has been appointed general manager of the Wheeler Reflector Co. of Canada Ltd.

Mr. Robinson graduated from the University of Toronto in 1935, with honors in electrical engineering, where he had specialized in illumination.

In 1935 he entered the lighting service department of C.G.E., where he trained in the application and design of lighting equipment. The following year he transferred to the lighting division of the company's supply department, specializing in commercial and industrial lighting, street and highway lighting, airport lighting, searchlights and floodlights.

An associate member of the Toronto Section of the Illuminating Engineering Society, Mr. Robinson has served that body in many important capacities. He is also a member of the Association of Professional Engineers and is on the executive of the committee of Affiliated Engineering and Allied Societies in Ontario.

STEEL AND IRON PRODUCTION

Vulcan Iron Works Limited, Winnipeg, Man., have recently issued a 4-page bulletin, Nos. 3 and 4, featuring the company's facilities for the production of immense quantities of basic steel alloys and of heavy castings produced from same, including parts for railroad rolling stock, mines, ships and army mechanized equipment. Illustrations show a number of the finished products and the company's laboratory, established to provide control of all phases of manufacture.

In another bulletin, designated as No. 6, samples of the products of this Company's structural steel and ornamental division are illustrated. Included are such varied items as watertight bulkhead doors, mine cars, blasting shields, fire escapes and steel and iron stairs. The bulletin also lists the company's wartime and peacetime products and indicates its readiness to resume production of the latter class of merchandise.

TIMBER CONNECTORS

Timber Engineering Co., represented in Canada by V. H. McIntyre Ltd., Toronto, Ont., have issued a 40-page manual which gives complete design information covering the use of "Teco" connectors, including data on load values, spacings, etc. The material is presented in chart form for ready use of architect and engineers and includes such additional information as recommended cambers for standard trusses, approximate weights of various timber connectored roof trusses and a table of dimensional properties of American standard-sized lumber and timbers.

RECEIVES PROMOTION

W. D. Moffatt has been appointed general manager for Canada of Alexander Murray & Co. Ltd., Montreal, roofing, insulation and allied building materials division of the Dominion Tar & Chemical Co. Ltd. Prior to joining the Murray organization in 1939 as sales manager, Mr. Moffatt was connected with the McConnell, Ferguson and McConnell, Eastman advertising agencies at London and Toronto, Ont., London, England, and Montreal.

W. D. Moffatt

THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 27 | MONTREAL, MARCH 1944 | NUMBER 3

"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

★ ★ ★

CONTENTS

One of the Horton spheres at Polymer Corporation, near Sarnia, Ont. (National Film Board Photo) . . . . . . Cover

INDUSTRIAL RESEARCH IN POST-WAR CANADA 136
C. J. Mackenzie, C.M.G., M.E.I.C.

MANAGEMENT'S NEED OF BROADER VISION 140
William L. Batt, Hon.M.E.I.C.

A NOTE ON A NEW FORM OF THE THREE-MOMENT EQUATION 143
I. F. Morrison, M.E.I.C.

SOCIAL SECURITY PLANNING IN THE ENGLISH SPEAKING WORLD 146
Discussion 148

THE DESIRABILITY OF ESTABLISHING TECHNICAL INSTITUTES IN CANADA 150
C. R. Young, M.E.I.C.

FIFTY-EIGHTH ANNUAL MEETING 152

SAID AT THE ANNUAL MEETING 160

FROM MONTH TO MONTH 164

PERSONALS 173
Obituaries 175

NEWS OF THE BRANCHES 178

LIBRARY NOTES 183

PRELIMINARY NOTICE 186

EMPLOYMENT SERVICE 189

INDUSTRIAL NEWS 190

PUBLISHED MONTHLY BY

THE ENGINEERING INSTITUTE OF CANADA

2050 MANSFIELD STREET - MONTREAL

Price 50 cents a copy, $3.00 a year: in Canada, British Possessions, United States and Mexico. $4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, $2.00 a year. —Entered at the Post Office, Montreal, as Second Class Matter.

THE ENGINEERING INSTITUTE OF CANADA

MEMBERS OF COUNCIL - 1944

PRESIDENT
deGASPÉ BEAUBIEN, Montreal, Que.

PAST-PRESIDENTS
*C. J. MACKENZIE, Ottawa, Ont.
‡K. M. CAMERON, Ottawa, Ont.
†C. R. YOUNG, Toronto, Ont.

VICE-PRESIDENTS
*W. P. BRERETON, Winnipeg, Man.
†G. L. DICKSON, Moncton, N.B.
†J. M. FLEMING, Port Arthur, Ont.
*L. F. GRANT, Kingston, Ont.
*C. K. McLEOD, Montreal, Que.
†E. B. WARDLE, Grand'Mère, Que.

COUNCILLORS
*J. E. ARMSTRONG, Montreal, Que.
*H. E. BRANDON, Toronto, Ont.
†H. L. BRIGGS, Winnipeg, Man.
‡R. S. EADIE, Montreal, Que.
†G. H. FERGUSON, Ottawa, Ont.
†E. V. GAGE, Montreal, Que.
†P. E. GAGNON, Quebec, Que.
*R. E. HEARTZ, Montreal, Que.
*A. JACKSON, Kingston, Ont.
†J. A. LALONDE, Montreal, Que.
†ALEX. LOVE, Hamilton, Ont.
†P. A. LOVETT, Halifax, N.S.
*A. M. MacGILLIVRAY, Saskatoon, Sask.
*N. B. MacROSTIE, Ottawa, Ont.
†J. McMILLAN, Calgary, Alta.
*A. W. F. McQUEEN, Niagara Falls, Ont.
†E. B. MARTIN, Moncton, N.B.
*G. E. MEDLAR, Windsor, Ont.
†W. MELDRUM, Lethbridge, Alta.
*J. P. MOONEY, Saint John, N.B.
†A. S. G. MUSGRAVE, Oak Bay, B.C.
*E. NELSON, Edmonton, Alta.
*H. G. O'LEARY, Fort William, Ont.
‡P. E. POITRAS, Montreal, Que.
†J. A. RUSSELL, Sydney, N.S.
*C. SCRYMGEOUR, Dartmouth, N.S.
†H. R. SILLS, Peterborough, Ont.
†C. STENBOL, Sault Ste. Marie, Ont.
*J. A. VANCE, Woodstock, Ont.
*H. J. WARD, Shawinigan Falls, Que.
*J. W. WARD, Arvida, Que.
*C. E. WEBB, Vancouver, B.C.
†W. S. WILSON, Toronto, Ont.

*for 1944. †For 1944-45. ‡For 1944-45-46.

TREASURER
F. C. MECHIN, Montreal, Que.

GENERAL SECRETARY
L. AUSTIN WRIGHT, Montreal, Que.

SECRETARY-EMERITUS
R. J. DURLEY, Montreal, Que.

ASSISTANT GENERAL SECRETARY
LOUIS TRUDEL, Montreal, Que.

STANDING COMMITTEES

FINANCE
C. K. McLEOD, *Chairman*
J. E. ARMSTRONG
G. A. GAHERTY
F. C. MECHIN
R. M. CALVIN

LEGISLATION
P. E. POITRAS, *Chairman*

PAPERS
L. F. GRANT, *Chairman*

LIBRARY AND HOUSE
E. V. GAGE, *Chairman*
A. T. BONE
J. S. HEWSON
M. S. NELSON
G. V. RONEY

PUBLICATION
R. S. EADIE, *Chairman*
R. DeL. FRENCH, *Vice-Chairman*
A. C. D. BLANCHARD
H. F. FINNEMORE
T. J. LAFRENIERE

SPECIAL COMMITTEES

MEMBERSHIP
J. G. HALL, *Chairman*
S. R. FROST
N. MacNICOL

PROFESSIONAL INTERESTS
J. B. CHALLIES, *Chairman*
O. O. LEFEBVRE, *Vice-Chairman*
J. E. ARMSTRONG
G. A. GAHERTY,
M. J. McHENRY
H. W. McKIEL
J. A. VANCE

INTERNATIONAL RELATIONS
M. J. McHENRY, *Chairman*
R. W. ANGUS
E. A. ALLCUT
A. E. BERRY
C. CAMSELL
J. B. CHALLIES
J. M. R. FAIRBAIRN
O. O. LEFEBVRE
W. H. MUNRO
C. E. WEBB
C. R. YOUNG

THE YOUNG ENGINEER
H. F. BENNETT, *Chairman*
J. BENOIT
D. S. ELLIS
J. N. FINLAYSON
R. DeL. FRENCH
R. F. LEGGET
A. E. MACDONALD
H. W. McKIEL

WESTERN WATER PROBLEMS
G. A. GAHERTY, *Chairman*
C. H. ATTWOOD
L. C. CHARLESWORTH
A. GRIFFIN
D. W. HAYS
G. N. HOUSTON
T. H. HOGG
O. O. LEFEBVRE
C. J. MACKENZIE
H. J. McLEAN
F. H. PETERS
S. G. PORTER
P. M. SAUDER
J. M. WARDLE

ENGINEERING FEATURES OF CIVIL DEFENCE
J. E. ARMSTRONG, *Chairman*
P. E. ADAMS
J. N. ANDERSON
S. R. BANKS
H. F. BENNETT
W. D. BRACKEN
W. P. BRERETON
J. M. DAVIDSON
R. S. EADIE
E. V. GAGE
G. A. GAHERTY
R. J. GIBB
A. GRAY
J. GRIEVE
J. L. LANG
R. F. LEGGET
I. P. MACNAB
J. A. McCRORY
H. J. McEWEN
C. B. MUIR
W. H. MUNRO
J. A. A. PICHÉ
G. MacL. PITTS
C. J. PORTER
M. G. SAUNDERS
W. O. SCOTT
T. G. TYRER
H. K. WYMAN

POST-WAR PROBLEMS
W. C. MILLER, *Chairman*
F. ALPORT
J. S. BATES
deGASPÉ BEAUBIEN
A. L. CARRUTHERS
J. M. FLEMING
E. R. JACOBSEN
G. R. LANGLEY
H. MASSUE
G. L. MacKENZIE
D. A. R. McCANNEL
A. W. F. McQUEEN
G. MacL. PITTS
P. M. SAUDER
D. C. TENNANT
H. G. WELSFORD

DETERIORATION OF CONCRETE STRUCTURES
R. B. YOUNG, *Chairman*
E. VIENS, *Vice-Chairman*
G. P. F. BOESE
A. G. FLEMING
W. G. C. GLIDDON
O. O. LEFEBVRE
J. A. McCRORY
C. J. MACKENZIE
J. H. McKINNEY
R. M. SMITH

INDUSTRIAL RELATIONS
WILLS MACLACHLAN, *Chairman*
E. A. ALLCUT
D. BOYD
J. P. BRIERLEY
J. C. CAMERON
E. R. COMPLIN
J. A. COOTE
R. DUPUIS
S. M. GOSSAGE
F. W. GRAY
E. G. HEWSON
I. F. McRAE
A. M. REID
W. J. W. REID

LIST OF INSTITUTE MEDALS AND PRIZES

Sir John Kennedy Medal		For outstanding merit or noteworthy contribution to science of engineering, or to benefit of the Institute.
Julian C. Smith Medal		For achievement in the development of Canada.
Duggan Medal and Prize	Medal and cash to value of $100.	For paper on constructional engineering involving the use of metals for structural or mechanical purposes.
Gzowski Medal	Gold medal	For a paper contributing to the literature of the profession of civil engineering.
Plummer Medal	Gold medal	For a paper on chemical and metallurgical subjects.
Leonard Medal	Gold medal	For a paper on a mining subject, open to members of the Canadian Institute of Mining and Metallurgy as well as The Engineering Institute.
Students and Juniors	Books to the value of $25 (5 prizes).	For papers on any subject presented by Student or Junior members.
University Students	$25 in cash (11 prizes)	For the third year student in each college, making the best showing in college work and activities in student or local branch of engineering society.

OFFICERS OF BRANCHES

BORDER CITIES
Chairman, J. B. DOWLER
Vice-Chair., A. H. MacQUARRIE
Executive, G. W. LUSBY, J. M. WYLLIE, J. F. G. BLOWEY
(Ex-Officio), G. E. MEDLAR, G. G. HENDERSON
Sec.-Treas., W. R. STICKNEY, 1614 Ontario Street, Walkerville, Ont.

CALGARY
Chairman, J. G. MacGREGOR
Executive, F. A. BROWNIE, H. R. HAYES, A. HIGGINS, W. E. ROBINSON
(Ex-Officio), J. McMILLAN, G. P. F. BOESE, H. J. McEWEN
Sec.-Treas., K. W. MITCHELL, 803-17th Ave. N.W., Calgary, Alta.

CAPE BRETON
Chairman, J. A. MacLEOD
Executive, J. A. RUSSELL, M. F. COSSITT
Sec.-Treas., S. C. MIFFLEN, 60 Whitney Ave., Sydney, N.S.

EDMONTON
Chairman, C. W. CARRY
Vice-Chair., B. W. PITFIELD
Executive, J. A. ALLAN, J. W. JUDGE, E. D. ROBERTSON, J. D. A. MACDONALD, I. F. MORRISON, H. W. TYE
(Ex-Officio), D. HUTCHISON, E. NELSON
Sec.-Treas., F. R. BURFIELD, Water Resources Office, Provincial Government, Edmonton, Alta.

HALIFAX
Chairman, G. J. CURRIE
Executive, R. J. BETHUNE, J. W. MARCH, J. E. CLARKE, C. D. MARTIN, K. L. DAWSON, L. E. MITCHELL, D. C. V. DUFF, H. A. RIPLEY, J. H. M. JONES, R. B. STEWART
(Ex-Officio), A. E. FLYNN, C. SCRYMGEOUR, P. A. LOVETT
Sec.-Treas., S. W. GRAY, Wartime Bureau of Technical, Personnel, 84 Hollis Street, Halifax, N.S.

HAMILTON
Chairman, H. A. COOCH
Vice-Chair., NORMAN EAGER
Executive, C. H. HUTTON, H. J. A. CHAMBERS, R. J. G. SCHOFIELD, A. R. HANNAFORD
(Ex-Officio), ALEX. LOVE, T. S. GLOVER
Sec.-Treas., W. E. BROWN, 91 Barnsdale Blvd., Hamilton, Ont.

KINGSTON
Chairman, S. D. LASH
Vice-Chair., H. W. HARKNESS
Executive, R. J. CARTER, D. C. MACPHERSON, H. R. ROGERS, F. A. ATHEY
(Ex-Officio), L. F. GRANT, A. JACKSON, K. M. WINSLOW
Sec.-Treas., R. A. LOW, Dept. of Civil Engineering, Queen's University, Kingston, Ont.

LAKEHEAD
Chairman, R. B. CHANDLER
Vice-Chair., S. T. McCAVOUR
Executive, S. E. FLOOK, O. J. KOREEN, E. L. GOODALL, J. I. CARMICHAEL, W. H. SMALL, A. D. NORTON, E. A. KELLY, J. S. WILSON
(Ex-Officio), E. M. G. MacGILL (Mrs. E. J. Soulsby), J. M. FLEMING, E. J. DAVIES, H. G. O'LEARY
Sec.-Treas., W. C. BYERS, c/o C. D. Howe Co. Ltd., Port Arthur, Ont.

LETHBRIDGE
Chairman, A. L. H. SOMERVILLE
Executive, J. M. CAMPBELL, A. G. DONALDSON, P. E. KIRKPATRICK, R. S. LAWRENCE
(Ex-Officio), W. MELDRUM
Sec.-Treas., T. O. NEUMANN, Dept. of Transport, Post Office Building, Lethbridge, Alta.

LONDON
Chairman, R. S. CHARLES
Vice-Chair., H. G. STEAD
Executive, E. B. ALLEN, F. C. BALL, H. F. BENNETT, V. A. McKILLOP, G. N. SCROGGIE
(Ex-Officio), T. L. McMANAMNA, J. A. VANCE
Sec.-Treas, A. L. FURANNA, 732 Wellington Street, London, Ont.

MONCTON
Chairman, J. A. GODFREY
Vice-Chair., A. S. DONALD
Executive, E. R. EVANS, H. W. HOLE, A. GORDON, G. C. TORRENS, G. E. SMITH
(Ex-Officio), H. J. CRUDGE, G. L. DICKSON, E. B. MARTIN
Sec.-Treas., V. C. BLACKETT, Engrg. Dept., C.N.R. Moncton, N.B.

MONTREAL
Chairman, C. C. LINDSAY
Vice-Chair., J. B. STIRLING
Executive, C. E. GÉLINAS, J. BENOIT, K. G. CAMERON, L. H. BURPEE, G. H. MIDGLEY, M. S. MACGILLIVRAY
(Ex-Officio), deGASPÉ BEAUBIEN, C. K. McLEOD, J. E. ARMSTRONG, R. S. EADIE, J. A. LALONDE, E. V. GAGE, P. E. POITRAS, R. E. HEARTZ
Sec.-Treas., L. A. DUCHASTEL, 40 Kelvin Avenue, Outremont, Que.

NIAGARA PENINSULA
Chairman, G. E. GRIFFITHS
Vice-Chair., W. D. BRACKEN
Executive, A. G. HERR, C. G. MOON, G. F. VOLLMER, H. E. BARNETT, J. W. BROOKS, G. MORRISON, D. S. SCRYMGEOUR
(Ex-Officio), C. G. CLINE, A. W. F. McQUEEN
Sec.-Treas., J. H. INGS, 2135 Culp Street, Niagara Falls, Ont.

OTTAWA
Chairman, W. L. SAUNDERS
Executive, W. H. B. BEVAN, J. H. BYRNE, D. G. KILBURN, J. M. WARDLE, C. D. WIGHT
(Ex-Officio), K. M. CAMERON, G. H. FERGUSON, N. B. MacROSTIE
Sec.-Treas., A. A. SWINNERTON, Dept. of Mines & Resources, Ottawa, Ont.

PETERBOROUGH
Chairman, A. R. JONES
Executive, R. L. DOBBIN, A. L. MALBY, F. R. POPE, C. R. WHITTEMORE
(Ex-Officio), D. J. EMERY, H. R. SILLS
Sec.-Treas., A. J. GIRDWOOD, 308 Monaghan Road, Peterborough, Ont.

QUEBEC
Life Hon.-Chair., A. R. DÉCARY
Chairman, RENÉ DUPUIS
Vice-Chair., E. D. GRAY-DONALD
Executive, S. PICARD, G. ST-JACQUES, L. GAGNON, A. E. PARÉ, G. W. WADDINGTON, Y. R. TASSÉ
(Ex-Officio), P. E. GAGNON, R. B. McDUNNOUGH, P. MÉTHÉ
Sec.-Treas., PAUL VINCENT, Colonization Department, Room 333-A, Parliament Bldgs., Quebec, Que.

SAGUENAY
Chairman, CHAS. MILLER
Vice-Chair., G. B. MOXON
Executive, J. FRISCH, W. E. COOPER, F. T. BOUTILIER
(Ex-Officio), R. H. RIMMER, J. W. WARD, ALEX. T. CAIRNCROSS
Sec.-Treas., ALEX. T. CAIRNCROSS, 8-C Brittany Row, Arvida, Que.

SAINT JOHN
Chairman, A. O. WOLFF
Vice-Chair., C. D. McALLISTER
Executive, G. M. BROWN, C. C. KIRBY
(Ex-Officio), J. P. MOONEY, D. R. SMITH, G. W. GRIFFIN
Sec.-Treas., F. A. PATRIQUEN, P. O. Box 1417, Saint John, N.B.

ST. MAURICE VALLEY
Chairman, J. H. FREGEAU
Vice-Chair., R. DORION
Executive, G. B. BAXTER, E. BUTLER, A. G. JACQUES, R. D. PACKARD, M. EATON, E. T. BUCHANAN, J. JOYAL, W. E. A. McLEISH, H. G. TIMMIS
(Ex-Officio), VIGGO JEPSEN, H. J. WARD, E. B. WARDLE
Sec.-Treas., DAVID E. ELLIS, Shawinigan Water & Power Company, P.O. Box 190, Three Rivers, Que.

SASKATCHEWAN
Chairman, A. M. MACGILLIVRAY
Vice-Chair., J. McD. PATTON
Executive, F. E. ESTLIN, E. K. PHILLIPS, J. I. STRONG, F. C. DEMPSEY, N. B. HUTCHEON, J. G. SCHAEFFER, R. A. SPENCER
(Ex-Officio), A. P. LINTON
Sec. Treas., STEWART YOUNG, P.O. Box 101, Regina, Sask.

SAULT STE. MARIE
Chairman, A. M. WILSON
Vice-Chair., G. W. McLEOD
Executive, G. W. HOLDER, C. O. MADDOCK, H. W. SUTCLIFFE
(Ex-Officio), N. C. COWIE, C. STENBOL
Sec.-Treas., A. H. MELDRUM, P.O. Box 251, Sault Ste. Marie, Ont.

TORONTO
Chairman, W. H. M. LAUGHLIN
Vice-Chair., S. R. FROST
Executive, F. J. BLAIR, R. F. LEGGET, E. G. HEWSON, A. H. HULL, C. F. MORRISON, E. A. CROSS
(Ex-Officio), H. E. BRANDON, W. S. WILSON, C. R. YOUNG, J. M. VAN WINCKLE
Sec.-Treas., S. H. deJONG, Dept. of Civil Engineering, University of Toronto, Toronto, Ont.

VANCOUVER
Chairman, T. V. BERRY
Vice-Chair., A. PEEBLES
Executive, J. P. FRASER, F. H. BALLOU, E. S. JONES, R. C. PYBUS, G. W. ALLAN, J. A. TAMES
(Ex-Officio), C. E. WEBB, W. N. KELLY
Sec.-Treas., P. B. STROYAN, 2099 Beach Avenue, Vancouver, B.C.

VICTORIA
Chairman, H. L. SHERWOOD
Vice-Chair., A. L. FORD
Executive, P. B. HUGHES, C. M. TRIPP, S. R. WESTON, J. N. ANDERSON
(Ex-Officio), A. S. G. MUSGRAVE, KENNETH REID
Sec.-Treas., R. BOWERING, 41 Gorge Road West, Victoria, B.C.

WINNIPEG
Chairman, T. H KIRBY
Vice-Chair., C. P. HALTALIN
Executive, B. B. HOGARTH, N. M. HALL, R. A. SARA, W. F. RIDDELL, E. V. CATON
(Ex-Officio), W. P. BRETERON, H. L. BRIGGS, J. T. DYMENT,
Sec.-Treas., T. E. STOREY, 55 Princess Street, Winnipeg, Man.

INDUSTRIAL RESEARCH IN POST-WAR CANADA

C. J. MACKENZIE, M.E.I.C.

Acting President, National Research Council of Canada, Ottawa; Dean of Engineering, University of Saskatchewan, Saskatoon.

A paper presented at the Fifty-Eighth Annual Professional Meeting of The Engineering Institute of Canada, at Quebec, on February 11th, 1944.

"The application of research is a certain means of increasing employment by the improvement of existing and the creation of new industries; conversely, *the lack of it spells stagnation and ultimate bankruptcy.*" That statement is not the opinion of a cloistered research scientist but is one of the considered conclusions reached by a Committee of The Federation of British Industries (1) which, under the chairmanship of Sir William Larke, has been studying intensively for the past year the future of British industry. It is a statement to which all good Canadians should give serious thought.

Later, other conclusions of this Committee will be referred to but I propose at the outset to state briefly the general ideas and suggestions which I shall endeavour to develop for your consideration.

First, using the above quotation as a text, I shall attempt to show that no country will be able to keep in the forefront even qualitatively from the standpoint of industrial or military efficiency unless scientific and industrial research is supported as a major activity. I shall next submit figures to show how relatively small was Canada's pre-war expenditure on industrial research and how little private industry contributed even to that small expenditure, and that, apart from the contributions of universities and government laboratories, Canadian industry, with a few notable exceptions, was existing on technological blood transfusions from Great Britain and the United States. I shall conclude by presenting in general terms a plan for the developing of industrial research in Canada which is both practicable and adequate.

Wartime Development of Research

While it is not proposed to discuss research as applied to war, I would like to suggest that, in a mechanized world, experience in war can be our greatest teacher for peace, as the technological factors involved are the same. In war, processes are compressed on a time basis; the tempo is increased, and one can see the overall picture clearly. On one end of the line we have invention, on the other, use. The user in war is the soldier in action, in peace he is a civilian. Each must be supplied with food, shelter, clothing and tools or weapons for the performance of his activities. All these supplies must be provided by what we call industrial processes. Leaving out as irrelevant to our discussion the purpose to which the user puts his equipment and how he is organized or directed in that regard, whether the product is a bomber for dropping block busters on Berlin or a transport plane to take pleasure seekers to Bermuda, the efficiency and effectiveness from the competitive aspect are the same. We have the identical technological steps—research, fundamental and applied, development engineering, industrial production and efficient use. There are of course superficial differences—the "seven years from test tube to tank car" or the "six years from scientific research to retail sales" may have to be cut by half in time of war, but an accordion is still an accordion extended or compressed, the sounds differ in pitch and volume, but the theory is the same; technologically speaking, the factors which make for potential success in war and in peace are the same.

Later, figures will be presented which show that, in the present conflict, the effectiveness of the warring nations is closely related to their former peace-time activities in scientific and industrial research. It is not therefore an unwarranted conclusion to draw that, in the peace to come, the relative success and effectiveness of the industrial countries will be co-related significantly with their activities in research, and if Canada is to play an important role as a well integrated industrial nation her scientific structure must be materially strengthened.

While it is probably true that the importance of industrial research and development in the national economy now receives almost universal assent in all enlightened countries, it is also true that many industries do not see in research anything of importance or value to them as individual units in the national economy. In discussing this aspect the Larke Committee, while admitting that in England different industries have different needs, states, "it is nevertheless our considered view that no industry can maintain progress without research. . . . Lip service to research is often paid by firms or industries which believe that they have no problem requiring scientific investigation. This attitude is not necessarily one of apathy but rather of lack of experience in the application of science to their production processes."

Practical Value of Scientific Research

The awareness and appreciation of the practical value of science is nowhere more evident than where competition has really become a matter of life and death. For instance in England, when the need became imperious, the armed forces, which had not previously been overly aware of the help which might be available from scientific investigations, quickly lost any apathy in that regard and to-day there is no place where scientific advice and research are more respected and used. Air Chief Marshal Sir Philip Joubert, Commander-in-Chief, Coastal Command, in an address in January, 1943 (2) talking of the Battle of Britain said, "It was the harmonious co-operation of science and the military art which achieved this outstanding success. While there is no doubt that the Fighter Command . . . was a highly trained and very efficient body, it could not have achieved success without the aid of scientists. Radiolocation was the reinforcement which they brought to the out-numbered squadrons of the R.A.F." In a modern war, the strains of competition are felt fully as much in the industrial as in the military field, and in dealing with the intricacies and ramifications of the supply problem, England, in her days of peril, was quick to enlist the aid of the scientist; Sir Stafford Cripps, Minister of Aircraft Production, in a recent speech (2) pointed out that to-day in Britain there are five members of the War Cabinet and several other Ministers as well who are concerned with and have responsibilities for scientific matters and that all of these have eminent scientists on their personal staffs whose duty it is to keep their respective Ministers well advised on all scientific and technical matters affecting their departments. In Germany, in Russia, and in the United States, scientists are also being used on the highest levels, not merely as doctors to be called in when trouble has developed, but as advisers and experts whose advice is taken in the pre-policy stages.

While we can find little to admire in Germany, no one with any knowledge would suggest that the great German dye trust, the I. G. Farbenindustrie was inefficient from the standpoint of technical resourcefulness, political and business ability, and it is interesting to note that its Board of Directors is composed largely of Ph. D's in chemistry, physics, engineering and economics, who have come up through the research departments to positions of power and responsibility. In an industrial age which is growing more scientific every day, it is questionable if a country can attain and maintain a commanding place unless science is taken in as a full partner not only to be responsible for carrying out research programmes but to advise where and how science can help and to recommend suitable programmes in the planning stages.

Neglect Hinders Industrial Success

In Canada there probably are many who pay lip service to research but feel that, on the whole, industries have done fairly well in this country even though they have not undertaken research on their own and that there is less need in Canada for such work as we can easily get our scientific ideas and leadership from the United States and Great Britain. This view is a dangerous delusion, for the neglect of initiative and research in business is like malnutrition in youth, frequently detected only when it is too late to repair the damage. Industrial success must be measured in long periods of time and the long term picture cannot be properly appraised if too short a view is taken.

It is of course true that many companies have done well for a time without research and the stimulation of new ideas, but a glance back over the past will show a still larger number of industries which have passed quietly away amidst the futile protesting of their proprietors against the march of progress which they mistook for hard times. Mr. H. S. Richardson ⑦ has recently presented some striking figures to show that the natural trend of industrial enterprises is down, not up, that a strong present position is no guarantee of future security but that only by the application of new ideas, the development of new and better products can this downward trend be prevented. He points out that, in 1901, there were listed on the New York Stock Exchange 170 dividend-paying stocks and that 35 years later only 41.1 per cent of these stocks were paying any dividend at all. In another study a table shows that of the 20 most popular dividend-paying stocks listed on the New York Stock Exchange for each of the years 1901, 1910, 1917 and 1926, as of December 31, 1936, only 5 of the 59 had maintained the annual rate of dividend each year and only 31 were paying any dividends at all. There are many localities in Canada where once a thriving wooden shipbuilding industry maintained prosperous communities; there was no need for research, they knew their business—they were reasonably prosperous and satisfied, but where the consequences of new developments in steel went unappreciated there now exist ghost towns or the genteel remains of former virile communities.

On the other hand, if in the early twenties the farmers of western Canada had not called in science to take up the long struggle to find a counter measure to the deadly rust disease which was just discernible in the south-east corner of Manitoba, and which many said would never spread northwards, little wheat would be grown in the Prairie Provinces to-day.

The history of technological development in America over the past one hundred and seventy years gives not only an interesting picture of the past but a good indication of what industry must face in the future. The War of Independence was fought nominally for political independence, but after armed hostilities ceased a greater struggle took place in the fight for industrial independence. In the seventeen seventies there was little applied science, the problem was essentially one of learning how to manufacture existing things in factories. The industrial revolution reached England first; America was still an agricultural colony when war broke out and when the importation of manufactured products was cut off a serious situation was created, but a more serious situation arose after the war when her industrial independence was threatened by a flood of manufactured goods from abroad. To meet this situation, societies to improve the mechanic arts were founded and there followed a period of prolific mechanical invention, but it was an age of artisans not scientists. During the Civil War, the United States were again cut off partially at least from outside contacts and, as is always the case in time of war, weaknesses in the national economy became apparent to all. It was suddenly realized that the great strides which had been taken in Europe in technical education and the application of science had been overlooked in America. The answer was the Morrill Act with the result that, in ten years, sixty-six engineering colleges were brought into being and from 1870-1914 there occurred a great period of construction, engineering, and industrial activity where daring and enterprise were at a premium but scientific refinements were not valued highly as resources were apparently unlimited; energy, initiative, and salesmanship paid higher dividends than refined scientific procedures.

Chemists and Physicists in Modern War

The First World War brought severe industrial shocks to America. It became known as a "Chemists' War" because research chemists had to be called in by a frantic country which had just realized that Germany had developed a new industry based on fundamental research in chemistry, the details of which neither Britain nor America knew much about and the products of which were vitally necessary to war. Again there was shown the characteristic energy of the great republic once it appreciates a situation. An intense interest developed in applied scientific research of a more fundamental nature, many large research laboratories grew up and American industry became more scientific. The result has been that while chemical industry is playing as great or even a greater part in the second world war, a well equipped chemical industry with adequate scientific staff and facilities has been able to meet the situation without abnormal difficulties and the public now hears little of chemical problems of war.

To-day, on the other hand, we hear much of this "Physicists' War"; everyone knows that physicists have shown great resource and ingenuity in developing and using weapons of war but there is a deeper significance for it means that, as has been the case in all past wars, we are now acknowledging a fundamental weakness in our former system; we have been unaware of the extent to which fundamental research in physics and mathematics can assist industry and of the many different fields where applications can prove valuable.

From our experience then we know that there has always been a lag between scientific discovery and industrial application. We also know that contacts between scientists, engineers and industrialists have not been intimate in the past. Wars however have always proved to be accelerators and, after every conflict, industry has become more scientific and science has been brought into closer contact with practical affairs. To me it seems to require little vision to realize what lies before industry in the post-war period; the easy expansive days of the past are gone forever, competition will become keener and keener and special training and ability will become relatively more and more important. The many scientists who have been responsible for the development of equipment and tactics which have played such a vital part in this war for survival will not all go back to their laboratories. Either they or their scientific offspring will enter permanently the industrial life of their different countries, and to paraphrase my opening quotation, the nation which does not build its industrial life on science and research will slowly but inevitably tread the path to "stagnation and ultimate bankruptcy."

Pre-War Expenditure on Research

I propose next to present a few figures to indicate the scale of support which was given to research by different countries in pre-war days, but I would like to stress the fact that it is impossible to obtain anything more than approximate figures as there are few official statistics available, and further, the word research is often used loosely to cover routine testing, plant control and similar activities. Notwithstanding this, it is believed that the following figures, taken as they were from reliable sources, represent at least the proper order of magnitude of the expenditures on what can properly be called scientific and industrial research in the countries listed.

that France and Italy were expending relatively little even in comparison with Britain, and that Canada on any proportional basis either of population or of national income was spending not more than one-eighth to one-tenth of what Russia and the United States were allotting to research and probably not more than one-third of Great Britain's expenditure; although Canada's population is one-tenth that of the United States, its research expenditures were only one-hundredth; Great Britain's total expenditure was over ten times Canada's although its population is only four fold.

From an examination of the above facts and from an appraisal of the strengths and effectiveness of the various countries in this conflict, it seems to the writer at least that the relative strength of a country, either in peace or in war, is significantly co-related to the quality of its scientific and industrial research and the quantitative support given to it.

While Canadian industry has an excellent record in war production and has shown skill and competence of a high order in manufacture, I think few would deny that if Canada had been cut off from the complete exchange of scientific and technical knowledge which was available from Great Britain and the United States, our contributions to this war would have been much as they were in the last one—superb front line fighting soldiers and the supply of simpler munitions such as shells and explosives, and our effectiveness as a self-contained, independent fighting nation would have co-related fairly well with our peacetime expenditure on research.

While the scientific developments of our allies even in the initial stages have been available to us in war, who can be sure that in the highly competitive days of peace such an arrangement will be possible. It should

Table of Estimated Expenditures on Research

Country	Date	Annual Exp. on Research in Millions	Exp. Per Capita	Exp. as Per cent of National Income
Russia [3] & [5]	1934	\$300 - \$500	\$1.80 - \$3.00	0.8% - 1% [4]
U.S. [4]	1935	\$300	\$2.40	0.5% - 0.6%
G. Britain [4]	1934	\$ 30	\$0.70	0.15%
Canada [6]	1938	\$2.4 - \$3.3	\$0.22 - \$0.29	0.06% - 0.08%

Even approximate figures for Germany, Japan, France and Italy are difficult to get for the corresponding periods but it is safe to assume the expenditures in Germany approximated those of the United States and that she was still leading in organized research. Of Japan, Bernal [4] says: "Industrial and Government laboratories and institutes in Japan are probably larger, better financed and organized in relation to the wealth of the community than in any other part of the world." Up until 1934 at least the expenditure on research in France was small, probably less than one-half of Britain's. In Italy under fascism science has remained on a level relatively much lower than that of Britain. While it must be recognized that the above figures cannot be used for drawing close comparisons, and while it should also be remembered that the ultimate value of research will be measured in terms of effectiveness and efficiency as well as total expenditure, nevertheless it is a sound deduction that Russia, Germany, the United States and Japan were all devoting relatively large amounts of their pre-war income to research, that Great Britain was far behind quantitatively, although it is known the quality was very high,

not be necessary to remind a technical audience of the difficulties of entering a highly scientific industrial field in competition with rivals who have years of research and development experience behind them; Germany by her initial headstart in the field of synthetic chemical industry based on fundamental scientific research almost defeated Great Britain and the United States in 1914-18 because they had never been able to recover the ground lost by early neglect of a scientific discovery made, as is so ironically the case, in England by an Englishman.

Turning again to the figures quoted a breakdown of the expenditure brings out another fact interesting to Canadians. In Russia, of course, all research establishments are government supported and controlled. In Japan, of the sixty-nine research institutes which were in operation in 1926, twenty-four were supported by private industry. In Great Britain, in 1934, industry was responsible for about 33 per cent of the total expenditures, while in Canada only from 5 to 7 per cent of the relatively meagre total expenditure on research was made by private industry. I suggest that from all these figures, approximate as they admittedly are, it is impossible to escape the conclusions that Canada as a whole must increase greatly her support of scientific research if she wishes to maintain her position in the future as a strong independent industrial country, and further that Canadian industry if it wishes to maintain the system of free, private enterprise which it advocates must not neglect its opportunity to engage in research where individual initiative and enterprise find their greatest rewards.

Suggested Post-War Policy for Canada

A word now as to the scale of research expenditures which might be regarded as reasonable in the post-war period. I will quote once more from the Committee report of the Federation of British Industry ①.

"We are of the opinion that if one per cent of the total value of our industrial production were expended on research and development involving the provision of personnel and facilities, the resulting increased efficiency and employment capacity would yield an annual return of many times such expenditure." Another responsible British body, the Parliamentary and Scientific Committee of the Houses of Parliament, in a report just printed ⑤, in discussing the future of research in Britain says, "We should certainly look forward to spending at least ten times as much annually after the war if we are to provide the basis without which neither our agriculture nor industry can effectively meet the needs of the future."

Translated into Canadian terms this would mean the annual expenditure of perhaps $50,000,000 to $65,000,000 per year or from fifteen to twenty times our pre-war rate. Naturally, these figures now appear large but how would our national budget of 1943-44 have appeared to the Finance minister of 1938, to say nothing of his predecessor of 1914? No one with a knowledge of the facts would suggest that the above scale of expenditures should or could be made within the immediate future in Canada as, even if the money were readily available, we could not find sufficient scientifically trained personnel in Canada to undertake the necessary work. At the present moment, speaking generally, it can be said that practically all available research personnel are now so engaged and the annual expenditure on research in Canada is certainly not greater than $10,000,000 or about one-fifth to one-sixth of the above mentioned totals.

I do suggest however, as a practical and feasible proposal, that Canada should maintain in the immediate post-war years her present overall scale of expenditure on research and look forward to increasing this year by year to the above figures as trained personnel become available. Nothing less should be considered. To those who suggest we cannot afford to make such expenditures, my answer is that on the contrary we cannot afford not to do so. As an example of the value of research, the British Parliamentary and Scientific Committee ⑤ shows that from the £440,000 spent by the Department of Scientific and Industrial Research in direct support of industrial research projects in the pre-war years an estimated annual saving direct and indirect to industry of £3,250,000 was obtained or a return of eight hundred per cent per annum on the capital spent and Canada cannot afford to overlook investments of that order.

A Comprehensive Plan Needed

Finally I wish to outline in general terms how I think industrial research in Canada should be developed, what immediate steps should be taken and the type of broad chart which should be followed.

As a basic axiom it must be recognized that applied research is founded on fundamental or pure research. The national research structure must be strongly linked vertically from the originating of new ideas to the practical application through industry for the benefit of humanity at large. Pure research is the capital, and application, the return. No country or person can progress or live long on its capital alone or, even worse, on borrowed capital. The first step, therefore, is to see to it that scientific research in our universities is strengthened and extended, as it is from our universities that was derived what scientific strength Canada has; and the future of industrial research in Canada, and indeed industry itself, will depend ultimately on the output of our universities in scientific research and personnel.

A second axiom is that the national research structure in Canada must be built from the co-related contributions of universities, governments, and private industry, linked together informally, it is true, but nevertheless firmly and effectively by vertical ties of goodwill, understanding and mutual benefit. The next step, therefore, which I suggest can be taken almost immediately is to make sure that the substantial corps of scientific and technical workers, brought together by government agencies for important war research, is not disbanded at the end of hostilities, but retained by the Dominion Government who should also enlarge the present facilities and construct other needed laboratories so that the second unit of our national structure will be strong and adequate in the immediate post-war period.

The government laboratories should be applied in outlook but operated on a high scientific plane, and problems should be attacked from a broad fundamental point of view. In this group should be found laboratories specializing in all the sciences such as chemistry, physics, biology, aeronautics, metallurgy, forestry, agricultural sciences, fisheries, and the many fields of engineering; such laboratories as we have at present at the National Research Council and the Departments of Agriculture, Mines and Resources, and Fisheries. All such units should be tied closely together horizontally as nearly every major research project involves the close co-operation of several sciences and the day has passed when progress can be made by the isolated efforts of detached sciences or laboratories. In addition, there is need for special institutes or groups dealing with special activities such as building research, road research, cold weather problems, industrial utilization of agricultural crops, and a host of others.

The third unit in the research structure should consist of the numerous laboratories, small and large, which are needed to deal with the immediate problems of individual industries. The need for this block in Canada is very great and apart from several outstanding exceptions there is, as has already been indicated, an appalling lack of real research work supported directly either by individual companies or associations of allied industries.

Building up this part of the structure will take time and I do not suggest that every industry or even a majority should immediately lay down plans for large research establishments. I do suggest however that "every industry should take stock of its position to ensure that it is devoting to research and development the maximum effort and funds commensurate with the nature of its problems" ①, and I also seriously suggest that at least every major industry should have competent scientists in its employ who would carry no

(*Continued on page 149*)

MANAGEMENT'S NEED OF BROADER VISION

WILLIAM L. BATT, HON.M.E.I.C.

Vice-chairman of the War Production Board and United States member on the Combined Raw Materials Board and Combined Production and Resources Board, Washington, D.C.; President, SKF Industries Inc., Philadelphia, Pa.

A luncheon address delivered at the Fifty-Eighth Annual General Professional Meeting of The Engineering Institute of Canada, at Quebec, on February 11th, 1944.

In a letter which I received only a few days ago from a young American soldier serving in the United States Army abroad, there was this paragraph which so impressed me as to suggest a subject for my talk to you to-day. I shall give it to you just as it was in his letter:

"One has such hopes that after the war one can settle down to a brave new world, replete with opportunities for useful work in an atmosphere of unity and reconstruction. But this bitterness and strife back home is not a harbinger of an era of good feeling, such as I'd hoped we might come to as a heritage from the internal unity engendered by the war abroad."

A brave new world, replete with opportunities for useful work, coming as a heritage from unity brought about by the war, what a challenge that is from the young men of the generation whose lives must now be risked to repair a world which we older ones have had in our care; young men who are fighting for their lives in the hope that the world in which they will live shall be a better world, and troubled because we seem to have failed somehow in finding a formula for the same unity in peacetime life which is so conspicuously marking our joint operations in producing wartime goods.

AMERICAN-CANADIAN UNITY

As I, an American, have the honor of addressing a distinguished Canadian audience, the thought of unity between the two countries particularly impresses itself on my mind. And speaking as an American, with a little experience in international wartime affairs, I can assess the unity between us with some authority and with a good deal of satisfaction.

Our national engineering organizations have found themselves so much at home with their Canadian members and in Canada that there has never been a feeling of a separateness on either side. Meetings have been held interchangeably on each side of the border; papers and written records have flowed as freely as they have flowed between the members in the different States of our Union. Your gracious act in conferring honorary membership on me, was, I am well aware, not alone a personal thing, but more truly a recognition of the group with which I have long been associated, The American Society of Mechanical Engineers. I feel sure that this was your way of saying that there was a fellowship and intimacy between these national groups of engineers which made you feel toward us as if we were your own. I have gratefully accepted the high honor which you have conferred on me with that broader understanding, and at the same time, with a tremendous personal pride.

There has been real unity between your country and mine in the conduct of the war. The savage onslaught against which we so vigorously defended ourselves bound us much more firmly together than ever before. First to the defense and, now, on the aggressive, both of us are giving sons and husbands and brothers and daughters to a common cause to march side by side against a common enemy. Both of us have geared our industrial machines to total war. Both of us have been forced to scramble desperately for the critical raw materials of war. How well we have succeeded in our joint effort is just now thoroughly clear to the world! It is taking effective and dramatic form with planes and shells and bombs and tanks in large supply, at the right place, at the right time.

It is beginning to become clear to the world that the United Nations have—and may I use a hockey term particularly familiar to you here in Canada—that we have stopped back-checking, that we are over the blue line with the puck firmly in our grasp, it is being passed back and forth between wing and center as we head toward the Axis net and the winning score.

THE WAR ISN'T OVER

It hasn't been easy. It never is easy to change overnight a democracy used to doing things on the basis of individual enterprise into an industrial machine geared for total war, but it has been pretty well done. Our job on the home front isn't finished by a good deal, let me emphasize that. Desperate battles lie ahead of us. Sad and cruel losses are likely yet to face us. Heavy demands for munitions of all kinds will come and many of them unexpectedly. This is no time for the American or Canadian people to let down in their efforts or to permit their satisfaction with the job they have done, to blind them to the size of the job yet to be done. We on the home front should not dare to go to sleep in the midst of battle any more than a soldier in uniform in the front line. The man in uniform has been turned from a civilian into a soldier with a respect not only for his own life, but for that of his teammates; Canada and the United States have found that same respect, and fight together and for each other.

I mentioned a moment ago the close co-operation which had welded Canada and the United States into one strong fighting instrument. The story has been frequently told, but let me touch on some phases of it again.

CO-OPERATION FOR PRODUCTION

You all know well the foundation stone of our joint endeavors in this war; the meeting at Ogdensburg in August, 1940, between your prime minister and our president which led to the establishment of the permanent Joint Board on Defense. But let me draw your attention especially to that Sunday a few months later, on April 20, 1941, when they sat down together at Hyde Park. The war clouds were darkening over our country and it was clear that we needed more intimate machinery for co-operation with you, our neighbor already in the war, if our defenses were to be organized to the best advantage. Out of those conversations came a formal statement of agreement in general terms, under which the productive facilities of the United States and Canada would be used for both local hemisphere defense and for assisting the democracies at war. It is known now as the Hyde Park Declaration. Here is the meat of that Declaration:

"It was agreed that as a general principle in mobilizing the resources of this Continent, each country should provide the other with defense articles which it is best able to produce and above all, to produce quickly . . . and the production programs should be co-ordinated to that end."

Certainly this was a comprehensive statement. It covered the ground in broad terms, yet was precise enough in meaning. But it was only a statement. That declaration had to be followed up in action, and it was.

One of the first organized bodies to be created was the Joint Economic Committee through which our common economic problems were immediately subjected to review.

Sometime before that, the Joint Materials Coordinating Committee, with two Canadian and two United States representatives, had been set up to provide a table around which the men in charge of the materials of the two Nations could meet and discuss and solve their common problems. I believe you Canadians will agree that this has been a most gratifying operation. History may well make out of it a fascinating story of how two nations working toward a common goal can accomplish great things.

A little later the Joint War Production Committee was created with the task of surveying and co-ordinating our joint munitions capacity, figuring out ways to specialize the war economies of the two countries in such a way that each country could concentrate on the things it could make best for the common good.

One of the first significant accomplishments of this group was the elimination of tariff barriers to permit the free flow of munitions and materials of war back and forth across the border. Still later on, you joined the Combined Production and Resources Board so that the production efforts of the three countries, Great Britain, Canada, and the United States, might be effectively harnessed together. That, too, has been a significant operation in developing international unity.

PRACTICAL NEIGHBORLINESS

There have been numerous other steps which we have taken in concert which I shall not take the time to talk about. I mention these more conspicuous partnership experiences in the feeling that they are what you are more particularly interested in and because they are typical of the steadily growing intimacy between the Canadian and the American people. Here, as nowhere else, perhaps, the world is seeing the good neighbor policy function in as nearly an ideal form as it is practicable to expect anywhere. It is, in some part, an answer to the demand of the young soldier with which I prefaced this address, for it is a useful demonstration for the whole world. Between us, every form of international problem is involved. There are long boundary lines—longer I think than those between any other two countries in the world, except perhaps between China and Russia—boundary lines full of provoking possibilities. There is competitive industry and competitive agriculture. There are constantly present all those factors which could readily create an atmosphere of friction and disagreement and distrust.

It is to the everlasting credit of your people and ours that both have so positively indicated to the world their determination to be friendly neighbors. Not alone by formal treaties or by declarations of high-sounding phrase has this been brought about, but rather is it the obvious outcome of a steadily growing recognition by both of us that the things we have in common are so infinitely more important than the few and insignificant things about which we might occasionally differ. There has been a great satisfaction to both of us, I think, in the fact that we have been able to live separate and independent lives alongside each other, and yet to associate intimately when we chose. Like neighbors who drop in on each other without knocking—lend an egg, or a cup of sugar, or the family lawn mower—who come over when illness and death are present and do those friendly things which need to be done with no other thought than to help. These homely measures of the good neighbor, you and I know. They never exist through law or statute; they grow only in the soil of friendly understanding.

You may properly begin to wonder when I shall make some reference to the text of my talk to you today—"Management's Need of Broader Vision." This particular title, as you may have surmised, was prompted again by that letter with which I opened my remarks—"One has such hopes that after the war one can settle down to a brave new world replete with opportunities for useful work in an atmosphere of unity and reconstruction." I have tried to lay the foundation for approach to this challenging responsibility by developing a bird's eye picture of the unity which already exists between those of us occupying a good part of the territory of North America. And I ventured to imply that the atmosphere of confidence and joint approach which so surely exists here is one which we would hope might steadily grow over the rest of the world.

The statesmanship of post-war management is likely to be challenged as never before. The problems which were encountered as we moved into war were difficult to be sure, but their solution was easier because all of us were bound together by great emotions, by fear, by patriotism, and by intelligence. The problems to be met when the war has been won, are so infinitely more difficult because at least the emotion of fear, which ties people together with bonds of unselfish sacrifice is not there. That more dangerous enemy, selfishness, again begins to rear its ugly head. Narrow group interest, labor conflicts, fear of government, fear of business, all of these unhappy and defeatist emotions, threaten to swing into action, and undo the very victory for which such a heavy price will have been paid.

STATESMANSHIP IN MANAGEMENT AND LABOR

Much is being written day by day as to the relations between labor and management. Whatever disappointment may be felt when disagreement between them delays needed production, there can be no denying the fact that they have come much closer together in the last ten years than in any similar period. I am now speaking, of course, of the conditions on this continent. There are many who have been disappointed that this movement hasn't proceeded at a faster pace; I am one of those. But perhaps it is just as well not to be too impatient. Sound labor leadership can only grow about so fast, and without sound leadership there cannot be any wide-spread acceptance by management of the principle of unionization. Perhaps the greater fault lies with management, in that it has not given fully of itself to lighten the growing pains of labor. Advice given years ago—such as a wise father might give to a wilful, but intelligent, son—might have made for a far better and understanding relationship between management and labor.

Looking at the problem broadly, I should think that management must assume a good deal of responsibility for the quality of union leadership. Good management, while not guaranteeing good leadership, will certainly tend to insure a better quality. Poor management or antagonistic management is almost sure to result in poor union leadership. Put another way, statesmanship in management has some reasonable assurance of producing statesmanship in the field of labor. I look to this friendlier understanding for valuable by-products of national safety. When leaders from these two great groups of the economy know each other better, call each other by their first names, even if they don't agree on specific matters, as frequently they won't, there is nevertheless provided a certain safety-valve of great significance to the social security of the country.

Sooner or later, labor leaders and management leaders must come to recognize that their interests are common. Labor learns that the bosses are human beings and not so bad after all; with a more informed point of view, they can see that their demands have to lie inside a safe limit if they are not to kill the goose that lays the golden egg.

Management, too, when it approaches the conference table with an open mind, finds that there are some fine labor leaders and is frequently surprised at their reasonableness when they have all the facts. This sort of approach, while bound to be disappointing at times to both sides, is the only approach that will pay dividends.

One of the great problems of the post-war period is to find some formula for enabling those who want to work as continuously and profitably in producing things for peace as they did in producing things for war. An opportunity to work, an opportunity to earn more in return for effort and initiative, some reasonable security—these are the things which labor wants. It is important to note that they are likewise the things which capital wants. How to find them for both is the challenge which is put before management, and labor and government. No one of these can solve it alone.

One day very recently I rode all day through my home State of Pennsylvania from East to West. It was a familiar picture, one of great inspiration. Here is a record of a century and a half of aggressive enterprise; enterprise which has steadily produced better and cheaper goods in ever larger volume. It was this sort of enterprise which built the United States. It produced good returns for capital; it made jobs in great number, and it contributed substantially to the steady enlargement of the standard of living of our people. As one looks at some of our industrial centers one cannot but feel that in some way or other, this period should have produced a better standard of living for many of our people. The living conditions around many of our large industrial centers leave too much to be desired, the things that in peacetime men may be justified, and I emphasize in peacetime, may be justified in striking for.

FREEDOM FOR LABOR AND ENCOURAGEMENT FOR CAPITAL

But just as I am convinced that the challenge of the future for maximum employment can't be met without freedom for labor, so I am convinced that there must be encouragement for capital. It will almost surely be an impossibility to put to peaceful work and to keep at work these millions now engaged in the conduct of the war without a much more favorable atmosphere for business. In an atmosphere of restriction, scarcity and disagreement, capital cannot be expected to take risks; but nevertheless, if the future of America is again to be one of expansion, as I think it must, capital must be encouraged to take risks and, what is fundamental, be compensated accordingly for its success. It is vital that once again we see new enterprise springing up to make new things, to buy materials, to spend money, and thus provide new labor opportunity.

One of the obstacles that has harassed us in the last few years, on our side of the line, is the too frequent and mutual suspicion between some business leadership and some government. Neither has had adequate confidence in the other and the result has been an atmosphere of criticism and distrust. Many of our influential business heads are honestly convinced that the country can't be prosperous, and men and capital profitably employed, unless government retires to the side-lines. On the other side, too many people in important places in government have been unfairly suspicious of the motives and practices of business management. To attempt to discuss these controversial questions, so full of emotional difference, would take more time than I have to-day; I must merely observe the vital necessity for reasonable agreement between these influential forces, business and government. No more can they be fighting each other like Kilkenny cats, than can business and labor or labor and agriculture.

GOOD INTERNATIONAL ECONOMIC RELATIONSHIP IS ESSENTIAL

Out of a more general national unity, where the interest of all the people as well as those of the few, may be fairly considered, should come a larger acceptance of the need for encouraging the maximum of trade abroad as well as at home. It has long been my conviction that the United States could not do its part in guaranteeing the peace of the world merely by paying its share of the cost of maintaining an Army and a Navy—however strong that military force might be. A surer contribution to long-range peace is to be found through sound international economic relationships. We, and of course I am now speaking for the United States, must seek every possibility of enlarging our foreign import trade rather than merely strengthening our gold reserve; we must buy more and more goods as well as sell more and more goods.

The last, of course, is easy. We can take it for granted that a substantial part of Europe's factories, her machine tools, her power plants, her transportation equipment, and so on at much length, will have to be replaced because they have been destroyed. All of those things we shall be able to manufacture, and indeed of many of them, we shall have a considerable surplus. So there is no question as to finding customers abroad who will want to buy large amounts of our domestic production.

But for the United States, any program which seems to lay emphasis on increasing imports, is certain to be viewed with suspicion by many of our citizens. And yet the basis for sound world commerce must rest on the broad principle of goods for goods and this is a lesson which too many of my fellow-citizens have yet to learn.

However, unless the United States, and Canada to the extent to which it applies, shall increasingly contribute to better world citizenship through steadily enlarging and easier trade relationships, I find great difficulty in seeing a long, continuing world peace. This is not free trade, but it is intelligent trade.

The sort of unity of thought and action that has characterized the relations between your country and mine, will, I have hope, enable our people regularly to find answers to any annoying and vexatious differences which may arise, before they become troublesome issues between our governments.

This is the kind of relationship one might hope may more and more frequently appeal to the whole world as desirable and practicable.

(*Continued on page 145*)

A NOTE ON A NEW FORM OF THE THREE-MOMENT EQUATION

I. F. MORRISON, M.E.I.C.
Professor of Applied Mechanics, University of Alberta, Edmonton.

INTRODUCTION

From time to time one comes across new forms for the three-moment equation. In what follows, the three-moment equation is derived by a simple process using moment surfaces and is finally put into a form in which the fixed-end moments of each span appear. This form is more simple than that usually given and, therefore, may be more easily remembered and easily applied. Therein, if anywhere, lies its value.

THE METHOD OF M-SURFACES

The equation for the displacement at any point in a framed structure derived from the fundamental principle of virtual work may be written in the following form:

$$\delta_m = \sum\left[\int\frac{\overline{N}Nds}{EA} + \int\frac{\overline{M}Mds}{EI} + \int\frac{\overline{V}Vds}{GAK}\right] + \epsilon\sum\left[\int\overline{N}tds + \int\overline{M}\frac{\Delta t}{h}ds\right]$$

Of the terms in the above equation, the first three have to do with the thrust, moment and shear respectively, on the various members of the frame. The remaining two are concerned with the changes in temperature. In what follows, the temperature of the structure will be assumed to remain constant, and thus the last two terms will disappear. In addition, experience shows that the first and third terms are usually numerically small as compared with the second and, therefore, as an approximation, they are often neglected in analyses of this sort. There is left, then, only one term and the equation becomes reduced to

$$\delta_m = \sum\int\frac{\overline{M}Mds}{EI}$$

in which the summation sign indicates that all of the members must be considered. The bending moments along the axes of the members are indicated by $\overline{M}$ and M.

The $\overline{M}$ is due to a unit load, or to a unit couple, applied at the point at which the displacement, δ_m, is to be found. If a unit load be applied at the point m, the displacement will be linear; if a unit couple, it will be angular, i.e., a change of position and a change of angle, respectively. The M is produced by the actual loads arranged in any manner along the members.

If the members be straight, as we shall assume, then ds may be replaced by dx and the integration may be carried out starting from any point but passing over the whole length of each member for each term of the sum.

If the bending moment curves be plotted for each member, the resulting surfaces are called M-surfaces or areas—sometimes moment-areas. The $\overline{\text{M}}$-surfaces are usually trapezoids, with the rectangle and triangle as special cases. The M-surfaces are usually irregular polygons or are bounded by curves such as parabolic arcs.

Figure 1 (a) shows the $\overline{\text{M}}$-surface for a portion of a member between two points a and b. At any point, x distance from a, the bending moment $\overline{M}$ will be

$$\overline{M} = \frac{x'}{l}\overline{M}_a + \frac{x}{l}\overline{M}_b$$

The M-surface is shown in Fig. 1 (b). By substituting for $\overline{M}$, the integral becomes broken up into two parts, thus:

$$EI\delta_m = \int_a^b \overline{M}Mdx = \frac{\overline{M}_a}{l}\int_b^a Mx'dx' + \frac{\overline{M}_b}{l}\int_a^b Mxdx,$$

in which EI has been assumed constant over the range of integration.

The integrals are now seen to be the statical moments of the M-surface about the lines bb′ and aa′ respectively. If one puts

$$\int_b^a Mx'dx' = S_b \quad and \quad \int_a^b Mxdx = S_a$$

then

$$EI\delta_m = \frac{\overline{M}_a}{l}S_b + \frac{\overline{M}_b}{l}S_a \qquad (1)$$

If the area of the M-surface be A and the distances to the centre of gravity from a and b, x_o and x'_o respectively then

$$EI\delta_m = \left(\frac{\overline{M}_a}{l}x'_o + \frac{\overline{M}_b}{l}x_o\right)A \qquad (2)$$

This is the well-known moment-area theorem.

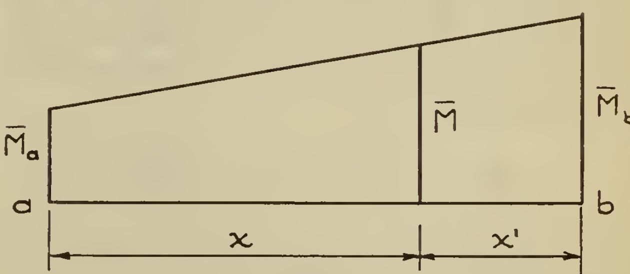


Fig. 1a

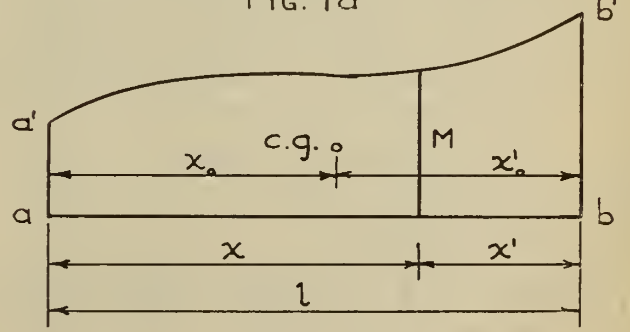


Fig. 1b

THE THREE-MOMENT EQUATION

Figure 2 (a) shows two contiguous spans of a continuous girder having constant values of EI in each span. At each support there is a negative bending

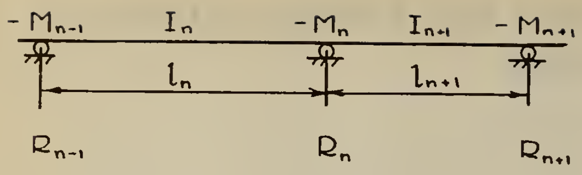


FIG. 2a

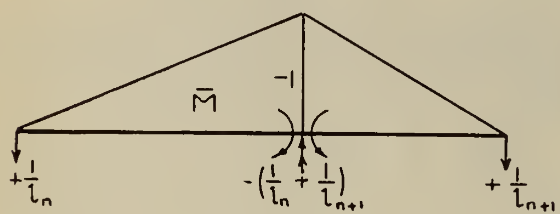


FIG. 2b

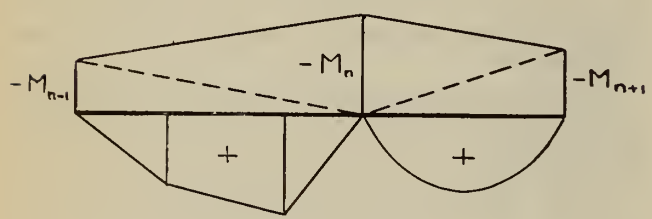


FIG. 2c

moment M_{n-1}, M_n, M_{n+1}, a reaction, positive upwards, R_{n-1}, R_n, R_{n+1}, and a deflection δ_{n-1}, δ_n, δ_{n+1}, assumed positive downward. The loads, not shown in the sketch, are assumed all vertically downward.

Figures 2 (b) and 2 (c) show the $\overline{M}$-surface and the M-surface respectively. The $\overline{M}$-surface is due to a unit couple of -1 ft. lb. applied at sections n to each span considered as simply supported. The M-surface is shown in two parts; that produced by the negative bending moments M_{n-1}, M_n, M_{n+1} and that produced by the actual loading acting on each span as simply supported.

The work equation is

$$\frac{\delta_{n-1}}{l_n} - \delta_n\left(\frac{1}{l_n}+\frac{1}{l_{n+1}}\right) + \frac{\delta_{n+1}}{l_{n+1}} + \sum\int\frac{\overline{M}Mdx}{EI} = 0$$

in which the last term represents the work done by the unit couple due to the change of angle produced at the ends of the two simple spans at section n by the actual loading. In order to evaluate the integrals, one uses the method outlined above. The trapezoidal portions of the M-surface can be divided into triangles as indicated by the dashed lines. For the n span

$\overline{M}_a = 0$, $\overline{M}_b = -1$, and the (n+1) span

$\overline{M}_a = -1$, $\overline{M}_b = 0$.

Then, using equation (2),

$$\int_0^{l_n}\frac{\overline{M}Mdx}{EI_n} = \frac{1}{EI_n}\left(-\frac{1}{l_n}\left(\frac{-M_{n-1}l_n}{2}\cdot\frac{l_n}{3} - \frac{M_n l_n}{2}\cdot\frac{2}{3}l_n\right)\right)$$

and

$$\int_0^{l_{n+1}}\frac{\overline{M}Mdx}{EI_{n+1}} = \frac{1}{EI_{n+1}}\left(-\frac{1}{l_{n+1}}\left(-\frac{M_{n+1}l_{n+1}}{2}\cdot\frac{l_{n+1}}{3} - \frac{M_n l_{n+1}}{2}\cdot\frac{2}{3}l_{n+1}\right)\right)$$

For the other portion of the M-surface, equation (1) is used.

$$\int_0^{l_n}\frac{\overline{M}Mdx}{EI_n} = -\frac{S_{n-1,n}}{EI_n l_n}$$

$$\int_0^{l_{n+1}}\frac{\overline{M}Mdx}{EI_{n+1}} = -\frac{S_{n,n+1}}{EI_{n+1}l_{n+1}}$$

Combining these results and simplifying the equations, there results

$$6\,E\left[\frac{\delta_{n-1}}{l_n} - \delta_n\left(\frac{1}{l_n}+\frac{1}{l_{n+1}}\right) + \frac{\delta_{n+1}}{l_{n+1}}\right]$$
$$+ M_{n-1}\,l'_n + 2M_n\,(l'_n + l'_{n+1}) + M_{n+1}\,l'_{n+1} = + \frac{6\,S_{n-1,n}}{l_n\,I_n} + \frac{6\,S_{n,n+1}}{l_{n+1}\,I_{n+1}} \quad (3)$$

in which $l' = \frac{l}{I}$. This is Clapeyron's three-moment equation, which is, of course, quite well known and which can be found in most texts on the theory of structures in special or curtailed form.

INTRODUCTION OF FIXED-END MOMENTS

In order to deal with the last two terms, which are not in convenient form, one can transform them into terms of fixed-end moments. Fixed-end moments are becoming no longer novel due to the necessity of computing them in the application of the moment distribution method and formulas for them are given in a number of books thus making them readily accessible. There are, for example, a number of cases given in the American Institute of Steel Construction (A.I.S.C.) Handbook.

Figure 3 (a) shows a beam having fixed ends and loaded with any arrangement of vertical loads. The

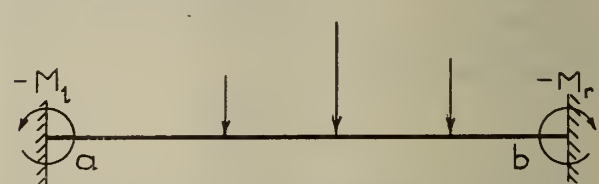


FIG. 3a

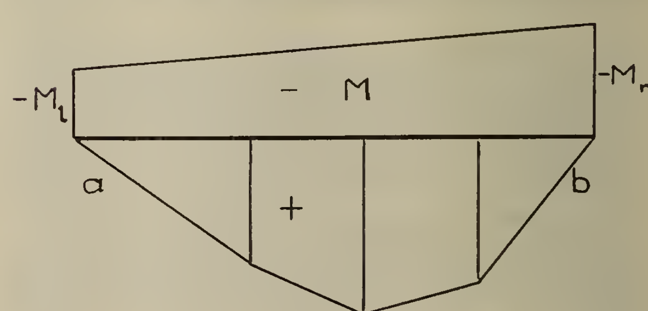


FIG. 3b

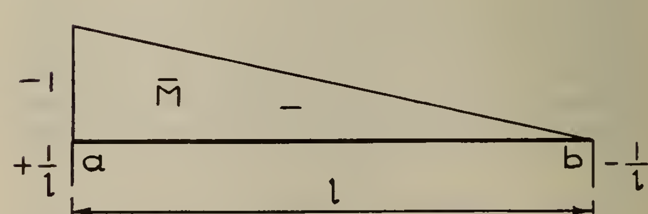


FIG. 3c

FIG. 4a

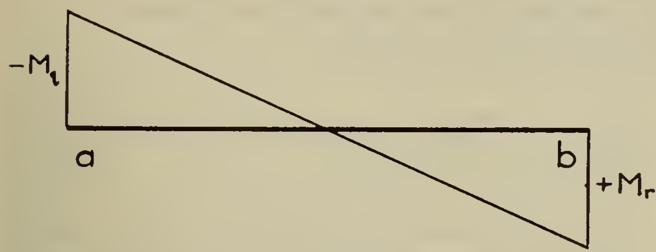


FIG. 4b

bending moments at the fixed ends are indicated by M_l and M_r. Figures 3 (b) and 3 (c) show the M-surface and the $\overline{\text{M}}$-surface respectively. Applying the conditions that there shall be no rotation and no deflection at each fixed end,

$$E\,I\,\delta_a = \frac{l}{6}(2M_l + M_r) - \frac{S_b}{l} = 0$$

$$E\,I\,\delta_b = \frac{l}{6}(M_l + 2M_r) - \frac{S_a}{l} = 0$$

from which

$$S_b = \frac{l^2}{6}(2M_l + M_r)$$

$$S_a = \frac{l^2}{6}(M_l + 2M_r).$$

The S_a and S_b are the same as $S_{n-1,n}$ and the $S_{n,n+1}$ of equation (3), because if the three-moment equation had been applied the same equations would have been obtained.

If there be a relative vertical displacement of the ends of the beam as shown in Fig. 4 (a), the fixed-end moments may be computed by the same methods as used above. Thus

$$-M_l = +M_r = \frac{6\,EI\,\delta}{l^2}$$

from which

$$\delta = -\frac{M_l l^2}{6\,EI} = +\frac{M_r l^2}{6\,EI}$$

Collecting the above results and substituting in equation (3), the three-moment equation now becomes, with the appropriate changes in notation,

$$M_{n-1}\,l'_n + 2M_n\,(l'_n + l'_{n+1}) + M_{n+1}\,l'_{n+1} = (M_{r,n-1} + 2M_{l,n})\,l'_n + (2M_{r,n} + M_{l,n+1})\,l'_{n+1}$$

in which $M_{r,n-1}$, etc., are the fixed-end moments arising from the actual loads and relative displacements of the supports, taken in pairs, for each span. The right-hand side of the equation is easily evaluated in terms of the fixed-end moments and the whole equation can be easily memorized. The form of the equation should be noted, for the two sides are very much alike. In this way, a set of three-term simultaneous linear equations with the bending moments at the supports of the continuous girder as unknowns are obtained. The solution of these equations is quite easy and has been discussed in detail in a previous paper.*

ILLUSTRATIVE EXAMPLE

A simple numerical example will suffice. Figure 5 shows a continuous girder having two spans. The data as regards loading, etc., are shown on the figure. In addition, relative to support A, support B sinks 1.0 in. and support C, 0.5 in. From the A.I.S.C. Handbook the fixed-end moment for the loadings contained in the example are

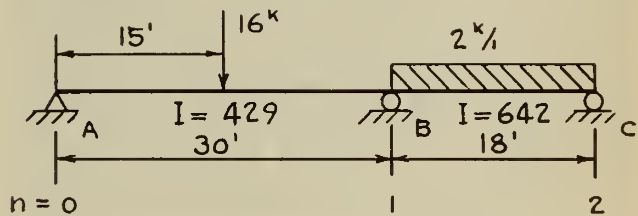


FIG. 5

$$M_{l,1} = -\frac{16}{8}.30 = -60 \text{ ft. kips} = M_{r,0}$$

$$M_{r,1} = -\frac{36}{12}.18 = -54 \text{ ft. kips} = M_{l,2}$$

To these must be added the fixed-end moments due to the sinking of the supports. Taking E = 30,000 kips per sq. in.

$M_{l,1} = \frac{6 \times 30{,}000 \times 429}{30^2 \times 12^2 \times 12} \times 1.0 = +49.7$ ft. kips, $M_{r,0} = -49.7$ ft. kips

$M_{r,1} = \frac{6 \times 30{,}000 \times 642}{18^2 \times 12^2 \times 12} \times 0.5 = +103.2$ ft. kips, $M_{l,2} = -103.2$ ft. kips

The three-moment equation becomes

$$2M_1\left(\frac{30}{429} + \frac{18}{642}\right) = (-109.7 - 20.6)\frac{30}{429} + (98.4 - 157.2)\frac{18}{642}$$ and $M_1 = -54.9$ ft. kips

The Engineering Journal, August 1941.

MANAGEMENT'S NEED OF BROADER VISION (*Continued from page 142*)

PRE-WAR STANDARDS ARE NOT GOOD ENOUGH

These vitally important days of the future confront us with problems of such profound gravity—questions that challenge the very existence of our democratic principles, as to demand our united effort toward their solution. Not much longer, my friends, can we afford this luxury of labor fighting business, of business damning government, of agriculture doubting all three, of sectional group against sectional group in complete disregard of the national interest. These grave issues cannot find their solution by that divided route.

For the old United States—I would assume, too, the old Canada—isn't good enough to suit the critical citizen of tomorrow. To propose to him—to the young soldier who provides the theme for my talk—merely to go back to pre-war national income, to pre-war employment, to pre-war standards of living is not enough.

He will insist on a much larger national income, higher average earnings, greater security, more goods for more people at lower prices: in other words, a better living in a better world. If you and I can't produce it, he will try to find those who can. Only in an atmosphere, peaceful, constructive, and co-operative, can these possibilities for the future which my young military correspondent hoped for, be brought about. Statesmanlike management can do much to bring that about, and it is to such a vision for management on your side and mine, that I appeal to-day.

SOCIAL SECURITY PLANNING IN THE ENGLISH-SPEAKING WORLD

MAURICE STACK
Advisor on Social Insurance, International Labour Office, Montreal.

Paper presented at the Fifty-Eighth Annual General Professional Meeting of The Engineering Institute of Canada, at Quebec, on February 11th, 1944

WHAT IS SOCIAL SECURITY?

Social security symbolises a great part of that hope of a world fit for the common man to live in which inspires the United Nations in the present struggle and which is given expression in the Atlantic Charter.

Social security means, above all, no return to the mass unemployment of the Thirties. Unemployment, however, is but one of the causes of undeserved economic distress, and perhaps not the most tragic for the individual. There is also the plight of the indigent aged and disabled, and of destitute widows and children. To these must be added sickness, which, in a working lifetime, may spell just as much loss of earnings as unemployment. Social security comes to mean, then, the guarantee of an income in all those common contingencies in which a worker, through no fault of his own, is deprived of his livelihood by inability to work or to obtain work.

But social security is as much a remedial as it is a palliative programme. It must be: otherwise it would be overwhelmingly costly. It must be because idleness and ill health are evils in themselves that no cash payment can cancel. In a worthwhile world, we must be waging war all the time against these causes of impoverishment.

So, in any comprehensive social security system, we must have, besides income security, medical services and employment services. Social security is then a tripod of which one support is maintenance when unable to work or to obtain it, another is medical care when unable to work, and the third, placement when out of a job. This tripod, however, cannot stand firm on rotten or shifting ground, although it does possess a good deal of inherent stability under stress or shock.

The philosophy of social security recognises, first, that we have evils present that we must deal with now adequately and justly, and second, that we have to attack these evils at their source in unsound sanitary and economic environments. The ground on which the tripod stands must be consolidated.

The medical professions demand that proper nutrition and housing be provided as the primary conditions for a successful health policy. The employment services in turn demand, on the one hand, some degree of stability and constancy of policy in industry, and, on the other hand, adequate schooling and vocational training as postulates for an effective employment policy. Thus social security calls for a modification of the social and economic system, a reshaping of it so as to cause the least waste and suffering that is compatible with the conservation of essential freedoms. In countries other than the Soviet Union, the exponents of social security have no desire to destroy the capitalist system: they regard the spirit of enterprise, which can only flourish under that system, as indispensable for economic progress. But they do desire that the system be humanely operated, and endowed with sufficient stability for the social security services to be able to cope with the disorder that necessarily accompanies any manifestation of spontaneous competitive development.

EXISTING PLANS

Of the eight countries of the world in which English is an official language, six have social security plans in different stages of advancement or application: they are the United States, Great Britain, Australia, Canada, New Zealand and South Africa. The remaining two are India, where a National Conference of trade unions, employers and government representatives has recently recommended the active consideration of social security problems, and Eire, where a government bill has just been introduced to provide children's allowances.

Some of these plans are on paper, some are in process of realization, and one is fully applied. Thus, Britain has its Beveridge Plan, of which the Government is about to issue a new and, as we hope, not too chastened edition. In the United States, the Administration has a very fine measure pending in Congress, namely: the Wagner-Murray-Dingell Bill, but no one would like to prophesy its fate. In Canada you have at the moment the Heagerty Bill for health insurance, and the Marsh Plan as the background of the promised income security legislation; and you have the useful corrective comments of Miss Charlotte Whitton on these proposals. From South Africa, we have just received word of the comprehensive proposals of the Government's Social Security Council. In Australia there is a joint parliamentary commission on social security, several of whose proposals have already been carried out by the Government in the midst of war, without waiting to find out if it could afford them. Finally in New Zealand there is a fully fledged social security scheme that has been working for the last five years.

Every one of these plans provides comprehensive income security and medical services. I propose to sketch and compare very summarily the main features of these plans.

With the employment programmes of these countries I shall not attempt to deal—it would take us too far into the field of economic reconstruction; I will only say that the Marsh Plan contains the most detailed proposals on employment, but that great attention is being paid everywhere to the problem of rehabilitating the disabled workers and fitting them to resume their place in industry.

Whether we are dealing with the income security or medical care features of these plans, we can distinguish two alternative principles underlying their organization. Either the scheme is principally one of social insurance, that is to say, demands a contribution from the prospective beneficiary; or it is one of social assistance, that is to say, the cost is borne out of taxation and the grant of benefit is in most cases subject to a means test.

INCOME SECURITY

The Beveridge Plan in Great Britain, the Wagner-Murray-Dingell Bill in the United States, and the

Marsh Plan in Canada are based primarily on an insurance principle. The Australian Plan is non-contributory throughout, with a means test for most of its features. The New Zealand scheme is half way between—a hybrid, which, on the one hand, requires a contribution proportional to income, and, on the other hand, grants benefit according to need. The South African Plan is contributory for sickness and unemployment allowances and retirement benefits, and non-contributory for disability and survivor's benefit and for medical care.

All the plans cover the entire gainfully occupied population, together with their wives and children, while the Australian, New Zealand and South African plans, embracing as they do every resident in the country, cover the unoccupied as well. The South African Plan, it should be noted, applies to black and coloured as well as to white people.

The range of contingencies covered is much the same: unemployment, sickness, maternity leave, permanent disability, old-age, widowhood and orphanhood.

The duration of sickness and unemployment benefits is limited under the American and Canadian plans—to 26 weeks—and unlimited under the Beveridge Plan. The old-age benefit falls due everywhere at 65 for men and 60 for women, except that in New Zealand 60 is the minimum age for both sexes. Under most of the plans, only the widow who is elderly or who has dependent children receives a benefit.

Under the insurance schemes the right to benefit is conditioned by the payment of a minimum number of contributions, and the maintenance of a certain regularity in their payment. The benefit is fixed at a subsistence level under the Beveridge Plan; it is proportional to the wage in the Wagner-Murray-Dingell Bill; while under the Marsh Plan it is fixed at subsistence level for disability, old-age, survivors' benefit and proportional to the wage for unemployment and sickness benefits. All the insurance schemes have to be supplemented by social assistance in order to cover persons who do not comply with the contribution conditions or—under the American and Canadian plans—exhaust their unemployment benefit. Exhaustion of sickness benefit, it should be noted, simply means the substitution of disability benefit, and does not involve therefore the intervention of social assistance.

The insurance schemes are financed by the contributions of employed persons and employers and the contributions of the self-employed, together with considerable State subsidies.

In New Zealand and Australia, all the benefits are on a subsistence level, equivalent to about 25 per cent of the unskilled workers wage for a man without dependents. There is a means test, but it is a very liberal one and allows, for example, full old-age benefit even to a person with some thousands of dollars of savings. Both countries give unemployment assistance to dependent workers who are seeking to enter employment. The New Zealand scheme is financed by a tax of 5 per cent on all incomes, while the cost of the Australian benefits is met out of general taxation and principally from income tax.

All the plans except the Wagner-Murray-Dingell Bill provide children's allowances. They do so because, as Beveridge has cogently argued, you cannot abolish want without providing children's allowances both for the man who is in work and for the man who is out of work. You cannot devise cash benefits which will meet even subsistence needs without them, unless you are prepared to pay more in benefit than the actual wages of an unskilled worker with a large family. It is true that you could, as Miss Whitton proposes, do much, if not as much, by a thorough-going policy of free school meals and subsidised housing for large families. But in some of these countries the aim of the children's allowances is not merely to assure the healthy upbringing of the younger generation, but to diminish by more evident and tangible help the economic handicaps of parenthood and positively to encourage larger families than are now usual. The menace of a declining population and the need to people empty spaces is being realized in the British Commonwealth as never before.

Medical Care

The principles underlying present day planning for medical care may be briefly stated as follows:

1. All necessary forms of medical care should be available to all members of the community without any economic barrier;
2. Care should be preventive as well as curative and should aim at maintaining positive health.
3. The family should be the unit for health policy and each family should have its regular doctor;
4. General practitioners should work in close co-operation with specialists and hospitals;
5. There should be close co-ordination between the medical care and the public health services.

The points of disagreement concern the form of administration, the conditions of service of doctors, and the field to be reserved for private practice. The line of cleavage is not drawn between the opinions of laymen and doctors, but between those of private practitioners on the one hand, and hygienists and public health officers on the other.

The British Medical Association and the Canadian Medical Association approve, in principle, of compulsory health insurance, but they would like to exclude from it the well-to-do, who would consequently be left for private practice. They stand also for free choice of doctor among all practising doctors and for the maintenance, at least provisionally, of the traditional system of individual practice in the doctor's own office. They are opposed to a salaried medical service and prefer remuneration by fee or a fixed amount per patient per annum. The American Medical Association, and the American drug industry are opposed to compulsory health insurance of any kind, or indeed to any State interference in the practice of medicine.

The planners on the other hand are mostly favourable to a free public service providing medical care in the same way as public education is now provided. Such a service would be complete and of high quality, available without payment to rich and poor alike, and financed from taxation. They demand that doctors should, where practicable, work in groups at fully equipped health centres, and recommend, but do not insist, that remuneration be mainly on a salaried basis. Proposals on these lines have been officially endorsed by the medical profession in South Africa.

Whatever solutions may eventually be adopted for these problems, the important conclusion may already be drawn that in Great Britain and the British Dominions the introduction of a national health service comprehensive both in scope and content, is no longer a matter of conjecture but only a matter of time.

J. H. Brace[1]

Associated with all proposed security plans it would appear that there should be a common denominator covering certain fundamentals:

1. Canada is still a land of opportunity. We continue to blaze new trails. The pioneer spirit has not yet disappeared. To the extent that we as individuals or groups leave some of our fundamental problems for the state to solve which we can very well handle ourselves, we shall have lost something of untold value.
2. Regimentation of the masses and bureaucratic control of the way of life of the individual have only a limited place in a young country such as ours.
3. Recognizing as a cardinal principle "Freedom from Want," I subscribe to the necessity for social security planning on the part of those who make our laws. To the fullest extent possible, any necessary forms of social security services promulgated by the authorities should be financed by some form of insurance payments by the citizens at large.

The moral fibre of the individual is not improved by presenting him with something which he has not earned. I believe we should keep to a minimum the number of things which reduce the right of the individual to hew out his own pattern of life, but experience clearly indicates the necessity on the part of our government to establish some forms of compulsory thrift.

I view with concern any legislation which will result in the regimentation of our medical, dental and similar services. The advances that have been made in these professions have been the result of individual effort—and that effort has been quickened not alone because the individual was an idealist but because of his own personal gain from his accomplishments. In our efforts to bring succour to those who might not otherwise be able to obtain it, let us not do anything which will retard the present rapid strides medical science is making.

Dr. Marsh defines "social assistance" as that form of relief, restricted to the sub-marginal group of the population, given in the form of charity. He states that "social insurance" brings in the resources of the community as a whole, that the insured person knows what he is entitled to, his benefits come as a right and not from charity. This is true to the extent that the insurance premiums cover the risk but not beyond that. It would be unhealthy to develop a general state of mind in this land of ours that "This country owes me a living."

There should be continual expansion of state assistance to those in distress. Otherwise the treatment accorded is dependent upon private giving and Canada's experience under the latter practice indicates clearly that this, too frequently, is far from meeting the requirements.

"Social assistance" and "social insurance" should be recognized as two distinct and separate problems. The first should have state aid to the extent necessary. The second, while under government direction, should be self-supporting from the premiums collected. By this means the great majority of our citizens can maintain their dignity and still have social security. This will give coverage to those of us who have had to meet various forms of distress beyond our normal expectations.

I am not unmindful of the steady progress that this country has been making. Gradually the "House of Industry" more commonly known as the "Poor House" is disappearing as a result of the old-age pension plan. Some form of compulsory saving in the years that have passed would have resulted in the old age pension plan being self-supporting to-day.

I subscribe to every necessary form of social security which will not result in lowering the moral fibre of the individual nor in slowing up the progressive advancement of those things which make for a fuller and better life for the citizens at large. To provide such security the individual should to the fullest extent possible finance, in the form of insurance premiums, his own risk.

I represent an industry which has positive views on this question of security. It became apparent to us a long time ago that if industrial management wants its employees to be interested in its objectives, then management must be interested in the objectives of the employees. It was clear to us that one of the basic objectives of wage-earning employees is freedom from worry about the financial burden involved in sickness, accident, unemployment, old age, and death.

For over a quarter of a century we have been "bargaining" with our employees, that is, bargaining in the broader sense of the term, through a Representation Plan, and we know from this that worry about sickness, etc., is one of their fundamental problems.

Their reasoning, of course, is logical. They say, if a wage-earner needs his wages while he is able to work and his expenses are normal he needs them that much more when he is not able to work and his expenses are increased because of illness, accident, etc.

So we have long since developed a Benefit Plan which is designed to minimize this problem for our employees. It was developed years ago when security plans or social security itself were not so popular as they are to-day, and it is a non-contributory plan. I fully realize that many such plans developed in recent years are on an employee contributory basis and there may be some advantages in this. But that is beside the point. In principle our plan serves its purpose. We are satisfied that its effect is invaluable. It is a powerful factor in developing employee loyalty and support. Obviously it serves the interests of both the employee and the employer.

As you may imagine therefore, I am a proponent of industry solving this problem itself insofar as it is possible to do so. I recognize the inevitable necessity of state plans, but it seems to me that industry can and should do a lot to solve this problem. To my mind, it is entirely possible that the chances of survival of free enterprise, as we have known it, are dependent to some degree on the extent to which it assumes its so-called social responsibilities.

An article by Austin M. Fisher, entitled "Insure Your Workers' Health," reproduced in the February number of *Reader's Digest* from *Forbes Magazine*, is well worth perusal. This places the problem of social security primarily on the shoulders of industry where it belongs. "Social Security" as a state plan should be supplemental only to the social security programme of industry.

E. R. Complin[2]

Mr. Stack referred to "the useful corrective comments of Miss Charlotte Whitton." For the benefit of those

[1]Vice-President, The Bell Telephone Company of Canada, Montreal, Que.

[2]Industrial Relations Manager, Canadian Industries Limited, Montreal, Que., Member of the Institute Committee on Industrial Relations.

who do not know, Dr. Charlotte Whitton was asked by Mr. John Bracken to examine the Beveridge and Marsh Reports and to submit her comments thereon, a piece of work for which her experience and understanding was fitted. There has been a tendency to wave aside Dr. Whitton's contribution because of the implied political beginnings of her contribution. Inasmuch as the Beveridge, Marsh and Heagerty reports have received considerable publicity through the press and governmental channels, their recommendations are fairly well known but Dr. Whitton's report has had to be published privately and is not nearly so well known.

For those who have not read it, I suggest that it contains many thoughts which are worthwhile studying whether or not one agrees with them. I was much impressed by the following quotation contained in Dr. Whitton's letter of transmittal, "If we are to plan correctly and powerfully for the post-war world, it is going to be essential that the public should distinguish between the motives of those who pull difficult questions out into the open in order to find the right answers and those who do so because they want a shelter for inaction."

She goes on to say that she does not necessarily expect that people will agree with all portions of her exposition but feels that there are two sides to any question and that alternative methods of arriving at social security should be considered. No one can quarrel with such an approach to any problem.

It has been pointed out that she prepared her report in four months and this is too brief a time to deal with such a subject. But, on the other hand, Dr. Marsh's report was, I understand, prepared in even less time.

Among the many things she points out, several appear of significance, and, as we have not the time to refer to all of them, I shall only briefly mention one or two.

In the first place, Great Britain is 90 per cent industrialized, and secondly, there is one stage less in the hierarchy of governments, that is to say, there is not our dominion, provincial, municipal situation. Despite these two advantages, and the advantage of many years of experience in moving toward a perfect structure with its resultant thoroughly organized provisions for local, social utility functions, Sir William Beveridge saw fit to place the needs of children, and health and medical care for all the population, outside of the insurance structure, even though, as I have said, there is in England a mature solvent insurance structure covering many types of risks and built up over a period of thirty years with millions of pounds in reserves. On the other hand, a country like Canada, whose basic economical, governmental and population structure is peculiarly her own, with a young untried unemployment insurance scheme, is counselled to embark on a programme which appears to be either dangerously similar to the British programme, or dangerously different. These are not matters for the layman to resolve. Certainly the advantages and disadvantages of various approaches to the problem cannot be adequately weighed by the general public and I doubt very much if experience would allow us to say that the solution approved by the majority of our representatives in Parliament is necessarily the most practical solution. It is in matters like this that all of us must turn to persons with the time and experience to weigh and evaluate the various aspects.

INDUSTRIAL RESEARCH IN POST-WAR CANADA (*Continued from page 139*)

administrative responsibilities but whose duty it would be to keep in close liaison with scientific developments in Canada and abroad, and bring to management the point of view of science—the eternal search for improvements, new products and new outlets.

Government Aid in Co-operative Research

I suggest that every industry, even if it maintains its own research laboratory, would be wise to make use of the existing facilities of government and private research laboratories where arrangements can be made to have special problems studied and where by payment for the entire cost of the work, all findings and patents can become the exclusive property of the company. This type of co-operative research agreement widely known as the "Mellon Institute" plan enables even the smallest industry to take advantage of first class facilities which, alone, it could not possibly support. I suggest that a more general use of this plan would, without the incurring of large initial obligations, enable industries to test the value of research, and those who found it profitable could then either increase their use of the scheme or build up their own laboratories in a sound and efficient way.

Before concluding, I would like to say that there can be no doubt as to the practicability of the above suggestions for in a limited but successful way they have been demonstrated by the National Research Council for many years. Even during the war there are several such co-operative agreements in operation and many more are awaiting the end of hostilities. I will cite only one outstanding case of a Canadian company which, brought into being in the last war to manufacture a product formerly supplied by an enemy country, found itself unable to compete in the early twenties when world trade was reestablished. When its management sought tariff protection as a solution, a wise Government offered research assistance instead, and for nearly twenty years a co-operative research was carried on at the National Research Laboratories. To-day the company is firmly established, the quality of its product has been raised to a competitive level by research, new products have been developed, the entire cost of the research has been liquidated and the scientific laboratories, which for many years were maintained at the National Research Council, have now been moved to the factory site and incorporated in the industrial organization. Incidentally, the present managing director and many of the senior administrative staff started their careers in the Council's Laboratories as research workers on this co-operative project.

Such examples are all too rare in Canada, but in the major industrial countries similar cases can be listed by the hundreds. And if we, in Canada, show the wisdom and enterprise in research which I believe we will, instead of "stagnation and ultimate bankruptcy" we may confidently look forward to a progressive, well integrated, and prosperous industrial life.

References

①Report of Federation of British Industries Research Committee, October, 1943.

②Proceedings, Association of Scientific Workers, January, 1943.

③Address, Dr. H. M. Tory, Canadian Club, Ottawa, October, 1934.

④Bernal—"The Social Function of Science," 1939.

⑤Parliamentary and Scientific Committee, London, October, 1943.

⑥Survey of Scientific and Industrial Laboratories of Canada, Bureau of Statistics, 1941.

⑦Annual Report—Vick Chemical Company, June, 1943.

THE DESIRABILITY OF ESTABLISHING TECHNICAL INSTITUTES IN CANADA

C. R. YOUNG, M.E.I.C.
Dean of the Faculty of Applied Science and Engineering, University of Toronto.
Past-President of The Engineering Institute of Canada.

A memorandum submitted to the Council of The Engineering Institute of Canada, on February 9th, 1944. Council approved the proposal and has since taken steps to initiate action through the provincial departments of education.

1. THE NEED FOR TECHNICAL INSTITUTES

One of the present obligations of the educational authorities and institutions in this country is to direct their resources towards a speedy and sound re-establishment of men discharged from the forces or released from war industry. A forward-looking and realistic technical educational programme ought to form an important part of the general scheme of rehabilitation. The faculties of engineering of the universities will, no doubt, do their share, but they are properly restricted to the professional field. It is therefore necessary that steps be taken under provincial auspices, but perhaps with federal support, to provide essential training to many men with technical aptitudes who either could not qualify for admission to a university or could not spend four more years of their lives in obtaining an education for a livelihood. Some plan should be devised whereby men without professional ambitions could have their needs satisfied in institutions giving a training above the ordinary vocational level but less advanced than that offered by the engineering colleges. Minimum qualifications for admission would naturally have to be less than complete university matriculation and might in some instances have to rest chiefly on personal capacity and interest, supplemented perhaps by assurances of future employability in technical pursuits.

Consideration of technical education in Canada clearly indicates a serious gap in it above the secondary school level and below that of the degree-granting engineering faculties and colleges. The universities, as the sole type of institution above the ordinary or vocational high school, cannot possibly serve adequately all of the needs of the country in the matter of advanced training of technical personnel and any attempt at doing so is bound to be unsatisfactory both to those seeking training and to the universities themselves. Experience in the United States, in Great Britain, and on the continent, has shown that the whole fabric of technical education is strengthened and marked public benefits realized from the establishment of an intermediate type of institution commonly designated as the "technical institute".

It is of importance to note that in the United States renewed emphasis is now being placed on the work of the technical institutes. Much of the technical training to be made available for men discharged from the forces and released from war industry will be given by them. As an evidence of the growing activity expected in this field, eight technical institutes are projected for New York State, to be built as part of the post-war construction plan and turned over to the State for operation.

2. EMPLOYMENT OF TECHNICAL INSTITUTE GRADUATES

While the graduates of engineering colleges look to professional employment involving investigation of the scientific and economic features of undertakings and are concerned with devising what are often original methods of analysis, design, construction, manufacture, or operation, the graduates of technical institutes are for the most part concerned with repetitive activities associated with production, operating or maintenance procedures. Graduates from the latter type of institution constitute the "line" side of an organization, as contrasted with the "staff" side, which is generally recruited from the graduates of professional schools.

Technical institute graduates very often limit their interests to, and are trained for, particular industries. Their duties are normally of a supervisory character, but may include minor technical functions such as drafting, design of details, laboratory testing, inspection, construction in the field, or the technical aspects of sales work.

Careful studies made in the United States indicate that the technical institute graduates required by industry represent from 2.2 to 3.0 times the number of graduates required from the professional schools. These two groups are related in much the same way as are non-commissioned officers and commissioned officers in the army.

3. TYPES OF TECHNICAL INSTITUTE STUDENTS

Technical institutes serve more effectively than the engineering colleges the following types of young men:

(1) Those who have had industrial experience and have already chosen a vocation upon which they wish to embark with the least possible loss of time.

(2) Those who have passed the state of "book-mindedness" and whose mental learning processes centre on actual doing rather than on formal study.

(3) Those who, for financial or other reasons, cannot devote four years to preparation for remunerative employment.

(4) Those who, having practical rather than intellectual interest, have had to leave college before progressing very far.

(5) Those whose educational qualifications would not admit them to a university.

4. GENERAL CHARACTERISTICS OF TECHNICAL INSTITUTES

While great diversity exists in the character and practices of the presently-operating technical institutes, they nevertheless exhibit certain well defined general characteristics. The courses offered are shorter and more practical than those available in the professional schools. While courses in the latter develop the specialized functions of research, analysis, design, and new production or operating procedures, the work of a technical institute is centered upon and seeks to rationalize the higher practical pursuits of industry. Students of the latter learn by doing rather than by studying and there is much less emphasis on independent study than in the universities. The mathematical and physical sciences are not taught as independent disciplines, but in intimate and very direct and practical connection with their technical applications.

The length of technical institute courses varies from one to four years, the most common being two years. Under favourable aspects, two years of intensive practical work with a sound grounding in the underlying sciences will result in a high employability of the graduate.

Three broad types of training are offered in technical institutes: — (1) generalized engineering courses, (2) technology of particular industries, (3) functional courses.

Experience has shown that there are innumerable positions in industry for the efficient occupancy of which a wide range of scientific or technical knowledge is not necessary. Many of these are conventionally classed as belonging to engineering and many open paths to posts of high responsibility in producing and operating organizations. The technical requirements of such positions can be adequately met by an intensive type of engineering training from which the more advanced scientific features are omitted. To meet this situation, so-called generalized engineering courses have been established in some of the technical institutes.

In the generalized engineering courses a strong effort is made to present basic science and technology that would be useful in any one of a variety of industries. Some of the subjects taught are mathematics, physics, chemistry, mechanics, engineering drawing, descriptive geometry, electricity, and materials of construction. To these there may appropriately be added industrial relations, sociology, industrial safety, and industrial law. The generalized engineering course in a technical institute parallels the engineering courses in the universities but represents an abridgment of them. The material is presented in a more practical form and in a manner not demanding of the student any marked attainments in mathematics or in theoretical science.

Many technical institutes offer courses in the technology of particular industries, often with a definitely local application. Some of the most successful of these institutions have grown out of the idea of service to one or more important local industries. An application of this principle in Canada might well be advantageous.

Some technical institutes offer what are called functional courses. These pertain to such activities as quantity surveying, textile designing, power plant management and operation, management, and general supervision.

The co-operative plan has been found particularly helpful in extending the usefulness of technical institute work. Under this, the student alternates between study in the institute and employment in industry. His experience and practical qualifications increase in parallel with his theoretical knowledge.

Although degrees cannot be granted on the completion of the typical short, practical courses offered by the technical institutes, it is highly essential that some form of certification should be adopted through which the graduate would be able to establish his qualifications. This has been admirably worked out in Great Britain. A scheme of examinations and credentials has been developed under the joint auspices of the English and Scottish Boards of Education and a group of professional institutions. *National Diplomas* are given for successful examinations following full-time day courses, and *National Certificates* for examinations following evening and part-time courses.

In order to guard against an effort by anyone to attain professional recognition without the prerequisite training, a clear understanding should be reached by those sponsoring technical institutes with the Provincial Associations of Professional Engineers respecting the attitude of the latter to applications for admission from technical institute graduates. Credentials obtained from a technical institute might be acceptable in lieu of part at least of the examinations required of non-graduates of professional schools for admission to the associations. The difference in required practical experience for the two types of graduates should be determined at the outset.

5. RELATION OF TECHNICAL INSTITUTES TO THE UNIVERSITIES

Experience has shown that it is not practicable for a degree-granting engineering college itself to attempt parallel technical institute activities on the same campus, under the same administrative and teaching direction, and during the same operating hours. No experiment of this kind has so far succeeded. Under such circumstances, the technical institute is soon regarded as a salvage mechanism for failures, culls and misfits. Students in the short courses are not accorded the full privileges of regular students in campus activities and organizations. Unconsciously, but nevertheless almost inevitably, the staff comes to favour the longer course, to the very great prejudice of the technical institute work and to the detriment of the morale of the institution as a whole. No such undesirable situation exists if the technical institute has its own administration, its own instructors, its own quarters, and its own particular policies and ideals, freed of any invidious comparison with institutions giving professional courses.

From the point of view of the engineering faculty or college the superposition of aims and objectives is undesirable. The colleges must protect their standing with the professional societies and accrediting agencies. They must insure that industry places definite value on their credentials. One standard of admission, one general level of work, and one grade of credentials are essential. It is not practicable to arrange the curriculum of an engineering college in such a manner that attendance of one, two, or three years would constitute adequate and final educational preparation for different types of technical employment. Many years ago, the German technical universities attempted this plan and had to abandon it in favour of different types of schools for different callings.

6. CREDITS TOWARD A UNIVERSITY COURSE

Experience has shown that it is difficult to arrange automatic credits for students who complete technical institute courses and desire to enter engineering colleges with a view to obtaining professional training. The two types of programmes are widely different. To obtain the greatest success, the methods of teaching should correspondingly differ.

A dominating principle in the technical institute work has been that the courses are of a "terminal" character. It consequently appears impracticable to admit graduates of technical institutes at any higher level than the first year, except in special cases. The difficulty arises in the fact that the so-called theoretical courses have by intention been made very different in content in the two institutions. In most cases, technical institute men have had neither the amount nor the type of mathematics that would serve as a prerequisite for the more advanced engineering subjects and for which the colleges will allow any considerable credit, however purposeful or useful the content or giving of the instruction has been. Graduates of the technical institutes would, on their part, often experience disappointment in being asked to start over again far down the line. They could scarcely escape a feeling of repetition, waste of time, discouragement, or even embarrassment.

While any regular plan of admission of technical institute graduates to advanced standing in the engineering courses appears to be impracticable, exceptional men, having higher educational qualifications than most technical institute students have, might be admitted to the professional schools above the first year. The possibility of this would prove highly attractive to young men thinking of entering a technical institute. Undoubtedly, it would be in the public interest for the universities, possibly in co-operation with the Department of Education for the province concerned, to arrange suitable "bridging" courses for facilitating such transfers.

7. ADVANTAGES OF THE TECHNICAL INSTITUTE PLAN TO THE UNIVERSITIES

Due to the comparative absence of technical institutes in Canada the engineering colleges have, in effect, been forced to conduct two over-lapping types of training. Primarily, the courses offered are designed for men seeking professional qualifications and capable of acquiring them. At the same time, however, there are, in every engineering college, appreciable numbers of students who can hope to attain only a general education or a sub-professional status. Their capacity, or interest, does not enable them to keep pace with the majority of their classmates. As a result, they waste their time and in some measure, hamper the training of the better students. Actually, their own interests are ill-served and industry is by no means a gainer in the process. It must be admitted, too, that a very substantial part of the demand for technical personnel could be filled by technical institute graduates with a greater continuity of service and often with greater immediate satisfaction to the employer.

The concensus of opinion amongst persons long experienced in educational matters is that strictly professional education would be advanced, the engineering colleges would be greatly relieved, and their primary objectives brought nearer, if those students whose interests are practical and vocational rather than professional were to seek their training in an institution of the type of the technical institute.

8. SUGGESTED ACTION

It is my belief that both education and industry would be notably served if, with the sponsorship of the provinces, a number of technical institutes were immediately established so as to be available for qualified demobilized men and displaced war workers as soon as they are free in substantial numbers.

THE FIFTH-EIGHTH ANNUAL GENERAL MEETING

Convened at Headquarters, Montreal, on January 27th 1944, and adjourned to the Château Frontenac, Quebec City, on Friday, February 10th 1944

The Fifty-Eighth Annual General Meeting of The Engineering Institute of Canada was convened at Headquarters on Thursday, January 27th 1944, at eight o'clock p.m., with President K. M. Cameron in the chair.

The general secretary having read the notice convening the meeting, the minutes of the Fifty-Seventh Annual General Meeting were submitted, and, on the motion of H. B. Montizambert, seconded by C. E. Gélinas, were taken as read and confirmed.

Appointment of Scrutineers

On the motion of Henri Gaudefroy, seconded by G. P. Cole, Messrs. H. F. Finnemore, C. E. Gélinas and R. E. Heartz were appointed scrutineers to canvass the officers' ballot and report the results.

There being no other formal business, it was resolved, on the motion of L. H. Burpee, seconded by J. A. Stairs, that the meeting do adjourn to reconvene at the Château Frontenac, Quebec City, at nine-thirty a.m. on the tenth day of February, nineteen hundred and forty-four.

Adjourned General Meeting at the Château Frontenac, Quebec City

The adjourned meeting convened at ten o'clock a.m., on Thursday, February 10th 1944, with President K. M. Cameron in the chair.

The general secretary announced the membership of the Nominating Committee of the Institute for the year 1944 as follows:

Nominating Committee—1944

Chairman: H. C. Fitz-James

Branch	*Representative*
Border Cities	C. G. R. Armstrong
Calgary	F. K. Beach
Cape Breton	J. R. Morrison
Edmonton	J. Garrett
Halifax	J. R. Kaye
Hamilton	W. J. W. Reid
Kingston	J. R. Carter
Lakehead	E. L. Goodall
Lethbridge	A. J. Branch
London	F. T. Julian
Moncton	A. Gordon
Montreal	J. M. Crawford
Niagara Peninsula	C. G. Cline
Ottawa	N. B. MacRostie
Peterborough	W. T. Fanjoy
Quebec	E. D. Gray-Donald
Saguenay	N. F. McCaghey
Saint John	D. R. Smith
Saskatchewan	E. K. Phillips
St. Maurice Valley	M. Eaton
Sault Ste. Marie	E. M. MacQuarrie
Toronto	A. E. Berry
Vancouver	H. N. Macpherson
Victoria	S. H. Frame
Winnipeg	D. M. Stephens

Award of Medals and Prizes

The general secretary announced the awards of the various medals and prizes of the Institute as follows, stating that the formal presentation of these distinctions would be made at the annual dinner of the Institute the following evening:

Sir John Kennedy Medal—"A recognition of outstanding merit in the profession or of noteworthy contribution to the science of engineering or to the benefit of the Institute"—To Dean C. J. Mackenzie, C.M.G., M.E.I.C., Acting President, National Research Council, Ottawa, Dean of Engineering, University of Saskatchewan.

Gzowski Medal (Gold)—To Frank E. Sterns, M.E.I.C., Ottawa, for his paper "Transit Shed with Concrete Roof Arches."

Duggan Medal and Prize—(Medal and Cash Prize of $100.00)—To W. R. Stickney, M.E.I.C., Walkerville, for his paper "Electric Arc Welding."

Julian C. Smith Medals—"For Achievement in the Development of Canada"—To Dr. George Joseph Desbarats, C.M.G., M.E.I.C., Ottawa; Dr. Frederic Henry Sexton, M.E.I.C., Halifax.

Students' and Juniors' Prizes

H. N. Ruttan Prize—(Western Provinces)—To N. Safran, Jr.E.I.C., Calgary, for his paper "Synthetic Rubber."

John Galbraith Prize—(Province of Ontario)—To A. C. Northover, Jr.E.I.C., Peterborough, for his paper, "New Methods and Substitute Materials in Wartime Construction."

Phelps Johnson Prize—(Province of Quebec, English) —To B. Mroz, S.E.I.C., Montreal, for his paper, "Portland-Montreal Pipe Line."

Ernest Marceau Prize—(Province of Quebec, French) —To H. Audet, S.E.I.C., Montreal, for his paper, "Locomotive de manoeuvre Diesel-électrique 660 B.H.P."

Martin Murphy Prize—(Maritime Provinces)—To J. L. Belyea, S.E.I.C., Fredericton, for his paper "Simplification in the Design of Automatic Weapons."

Honorary Memberships

The general secretary reported that the following had been elected to Honorary Membership in the Institute, and that certificates would be presented at the annual dinner:

Daniel Webster Mead, Past-President, American Society of Civil Engineers, Consulting Engineer, Madison, Wisconsin.

Robert Ernest Doherty, President, Carnegie Institute of Technology, Past-Chairman, Engineers' Council for Professional Development.

Report of Council

On the motion of deGaspé Beaubien, seconded by G. L. Dickson, it was resolved that the report of Council for the year 1943, as published in the February *Journal*, be accepted and approved.

Report of Finance Committee, Financial Statement and the Treasurer's Report

On the motion of C. K. McLeod, seconded by R. E. Heartz, it was resolved that the report of the Finance Committee, the financial statement and the treasurer's report, be accepted and approved.

Reports of Committees

On the motion of L. F. Grant, seconded by C. F. Morrison, it was resolved that the reports of the following committees be taken as read and accepted: Board of Examiners and Education, Industrial Relations, International Relations, Western Water Problems, Professional Interests, Legislation, Publication, Post-War Problems, Membership, Employment Service, Engineer in the Active Services, Professional Ethics, Engineering Features of Civil Defence, Papers, Library and House, Engineer in the Civil Service, The Young Engineer and the Deterioration of Concrete Structures.

Branch Reports

On the motion of W. R. McCaffrey, seconded by Wills Maclachlan, it was resolved that the reports of the various branches be taken as read and approved.

Amendments to the By-laws

In accordance with section 80 of the by-laws, Council presented to the meeting for discussion certain proposals for the amendment of sections 22, 29, 31 and 78 of the by-laws and for the introduction of a new section 82. These had been published in *The Engineering Journal* for December, 1943, and mailed to all corporate members.

At the president's request, the general secretary outlined the proposals. He explained that the purpose of the proposed new by-law was to enable Council to enter into co-operative agreements with sister societies in Canada, the United States and Great Britain, and to give such societies the right to appoint one of their members, who must also be a corporate member of the Institute, to the Council of the Institute. The amendments to sections 29 and 31 become necessary if the proposed new by-law is approved.

The amendment to section 78 gives to those associations of professional engineers with which the Institute already has or may have co-operative agreements, the same privilege of appointing a representative to the Institute Council.

The proposal to amend section 22 is for the purpose of supplying *The Engineering Journal* to every Student of the Institute at a nominal cost of $1.00 per year, instead of the present arrangement whereby the *Journal* subscription is optional to Students at $2.00 per year. Council felt that in this way a better contact would be maintained with the Students and the usefulness of the Institute greatly increased.

The general secretary explained that Council, at its meeting on the previous day, had decided to propose an addition to the amendment to section 29, whereby the treasurer of the Institute would be made a member of Council. At the present time it is the treasurer's duty to attend Council meetings but he is not entitled to vote.

Proposed New Section 82

It was moved by J. E. Armstrong, and seconded by C. E. Sisson, that the proposed new section 82 of the by-laws be approved.

Colonel Grant asked if this would be a reciprocal arrangement. Would the Institute have the right to appoint one of its members to the governing body of a society with which it had a co-operative agreement ? In answering Colonel Grant, the president pointed out that such a point would be covered in the actual agreements as negotiated. At the moment the objective was to have an organization which would be fully representative of all engineering societies in Canada. The decision as to whether or not the Institute should appoint representatives to the Councils of the other societies would rest with those societies, but provision for such representation is made in the proposal.

Following some discussion, Mr. Armstrong pointed out that the proposed new section is enabling legislation only, and that the points raised in the discussion had to do with matters that would be worked out in any agreements which might be arranged. Such agreements would have to be submitted to the membership before approval and therefore these matters would be discussed at that time.

On being put to the meeting, the motion was carried, and the proposed new by-laws, as published on page

688 of the December 1943 *Journal*, was approved for submission by letter ballot to all corporate members.

PROPOSED AMENDMENTS TO SECTIONS 22, 29, 31 AND 78

It was moved by C. R. Young, and seconded by J. B. Stirling, that the proposed amendments to sections 22, 29, 31 and 78 be approved.

Following Council's decision that the treasurer of the Institute should be made a member of Council, it was moved by deGaspé Beaubien, and seconded by L. F. Grant, that the following words be added to the proposed amendment to section 29—"and the treasurer of the Institute", making the proposed amendment read as follows:

Section 29—Add—

"and one councillor from each society or association with which the Institute has a co-operative agreement as described in sections 78 or 82 of the by-laws, as such councillors are appointed, and the treasurer of the Institute."

The president put before the meeting the amendment to the amendment to section 29, and asked if there was any discussion thereon.

Past-President Challies informed the meeting that a petition had been presented to Council signed by all living past-treasurers with the exception of one, Mr. Pratley, in which unanimous support was given to the proposal. He explained that past-treasurers had felt that their usefulness to the Institute and facility with which they could do their work would be greatly increased if they were members of Council.

Mr. Pratley explained that during his term as treasurer he had not experienced any inconvenience, but he explained that at the same time he was a councillor of the Institute representing the Montreal Branch. He felt that as the treasurer was an appointed officer he should not be given a vote.

Mr. Pitts was in favour of the treasurer having a vote but thought that under such circumstances he should be an elected officer rather than one that was appointed.

Mr. Beaubien and Mr. Hunt both supported the proposal and drew attention to the fact that the proposed amendment to section 78 and the proposed new section 82 both provided that a person appointed by a sister society could have a vote on Council, and expressed the opinion that if this privilege was given to representatives of sister societies it should also be given to the Institute treasurer.

On being put to the meeting, the amendment to the amendment to section 29 was carried.

Commander E. C. Cullwick suggested that the proposed amendment to section 78 should be reworded slightly in order to make it definite that the representatives of the associations referred to must be corporate members of the Institute at the time of their appointment to Council. This was seconded by Mr. Armstrong, and, on being put to the meeting, was carried unanimously. The revised wording of the amendment is as follows:

Section 78—Add at the end of the by-law:

"The Association shall have the right to appoint to the Council of the Institute a representative who is a corporate member of the Institute, who shall enjoy all rights and privileges as described in Section 32 of the by-laws."

Dean Young's motion was then put to the meeting and carried, the proposed amendments to sections 22, 29, 31 and 78 being approved for submission by letter ballot to all corporate members.

TECHNICAL INSTITUTES

In response to a request from the president, Dean Young outlined a submission which he had made to Council with reference to technical education. He referred to the situation which would exist at the universities when the thousands of young men now in the armed forces and war industry were released and found it necessary to take new training to fit them for new occupations.

He thought that in Canada it would be advisable to establish some technical institutions to give a course somewhere between that of a high school and that of the engineering colleges. There are no such institutions in Canada now but there are many of them in England and some in the United States. In England they are known as "Technical Colleges" and in the United States as "Technical Institutes." Courses are devised to turn out persons who are more interested in production and management that in theoretical study and design.

He thought the universities would be unable to handle this additional burden and that the high schools and technical schools were not equipped for it. Graduates from the schools would be of a sub-professional level but would be above the ordinary technician grade. It was not likely that their graduation from these institutes would qualify them for membership in the provincial professional associations.

Dean Young read the resolution which had been approved at the meeting of Council the day previous which indicated that Council supported the proposal and that the Institute should inform the branches of it so that provincial departments of education might be approached to consider the idea. The resolution also suggested that the Institute inform each provincial association or corporation of Council's decision and make available to them copies of Dean Young's memorandum.

Dean Young explained that he was not making any motion at this meeting but simply reporting Council's action so that the membership might be informed.

STATISTICAL CONTROL OF QUALITY IN PRODUCTION

The president reported that at the Council meeting on the previous day consideration had been given to making an exploratory study of the statistical control of quality in production. He asked Colonel W. R. McCaffrey, the secretary of the Canadian Engineering Standards Association (C.E.S.A.) to speak to this subject.

Colonel McCaffrey stated that the subject had been discussed before the C.E.S.A. and that the decision reached indicated that an organization such as The Engineering Institute of Canada would be better able to make this study than the Association. He explained that the C.E.S.A. was very anxious to see this study carried out and he thought it was a splendid idea for the Institute to accept the responsibility.

ELECTION OF OFFICERS

R. E. Heartz read the report of the scrutineers appointed to canvass the officers' ballot for the year 1944 as follows:

President.............deGaspé Beaubien, Montreal

Vice-Presidents:

Zone B (Province of Ontario), J. M. Fleming, Port Arthur

Zone C (Province of Quebec), E. B. Wardle, Grand'-Mère

Zone D (Maritime Provinces), G. L. Dickson, Moncton

AT THE PRESIDENT'S DINNER

The head table. Past-Presidents C. J. Mackenzie, J. B. Challies, A. J. Grant, J. M. R. Fairbairn, President K. M. Cameron, Past-Presidents A. R. Décary, O. O. Lefebvre, F. A. Gaby, F. P. Shearwood, C. R. Young, and Councillor J. E. Armstrong of Montreal at the end of the table.

Councillors E. D. Gray-Donald, Quebec; J. R. Kaye, Halifax; J. A. Vance, Woodstock; C. Scrymgeour, Halifax.

Robert Blais, assistant chief engineer of the Department of Public Works of Canada; Chairman W. H. M. Laughlin of the Toronto Branch and Councillor A. W. F. McQueen of Niagara.

Vice-President G. L. Dickson, of Moncton, was a very welcomed guest.

The reminiscences of A. J. Grant get rapt attention from J. B. Challies.

Alex. Larivière and Brigadier A. Thériault of Quebec with Vice-President Lieut.-Col. L. F. Grant of Kingston.

Quebec Branch Chairman René Dupuis chats with Dr. A. Frigon of C.B.C.

Quebec Branch Secretary Paul Vincent, St. Maurice Branch Chairman J. H. Frégeau and Quebec Councillor Dr. Paul Gagnon.

Vice-President E. B. Wardle of Grand'Mère and Councillor Carl Stenbol of Sault Ste. Marie.

President K. M. Cameron was presented with the key to the city.

J. B. Carswell, president of War Assets Corporation, speaks from the book of Isaiah.

The new president, de Gaspé Beaubien.

Councillors:

Victoria Branch	A. S. G. Musgrave
Lethbridge Branch	Wm. Meldrum
Calgary Branch	James McMillan
Winnipeg Branch	H. L. Briggs
Sault Ste. Marie Branch	Carl Stenbol
Niagara Peninsula Branch	A. W. F. McQueen
Hamilton Branch	Alex. Love
Toronto Branch	W. S. Wilson
Peterborough Branch	H. R. Sills
Ottawa Branch	G. H. Ferguson
Montreal Branch	R. S. Eadie
	P. E. Poitras
Quebec Branch	P. E. Gagnon
Moncton Branch	E. B. Martin
Halifax Branch	P. A. Lovett
Cape Breton Branch	J. A. Russell

On the motion of R. E. Heartz, seconded by J. G. Hall, it was resolved that the report of the scrutineers be adopted, and that the ballot papers be destroyed.

The president announced that the newly elected officers would be inducted at the annual dinner of the Institute the following evening.

President Cameron then delivered his retiring address which appears in full on page 160 of this issue of the *Journal*.

On the motion of T. M. Dechene, seconded by P. L. Pratley, it was unanimously resolved that a hearty vote of thanks be tendered to the retiring president and members of Council in appreciation of the work which they have done for the Institute during the past year. In seconding the motion, Mr. Pratley commented on the fact that the past year had been a strenuous one in the history of the Institute, and he felt that the Institute had been fortunate in having a man such as Mr. Cameron as its president.

On the motion of Arthur Jackson, seconded by I. S. Patterson, it was unanimously resolved that a hearty vote of thanks be extended to the officers and members of the Quebec Branch for their courtesy, hospitality and unfailing kindness in connection with the Fifty-Eighth Annual General Meeting.

There being no further business, the meeting adjourned at eleven fifty-five a.m. .

THE GENERAL PROFESSIONAL MEETING OF 1944

It is both unnecessary and futile to attempt to describe the Quebec meeting to persons who were there. Their own senses will recall the highlights of every occasion and the general overall feeling of satisfaction, better than can any printed word. Nevertheless, for the benefit of those who were not fortunate enough to be present, the following narrative account is offered.

Council Meeting

Following events in chronological order, the first item to record was the meeting of Council on the morning of Wednesday, February 9th. The minutes of the meeting appear elsewhere in this *Journal*, but it is interesting to note that 27 councillors and 11 guests were present to participate in the deliberations. The meeting was presided over by the retiring president, K. M. Cameron, who referred fittingly to the fact that this was his last council meeting as president. It must have given him a great deal of pleasure and satisfaction to look back over the year's attainments, and to realize all that was accomplished under his jurisdiction.

President's Dinner

The dinner given by the retiring president has developed into one of the most important and pleasant functions of an annual meeting. This year was certainly no exception. It took place at the Garrison Club and was attended by 64 guests. Previous to the dinner, all the guests were entertained at the home of Dr. Paul Gagnon and Mrs. Gagnon. The wives of those attending the president's dinner were also present at this reception.

With the president at head table were nine past-presidents. Each of them was called on by Mr. Cameron for a few remarks, and in this way afforded the assembly a delightful evening's entertainment.

The Quebec ladies were hostesses at dinner to the wives of all those persons who were attending the president's dinner. All reports indicate that this function was very enjoyable and much appreciated by the visiting ladies.

Thursday, February 10th

On Thursday morning, February 10th, the annual general meeting took place in the Jacques Cartier room, with President K. M. Cameron presiding. A full account of this meeting appears above.

At noon, a luncheon was held in the ballroom, with Professor René Dupuis, chairman of the Quebec branch, presiding. The speaker was J. B. Carswell. His subject was "They Shall Beat Their Swords into Ploughshares." Mr. Carswell described the serious problem which was before the War Assets Corporation which he, as president, must be concerned with for many years to come. 510 sat down for the luncheon.

The afternoon was devoted to a paper by Dr. Harry G. Acres, "The Design of the Shipshaw Power Development." McNeely DuBose, vice-president of the Aluminum Company of Canada, was in the chair. Dr. Acres' paper will be printed in full in the April number of the *Journal*, and therefore no comment is being made on it here, except to say that it was attended by about four or five hundred persons who were deeply interested in the paper itself and the discussion which followed.

In the evening at 8.30 p.m. an unusual event was featured. The Université Laval presented honorary degrees of Doctor of Science to the retiring president, K. M. Cameron, and Brigadier A. Thériault, M.E.I.C. This was a most colourful occasion, and greatly appreciated by all those who were privileged to attend. Cardinal Villeneuve, as Chancellor of the University, congratulated the recipients, and presented them with their certificates. The citations were read by Monsieur Aimé Labrie, general secretary of the University, and the rector, Monseigneur Cyrille Gagnon, presented the candidates to the chancellor.

Mr. Cameron's address in reply to the presentation was one of the finest things that has been heard by an engineering audience. It was excellent material, delivered clearly and concisely. It is being reprinted in full in another part of this *Journal*. Brigadier Thériault also made very grateful and adequate response. His address was delivered in French.

The engineers of Canada will be greatly interested and pleased at the innovation which was indicated by the presentation of honorary degrees to members of their profession. It is a graceful compliment that, in departing from the procedure of honouring only classics scholars, engineers were selected for the inauguration.

The same evening special entertainment in the form of a Cabaret-Chantant was held in the ballroom of the Chateau. This provided some interesting divertissement, much enjoyed by all those who participated.

Friday, February 11th

Friday's programme was opened with two professional sessions, one of which ran all day, and the other made up of four separate papers, two in the morning and two in the afternoon. The long paper was on the subject of post-war planning for which Elliott M. Little, general manager of the Anglo-Canadian Pulp & Paper Mills, Ltd., presided.

The basis of this session was a paper written under the joint authorship of John E. Armstrong, M.E.I.C., chief engineer, Canadian Pacific Railway Company; R. M. Brophy, general manager, Canadian Marconi Company; G. A. Gaherty, M.E.I.C., president, Calgary Power Company and president, Montreal Engineering Company; Arthur Surveyor, M.E.I.C., consulting engineer, Montreal; R. L. Weldon, M.E.I.C., president, Bathurst Power & Paper Company Ltd.; H. G. Welsford, M.E.I.C., vice-president and general manager, Dominion Engineering Company, Limited.

The three sections of the paper were delivered by Messrs. J. E. Armstrong and J. B. Stirling. Unfortunately, three of the authors were absent because of illness. Mr. Stirling was asked to assist in the delivery of the paper because of his excellent qualifications for such an assignment.

The paper by the joint authors was followed by another under the authorship of Past-President C. J. Mackenzie. R. S. Jane, Director of Industrial Research, The Shawinigan Water & Power Company, was in the chair. This paper also dealt with post-war planning, under the title "Industrial Research in Post-war Canada." Both these papers proved to be extremely interesting, and it was quite evident they made a real contribution to the solution of this serious problem. It was also quite apparent that under the stimulation of such fine papers there was insufficient time for constructive discussion. Both papers will be printed immediately, and made available to the members of the Institute.

At the conclusion of the first paper, a resolution was approved whereby the Council of the Institute was asked to follow-up this session in whatever manner it was thought most assistance could be given. From this it is expected that Council will establish some further programme in the belief that the Institute can be of real assistance.

Of the parallel sessions, the first one was presented by M. G. Saunders, mechanical superintendent, Aluminum Company of Canada, Ltd., Arvida, under the title "The Development of Steam Production at Arvida." This meeting was very well attended, in spite of the strong counter-attraction provided by the post-war session. Mr. Saunders' paper will be printed in an early number of the *Journal*. Ralph C. Flitton, assistant to the manager, Engineering Division, Canadian Vickers, Ltd., presided.

The next session was on "Improved Soil Stabilization," a paper presented by Guillaume Piette, Jr.E.I.C., under the chairmanship of Ernest Gohier, chief engineer, Department of Highways, Quebec. This paper also will be presented to the members through the Journal.

At luncheon that day, under the chairmanship of Hector Cimon, vice-president of the Institute for Quebec, a very fine address was delivered by W. L. Batt, Hon.M.E.I.C., titled "Management's Need of Broader Vision." Mr. Batt's address is printed in this issue. Ontario Vice-President, Lieut.-Col. L. F. Grant, made an excellent speech in thanking Mr. Batt. The attendance at the luncheon was 594.

In the afternoon, the first session was "Social Security Planning in the English Speaking World." The speaker was Mr. Maurice Stack, technical adviser on social insurance, International Labour Office, Montreal. Mr. Wills Maclachlan, chairman of the Institute's Committee on Industrial Relations, was in the chair. Unfortunately, this meeting was not as largely attended as it should have been, due doubtless to the difficulty in locating the room in which it was delivered, and also to the keen competition afforded by the post-war session. However, Mr. Stack's paper and the discussion are printed in this issue of the Journal.

The last of the sessions on Friday was "Electronics, Radio, and Television", presented by H. L. Sheen, manager, Radio Section, Canadian General Electric Company, Toronto. Dr. Paul E. Gagnon, director of the Department of Chemistry, Laval University, presided. Mr. Sheen presented his paper in a very informal manner, much to the pleasure of his audience.

Annual Banquet and Dance

As usual, the banquet on Friday evening provided the highlight of the whole programme. 620 people were present, which is the second largest attendance which can be discovered among the Institute's records. K. M.

Dr. K. M. Cameron.

Mr. Cameron receives his doctor's degree from the chancellor of Laval University, Cardinal Villeneuve.

W. L. Batt, Hon.M.E.I.C., vice-president of W.P.B. and president of SKF speaks at the Friday luncheon.

"Anyone in the hall know anything about N.S.S. regulations?" asks E. M. Little, Chairman of the Post-war Planning Session.

Vice-President Hector Cimon, Quebec, presides at the Friday luncheon.

Dr. C. J. Mackenzie speaks on Industrial Research in the Postwar.

Cameron presided, although towards the end of the programme he turned over the reins of office to deGaspé Beaubien.

The prizes, medals, and honours of the Institute were presented and included the award of two certificates of honorary membership.

The speaker of the evening was the Hon. Adélard Godbout, Prime Minister of the province of Quebec, and his subject was "The Engineer and the Province of Quebec." He paid a very fine tribute to the profession and pointed out the opportunities which had always existed in the province of Quebec for the practice of engineering. The substance of his address is printed elsewhere in this issue.

Previous to the dance which followed the banquet a reception was held by the new president, deGaspé Beaubien and Madame Beaubien, the retiring president K. M. Cameron and Mrs. Cameron, and the chairman of the Quebec Branch Professor René Dupuis and Madame Dupuis. This afforded all members and guests an opportunity to meet these outstanding members of the profession and officers of the Institute.

Until an early hour in the morning, dancing held forth in the ballroom. It was a gay note upon which to conclude this day full of special features. The institution of "Muriel's Room" aided materially, and was much appreciated by everyone.

Ice-breaker Trip

A very special feature was added to the programme on Saturday morning, consisting of a trip up the river as far as the Quebec Bridge on the icebreaker *N.B. McLean*. About 150 people participated and everyone voted it a most unusually pleasant affair. Unfortunately, the combination of wind, weather, ice and tide made it necessary to alter the original arrangements, and in the shuffle a small group of people "missed the boat." This was a most regrettable occurrence, but was something over which no possible control could be exercised.

Many persons felt that this was the finest annual meeting ever held by the Institute. Certainly it will be difficult to arrange one that will be any better. Certain it is that no finer hospitality could be provided, or no better setting found, for such a meeting. Members from coast to coast are greatly indebted to the Quebec Branch for its most outstanding contribution to the life of the Institute. The opinion was expressed on all sides that another meeting should be taken to Quebec just as soon as possible. This is, perhaps, the finest tribute that could be paid to the branch.

AT THE ANNUAL BANQUET

Premier Adélard Godbout praises the engineers.

Dr. C. J. Mackenzie receives the Sir John Kennedy Medal from Premier Godbout.

Col. C. E. Davies, secretary of The American Society of Mechanical Engineers, enjoys a joke.

H. H. Henline, national secretary of the American Institute of Electrical Engineers, receives the certificate of honorary membership on behalf of Dr. R. E. Doherty, president of Carnegie Institute of Technology.

A. C. Northover of Canadian General Electric Co. Ltd., Peterborough, receives the John Galbraith Prize of the Institute.

Mrs. W. J. W. Reid of Hamilton, Ernest Hartford, executive assistant secretary of The American Society of Mechanical Engineers and Mrs. Hartford of New York, and E. M. Little of Quebec.

James L. Belyea, fourth-year student at the University of New Brunswick, came all the way from Fredericton to receive the Martin Murphy Prize.

SAID AT THE ANNUAL MEETING

President's Retiring Address

K. M. Cameron

The report of your Council has been presented to you for your consideration. It reflects the thought and care given to your Institute's business during the past year, the continuance of policies initiated during preceding years, the impact of conditions under which we are now carrying on, and the progress that has been achieved. It is a report of steady endeavour and progress both in matters of immediate and of long term value and importance to the profession and, we hope, to our country.

It is not my purpose to refer to specific matters dealt with by your Council. I would, however, express my deep appreciation of the attention and interest given by members of Council to your business, the ever willing desire to be of service in any capacity though unquestionably at considerable personal inconvenience and expense, the incisively constructive thought and study, in which respect no distinction can be found as it applies to the members of all your committees as well as to the members of your Council. To them all I extend my most appreciative thanks for unfailing and courteous, but most constructive assistance. To your general secretary, your assistant general secretary, and the loyal, efficient and hard working staff at headquarters your thanks, with mine are gratefully extended. To me it has been a fruitful and stimulating experience.

And I would like to take this occasion to say how deeply I appreciate the whole hearted and encouraging hospitality so genuinely shown when, following the now acknowledged custom, I visited the Institute branches. This was fully equalled by the interest shown in Institute and professional affairs, both present and future, and I therefore venture to submit some thoughts for your consideration.

Engineers discuss their activities from a professional viewpoint, and refrain from being vocal about the frequent changes of residence which are a characteristic of engineering employment. They do recognize and appreciate as beyond value the loyalty and devotion so unstintingly given by their wives. The profession is under a debt to these women it can never discharge. God bless them! They can take it!

The Young Engineer

No contribution of greater value to the people of Canada can be made by the engineering profession than that of fostering and developing the young engineer. Our engineering schools maintain the highest standards. Let us continue to support them, to assist them in their development. They are the threshold over which the young man steps into the world of engineering, that world where "all experience is an arch wherethro' gleams that untravelled world, whose margin fades forever and forever as I move." Much has already been exceedingly well done through the Institute to assist in the selection and guidance of the young engineer. There remains much to be done. It is an opportunity, an obligation, and the results, if consistently followed, will be of inestimable value to the country and to the profession.

Co-operation

Through the medium of this Institute the members of the engineering profession have steadfastly worked for the furtherance of the aims set forth in the by-laws. Through the Institute the value of the profession has been enhanced. By the consistent high standards set and maintained by its members, the Institute has gained a place and a voice in the development of this country, and in the respect the profession in Canada is held in other lands. This is a heritage we must appreciate at its true and high value. It is there to be shared with all engineers in Canada.

As the only voluntary, wholly Canadian, all-embracing professional engineering body, and as the largest and oldest of technical organizations, the Institute has rightfully taken the lead in the movement for co-operation. As the benefits of co-operative agreements already entered into become more widely known, and as the purpose or objective gains wider recognition, the progress already made will quicken. Maybe it will always encounter some opposition. That may be an advantage. Constructive and forward looking criticism is always valuable. But it is not very difficult to see its ultimate acceptance by all professional bodies who wish to retain their Canadian identity; another example of engineering foresight, of constructive long range planning.

The Engineer on Active Service

Science and engineering are the outcome of man's continuing urge to make available for himself, and others, the fruits of his God-given reasoning, observing, thinking powers applied to the latent resources so abundantly provided by the Almighty. It would seem one of the inexplicable contradictions or obstacles in the path of human progress that the implements, processes and materials man has developed for his betterment under divine inspiration, should be turned to his destruction. That attempt is now being made by that arch-criminal and vile person, Hitler, and those who follow his evil course. Is it that in its development and application of other humanizing concepts, society has fallen behind the progress in science and engineering ?

It is to the developments in these arts that the world has to turn to rid itself of this scourge. It constitutes a challenge to science and engineering of the most profound order to so acquaint itself with the course of events and of trends that in addition to developing those things which add to material comfort and well being, it shall so influence the development and application of humanizing concepts that no further cataclysms will be possible.

This is a large order. But science and engineering have been the outgrowth of truth and right.

From the ranks of those in this and other lands who follow the profession of engineering, many have gone forth to war for the right. Of the honour they have brought to the profession we are gratefully proud. The memory of those who will not again be among us will continue to shine down through the years. Our continued efforts to prepare for the future of those who will return will constitute our best commemoration of their willing and unselfish sacrifice. It is the least we can do. I am confident they would have it so.

It is to the spirit which prompted these and all other valiant men to go forth, and to the contribution of those who remained behind to see to their support that we owe the accomplishments already made in this great struggle for mastery, and the maintenance of right and freedom over evil and oppression. It must continue to be our first thought and pre-eminent task, above and beyond any consideration of personal comfort and gain, to see that these indomitable men, and women, lack nothing. They can be counted on to do their valorous duty, that the name of Canada will forever be honoured among all peoples. Can we do less ?

Together we are defending a priceless heritage, in our land and in our way of life. When the present struggle ceases, we must be prepared to improve and develop that heritage. We must show by thought and word and deed that we, engineers, have faith in Canada, and in its future, and to that future we dedicate the best that lies in us.

Greetings from Laval University

Monseigneur Cyrille Gagnon, p.a.
Rector

C'est avec un extrême plaisir que j'accueille ici, au nom de l'Université Laval, les hôtes distingués qui sont venus de tous les coins du pays, et même des Etats-Unis, pour assister dans notre ville au 58ème Congrès de l'Institut Canadien des Ingénieurs, et je souhaite à tous et à chacun la bienvenue la plus cordiale dans cette institution qui remonte, par le Séminaire, aux premiers temps du Canada français.

Je salue avec une joie particulière les anciens présidents et les autres docteurs qui nous ont fait l'honneur de se joindre à notre corps universitaire en revêtant leur toge pour cette circonstance.

Un congrès de l'Engineering Institute of Canada est toujours un événement important, qui attire les ingénieurs les plus renommés et les plus influents du Canada et même des Etats-Unis; aussi ne sommes-nous pas surpris que les grandes villes de notre pays se disputent l'honneur d'en être le siège. Cette année, c'est la vieille cité de Champlain qui est à l'honneur; et sans doute l'une des raisons qui l'ont fait choisir pour ces assises solennelles, c'est qu'elle est une ville universitaire; et plus précisément on a voulu, je crois, rendre hommage à l'Université Laval pour le magnifique essor, les merveilleux progrès de sa faculté des sciences. Je pense bien qu'on a voulu également reconnaitre la valeur et les mérites des membres de la section de Québec et particulièrement de son président M. René Dupuis, l'infatigable directeur de notre Département de Génie Electrique. Et je m'en réjouis vivement, avec tous mes collègues de l'Université.

L'Institut Canadien des Ingénieurs, Mesdames, Messieurs, accomplit dans notre pays une oeuvre de haute valeur scientifique et de grande portée sociale et nationale. Et c'est en partie pour reconnaître ce fait et offrir à l'Institut un témoignage sensible de notre estime et de notre sympathie que nous avons voulu décerner un diplôme d'honneur à deux de ses membres les plus actifs, les plus dévoués, les plus méritants, M. Kenneth MacKenzie Cameron, son distingué président, et le brigadier Antonin Thériault, surintendant général des arsenaux du Canada.

Dr. Cameron Praises Laval

It is a great honour Laval University confers on my colleague, Brigadier Thériault, and on me, and it is moreover a pleasure, indeed, to receive this tangible evidence of that honour at the hands of one we hold in highest esteem, for his simple kindliness of spirit, his broad outlook, and his attainments in the service of his people and his country.*

We are the outward recipients of this distinction. In its broader sense, we feel that Laval University wishes to give tangible evidence of its recognition of the part that science and engineering, pure and applied, have played and may play in our national life. We feel that recognition by Laval University will stimulate us all to continue and to increase our devotion to our task.

Laval University, although incorporated by Royal Charter in 1852, possesses a background in tradition, in service, reaching back to the earliest days of our country. Our history is replete with instances of courage, of fortitude, of service, emanating from the spirit which has fortified, guided and inspired those gallant men who went forth from these halls. That they will have worthy successors in abundance we have every faith. We owe a heavy debt to the founders of this University, and to these men, these pioneers in a pioneer country. They left their mark on it. With you, whose forefathers came from the land of Jacques Cartier, of Champlain, of Bishop Laval, we whose forefathers came from other lands join in remembering their service in the development of our country and their service to its people.

The country has developed and will continue to develop. In the forefront of all development is education, and universities not only interpret education, but foster its development. It is, as Lord Halifax points out in the address delivered here on May 29, 1943, necessary that education be supported by, not forcibly divorced by religion, that it is one of the first principles of religion—"to welcome careful search for truth, and it is a cardinal rule of science to despise or neglect no facts, however difficult or inconvenient." "Religion answers why, and science answers how, and these questions are complementary, and not in opposition, to each other."

With this background of history, of tradition, of service, and in consonnance therewith Laval University has added a Department of Sciences to its field in education. The development of this, as of other lands, has found science and engineering keeping pace with the other arts. Laval may be assured of the helpful support of The Engineering Institute of Canada in this enlargement of the sphere of usefulness. Just as science and engineering throughout the world appreciates the many noteworthy contributions made by men and women of France in that field, so do we of the scientific and engineering profession in all Canada value them, and value the contributions made by Canadians of French extraction in Canada. The Engineering Institute of Canada provides a means for interchange of knowledge, of views, of stimulating education, and development. But in a larger sense that contact brings us to know each other, to an appreciation of our own, as well as of the other man's shortcomings, and to appreciate even more fully that contribution we may make in our national life.

I consider myself indeed fortunate that I have been privileged to have known many engineers of French extraction. I honour the memory of those who have passed from among us. I cherish the friendship of those who permit me to call them friends. I look forward to increasing that circle of courteous, helpful, and stimulating friends and associates.

The extension of the facilities of Laval in the field of education in science and engineering is a matter worthy of special emphasis in these days of world conflict between those who endeavour to impose the abominable ideology of Hitler and those nations allied on the side of right. Hitler thinks he can destroy the result of centuries of advancement by causing the burning of books, by warping the minds of the young and leading them into the paths of evil, by an attempt to crucify

*Cardinal Rodrigue Villeneuve, chancellor of Laval University.

the spiritual example set us by our Lord and Master. He will surely fail. We must see that he does.

The young men and women you will train to take their places in our national life will learn from you the value of truth, will learn to think, to observe, to enquire, to reason, to become useful citizens. They will value more and more this training, will develop a deeper concept of the value of education, of knowledge. They will more and more realize the debt they owe to this University and its staff. They will learn respect for themselves, and will learn that service, under God, is the truest measure of a man.

The country needs such men and women. There is a place for them. There is work to do. We have faith in Canada. It is our country. Others have love for their countries. David, the psalmist, wrote: "Lord, Thou has been bountiful unto this Thy land." Sir Walter Scott wrote: "This is my own, my native land." Sir Adolphe Routhier: "O Canada, terre de nos aieux." These were their prayers.

May we not then, we of diverse origins, pray for understanding, for mutual respect, and apply the words of President Roosevelt as a prayer for ourselves.

"Let us, then, march forward, together, facing danger, bearing sacrifice, competing only in the effort to share even more fully in the great task laid upon us all. Let us, remembering the price that some have paid for our survival, make our contribution worthy to lie beside theirs on the altar of man's faith."

Citations for new Honorary Members

Daniel Webster Mead

Some engineers there be whose technical work is of a type which appeals directly to the public, because its visible results obviously contribute to the welfare of humanity. Dr. Mead is one of these, for in his special branch of engineering, he has been called upon to deal with problems of flood control, not only on great rivers in North America but in far off China as well.

Since his retirement in 1932 from the chair of hydraulic and sanitary engineering at the University of Wisconsin, one of his chief interests has been to study the training and subsequent progress of the young engineer and the many complex questions connected therewith.

He has been the recipient of many honours from his fellow-engineers in the United States, including the presidency of the senior Founder Society, the American Society of Civil Engineers, and the Washington Award given for "accomplishments which pre-eminently promote the happiness, comfort and well being of humanity." To these distinctions the Council of The Engineering Institute of Canada now has the pleasure, in the 60th year of service to the profession, of adding election as an honorary member of the Institute.

Mr. President—I have the honour of presenting to you for an honorary membership, *Dr. Daniel W. Mead*

Robert Ernest Doherty

Membership in the Engineers' Council for Professional Development, which The Engineering Institute of Canada has now held for more than three years, has helped to give us in Canada a better understanding of the many problems of professional education, ethics, and organization which face our fellow engineers in the United States. It has also made them aware of some of the difficulties which face us.

Under the chairmanship of Dr. Doherty, covering a period of three years, E.C.P.D. made very substantial progress in the important task of co-ordinating professional efforts. His wide outlook as chairman was based on his knowledge of the needs of young engineers on the staff of the General Electric Company at Schenectady, and also on his educational work as Dean of the School of Engineering at Yale University, and then as President of the Carnegie Institute of Technology at Pittsburgh. His recent election as President of the Society for the Promotion of Engineering Education is a testimony to his eminence as an authority in that field.

In addition to these matters, Dr. Doherty has undertaken much responsible war work, as a consultant and committee member, in connection with military training, production and management, for the U.S. Ordnance and War Departments. He is a member of long standing in the American Institute of Electrical Engineers, and the Lamme Medal of that society was awarded to him in 1937. To-day, in recognition of his attainments as an engineer and educationalist, the Council of The Engineering Institute of Canada is conferring upon him an honorary membership in the Institute.

Mr. President—I have the honour of presenting to you Mr. H. H. Henline, Secretary of the American Institute of Electrical Engineers, to receive an honorary membership on behalf of *Dr. Robert Ernest Doherty.*

The Engineer and Québec

(Abridged)

Honourable Adélard Godbout
Prime Minister of the Province of Quebec

I was greatly pleased, on looking through your heavily-charged programme, to note that not only were technical subjects listed, but that you also included post-war problems, and the responsibility which is incumbent upon governments and industry in general to maintain a higher standard of living for our people, after the war is over.

I wish to compliment you on this farsighted thinking. Engineers have ever been builders, active patriots, big-hearted and broadminded. They are the first artisans in the development of a land and the prosperity of a nation. Their suggestions are therefore very precious to those who have the heavy burden of administering the public domain.

For me to try to outline the great debt Canada owes to the talent, the initiative and perseverance of engineers would be a truly formidable undertaking. Despite the enormous difficulties confronting them, they have traced, in granite, cement and steel the gigantic monument which to-day forms the base of our economic backbone. But times have changed. Events sometimes move faster than man. The present situation has created special problems which will have to be solved without delay. And it is in reconstruction work, arising out of the war, in the application of truly peacetime works that the engineer shall allow his talent, science and devotion full scope. He shall aid public organizations and chiefs of industry to set on a new pedestal the activity we have displayed in helping win the war and assuring victory.

The Engineering Institute of Canada is composed of specialists, and for some time now we have lived in an era of specialization. Mechanical and electrical engineering were not fully developed at the beginning of the present century. Chemists had not yet occupied the prominent place they hold to-day in industry. Your association has brought all these scientists together under the one banner, and has given them the prestige to which they are entitled. I am pleased to note that since your group was first founded in 1887 six of my French-speaking fellow citizens have been called upon to fill the post of president. Some are still alive. You will, I am sure, allow me to congratulate them on having been chosen by their confrères, and also for having so brilliantly attained the foremost rank in their profession. . . .

We are not content to sit back and rest on our laurels. We believe that by increasing our provincial patrimony we will at the same time be working towards the general expansion of Canada, a land we want to see great and prosperous.

That is why it is so vital to stress, among our own people, the advantages of a technical education. We are not overlooking its importance for we have in the province, in addition to our technical schools and trades and arts schools, the École Polytechnique, in Montréal, from whence have come some of your society's most distinguished members; also a School of Forestry in Québec, affiliated with Laval University. In addition there have been founded in this city, with the aid of the provincial government, a School of Chemistry, a School of Mining and, barely two years ago, a School of Electrical Engineering, the direction of which has been entrusted to your tireless local chairman, Professor René Dupuis.

We are anxious to satisfy the scientific curiosity of our young people. They are showing keen interest in the applied sciences, and I am able to pridefully state that they have already given proof of their clear thinking and ability, in industry and teaching.

Our classical colleges develop and train priests, physicians, barristers and notaries, all of whom have brought honour to their professions, but the number turning towards scientific careers is increasing yearly. We are endeavoring to respond to this tendency by creating the necessary institutions.

Sensational revelations will doubtless be made public by scientists after the war, and we may logically expect the application of new and more economic processes, in the majority of manifestations of human genius. We should hold ourselves in readiness to profit by these improvements, to obtain our share of progress and, if necessary, to anticipate these precursors.

This is why we wish to co-operate with you, with sane capital, with all our compatriots, and with the rest of the world. Co-operation is the finest expression of peace. It is the common contribution of all men of goodwill who have the common welfare as their goal. The Province of Québec has, as have you all, made great sacrifices to assure the success of our armed forces. She also wishes to excel in pacific undertakings, and prepare for unborn generations a glorious future.

True patriotism is both idealistic and realistic. In my opinion it consists of fructifying, as required, the special talents of individuals as well as the riches which Providence has entrusted to our care in the corner of the world we inhabit.

Our country has reached the adult stage. It makes its power felt. Its commercial relations are growing. It now sends its own ambassadors to foreign countries. Its people, profiting through the genius of the two great races, are linked to the soil of Canada by deep-rooted beliefs and century-old traditions.

There only remains the creating, among all Canadians, of the true union that will make us a powerful people, of generous aspirations, working under the national flag—which unfortunately, we do not yet possess—for the general welfare of the nation.

Ladies and gentlement, I can think of no better symbol of unity than your Institute. Those who honour me this evening by listening to me come from all parts of Canada and the United States. They have left their homes and families to gather here, under the banner of a professional association, to discuss problems that interest the entire population. You understand each other perfectly because your goal is a common one, your ambitions are identical, and you like your work. I sincerely hope that all Canadians, whether they be of English, French or other origin, love their country as you love your profession. When this has been accomplished, we need entertain no doubt as to the future. Canadians will form a truly united family, ready to proudly stride forward to its destiny.

The head-table and part of the hall at the Annual Banquet.

From Month to Month

News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

YOUR INSTITUTE

The achievements of the engineering profession in the last five years have been outstanding. New levels of accomplishment have been reached by the engineers in all the active services and those at home, untiring in their efforts, have built and developed a war industry that has proved unequalled in quality, diversity and volume of production. In all of this The Engineering Institute of Canada has been privileged to help by disseminating technical information, and by special services to the government and to the engineers.

Now that the light of victory is dawning on us, preparation must be made for the transition from war to peace. During that difficult period, a great responsibility will rest upon the engineer. Many problems will arise which his special qualifications will help him to solve. These problems may be technical, economical, or social. In all of them he has a special part to play.

The engineer knows labour well. He understands its aspirations, its frustrations, its importance in our social system. He is known to and respected by labour, not only because of his personal qualities, but also because his mind develops the projects which give labour its employment.

Who better than the engineer can assist labour to see the problems of the employer, and the employer to realize the needs of labour? Production is the basis of prosperity, and unless the relationships between these two groups lead to maximum production there will be prosperity for neither. No matter what proposals are advanced as solutions to the post-war problem, we still can consume only what we produce.

The Institute itself will have definite post-war problems. One of these will be the successful transfer of its members from active services and from war industry into peacetime occupations. While the Wartime Bureau of Technical Personnel may be continued after the war, it seems evident that the Institute itself can also do much to help its members through that period of change.

During the past decade, steady development in the organization of the engineering profession in Canada has shown the necessity of closer association between our various technical societies. With this in view, certain proposals have now been made to change the by-laws of the Institute, so as to enlarge its field of usefulness and enable it to align itself more closely with bodies having kindred aims. Council has approved these proposals, and it is my earnest hope that all our members will vote for their adoption.

I am confident that in the future, as in the past, the Council will regard as of prime importance all matters of national significance which touch on the profession of engineering in Canada. In dealing with these questions, and in the discussion of important technical problems, the Institute's policy will continue to aim at the development of a national, rather than a local, point of view.

These and the many other endeavours of Council to promote the well-being of the engineers of Canada, deserve—and I am sure that they will receive—the fullest support of all our members.

President.

ANNUAL MEETING

The 58th Annual General and General Professional Meeting of the Institute has now joined with all previous meetings to build up that important part of the history of the Institute. It is difficult to imagine a more delightful occasion than that afforded in the city of Quebec on February 10th, 11th and 12th.

Since the start of the war, there has been a very definite development towards large attendance at annual meetings. This is true of all Canadian organizations, and American as well. The Institute records show that under to-day's conditions the attendance will run from 50 to 100 per cent greater than would have occurred previous to the war.

Doubtless there are several factors that contribute to this result. As far as the Institute is concerned, the first may well be that engineering topics of great general interest have come out of the war itself. These draw people to the centres where such matters are to be discussed. Another reason is that the level of employment is higher now than previous to the war, and therefore more persons find themselves able to meet the financial expenditures required. A third reason may be that the success of one meeting contributes to the success of another.

In the case of Quebec these was the additional reason provided by the attractiveness of the city itself. No city in Canada draws people to it as does Old Quebec. Coupled with the picturesque and historic features of the city, we have the famous hospitality of its people. This factor alone will do much toward bringing back to Quebec for subsequent meetings any or all of those persons who were fortunate enough to be present this year.

The largest attendance ever recorded for an annual meeting was that in Montreal in 1942, at which time over 1,100 people registered. The meeting just concluded at Quebec now ranks second, from that point of view. The registration ran to 821. There is no doubt but that a great many people attended the professional sessions without registering and it is more than likely that a correct figure, if everyone had registered as requested, would be between 900 and 1,000. In endeavouring to compute the number of persons who might attend this meeting, a maximum figure of 500 was selected, but an actual figure of 400 was taken as a likely average. In view of the facilities of the hotel, one may readily imagine the congestion which developed from such an unexpected attendance. The committees and the hotel were working under extremely difficult circumstances, and it is a miracle that they turned out such fine results.

The registration of ladies was perhaps the highest in percentage that has ever been attained. 222 were registered, of which 105 were from places other than Quebec city.

The professional programme was well received. Perhaps most prominence has been given to the papers on post-war planning, but in addition to these there were others of great importance. The press across the country seized on the post-war planning subject because it made the best news. The Institute has received many compliments and suggestions for future activity along the same lines.

The Quebec committees did a masterful piece of work. In spite of conditions which were severely adverse, they met every requirement and facilitated everyone in obtaining the maximum benefits from the meeting. The hotel, the city, the people, and the programme made a unusual combination. There may be larger meetings in the future, but no higher level of attainment will be achieved than that which now stands to the credit of the Quebec committees. The thanks of all those who participated have been earned by the branch, and have been freely given.

PRESIDENT'S MARITIME TOUR

The *Journal* presents herewith the itinerary for the president's tour of the Maritime branches and universities. It will be noticed that a Council meeting will be held in Halifax on Saturday, April 22nd.

The president will be glad to have with him for part or all of the journey any officers or members of the Institute who can see their way clear to make the trip. It is always appreciated by branches when the president includes in his party the members of other branches. It is realized, of course, that the congestion associated with travelling these days may make it more than usually difficult for persons to join the party.

It will be noticed that the president proposes speaking to the students at seven universities. This will be the greatest number yet included in a presidential tour. Last year K. M. Cameron broke new ground in visiting the University of New Brunswick at Fredericton, and the Nova Scotia Technical Institute at Halifax. The previous year he and Dean C. R. Young had visited at St. François-Xavier College at Antigonish. This year president Beaubien will add the Universities of Dalhousie, St. Mary's, Acadia and Mount Allison.

PROPOSED ITINERARY

Lve. Montreal.....Sunday, April 16th.....7.30 p.m. (Ocean
Arr. Moncton.....Monday, April 17th....3.40 p.m. Limited)

Branch Meeting, Monday Evening

Lve. Moncton.....Tuesday, April 18th....5.25 a.m. (43)
Arr. Saint John....Tuesday, April 18th....9.40 a.m.

Branch Meeting, Tuesday Evening

Lve. Saint John....Wednesday, April 19th..a.m.
Arr. Fredericton...Wednesday, April 19th..a.m.

Meeting with Students, Wednesday Afternoon

Lve. Fredericton...Wednesday, April 19th..p.m.
Arr. Saint John....Wednesday, April 19th..p.m.
Lve. Saint John....Thursday, April 20th... 7.15 a.m. (44)
Arr. Moncton.....Thursday, April 20th....10.15 a.m.
Lve. Moncton.....Thursday, April 20th....10.50 a.m. (2)
Arr. Sackville.....Thursday, April 20th....12.40 p.m.

Meeting with Students, Thursday Afternoon

Lve. Sackville.....Thursday, April 20th...5.05 p.m. (4)
Arr. Halifax.......Thursday, April 20th...10.50 p.m.

Meeting with Students, Friday.
Meeting with Branch, Friday Evening.
Council Meeting, Saturday Morning.

Lve. Halifax.......Monday, April 24th....a.m.
Arr. Wolfville.....Monday, April 24th....a.m.

Meeting with Students.

Lve. Wolfville.....Monday, April 24th....p.m.
Arr. Halifax.......Monday, April 24th....p.m.
Lve. Halifax.......Tuesday, April 25th....a.m.
Arr. Antigonish....Tuesday, April 25th....p.m.

Meeting with Students.

Lve. Antigonish
Arr. Sydney.......Tuesday, April 25th..a.m.
or Wednesday, April 26th..p.m.

Meeting with Branch Wednesday Evening.

INSTITUTE PAPERS ON THE POST-WAR

One of the greatest contributions to a national problem ever to be made by the Institute was that of the post-war session at the recent annual meeting. The paper by Past-President Mackenzie on Industrial Research in Post-war Canada, and the joint paper by six authors dealing with the post-war problem, were of unusual merit. It is expected that the demand for these papers in reprint form will be very large.

The final copy for the joint paper was not ready in time for inclusion in the March *Journal* and, as the April issue is being devoted entirely to the papers on Shipshaw, it has been printed as a separate which accompanies this number. The discussions also were not available for the March *Journal* but will appear in an early issue. The meeting at Quebec was concluded with a resolution which urged Council to follow up on the subject, and that something further be done with the paper. It is expected that at the next meeting of Council final plans along this line will be agreed upon.

Already there have been several demands for copies of Dean Mackenzie's paper. It appears in this number of the *Journal*, and a substantial quantity of reprints are at headquarters for further distribution. Members or non-members who require additional copies of either of these papers may obtain them through headquarters.

NEW HONORARY MEMBERS

One of the events of the recent annual meeting was the presentation of certificates of honorary membership in the Institute to two outstanding American engineers.

The first certificate was presented to Dr. Daniel W. Mead, a consulting engineer resident in Madison, Wisconsin. Dr. Mead was president of the American Society of Civil Engineers, in 1936. He is one of the best known engineers in the United States, and in honouring him the Institute has certainly honoured itself.

The second certificate was awarded to Robert Ernest Doherty, president of the Carnegie Institute of Technology at Pittsburgh. Dr. Doherty is a past-chairman of the Engineers' Council for Professional Development, and is at present president of the Society for the Promotion of Engineering Education.

These two gentlemen represent the finest things in the profession and the members of the Institute may well be proud of their new associates. So that Canadians will know more about their new fellow-members, the following biographic sketches are submitted.

Daniel W. Mead

Dr. Daniel W. Mead was president of the American Society of Civil Engineers in 1936. He is a well-known hydraulic, power, and valuations engineer. He received his preliminary training at Rockford, Illinois, and entered Cornell University and completed the usual four year civil engineering course in three years, being graduated in 1884. He returned to Rockford, where he became city engineer.

For a brief period he operated as a contractor on municipal works, but shortly returned to engineering practice as a consultant in the field of water supply. In 1904 he was asked to head the Department of Hydraulics and Sanitary Engineering at the University of Wisconsin, a position which he occupied for 28 years, retiring in 1932.

Dr. Mead is the author of many outstanding works. He is a member of the firm of Mead & Seastone of Madison, Wisconsin, and of Mead & Scheidenhelm of New York. He was a member of the engineering board sent to China in 1914 by the American Red Cross and the Chinese Republic to study the problem of flood control. He was a consulting engineer for the Miami Conservation District on flood protection works in 1915, and as a member of the committee investigated the 1927 Mississippi floods for the National Chamber of Commerce. He was a member of the Colorado River Board appointed under joint resolution of Congress to pass upon the plans for the Boulder Canyon project. He is a member of the board in connection with the construction work done in the Chicago Sanitary District.

In 1932 he was given the honorary degree of LL.D. at the University of Wisconsin and, in 1931, he was

Dr. D. W. Mead, Hon.M.E.I.C., "dean of engineering of North America," acknowledges honorary membership in the Institute at the Annual Banquet, in Quebec.

made an honorary member of the American Society of Civil Engineers.

One of Dr. Mead's principal interests has been the training and welfare of the young engineer, and he has established prizes for juniors and students in the American Society of Civil Engineers for papers on technical topics and ethics. He conducts a department in "Civil Engineering" dealing with the various phases of professional conduct.

He was the recipient of the Washington award, which is made upon the recommendation of the four Founder Societies and the Western Society of Engineers. It is awarded "as an honour" conferred upon a brother engineer by his fellow engineers on account of accomplishments which pre-eminently promote the happiness, comfort and well-being of humanity."

Two years ago Dr. Mead presented to the Institute 3,000 copies of his pamphlet "Standards of Professional Relations and Conduct", for distribution to engineering students in Canada. This pamphlet is one of the best works ever published on the subject.

Robert Ernest Doherty

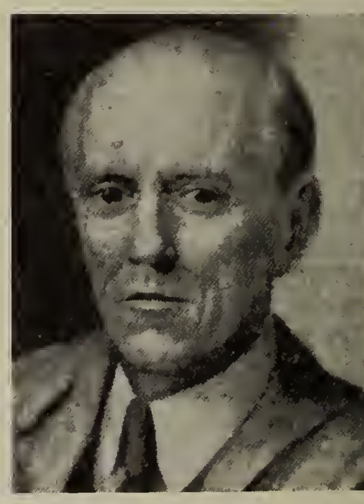
Dr. Doherty was born in Clay City, Illinois. He was graduated from the University of Illinois, in 1909, with a degree of B.Sc., and from Union College, in 1920, with the degree M.Sc. In 1931, he was given the honorary degree of Master of Arts from Yale, and in 1936 an honorary LL.D. from the University of Pittsburgh.

Dr. Doherty started as a student engineer with the General Electric Company, Schenectady, in 1909, and in 1910 became designing engineer on a-c machinery. Later, he became assistant to C. P. Steinmetz, and in 1922 was appointed consulting engineer. In 1931 he was appointed professor of electrical engineering at Yale University, and in 1933 became Dean of the School of Engineering. In 1936 he became president of the Carnegie Institute of Technology in Pittsburgh. In 1940 he was chairman of the Engineers' Council for Professional Development. In 1937 he received the Lamme Medal of the A.I.E.E. He is now president of the Society for the Promotion of Engineering Education.

Dr. Doherty is one of the outstanding members of the profession in the United States. He combines in excellent proportions the practising engineer and the teacher. All through his life he has been interested in technical education, and through scholarships at the General Electric, and through his teaching at different institutions, he has made a great contribution to the improvement of technical education.

He has always supported technical organizations, and under his presidency the Engineers' Council for Professional Development made its greatest advance. In his present office of president of the Society for the Promotion of Engineering Education, the indications are that he will establish an equally valuable record.

Besides his interest in the profession and education, Dr. Doherty has accepted heavy obligations on behalf of his country. For instance, he is chairman of the Consultative Committee on Engineering, War Manpower Commission; a member of the Civilian Advisory Council to the Military Training Service of the Ordnance Department; expert in the Army Specialized Training Division, Headquarters, Services of Supply, War Department; member of the National Advisory Committee, Engineering, Science, and Management War Training. He was chairman of the OPM Production Planning Board in 1941, and a member of the National Advisory Committee on Aeronautics in 1940-41. President Roosevelt appointed him to the board of visitors to the Naval Academy at Annapolis.



Dr. R. E. Doherty, Hon.M.E.I.C., after a portrait painted by himself.

He is a member of the American Institute of Electrical Engineers, American Society of Mechanical Engineers, Society for the Promotion of Engineering Education, Engineers' Society of Western Pennsylvania; a Director of the Forbes National Bank, Montour Railroad Company, and chairman of the Pittsburgh Branch of Board of Directors of the Federal Reserve Bank of Cleveland. His hobbies are painting and music, and several of his paintings have received widespread recognition. His contributions to the literature of the profession entitle him to rank in the forefront of such authors.

Just recently, Dr. Doherty has been selected by the Junior Board of Trade at Pittsburgh as the man of the year. Almost simultaneously with this honour he was awarded first prize by the Associated Artists of Pittsburgh for a self-portrait which is reproduced herewith.

Dr. Doherty will be welcomed into the Institute by great numbers of members who have had contacts with him through some of his many activities, and by others who hold great respect for him because of the attainments which are so well known to the members of the profession. It was unfortunate that illness prevented him from being present at the annual meeting to receive his certificate. At his request it was presented to Mr. H. H. Henline, national secretary of the American Insitute of Electrical Engineers.

WASHINGTON LETTER

A few days ago the Baruch-Hancock Report on "War and Post-War Adjustment Policies" was submitted to Director of War Mobilization Byrnes. As is usually the case with Mr. Baruch's reports, the document itself is comparatively short, terse and to the point. The report proper runs to forty-four double-spaced typed sheets with a summary and special sections on Contract Termination and Surplus Property. The report indicates that the two primary considerations are to get people back into peacetime enterprises and to effect the transition of business from Government domination back to the control of private enterprise. In respect to the first consideration, the report indicates that it may be necessary to set up a special authority under a Director of War Mobilization. This would probably mean that the job would be done by Executive Order. During the last week, Chairman George of the Senate Post-War Committee has been drafting a comprehensive programme for the post-war conversion of industry which parallels in many respects the Baruch report. But Chairman George would do the job through an agency created by Congress. These two approaches to the problem of giving effect to conversion plans will probably be the subject of considerable discussions.

The main sections of the report deal with the following aspects of the problem—Demobilization, Settlement of Terminated War Contracts, Disposal of Surplus Property, General Tightening of the Entire Government War Machine for Both Mobilization and Demobilization, Special Planning Against the Event of a Sudden Collapse of Germany, Extension of Certain Existing War Powers, Tightening of the Handling of Cancellations, Small Businesses, Drafting of a Post-War Tax Law and Initiating of a Public Works Programme.

Of the many significant statements, the following is a good example:

"Our concern over pressure groups is another reason why we have guided our recommendations so that once victory is won we can close the books on the war as quickly as possible.

"We have not wanted to leave the government after the war a jackpot of controls which invite every pressure group to hit it."

Also in the post-war planning field, the National Association of Manufacturers have mapped out an extensive programme which includes nearly all phases of the problem as it is presented to manufacturers. The Chamber of Commerce has picked out fifty-three typical cities in the United States whose economy has been most seriously affected by the war. Complete studies are being made regarding the conversion problems facing these communities. The results of what is at present known as the "Fifty-Three City Survey" should be very significant. Last week at Atlantic City, representatives of labour, agriculture and business held a Post-War Conference and studied, amongst other matters, the recommendations of the Baruch Report. In addition to the associations already mentioned, the A.F. of L., American Legion, Association of American Railroads, Committee for Economic Development, C. I. O., National Foreign Trade Council, National Grange, Rotary International and many other associations are giving thought to this problem.

President Roosevelt has before Congress a very ambitious Highway Plan, involving a network of some 34,000 miles of super highways crossing the country. This project is designed with a view to providing work in the immediate post-armistice period. The plan has been drafted by the National Inter-regional Highway Committee and calls for the expenditure of $750,000,000 annually for a period of from 10 to 20 years. Direct and indirect employment of an estimated 2,000,000 persons would be involved. It is interesting to note that while the network would comprise only about 1 per cent of the total road mileage of the country, it is expected that it would carry about 20 per cent of the total travel.

Feb. 21st, 1944. E. R. Jacobsen, M.E.I.C.

MEETINGS OF COUNCIL

The Annual Meeting of the Council of the Institute was held at the Château Frontenac, Quebec City, on Wednesday, February 9th, 1944, convening at ten o'clock a.m.

Present: President K. M. Cameron (Ottawa) in the chair; Past-Presidents C. J. Mackenzie (Ottawa) and C. R. Young (Toronto); Vice-Presidents Hector Cimon (Quebec), L. F. Grant (Kingston), G. G. Murdoch (Saint John), and C. K. McLeod (Montreal); Councillors J. E. Armstrong (Montreal), E. D. Gray-Donald (Quebec), R. E. Heartz (Montreal), W. G. Hunt (Montreal), W. Jackson (Kingston), J. R. Kaye (Halifax), J. A. Lalonde (Sorel), N. B. MacRostie (Ottawa), A. W. F. McQueen (Niagara Falls), H. G. O'Leary (Fort William), G. M. Pitts (Montreal), C. Scrymgeour (Halifax), J. A. Vance (London), and H. J. Ward (Shawinigan Falls); President-Elect deGaspé Beaubien (Montreal), Vice-President Elect E. B. Wardle (Grand'Mère); Councillors-Elect R. S. Eadie (Montreal), P. E. Gagnon (Quebec), P. E. Poitras (Montreal), and C. Stenbol (Sault Ste. Marie); General Secretary L. Austin Wright and Assistant General Secretary Louis Trudel.

There were also present by invitation—Past-Presidents J. B. Challies, O. O. Lefebvre and F. P. Shearwood, of Montreal; Past-Councillors A. Larivière (Quebec) and E. Viens (Ottawa); W. L. Saunders, chairman of the Ottawa Branch; H. F. Bennett (London), chairman of the Committee on the Training and Welfare of the Young Engineer; J. G. Hall (Toronto), chairman of the Membership Committee; R. B. Young (Toronto), chairman of the Committee on the Deterioration of Concrete Structures; René Dupuis, chairman of the Quebec Branch, and A. E. Paré, member of the Quebec Branch Executive Committee.

Committee on Employment Conditions—The general secretary explained that this is the same subject as appeared on the agenda of the last meeting of Council under the heading "Collective Bargaining". The new title had been chosen as it was more comprehensive and placed less emphasis on the union angle of the problem. After a short outline of the conditions which had led up to the appointment of a committee by the president, the general secretary read the report of the committee as follows:

> The committee, as selected by President Cameron, is as follows: G. McL. Pitts, P. B. French, G. N. Martin, and the general secretary. The committee

met in Montreal on Tuesday, February 1st, with a full attendance.

The committee believes that this is a very important and serious problem which the Institute must face immediately. It is not a simple one inasmuch as a great many factors are involved, and not much is known about some of them at the present time.

The resolutions from the two branches are symptomatic. There are indications that this subject is being discussed in many other sections of the Institute. It is particularly important to the young engineer, and therefore in setting up committees and at all stages in our deliberations, it is recommended that there be a fair representation of the younger members.

After considering the resolutions forwarded to Council by the Halifax Branch and the Moncton Branch, and after making a preliminary of recent developments in the United States, the committee reports as follows:

(1) The question of employment conditions which involves labour unions, collective bargaining, remuneration, etc., should be closely studied by the Institute. *It is recommended* that a small committee be selected by the president to study the problem in complete detail. This committee might be made up of members in Montreal, Toronto, and Ottawa. Perhaps committee members might be selected in more remote points, with the idea that all could meet together at an appropriate time at a central place to discuss and record their individual conclusions.

As this study will be based largely on legislation, both that which is proposed and that which has been enacted, reports, reviews and practices in other countries, it can be studied by members of a committee working singly, but it is desirable that they be brought together at some time in order to review their ideas and to arrive at common conclusions. The committee should not be large, but must be carefully selected.

(2) *It is recommended* that the general secretary secure all the information on this subject that is available, which will include experiences in the United States, Great Britain, and, if possible, Germany as well. This information should go to the committee which will select portions that should be sent to every member of the Institute through the *Journal*, and/or by direct mail.

(3) *It is recommended* that the problem be placed before branches for discussion, the idea being that at least one meeting will be held at which members may ask questions and express opinions. If possible, resolutions should be passed by the branches, expressing the opinion of the meeting.

(4) *It is recommended* that after the information has been placed before every member and before all branches, a ballot be circulated to record the opinions of all Juniors and corporate members of the Institute.

This vote shall be used as a basis of action by Council.

The general secretary explained the developments in the United States which had brought this subject to a head within recent months. He pointed out that, in the United States, the Wagner Act provided for national collective bargaining, whereas there was no similar legislation in Canada. He emphasized that "employment conditions" could very well include many things besides the possible union type of organization for engineers. He reported that the first sections of the American Society of Civil Engineers which had voted on their proposal to establish collective bargaining units for the engineers had voted 94 per cent in favour of the units as against 6 per cent opposed. In one section 97 per cent voted in favour of the bargaining unit being established.

Mr. Pitts emphasized the importance of the Institute studying this problem. He was of the opinion that an engineer who was a member of the Institute or of a provincial professional association should not be in a trade union. He emphasized the conditions of labour in Canada which he thought were only temporary and therefore recommended that the Institute advance very slowly in these matters.

Mr. Poitras, on the other hand, recommended that the Institute act very quickly, as additional union organizations were being established which the engineers were being invited to join.

Mr. Eadie pointed out the difficulty which the young engineer would have in staying out of the union that was in control in a plant where he was working, particularly when the engineer was not doing professional work. He thought that the young engineer's desire for salary protection might encourage him to be interested in a trade organization.

Mr. Lalonde supported the committee's proposal to study the problem and he recommended that conditions in each province be kept in mind as the labour legislation, up to the present, was provincial rather than federal. He thought it might be advantageous to consider it first in the provinces and then study it nationally.

Mr. Kaye commented on the condition in Halifax which has prompted his branch to send the resolution to Council. He thought his branch was sympathetic to a collective bargaining organization and would support a move in that direction.

The general secretary reported that the co-operation of the provincial associations had been included in the deliberations of the special committee, but that it had been thought that the study could be done quicker by a smaller group and that the findings might, with advantage, be referred to the provincial associations and their co-operation invited.

Dean Young and Mr. Bennett spoke of the interest in this problem which had been shown by the Ontario Association of Professional Engineers. It was thought that the Association had this in mind at the time it decided to appoint a field representative.

Mr. Pitts raised the point as to whether or not other professions were interested in this development. Dean Young and the general secretary referred to the other professions in Ontario and in the States, indicating that they were not involved, principally because they were mostly self employed.

The possibilities of the young engineer being excluded from certain portions of his junior work, such as drafting, if he did not belong to a trade union was brought out by Mr. Hunt, Mr. Lalonde, Mr. Bennett, and Mr. MacRostie. Mr. Shearwood also spoke on this phase of the problem and pointed out the difficulty there was in drawing a proper line. He also commented on the fact that many members of the Institute are employers as well as employees. This might lead to some confusion in working out a solution. He expressed emphatically, the opinion that there was no one so badly paid as the expert draftsman.

Mr. Eadie mentioned the situation that faces the student and young graduate who are gathering their practical experience in the shop. These young men are in direct contact with the unions and the situation is quite difficult. Dean Young, in commenting on Mr. Eadie's remarks, told of the head of a department of metallurgical engineering in the States. He had found great difficulty in placing his students and young men in the field so that they could get practical experience because the unions would not permit them to work without becoming members of the union.

Dean Mackenzie supported the report of the committee and thought that it was very essential that a committee be set up immediately to study the problem. He emphasized the need of approaching the problem in a tolerant manner and avoiding any snap judgment. He mentioned the fact that in England there was a trade union organization headed up by one of the principal scientists in that country. This union was doing a very fine work and members of the profession were quite satisfied with it.

On the motion of Mr. Pitts, seconded by Dean Mackenzie, it was unanimously resolved that the report of the committee be adopted.

Committee on the Young Engineer—In commenting on the work of the Committee on the Training and Welfare of the Young Engineer which had been covered in his annual report to Council, Mr. Bennett felt that there were two developments in which the Council would be particularly interested. Arrangements had been completed whereby the Canadian Legion Educational Services were having printed a special edition of the committee's booklet, "The Profession of Engineering in Canada" for distribution to the armed forces as part of their programme for the rehabilitation of returned men. The booklet is to have different cover from that of the Institute edition, and several of the pages have been revised to bring the context up to date. The type was to be kept standing so that the Institute's committee could have a new edition made for its own use. Both Mr. Bennett and Headquarters had received the thanks of the Canadian Legion for this assistance.

The second request for the use of the booklet and the committee's set-up of counsellors had come from Mr. Crawford, superintendent of Vocational Training in the Department of Pensions and National Health. Mr. Bennett reported that on behalf of his committee he had offered the Department the services of its organizations right across Canada. He expected this would be of material assistance to the Department in its rehabilitation programme.

Mr. Bennett reported that in addition to the section which had been operating in Montreal for a long time, new Junior Sections have been opened up at Toronto, Peterborough and the Saguenay branches, and a Student Section has been established at the University of British Columbia. Requests for Student Sections have been received from other universities as well. He expressed the hope that the work of his committee had been acceptable to Council, and asked that it be continued. He pointed out that the committee has now completed five years service.

As one who had for some time sat in on the Canadian Legion Educational Committee, Mr. MacRostie felt that he would like to pay tribute to the work of Mr. Bennett's committee. He knew something of the work of that committee and also of the Canadian Legion Educational Committee, and felt that it was a high honour to the Engineering Institute to have its work recognized in this way. He thought that the Council should place on record its appreciation of the work done by Mr. Bennett and his committee, and he had much pleasure in so moving. Mr. Hunt seconded the motion, which was carried unanimously. In conveying this appreciation to Mr. Bennett, Mr. Cameron stated that one of the most effective pieces of work which the Institute has done in recent years has been carried out by Mr. Bennett and his committee.

Mr. Challies made reference to a manual which is being prepared by a committee of the Engineers' Council for Professional Development for the use of the young engineer. He thought this was a field in which Mr. Bennett's committee might become increasingly active. In answer to this suggestion, Mr. Bennett stated that this matter had not been overlooked. In Canada, junior engineers are very anxious to get something along the line referred to by Mr. Challies, and his committee has decided to use the E.C.P.D. manual to which he referred which is being prepared under the editorship of Dr. Wickenden. It is expected that it will be ready during this year, for distribution by the Institute in Canada. Student selection and guidance is only the beginning of the committee's work. The committee is planning to follow through so that students will be well established and their performance as citizens will be a credit to the profession.

Technical Education—The president explained that a memorandum had been submitted by Dean Young which made certain recommendations with reference to technical education in Canada. This memorandum appears elsewhere in this issue.

In response to a request from the president, Dean Young summarized the memorandum as follows: The question of technical training between the level of technical schools and the engineering faculties of the universities is becoming extremely important, particularly in view of the men returning from overseas and others being released from industry. He pointed out that a great many persons who desired technical education would not be able to take the full professional course. The institution which he had in mind was known as a "Technical Institute." It gave two years training beyond high school. Students therein usually have direct practical objectives in mind and are more interested in doing things than in theoretical study. They make excellent foremen, superintendents, managers, etc. Those who show up to advantage in such a short course might well go on to the professional degree.

He thought that the universities would find it impracticable to enlarge their premises and their organizations to do this work satisfactorily. He also thought that the training was more advanced than that supplied in the secondary schools. Therefore, he was of the opinion that new organizations would have to be established, and he mentioned the possibility of many buildings now being used for war work being suitable for such schools, particularly as they were filled with mechanical equipment suitable for such training.

Considerable discussion followed Dean Young's explanation and was participated in by Messrs. Pitts, Poitras, Mackenzie, Vance, and the president. In conclusion, the following resolution was moved by Mr. Armstrong, seconded by Mr. Vance, and carried unanimously:

> That the Council of the Institute approves of the principle of establishing a number of technical institutes in Canada in accordance with the memorandum submitted by Dean Young;
>
> That the Institute request its branches in the various provinces to bring the need for some action in this matter to the attention of the provincial Department of Education; and
>
> That the Institute inform each provincial Association or Corporation of Professional Engineers of

the above procedure and request their co-operation in the movement.

Committee on the Engineer in the Active Services—The general secretary outlined the work of this committee since its inception in February of last year. He reported that a final brief was now before each member of the committee for review with the idea of presenting it to the Minister of National Defence, Colonel Ralston. He summarized the report, indicating that the three points which were to be emphasized were as follows:

1. The failure of the Royal Canadian Ordnance Corps to give engineers senior appointments whereby they might be in charge of the engineering work done by the Corps.
2. The appointment of non-technical persons to positions which call for technical knowledge and experience.
3. The failure to give engineers rank or pay as a professional recognition, as contrasted with the treatment given certain other professions.

Committee on the Engineer in the Civil Service—Mr. MacRostie, chairman of the committee, reviewed the work which had taken place since the establishment of the committee in February of last year. He reported that a brief had been presented before the Coon Committee which was considering Civil Service salaries, and that by way of following up, the committee had called upon Mr. Ilsley, the Minister of Finance, and more recently upon the Hon. Mr. McLarty, who was chairman of a Cabinet committee discussing the same question.

Mr. MacRostie pointed out that the work of the committee had been reported in full from time to time in the *Journal*, and that up to the present time the committee could not report that any of its objectives had been obtained. He now asked the Council for further instructions. Did Council want the committee to stop where it was or could it suggest further action that might produce the desired increases in the salaries for this underpaid group?

Mr. Beaubien, a member of the committee, amplified Mr. MacRostie's report, and expressed the opinion that it might not be necessary to keep the committee standing unless Council had some definite instructions to give.

Mr. Pitts was of the opinion that the committee should be continued so that there would be a liaison in Ottawa in case any further openings should develop in which the Institute might be of service. This recommendation was accepted with the suggestion that the Ottawa Branch endeavour to keep the committee informed.

Statistical Methods of Quality Control—The general secretary read the following letter which he had received from President Cameron:

"The subject of Statistical Methods of Quality Control was discussed at a recent meeting of the directors of the Canadian Engineering Standards Association and the opinion was expressed that such matters were possibly more the function of the Engineering Institute, or a body of like nature, than a standardizing body such as the C.E.S.A.

"Since this subject has been discussed in papers read at several meetings of the Engineering Institute, I am, with the knowledge and approval of the secretary of the C.E.S.A., writing to suggest consideration of the establishment of a continuing body to study this important matter.

"It is, I know, a matter in which Mr. W. P. Dobson, M.E.I.C., is much interested, and, if it should be decided to form a committee, he might be prevailed upon to accept the chairmanship. Other suggestions were made that the Northern Electric Company and the Bell Telephone Company, among others, might be interested."

Dean Young felt that this was a matter of great importance. The University of Toronto had given thought to it, but at present found it impracticable to include any course in the curriculum.

Mr. Armstrong felt that the Institute should certainly take some action and, following further discussion, on the motion of Mr. Armstrong, seconded by Mr. McLeod, it was unanimously resolved that a committee be appointed to explore the possibilities and see what contribution the Institute could make, such committee to be selected by the president on the advice of the incoming Council.

Conditions of Life Membership—The general secretary reminded Council that two years ago at the Annual General Meeting a proposal suggesting that life membership in the Institute be made automatic had been discussed. Following consideration at several Council meetings, it had been decided that no action should be taken and that the proposal should be tabled. Since that time the general secretary had made inquiries and had secured information as to the conditions of life membership in other societies. He had received many inquiries as to what the Institute was going to do about this, and would like an expression of opinion from Council.

As chairman of the Finance Committee which had considered several applications for life membership during the past year, Mr. McLeod said he would like to know the views of Council on this matter. The committee had made recommendations to Council on the basis that if a member was ill or financially unable to pay his fees, he should receive every consideration, but if a man was still practising, the committee felt very strongly that life membership should not be granted.

Mr. Vance pointed out that Institute fees were very much lower than those of the societies which had some form of automatic life membership.

It was finally decided that a committee should be appointed by the president to investigate this matter and present a report to Council.

Treasurer of the Institute—A petition was presented from all surviving past treasurers of the Institute except one, recommending that the treasurer of the Institute be made a member of Council with full voting privileges.

The Council was sponsoring a new by-law which would permit sister societies with which the Institute has co-operative agreements, to appoint one of their members, who is also a Member of the Institute, to the Council of the Institute. An amendment to section 29 of the by-laws was being put forward to provide for the inclusion of such persons on the Council, and it was suggested that, at the Annual Meeting, Council should propose an amendment to the amendment to include also the treasurer of the Institute.

In Mr. Pitts' opinion, as the treasurer was appointed by Council and not elected, he should not be given voting privileges. In order to have full privileges, Mr. Pitts felt that the treasurer should be an elected member of Council.

Several persons, including Messrs. Armstrong, Vance, Hunt and Beaubien, spoke in favour of the suggestion, and on the motion of Mr. Vance, seconded by Mr. Murdoch, it was unanimously resolved that Council, at the Annual General Meeting, should propose an amendment to the amendment of section 29 of the by-laws, to include the treasurer as a full member of Council.

Elections and Transfers—A number of applications were considered and the following elections and transfers were effected:

ELECTIONS AND TRANSFERS

Members

Fontaine, Roland, B.A.Sc., C.E. (Ecole Polytechnique), asst. divn. engr., Department of Roads, Province of Quebec, Ormstown, Que.

Goldwag, David, Diploma Engr. (Tech. Univ. of the Free City of Danzig), tool designer, Engineering Dept., Canadian Car & Foundry Co., Montreal, Que.

Lamoureux, Georges, B.A.Sc., C.E. (Ecole Polytechnique), junior engineer, Department of Public Works of Canada, Montreal, Que.

Latreille, Raymond, B.A.Sc., C.E. (Ecole Polytechnique), chief engr., Hydraulic Service, Dept. of Lands & Forests, Province of Quebec, Quebec, P.Q.

Longpré, Arphile, B.A.Sc., C.E. (Ecole Polytechnique), asst. engr., Works Department, City of Quebec, P.Q.

Morissette, Emile, B.A.Sc., C.E. (Ecole Polytechnique), engr., i/c east section, Roads Dept., City of Montreal, and associate professor on roads, Ecole Polytechnique, Montreal, Que.

Royer, Maurice, B.A.Sc., C.E. (Ecole Polytechnique), S.B. (Civil) (Mass. Inst. of Technology), consulting engr., and professor, Faculty of Science, Laval University, Quebec, P.Q.

Sproule, Stanley M., B.Eng., B.Arch. (McGill Univ.), i/c design, Robert A. Rankin & Co., Montreal, Que.

Watson, Norman Stewart Bain, B.Sc. (N.S. Tech. Coll), elect'l. engr., chief Architect's Department, Canadian National Rlys., Montreal, Que.

Juniors

Brière, Roger, B.A.Sc., C.E. (Ecole Polytechnique), junior engr., Dept. of Transport, Montreal, Que.

Brochu, Blaise, B.A.Sc. (Laval Univ.), sales engr., LaSalle Builders' Supply, Montreal, Que.

Elliott, Robert Barry, B.Eng. (McGill Univ.), inspn. supervisor, Defence Industries, Ltd., Brownsburg, Que.

Millman, Robert Noverre, B.Sc., (Univ. of Sask.), Sub.-Lieut. (Special Br.) R.C.N.V.R., Works & Bldg. Dept., Naval Service, Ottawa, Ont.

Morgan, John Willis, B.Sc., (Univ. of Alta.), prodn. engr., British American Oil Co. Ltd., Toronto, Ont.

Patterson, Samuel Morse, B.Sc., (Univ. of Toronto), supervisor of process control, Bayer Ore Plant No. 2, Arvida, Que.

Scott, H. Melville, B.A.Sc., (Univ. of Toronto), technologist, Campbell Soup Co. Ltd., New Toronto, Ont.

Zirul, Melvin Lee, B.A.Sc., (Univ. of B.C.), engr., Dominion Water & Power Bureau, Dept. of Mines & Resources, Vancouver, B.C.

Affiliate

Henderson, John D., 376 Redfern Ave., Westmount, Que.

Transferred from the class of Junior to that of Member

Berry, Melville Douglas, B.Sc., (Univ. of Man.), chief engr. Leland Electric Can. Ltd., Quelph, Ont.

Clarkson, Arthur Grant, B.A.Sc., (Univ. of Toronto), aeronautical engr., Canadian Pacific Air Lines, Ltd., Edmonton, Alta.

Martin, Gerald N., B.A.Sc., C.E., (Ecole Polytechnique), combustion sales engr., Dominion Bridge Co. Ltd., Lachine, Que.

Transferred from the class of Student to that of Junior

Binks, Wyman Rodger, B.Sc., (Queen's Univ.), F/Lt., R.C.A.F., armament officer, Western Air Command, Vancouver, B.C.

Drynan, David Alan, B.Sc., (Univ. of Man.), asst. switchgear engr., Peterborough Works, Canadian General Electric Co., Peterborough, Ont.

Pasquet, Pierre Auguste, B.Sc., (Queen's Univ.), designing engr., H. G. Acres & Co., Niagara Falls, Ont.

Singer, Gerald Gershon, B.Eng., (McGill Univ.), Manager, Atlas Engineering Works, Montreal, Que.

Admitted as Students

Armstrong, Gordon Millard, (Univ. of N.B.), Lawrence Station, N.B.

Belford, Richard Bruce, (Univ. of Toronto), 13 Wilgar Rd., Toronto, Ont.

Black, James William, (Cent. Tech. School, Toronto), 168 Dufferin Rd., Ottawa, Ont.

Ilovitch, Eli Louis, (Montreal Technical School), Air Conditioning Engr. Co., Montreal, Que.

Longworth, Jack, (Univ. of Alta.), Box 75, Bellevue, Alta.

Maxwell, Douglas Garvin, (Univ. of Man.), 507 Rosedale Ave., Winnipeg, Man.

Page, John Edward, (Univ. of Man.), 998 Jessie Ave., Winnipeg, Man.

Pouliot, Jean, (Laval Univ.), 46 duBuisson, Beauport, Que.

Roy, Douglas John, (Univ. of Man.), 352 Bartlett Ave., Winnipeg, Man.

Spence, Allan John, (Univ. of Alta.), 9832-113 Street, Edmonton, Alta.

Students at Ecole Polytechnique

Bernardi, Aldo, 5008 Papineau St., Montreal, Que.
Donato, Paul, 9333 Bellevue, Montreal, Que.
Douville, Gerard, 1603 St. Hubert St., Montreal, Que.
Duchesneau, Jean Joseph Noel, 10806 St. Denis, Montreal, Que.
Fyen, Roger, 4086 St. Hubert St., Montreal, Que.
Gariépy, Jacques, Ecole Polytechnique, Montreal, Que.
Gignac, Jean-Paul, 3483 Laval, Apt. 3, Montreal, Que.
Gilbert, Edgar, 185 Sherbrooke St. East, Montreal, Que.
Godbout, Serge, 5037 Fabre St., Montreal, Que.
Grenon, Jean-Joseph, Ecole Polytechnique, Montreal, Que.
Jutras, Gaston, Ecole Polytechnique, Montreal, Que.
Laganière, Fernand, 4702 Lafontaine, Montreal, Que.
Laganière, Gabriel, 4702 Lafontaine, Montreal, Que.
Lalonde, Marcel, 4-13th Ave., Lachine, Que.
Langlois, Roger Prendergast, 1908 Van Horne, Montreal, Que.
Laurier, Armand, 1735 Dufresne, Montreal, Que.
Masse, Robert, 4108 Hingston Ave., Montreal, Que.
Monty, Jules Guy, 2630 Soissons, Montreal, Que.
Noiseux, G. Fernand, 413 Metcalfe Ave., Westmount, Que.
Pageau, J. H. Albert, 3089 Blvd. Lapointe, Tetreaultville, Que.
Piché, Jean-M., 2135 Marlowe Ave., Montreal, Que.
Saint-Louis, Renel, 7005 Iberville, Montreal, Que.
St. Pierre, J. C. D'Arcy, 5055 Turcot St., Montreal, Que.
Tessier, Rene, 360 St. Just St., Montreal, Que.
Theault, Robert Charles, 3156 Tremblay St., Montreal, Que.

Students at McGill University

Bloomberg, Allan David, 5136 Decarie Blvd., Apt. 8, Montreal, Que.
Brennian, Frank Hugh, 620 Prince Arthur St. West, Montreal, Que.
Filion, Marcel, 5586 Philips Ave., Montreal, Que.
Leach, John Gordon, 41 Arlington Ave., Westmount, Que.
Levitt, Morton, 5436 Hutchison St., Outremont, Que.
Miller, Thomas Arthur, 3671 Jeanne Mance St., Montreal, Que.
Scott, Walter Barrett, 3516 Lorne Ave., Montreal, Que.
White, H. Edward, 340 St. Joseph St., Lachine, Que.

Students at Nova Scotia Technical College

Coish, Harry Oswald, Pine Hill Residence, Halifax, N.S.
Cook, George Hamilton, Box H, Dorchester, N.B.
Cosgrove, Edward Thomas, 155 Walnut St., Halifax, N.S.
Cox, Burnell Bigelow, 16 Prince Arthur St., Amherst, N.S.
Cummings, George William, 247 Le Marchant Rd., St. John's, Nfld.
Rice, Robert McNeill, 386 South St., Halifax, N.S.

Students at Royal Naval Engineering College, Plymouth, England

Arnsdorf, Hans, R.N.E.C., Manadon, Crownhill, Plymouth, England. (Home—Lethbridge, Alta.)

Boyle, Lionel, R.N.E.C. Manadon, Crownhill, Plymouth, England. (Home—Ottawa, Ont.)

Jones, Donald Stephenson, R.N.E.C., Manadon, Crownhill, Plymouth, England. (Home—Calgary, Alta.)

Wade, Henry John, R.N.E.C., Manadon, Crownhill, Plymouth, England. (Home—Ottawa, Ont.)

By virtue of the co-operative agreements between the Institute and the provincial associations of professional engineers, the following elections have become effective:

Doull, George Roy, asst. engr., C.N.R., Moncton, N.B.

Bartley, Edward John, B.A.Sc. (Univ. of Toronto), S/L (Elec.), R.C.N.V.R., elec. artificers' workshop, H.M.C. Dockyard, Halifax, N.S.

Nutter, Ned Frankling, B.Sc. (Civil), (Worcester Poly. Inst.), i/c Western Union Telegraph plant dept., N.B., N.S. and Nfld., 78 King St., Truro, N.S.

Stein, Marcus, B.Eng. (McGill Univ.), asst. constrn. mgr., Foundation Maritime Ltd., 12 Second Street, Halifax, N.S.

In adjourning the meeting, President Cameron thanked all members of Council for the splendid co-operation and support he had received during his term of office.

The Council rose at one fifty-five p.m.

A meeting of the new Council of the Institute was held at the Château Frontenac, Quebec City, on Thursday, February 10th, 1944, convening at five o'clock p.m.

Present—President deGaspé Beaubien in the chair; Past-Presidents K. M. Cameron, J. B. Challies, O. O. Lefebvre, and C. R. Young; Vice-Presidents J. M. Fleming, L. F. Grant and C. K. McLeod; Councillors J. E. Armstrong, R. S. Eadie, P. E. Gagnon, R. E. Heartz, N. B. MacRostie, A. W. F. McQueen, H. G. O'Leary, P. E. Poitras, C. Scrymgeour, H. R. Sills, C. Stenbol, J. A. Vance, H. J. Ward and W. S. Wilson; Past Vice-President G. G. Murdoch, Past-Councillors J. R. Kaye, G. M. Pitts and E. Viens; H. F. Bennett, chairman of the Committee on the Training and Welfare of the Young Engineer, and General Secretary L. Austin Wright.

Mr. Beaubien expressed his appreciation of the honour which had been conferred upon him in his election as president of the Institute. He hoped to keep up the high standard which had been set by his predecessors, and in order to do so was counting on the co-operation and support of all members of Council.

Death of Past Vice-President Newell—In commenting on the members of the Institute who had passed away during 1943, Past-President Challies suggested that some special mention should be made of the recent passing of Mr. Fred Newell, a past vice-president of the Institute. He read the following tribute to Mr. Newell and, on the motion of Mr. Armstrong, seconded by Mr. Poitras, it was unanimously resolved that this be recorded in the minutes of this Council meeting:

> "This general meeting of Council should not adjourn without some reference to the great loss which the Institute has suffered in the passing of so many of our actively interested members during the past year. No doubt, each of us will recall the names of personal friends whom we shall greatly miss at Institute meetings, but I am sure all of us will wish particularly that special reference be made to Fred Newell.
>
> "Fred Newell was my own mentor all during my year of office as president in 1938. Undoubtedly he was largely responsible for what was good and progressive in Institute affairs during that year. His quiet, genial personality, his dignified bearing and his outstanding professional attainments made a lasting impression at all the branch visits of the presidential party in 1938. His addresses to the students in the engineering colleges were his principal contribution to these visits. Not only were they timely, helpful and encouraging, but they gave hundreds of young men a new perspective regarding their proper responsibilities in their chosen profession.
>
> "He was very proud of the prestige of the Institute, was alert to protect its prerogatives and was always ready to help extend its sphere of usefulness. He was enthusiastic about the opportunities for greater service made possible by the new by-law permitting co-operative agreements with the associations, and I am certain he would have given his blessing to the present by-law proposals of the Council because they will promote a real entente cordiale between the Institute and its sister societies. Few vice-presidents have better earned promotion in the Institute, and but for his poor health during the last few months, he would certainly have had an opportunity to occupy the presidential chair.
>
> "In his passing the Institute has lost one of its wisest leaders, the profession one of its finest ornaments and scores of us one of our best friends."

Institute Prizes—At the meeting of Council held in Ottawa in January, a suggestion had been made that there should be some uniform method of judging the papers for the various Institute prizes, and it had been recommended that the incoming Council should give some consideration to this matter.

Under our present system it was possible for one committee to decide that a certain paper was not worthy of an award while another committee might recommend this same paper for an award—perhaps of a more senior nature. The general secretary explained that some of the American societies have a system whereby the work of the various prize committees was co-ordinated, and, following some discussion, it was agreed that he be asked to gather what information he could on the subject and present it to a later meeting of Council.

Historical Research—At the retiring president's dinner the previous evening Past-President Fairbairn had given some interesting details of the early engineering achievements of Canadian engineers, and it had been suggested that the Institute might appoint a committee to gather such material and prepare it for the Institute's records and publication in the *Journal.* It was unanimously resolved that Mr. Fairbairn be appointed chairman of such a committee with power to name the other members.

Committee on the Young Engineer—Mr. Bennett expressed his regret that he had not been present at the Annual Meeting when the annual report of his committee had been submitted. In that report his committee had recommended the printing of a second and revised edition of ten thousand copies of the booklet, "The Profession of Engineering in Canada," at a cost of approximately $400.00.

The general secretary explained that such an expenditure should be approved by both the Finance Committee and the Publication Committee. Following some discussion, on the motion of Dean Young, seconded by Mr. MacRostie, it was unanimously resolved that the printing of the ten thousand copies be proceeded with just as soon as the Finance Committee and the Publication Committee had given their approval, this to be secured with as little delay as possible.

Vote of Thanks to Retiring Councillors—In proposing a vote of thanks to the retiring president and councillors, Dean Young commented on the effective and efficient manner in which the Council for 1943 had conducted its work. It had been a great year in Institute affairs, and he felt that the membership was eminently satisfied with the accomplishments of Council. Dean Young's motion was seconded by Mr. Eadie and carried unanimously.

Annual Meetings—Professor Jackson suggested that it might tend to increase the attendance at annual meetings—particularly of the younger engineers, if such meetings could be held some time during the early summer months. Mr. Cameron pointed out that in accordance with the by-laws, the date of the annual meeting was more or less of a fixture, but he expressed the hope that in the not too distant future, it might be possible to resume the professional meetings which used to be held in different parts of the country at more pleasant times of the year. Mr. Vance emphasized the desirability of continuing the practice of holding regional meetings of Council in various parts of the country, which might very conveniently be combined with such professional meetings.

Vote of Thanks to Quebec Branch—On the motion of Mr. O'Leary, seconded by Mr. Armstrong, it was unanimously resolved that a hearty vote of thanks be extended to the officers and members of the Quebec Branch for their warm welcome, many courtesies and gracious hospitality.

The Council rose at six fifteen p.m.

Personals

Relatives and friends of members in the active forces are invited to inform the Institute of news items, such as locations, promotions, transfers, etc., which would be of interest to other members of the Institute and which should be entered on the member's personal record kept at Headquarters. These would form a basis of personal items in the *Journal*.

News of the Personal Activities of members of the Institute

Major F. L. C. Bond, D.S.O., M.E.I.C., vice-president and general manager of the central region of Canadian National Railways, Toronto, has recently retired after 45 years of service with the railway. Major Bond graduated from McGill University in 1898 and shortly thereafter entered the service of the Grand Trunk Railway as assistant to the resident engineer of the Eastern Division. He was soon promoted to the position of resident engineer, which he held until he went overseas with railway construction troops. At the conclusion of the war, he was cabled the appointment of chief engineer of the Grand Trunk Railway System.

W. L. Saunders, M.E.I.C.

R. S. Eadie, M.E.I.C.

W. B. Nicol, M.E.I.C.

Upon the formation of the Canadian National Railways, Major Bond was transferred to the position of chief engineer of the central region with headquarters in Toronto, while in 1924 he received an appointment as general superintendent with headquarters in Montreal. In 1936 he was promoted to general manager, central region, and in 1939 he was made vice-president.

Past-President H. W. McKiel, M.E.I.C., of Sackville, N.B., has been elected third vice-president of Rotary International, succeeding the late Sinclair J. McGibbon of Perth, Australia. Dr. McKiel is dean of the Science Faculty at Mount Allison University, Sackville.

H. G. Welsford, M.E.I.C., vice-president and general manager of Dominion Engineering Works Limited, Montreal, Que., has been elected a director of The Shawinigan Water and Power Company.

Sydney T. Fisher, M.E.I.C., whose appointment as assistant to the president of Rogers Radio Tubes Limited, Toronto, was announced last spring, has now been appointed vice-president and elected a director of the company.

W. L. Saunders, M.E.I.C., is the new chairman of the Ottawa Branch of the Institute. Born at Goderich, Ont., Mr. Saunders studied engineering at the University of Toronto. From 1907 until May, 1922, he was engaged in railway engineering, with both the Canadian National Railway and the Canadian Pacific Railway. During the last war he held the rank of lieutenant in the 6th Battalion of Canadian Railway Troops, serving in France from April, 1917, to March, 1919, and being discharged from the C.E.F. in April, 1919. He has been with the Department of Highways of Ontario since June, 1922, and has been division engineer with the department since November, 1928, his present position being division engineer at Ottawa.

G. F. Layne, M.E.I.C., has been appointed chief engineer of Price Brothers & Company, Limited, at Quebec. A graduate of McGill University in 1914 he served overseas during the last war and joined Price Bros. and Company, Limited, at Kenogami, Que., in 1920. Before his recent promotion Mr. Layne was mechanical superintendent at Kenogami, Que.

C. T. Robinson, M.E.I.C., joined the Consolidated Paper Corporation last December as electrical superintendent of the Belgo plant at Shawinigan Falls, Que. He was previously with Canadian International Paper Company, Three Rivers, Que.

William B. Nicol, M.E.I.C., was appointed chief engineer of Hamilton Bridge Company, Limited, last month.

Mr. Nicol was born in Scotland and educated at Heriot-Watt College, Edinburgh. He came to Canada in 1928, and for seven years was designing engineer with Canadian Vickers, Limited, Structural Division, Montreal. He joined the Hamilton Bridge Company, Limited, in 1937, as designing engineer, and was appointed assistant chief engineer in November, 1942.

R. S. Eadie, M.E.I.C., was appointed, last month, chief engineer of the Eastern Division of Dominion Bridge Company Limited, Montreal. In his new position, Mr. Eadie will not only be in charge of the Engineering Department of the Eastern Division but will take over the duties formerly performed by the late Mr. Fred Newell when he was chief engineer of the company.

Mr. Eadie was chairman of the Montreal Branch of the Institute last year and he was elected a Councillor at the annual meeting last month.

R. A. Campbell, M.E.I.C., previously assistant superintendent and production engineer with R. Melville Smith Company, Limited, on the Alaska Highway at Fort Saint John, B.C., is now general manager of the company, with offices in Chicago.

J. A. Reynolds, M.E.I.C., has left the Department of Munitions and Supply, at Ottawa, to join the staff of the Ontario Steel Products Company, Limited, Gananoque, Ont.

Donald W. Miller, M.E.I.C., has returned from Newfoundland, to the head office of the Aluminum Company of Canada Limited, Montreal.

Dr. John S. Bates, M.E.I.C., of Price and Pierce, Montreal, was elected vice-president and chairman of the executive committee of the Canadian Forestry Association at the annual meeting held last month in Montreal.

Brigadier Antonin Theriault, C.B.E., M.E.I.C., was given an honorary degree of Doctor of Science by Laval University, Quebec, during the recent annual meeting of the Institute. Born at Rimouski, Que., he was educated at Ecole Polytechnique, where he graduated in 1910. Upon graduation he joined the Department of National Defence and during the last war served overseas, being demobilized as a major and having been mentioned in despatches. After the war he studied military engineering for three years at the College of Science, Woolwich, England. Upon his return to Canada he was appointed assistant superintendent of the Quebec Arsenal, becoming superintendent in 1936. In 1940 he was appointed chief superintendent of arsenals for the Department of Munitions and Supply, and in 1942 was made a brigadier.

E. L. Johnson, M.E.I.C., who was previously works manager of Canadian Industries Limited at Brownsburg, Que., has been transferred to works manager, Montreal Works, of Defence Industries Limited, Montreal.

R. A. Marvin, M.E.I.C., has been transferred from Montreal to the Winnipeg office of Northern Electric Company, as power apparatus sales engineer.

John Frisch, M.E.I.C., previously mechanical superintendent with Price Bros. & Company, Limited, Riverbend, Que., has joined the Canadian Celanese Limited, Drummondville, Que., as mechanical engineer.

Major J. M. Riddell, M.E.I.C., is now stationed at Halifax, N.S., as Command Engineer Officer to Atlantic Command. He was formerly stationed in Ottawa, as Officer Commanding, 28th Field Company, R.C.E.

W. G. Dyer, M.E.I.C., who was division engineer at Moose Jaw, Sask., with the Canadian Pacific Railway has been transferred to Penticton, B.C., as division engineer.

Fernand Dugal, Jr.E.I.C., has left the R.A.F. Transport Command, maintenance department, Dorval, Que., to take the position of manager of Jacques Cartier Industries Limited, Longueuil, Que.

A. G. Clarkson, Jr.E.I.C., now holds the position of aeronautical engineer with Canadian Pacific Airlines Limited, Saint James, Man.

A. E. Adlam, Jr.E.I.C., has left the employ of Atlas Steels Limited, Welland, Ont., to accept a position as civil engineer with the Toronto Transportation Commission.

F. R. Reevely, M.E.I.C., has left the Department of Munitions and Supply to join the Power Tube Division of Rogers Radio Tubes Limited, Toronto, as production superintendent.

F. R. Reevely, M.E.I.C.

Paul-E. Douville, S.E.I.C., is now on the staff of the Acton Rubber Limited, Actonvale, Que. He is a graduate in chemical engineering from Ecole Polytechnique, in the class of 1943.

G. W. Ross, S.E.I.C., has left the Canadian General Electric Company Limited, Peterborough, several months ago, to join the R.C.A.F.

W. R. Mackay, S.E.I.C., has recently joined the staff of The Shawinigan Water & Power Company, at Three Rivers, Que.

G. M. Webster, S.E.I.C., who was previously employed with Defence Industries Limited, Verdun, Que., has been transferred to Kingston, Ont., where he has taken a position in the operating department of Canadian Industries Limited, Nylon Division.

C. R. Mathews, S.E.I.C., has left the Dominion Rubber Munitions Limited, Cap de la Madeleine, Que., to join the engineering staff of Consolidated Paper Corporation Limited, Wayagamack Division, at Three Rivers, Que.

Joseph Van Damme, S.E.I.C., resigned his position as junior research engineer at the National Research Council, Ottawa, Ont., last May to enlist in the R.C.N.V.R., as a Sub-Lieutenant. He was loaned to the Fleet Air Arm of the Royal Navy last October and was sent to Great Britain for further training as Air Radio Officer.

ANNUAL FEES

Members are reminded that a reduction of one dollar is allowed on their annual fees if paid before March 31st of the current year. The date of mailing, as shown by the postmark on the envelope, is taken as the date of payment. This gives equal opportunity to all members wherever they are residing.

Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

William Henry Breithaupt, M.E.I.C., died in the hospital at Kitchener, Ont., on January 26, 1944. Born at Buffalo, N.Y., on January 25, 1857, he was educated at Rensselaer Polytechnic Institute, Troy, N.Y., where he graduated in 1881 with the degree of civil engineer. During the first years of his career he was engaged in railway work in the United States, specializing in bridge construction. From 1896 to 1899 he was a consulting structural engineer in New York. He then moved to Canada and established himself at Kitchener, Ont.

Mr. Breithaupt was prominent in the development of Kitchener, assisting in the establishment of the gas works, the electric street railway which succeeded horse-drawn cars connecting Kitchener, Waterloo and Bridgeport, and also the establishment of the Grand River Golf Club, the first in the district.

Mr. Breithaupt took a keen interest in modernizing the Kitchener Public Library. He was first president of the Waterloo Historical Society.

He was a recognized authority on the history of Waterloo County, and served for two years as president of the Ontario Historical Society. After years of effort, the Waterloo County Pioneer Memorial Tower was completed in 1926, situated on a high bluff on the eastern bank of the Grand River.

Forty years of careful observation included a complete survey, on foot, of the Grand River, walking from one end to the other. Mr. Breithaupt lived to see in 1942 the fulfilment of a long-cherished dream—the day the Grand Valley Dam at Lake Belwood was formally opened by the premier of Ontario. He also initiated construction of the Bridgeport Railway, suburban to Kitchener, in 1902. He was first chairman of the Kitchener City Planning Commission in 1917, a post which he held until 1921. He was the author of several technical papers including a history of the Grand Trunk Railway.

Mr. Breithaupt joined the Institute as a Member in 1903 and was made a Life Member in 1932.

Hugh Joseph Dunne, M.E.I.C., died suddenly at his home in Ottawa on January 23, 1944. Born in Ottawa on October 11, 1881, he received his education locally and entered the service of the Dominion Government in 1904, in the Geodetic Survey Branch of the Department of Public Works.

He remained in that department during his entire career and was closely connected with the establishment of precise surveys in central and eastern Canada.

Mr. Dunne joined the Institute as an Associate Member in 1921 and became a Member in 1940.

Hughe J. Dunne, M.E.I.C.

J. J. Newman, M.E.I.C.

Charles Johnston, M.E.I.C.

Charles Johnston, M.E.I.C., died suddenly at his home in Oakville, Ont., on December 7th, 1943. Born at Mildmay, Ont., on June 13, 1881, he was educated at the University of Toronto, where he graduated in 1906. He received the degree of civil engineer from the same university in 1917. Upon graduation he joined the Canadian Northern Railway and until 1914 he was engaged on construction work in Ontario. From 1914-1917 he was assistant engineer with the Toronto-Hamilton Highway Commission at Oakville. Later he became vice-president of Lumsden Engineering and Transport Company at Toronto. For several years afterwards Mr. Johnston was chief engineer of the Dufferin Paving Company Crushed Stone Limited, at Toronto.

Mr. Johnston joined the Institute as a Member in 1918.

John James Newman, M.E.I.C., of Windsor, Ont., was instantly killed in an auto accident near Woodstock, Ont., on January 27, 1944. He was born in the County of Essex, Ont., on March 10, 1872, and received his education at the Windsor High School and attended the University of Toronto. In 1894 he moved to Windsor and worked in the engineering firm of his brother, William. In 1898 he formed a partnership with his brother under the name of Newman Brothers. This continued until 1906 when William transferred to Winnipeg and Mr. Newman continued his civil engineering practice under his own name. In 1925, the firm became Newman and Armstrong with the addition of C. G. Russell Armstrong to the company as partner.

Mr. Newman had been Essex County engineer for a number of years and also looked after the engineering problems of many townships and towns in the counties of Essex and Kent. He was also an authority on municipal drainage matters in the province of Ontario.

Mr. Newman joined the Institute as an Associate Member in 1919 and transferred to Member in 1920. He was a member of the Association of Professional Engineers of Ontario since 1925. In 1935 he was presented with an engraved Institute badge in recognition of his many services to the Border Cities Branch of the Institute and the community.

Alfred Stansfield, M.E.I.C., professor emeritus of metallurgy at McGill University, Montreal, died at his home in Westmount on February 5th, 1944. Born at Bradford, Yorkshire, England, he studied at the Royal School of Mines, London, and carried research work on metallic alloys as assistant to the late Sir William Roberts-Austen at the Royal Mint from 1890 to 1898. He was in charge of the metallurgical and assaying laboratories at the Royal College of Science, London, from 1898 to 1901, and was awarded a Carnegie Research Scholarship. In 1901 he was appointed professor of metallurgy at McGill University, Montreal, later becoming head of the Metallurgical Department. Dr. Stansfield retired from active duties in 1936, but until his death continued his interest in scientific work in his field, and on the recent occasion of the centennial of Sir William Roberts-Austen wrote an account of the work of that great scientist for a scientific journal.

During his 35 years at McGill, he made a special study of electric-metallurgy and his books on the electric furnaces gave him a world wide reputation on this subject. He visited Sweden as a representative of the Dominion Government, Mines Branch, in 1913 to study the electric smelting of iron ores and he made reports on this subject to departments of the Dominion, Ontario and British Columbia governments. He also conducted extensive experiments in electric smelting of zinc and production of zinc oxide paints at Shawinigan Falls, Que.; he also investigated the process of electric reduction of magnesium. At one time, Dr. Stansfield was associated with J. W. Evans at Belleville, Ont., in the production of electric steel and also of ferro-molybdenum.

He was a member of the Government Commission appointed in 1915 by the Minister of Militia and Defence to report on the copper and zinc possibilities in Canada for the manufacture of shells. He was a member of the PYX Commission reporting yearly on the quality of Canadian coinage. He was the first editor of *Iron and Steel of Canada* and wrote several articles on various branches of metallurgy.

Dr. Stansfield was vice-president of the Electrochemical Society and was made a Life Member of this society as well as of the Canadian Institute of Mining and Metallurgy. He also held memberships in the British Association, British Institute of Metals, the Iron and Steel Institute and was a Fellow of the London Chemical Society and the London Society of Arts.

He joined The Engineering Institute of Canada as an Associate Member in 1904, transferring to Member in 1918. He was made a Life Member in January, 1936.

Although Mr. Elliot was not a member of the Institute, the Journal wishes to record his passing in view of wide acquaintances in the profession.

Robert Andrew Elliott, general manager of the Deloro Smelting and Refining Company Limited, died suddenly at his home in Deloro, Ont., on February 9th, 1944. Born at Goderich, Ont., in 1886, Mr. Elliott was educated at Woodstock Public School and Woodstock Baptist College. He graduated with a Bachelor of Science degree from Queen's University in 1912. In 1915, he was appointed superintendent of the Cobalt Oxide Plant at Deloro and in 1917 was appointed works superintendent of the Deloro Smelting & Refining Company. He was appointed a director and general manager of the company in 1940.

In addition to being reeve of the Village of Deloro, Mr. Elliott was also vice-president and treasurer of the Deloro Trading Company. He was a past-president of the Association of Professional Engineers of Ontario and a member of the Canadian Institute of Mining and Metallurgy, the American Institute of Mining and Metallurgical Engineers and the American Society for Metals, and the Engineers' Club of Toronto.

He is survived by his widow, one son Robert A., with Macalder Mines Ltd., Kismur, Kenya Colony, British East Africa; a daughter Mary with the Women's Division, R.C.A.F.; and a daughter Jean at home.

INSTITUTE PRIZE WINNERS

Chalmers Jack Mackenzie, C.M.G., M.E.I.C., acting president of the National Research Council at Ottawa and dean of engineering at the University of Saskatchewan, Saskatoon, is the recipient of the Sir John Kennedy Medal of the Institute for 1943.

The citation, read upon presentation of the medal at the annual banquet in Quebec, is as follows:

"The Sir John Kennedy Medal of the Institute is awarded 'as a recognition of outstanding merit in the profession or of noteworthy contribution to the science of engineering or to the benefit of the Institute.'

"All of these requirements are fulfilled by Chalmers Jack Mackenzie, upon whom the Institute Council is conferring the medal this year. After a distinguished military career during the last war, he returned to Saskatoon to resume his work of developing the engineering courses at the University, and to continue his consulting practice there. In 1921 he became dean of the engineering school, which since that time has established a remarkable record for growth and stability. He held that position till 1939, when he was called to Ottawa to be acting president of the National Research Council, replacing General McNaughton who went overseas.

"To form an idea of Dean Mackenzie's contributions to the science of engineering, one need only reflect on the achievements of the National Research Council and its staff during the past four years. It is true that much of their work necessarily remains secret for the time being, but it is known that under his direction they have devised and developed a great many of the scientific aids upon which our navy, army, and air force depend for the successful prosecution of the war.

"As regards his services to the Institute, his ripe experience in Institute affairs, gained as chairman of the Saskatchewan Branch in 1925, as a vice-president in 1929-30, and as president of the Institute in 1941, (and —it should be added—in 1930 as president of the Association of Professional Engineers of Saskatchewan), has enabled him to render most valuable help in establishing and maintaining the cordial relations which now exist between the various engineering bodies in the province of Saskatchewan."

George Joseph Desbarats, HON.M.E.I.C., is one of the recipients of the Julian C. Smith Medal of the Institute for 1943. Dr. Desbarats could not be present at the annual banquet to receive his medal. The citation which accompanies the award reads as follows:

"During his more than thirty years service as Deputy Minister, first in the Department of Naval Service, and then in the Department of National Defence, Dr. Desbarats took part in the early developments which led to the formation of the present Royal Canadian Navy, now a fighting organization of more than seventy thousand officers and ratings with six hundred ships. Since his retirement from the civil service in 1932, he has had the satisfaction of seeing the fruition of these years of effort.

Much of his early engineering work was carried out in the government service in connection with waterways and hydrographic surveys. Latterly he has been prominent in the work of the Canadian Red Cross Society. During Dr. Desbarats' long connection with the Institute, he has taken an active part in its affairs, and has rendered most valuable services in connection with Institute and branch committee work. He joined as a Member in 1897, served on Council in 1900, 1907, 1933 and 1934; was a vice-president in 1909 and president in 1937. In 1936, Council elected him an Honorary Member, and now further recognizes his record of public service in the development of Canada, by the award of a Julian C. Smith Medal."

Frederic Henry Sexton, M.E.I.C., is one of the recipients for 1943 of the Julian C. Smith Medal awarded by the Institute "for achievement in the development of Canada." The citation read upon presentation of the medal to Dr. Sexton at the annual banquet is as follows:

"Old Izaak Walton wrote 'He that hopes to be a good angler must not only bring an enquiring, searching, observing wit, but he must bring a large measure of hope and patience, and a love and propensity to the art itself.' These words might equally well have been written about education instead of angling, and are doubly applicable to a man who is a skilful and scientific fisherman, even if his eminence as an angler is quite overshadowed by his achievement as an educator.

"Such a man, in the person of Dr. F. H. Sexton, president of the Nova Scotia Technical College, is this year receiving one of the Institute's Julian C. Smith medals. For over thirty years, as head of an engineering college and director of technical education for the Province of Nova Scotia, he has staunchly supported high ethical and technical standards and has taken a leading part in engineering life and progress in the Maritime provinces.

"Through his contacts with the great number of students who have studied under him, his influence upon them at their most receptive time of life has been a real factor in the development of Canada."

Frank E. Sterns, M.E.I.C., engineer, National Harbours Board, Ottawa, has been awarded the Gzowski Medal of the Institute for 1943, for his paper "Transit Shed with Concrete Roof Arches." A graduate of McGill University, he joined the staff of the Panama Canal in 1908 and was employed for five years on the design of machinery and equipment. He left the Isthmus to take a position on the staff of the Welland Ship Canal and was later appointed design engineer. He was employed on the Welland Canal for 19 years, and during the period that the work was shut down, he assisted in the design of equipment for the New Orleans Canal.

After completion of the Welland Ship Canal, he did some work in a consulting capacity for the United States government on the navigation features of the Bonneville power-navigation project. Since then he has been employed by the National Harbours Board of Canada on miscellaneous work.

W. R. Stickney, M.E.I.C., welding engineer of The Canadian Bridge Company Limited, Walkerville, Ont., is the recipient of the Duggan Medal and Prize of the Institute for 1943, for his paper on "Electric Arc Welding". A graduate of the University of Toronto in chemical engineering, in the class of 1936, Mr. Stickney spent a few months after graduation in the electro-plating department of Ford Motor Company of Canada, Windsor, Ont., and in 1937 joined the staff of The Canadian Bridge Company at Walkerville. He was appointed welding engineer in 1939. He is the secretary-treasurer of the Border Cities Branch of the Institute.

J. L. Belyea, S.E.I.C., is the recipient of the Martin Murphy prize of the Institute for 1943, for his paper "Simplification in the Design of Automatic Weapons," presented at a branch meeting. Born at Saint John, N.B., he attended the Saint John High School, winning the Gold Medal of that city and the Lord Beaverbrook scholarship on matriculation. He is attending the University of New Brunswick at present, and he expects to graduate in electrical engineering this spring. He is active in student organizations, having been secretary-treasurer of the Engineering Society in his junior year, and having taken part in the debating societies, the college newspaper, and the activities of the students council.

Henri Audet, S.E.I.C., the recipient of the Ernest Marceau prize for 1943, was born at Montreal and educated at Collége Jean-de-Brébeuf, and later at Ecole Polytechnique, Montreal, where he graduated with honours, in 1943. Upon graduation, he received a scholarship from the provincial government and is at present doing post-graduate work in electrical engineering at the Massachusetts Institute of Technology, Cambridge, Mass. He was the winner of the Institute prize in his fourth year and was president of the Under-graduate Society at Ecole Polytechnique.

Boris Mroz, S.E.I.C., is the recipient of the Phelps Johnson prize of the Institute for 1943. Born in Poland in 1921, he came to Canada in 1935, and completed his primary education in Montreal, entering McGill University in 1939. He expects to graduate this spring in mechanical engineering. During his summer vacations he worked on survey of the Portland-Montreal pipe line and in the mechanical department of the Dominion Bridge Company Limited.

A. C. Northover, Jr.E.I.C., is the recipient of the John Galbraith prize of the Institute for 1943, for his paper "New Methods and Substitute Materials in Wartime Construction," presented at the Peterborough Branch. Mr. Northover graduated in 1937 in civil engineering from the University of Toronto. Upon graduation he was engaged in structural steel drafting in Hamilton for a while, later travelling south to the West Indies, where he was engaged in field engineering work. Upon his return, he was employed as a concrete engineer on the Shipshaw project. He is at present engaged in the plant engineering department of the Canadian General Electric Company Limited, Peterborough Works, as a structural mechanical engineer.

Nathan Safran, Jr.E.I.C., is the recipient of the H. N. Ruttan prize of the Institute for 1943. Born at Calgary in 1914, he was educated at the University of Alberta, where he received the B.Sc. degree in chemistry in 1935, and the M.Sc. degree in 1936. Upon graduation he worked for a time with the Royalite Oil Company, in the Turner Valley, Alta., later joining the staff of the Provincial Institute of Technology and Art in Calgary, where his present position is that of head of the science Department. He has done research work for the R.C.A.F. and has acted as consultant chemist and analyst for several problems at the Provincial Institute in Calgary.

News of the Branches

Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

BORDER CITIES BRANCH

W. R. Stickney, m.e.i.c. - *Secretary-Treasurer*
G. W. Lusby, m.e.i.c. - *Branch News Editor*

The first monthly meeting of the year was held at the Prince Edward Hotel on January 14, with J. B. Dowler, chairman of the Branch, presiding.

The guest speaker of the evening was Mr. Clarence J. DeFields, Chief of the Windsor Fire Department, and District Deputy Fire Marshal for the Province of Ontario, who spoke on **"Your Fire Department"**. Mr. DeFields, who came up through the ranks to the position he now holds, has spent nearly half a century with the Windsor Fire Department. His comparison of duties, salaries, and equipment of the early days, with those of to-day, proved most interesting. It has been largely through his efforts that Windsor now enjoys one of the most favourable insurance rates in Canada. Industrial plants give 100% co-operation with the fire department and one of its members spends all of his time on plant inspection. Windsor, the fourth largest industrial city in Canada, has not had one serious fire during the war, a fact of which the citizens can be well proud.

In the discussion period following, much interest was shown and questions asked relative to safety features in buildings.

The February meeting was held at the Prince Edward Hotel on February 18. J. B. Dowler, chairman of the Branch, presided.

The guest speaker of the evening was Mr. P. Thompson, Illumination Sales Manager of the Northern Electric Co., who spoke on **Infra-red Applications in Industry.** The subject dealt with the near infra-red rays which lie adjacent to the visible rays in the spectrum, and their application as a heating and drying medium in industry.

The original source of this energy, the incandescent lamp, was further developed after considerable research, to provide a more intense heat and a longer lasting filament, to make its use economical.

Applying the principle of radiation and concentrating the rays by the use of gold plated reflectors, a very efficient drying system results, such system being governed by a definite set of laws, as follows:

1. The rays are absorbed by a body directly in proportion to its area and absorption factor, and inversely to its weight.
2. The intensity of the radiation varies inversely with the square of the distance from its source.
3. The mass being radiated attains a maximum temperature when equilibrium is reached between the radiant heat absorbed and the heat lost to the surrounding atmosphere.

The advantages of Infra-Red drying can be summed up as follows:

1. The vaporized solvents are permitted to escape from the coating throughout the entire drying period, and are not trapped by a surface film as is the case of convection drying.
2. It permits exact temperature control within definite range as required for proper coating.

Various surface effects can be obtained by infra-red drying. However, it is essential to supply the infra-red drier manufacturer with complete information as to the type of coating used, and the production conditions.

At the conclusion of Mr. Thompson's talk, slides were shown of typical installations throughout the United States and Canada.

CALGARY BRANCH

K. W. Mitchell, m.e.i.c. - *Secretary-Treasurer*
A. B. Geddes, m.e.i.c. - *Branch News Editor*

A general meeting of the Calgary Branch was held at the Palliser Hotel on Friday, October 22nd, at 8 p.m. The speaker, W. L. Foss, district engineer of large projects for the P.F.R.A., spoke on **Water Development Possibilities in the Post-War Period.**

Mr. Foss traced the history of the P.F.R.A. since its inception in 1935, up to the present. It now has a million and a half dollar project under construction and a fifty million dollar project under consideration. The speaker dealt mainly with the water development branch of the P.F.R.A.

A post-war programme has been submitted to the House of Commons Committee on Reconstruction. The programme covers 42 projects and will cost an estimated 111 million dollars.

The large post-war projects include the Oldman River system which would irrigate 430,000 acres at an estimated cost of nearly 17 million dollars. This project includes 10,000 hp. of power development. The Bon River system which covers 315 thousand acres at an estimated cost of $10,275,000. This project is also available for the production of power.

The North Saskatchewan and the Red Deer River system constitutes the famous Wm. Pearce scheme and would irrigate nearly 1 million acres of land and possibly develop as much as 60,000 hp. of hydro energy directly.

It was pointed out by the speaker that in the development period of our irrigation projects it was assumed that the man on the land was the sole beneficiary of the development and all costs should be borne by him. In the United States an industrial engineer went into this question fully and by an involved study concluded that the farmer benefitted to the extent of 31 per cent of the increased production, local and regional districts by 34 per cent and the country at large by 35 per cent.

Checking this with the estimated 1943 sugar beet crop at Lethbridge of $10,000,000 we find the gross return to the farmer is $3,136,000 or about 31 per cent of the total final value of the sugar crop.

The projects under consideration would provide considerable employment totalling about 18 million man-days or employing 15,000 men over a period of four years. Approximately half of these would be employed directly on the projects and the other half indirectly.

At a regular meeting of the Calgary Branch on Thursday, January 13th, Dr. H. H. Beach, geologist with McColl-Frontenac Oil Company, spoke on **History of Exploration of the Canadian Rockies.** Dr. Beach was formerly geologist for the Geographical Survey of Canada and spent most of his time in the Rockies.

The Canadian Rockies were first viewed by a white man in 1736. The real beginning of a remarkable intensive exploration era began however in 1804 when a number of independent fur-traders in Manitoba organized to form the North-West Fur Company. This was a very virile company and four of the great explorers of the Canadian West were included in this group, Mackenzie, Thompson, Harmon and Fraser.

These men set out to enlarge their territory and in 1789 Alexander Mackenzie discovered the Mackenzie river and in 1793 he crossed the Rockies to the Pacific Ocean.

In the middle of the nineteenth century the Hudson's Bay Company charter came up for renewal and two expeditions were sent out, the Palliser and the Hind. These expeditions did a remarkably fine job of establishing fundamentals of the Rockies.

David Thompson mapped 750,000 sq. mi. in twenty years from Western Ontario to the Columbia river in British Columbia and up to 1928 his map of 1810 was the best of the Columbia river.

An interesting facet in the history of Canada is the incident in the Napoleonic wars when Napoleon sent spies to England to obtain a report of McKenzie's. He had this report studied and planned to invade Canada from the North.

The speaker had a collection of fine old maps, some printed by the famous Arrowsmiths of London which were remarkable for their accuracy and detail.

KINGSTON BRANCH

R. A. Low, M.E.I.C. - - *Secretary-Treasurer*
C. E. Craig, S.E.I.C. - *Branch News Editor*

Kingston Branch members during January showed great interest in two meetings on very diverse subjects.

On January 11th, Professor D. M. Jemmet, head of the electrical department at Queen's University, spoke on **Evolution of the Steam Engine.**

The earliest recorded attempt to use steam as a motive agent was about two thousand years ago in the days of Hero of Alexandria. Professor Jemmet then followed the slow development of this important agent into the days of Savery, Newcomen and Watt during the 17th century, through the 18th century when Stephenson, Fulton, De Laval, Parsons and others applied and improved steam in its mobile applications. In concluding, the speaker described the more modern, high-pressure applications of steam and outlined the theory and possibilities of the newer mercury cycle.

A spirited discussion followed and the meeting adjourned for refreshments served by the student members at Queen's University.

On January 26th, Mr. V. T. Griffiths, plastics engineer of the Canadian General Electric, at Peterborough, addressed a joint meeting of the Kingston branches of the Engineering Institute and the Canadian Institute of Chemistry, on the subject of **Plastics.** The speaker confined his information to the laminated sheet types. With numerous lantern slides the physical and mechanical properties of this vital insulating material were outlined.

Mr. Griffiths could not foresee a successful challenge of laminated and sheet plastics to the lighter metals in the use of such materials in post-war construction. Limited physical properties and prohibitive fabricating costs confine this material more or less to its original use.

Professor L. A. Munro of Queen's University in thanking his former student for the wealth of information divulged cited several examples of the use of laminated plastics in the war effort. Outstanding among these, the United States Army water bottle has replaced the usual metal canteen, thus effecting a substantial saving in weight and materials with no sacrifice in quality.

Dr. S. D. Lash, chairman of the Kingston Branch, presided at both meetings.

MONTREAL BRANCH

L. A. Duchastel, M.E.I.C. - *Secretary-Treasurer*
H. H. Schwartz, Jr.E.I.C. - *Branch News Editor*

On Wednesday, January 19th, J. R. Auld of Canadian Industries Ltd. delivered a paper on **Electric Systems in Military Explosive Plants,** covering the main features of the electric systems used in various plants recently constructed in Canada. It included the design and description of the various types of electric distribution used, the factors determining the choice of equipment and comparative costs. R. N. Coke was chairman of the meeting.

The annual meeting of the Montreal Branch was held on January 27th. The report of the retiring executive and the financial statement were read. The results of the election for officers for the year 1944 were announced.

K. M. Cameron, president of the Institute, was present on his official visit to the Branch. He addressed the meeting and discussed the **Post-War Possibilities for Canada.**

R. S. Eadie was chairman of the meeting.

On February 3rd, Dr. W. H. Cook spoke on **Some Wartime Applications of Refrigeration.** One of the greatest problems in supplying Britain with meat was the question of refrigeration. Special refrigerated ships were not available. The meat had to be transported in ordinary freighters with the addition of the minimum equipment possible. Dr. Cook explained how the limits on storage temperature were set up. It was found that if the meat was cold when placed in the ship and if it was placed deep in the hold, the meat would rise in temperature only slightly. The meat kept very well at temperatures below 50 deg. F. Therefore the problem was to maintain this temperature. This was done by adding a refrigeration unit to the ship. Since the addition of cooling pipes and brine was out of the question, owing to the time and money involved, resort was had to air cooling. The meat was stacked so as to form air ducts, and cold air from the refrigerator unit was blown through these ducts. Thus a simple and practical solution to the problem was achieved.

A. T. Eric Smith was chairman of the meeting.

C. C. Lindsay, the new chairman of the Montreal Branch, and L. A. Duchastel, secretary-treasurer.

On February 10th, 1944, Mr. John Mills spoke on **Everyday Electronics.** Electronics is the science of dealing with free electrons, either in a vacuum or in a gas. There is a distinct difference in behaviour between gas filled tubes and vacuum tubes. Essentially, in a gas filled type, once an electron current is started through the tube, the flow is uncontrolled, whereas in a vacuum tube the flow is at all times under control. Therefore, gas filled tubes are used for such purposes as switching, whereas vacuum tubes are used for amplification.

To-day the vaccum tube is used extensively in warfare. One outstanding application is Radar. Although unable to mention any details, Mr. Mills suggested the example of the flight of a bat. The bat emits a series of high pitched supersonic notes, around 90,000 cycles per sec. These sound reflect off all adjacent objects. By observing the direction from which the echo comes, and the time taken for the echo to arrive, the bat determines the location of objects. Thus blind bats can thread their way through a maze of wires quite readily, but deaf or dumb bats cannot.

C. A. Peachey was chairman of the meeting.

The Montreal Branch executive entertained at dinner for President Cameron.

On February 17th, H. H. Lank, vice-president of Canadian Industries Limited, spoke on **Future Products for the Chemical Industry.**

Today the engineer is mainly concerned with development, research, and production. A new field, as important as any of these, and as yet untouched is that of marketing and administration. It is only when the existence of a potential demand is realized, that the wheels of research can be set rolling to produce the article.

An interesting example of this has been the development of nylon. This research was initiated sometime in 1927, as an investigation in the fundamental action of polymerization. It was only after many years of painstaking effort that any commercial possibilities were seen in the product. The first factory was put up in the U.S.A. in 1938, the second in 1940, and the third in Canada in 1941.

Many other new products are on the way. Some, however, are still on the secret list. A new type of cable insulation that may allow all cables to be placed underground shows promise for post-war use.

G. R. Stephen was chairman of the meeting.

OTTAWA BRANCH

A. A. Swinnerton, M.E.I.C. - *Secretary-Treasurer*
R. C. Purser, M.E.I.C. - - *Branch News Editor*

At the first noon luncheon of the 1944-1945 season under the chairmanship of the recently-elected chairman of the Ottawa branch, W. L. Saunders, there was a particularly large attendance. J. G. Turgeon, M.P. for Cariboo constituency, addressed the gathering on some of the problems of reconstruction and re-establishment that will have to be met. Mr. Turgeon is chairman of the House of Commons Committee on Re-construction and Re-establishment and in the course of his address referred to the recent report of this committee submitted to the House.

Although the war must first be won, and it is a war in which Canada's very life is at stake, everything that can reasonably be done for post-war conditions should be done immediately. There are, for instance, slums in cities, towns, and rural areas. These should be eliminated with financial and other help from the federal government. There are ways in which a proper utilization of natural resources can be made to help. Control should be exercised by a body acting under ministerial responsibility, as announced in the speech from the throne.

The minister of the proposed new department of reconstruction, he felt, should carry on more as a co-ordinator than as an administrator working alone. Mr. Turgeon made a specific reference to the coal industry of the province of Nova Scotia and to conditions in the Maritimes generally. If pre-war conditions were permitted to prevail then this coal industry will find itself incapable of existing without direct help from the government in the way of subventions or some form of tariff restrictions or both. If tariff restrictions are to be considered then the Atlantic Charter must not be forgotten. He recommended that a survey of the Maritimes should be undertaken as a necessary background toward helping this region.

A new relationship should be built up between agriculture and industry, and between agriculture and the government. If certain things were not done he warned that socialism would follow. "You cannot forever maintain a country such as Canada," he said, "without making the necessary adjustments from time to time." Industry should include capital, management and organized labour, he said.

New industries should be properly distributed, the speaker said. He wanted to see nothing taken from Ontario and Quebec but he did want to see the rest of Canada get more industries, which economic potentialities really warranted.

After the complete turnover from war to peace a good level of employment should be maintained. He held also that there are ways and means of maintaining "an even keel of employment conditions in the transition period." Preference will be given to the members of the armed forces and the merchant navy subject, of course, to the necessary qualifications.

* * *

The part of electricity in modern warfare was the subject of an evening address on February 24 at the auditorium of the National Research Building. G. B. Bourne, of Toronto, was the speaker.

In the illustrated address the speaker referred to a wide range of uses, including the electric welding of Bren gun parts, the floodlighting of war factories to prevent sabotage, aircraft listening devices on the English channel, the giant searchlights of battleships at sea, and the delicate instrument panels of aircraft over Berlin and in tanks in Italy.

Mr. Bourne told of great searchlights of 800 million beam candlepower trapping an Italian warship in the Ionian sea, and explained the operation of the improved hydrophone in submarine hunting and of the range-finding predicator for anti-aircraft batteries, all depending upon electricity. He illustrated the use of the degaussing equipment, which nullifies the magnetism of a ship's hull, thus rendering the German-used magnetic mine impotent. Mr. Bourne also related how an airplane, circled by a magnetized cable, worked with just the opposite effect in exploding mines and clearing Sicilian and Italian harbours before the invasion.

Electricity in the modern warplane was dealt with in detail, from the 4-watt fluorescent non-glaring lamp in the bomber's instrument panel, to the present-day instruments for flight and navigation, some of which have eliminated the former dangerous practice of bringing oil and gas-gauge tubes into the cock-pit in order to register supply. Electricity now enables the pilot to determine his supply of gas and oil without piercing the tank, registration being accomplished magnetically through the tank wall.

"Whether the war is decided by new explosives, faster aircraft, improved communications or increased industrial production, electricity will be woven closely with the victory," concluded Mr. Bourne.

PETERBOROUGH BRANCH

A. J. Girdwood, Jr.E.I.C. - *Secretary-Treasurer*
J. F. Osborn, M.E.I.C. - *Branch News Editor*

The January 13th meeting of the Peterborough Branch was addressed by Mr. C. Southmayd of the Canadian Allis Chalmers Company, Toronto, who spoke on **Reaction Type Hydaulic Turbine Design.**

Modern reaction turbines had their beginning about a hundred years ago when J. B. Francis brought out an inward flow turbine with the wheel in a horizontal plane mounted on a vertical shaft. Water was delivered in a closed conduit to a box completely surrounding the wheel rim and was directed by baffles towards blades rigidly mounted about the periphery of the wheel. The addition of a scroll case permitted a constant velocity of water at the wheel periphery. A draft tube from the central conduit formed a convenient discharge for the water.

The design of a 100,000 hp. reaction turbine was discussed with the general conditions surrounding the application of the unit. In addition to being huge in size this turbine had other remarkable features such as all welded spiral casings attached by welding to the speed ring. Despite problems of adverse climate and stress relief the welding was entirely successful. An idea of the machine's size may be gained from the weight of the shaft and runner which was 65 tons.

The solution of various design problems as described by the speaker impressed the audience with the great attention given to efficient operation, reliability and ease of maintenance.

Brief mention was made of the propeller or axial flow type turbines. These are found most satisfactory on low heads where their greater speed for similar flow and head conditions is advantageous. Where fixed blade propellers are used it is necessary to maintain output at a high level to attain any efficiency. Refinements have been made to the fixed blade principle where conditions call for a variable output by controlling the pitch. This may be done manually or by means of a hydraulic system connected to the governor.

A. R. Jones, Branch chairman, presided at the meeting and M. V. Powell conveyed the thanks of the meeting to the speaker.

SAINT JOHN BRANCH

F. A. Patriquen, M.E.I.C. - *Secretary-Treasurer*

The annual joint dinner meeting of the Saint John Branch of the E.I.C. with the Association of Professional Engineers of the Province of New Brunswick was held in the Admiral Beatty Hotel, on January 26th at 6.30 p.m., following the annual meeting of the Association at which J. T. Turnbull, M.E.I.C., of the Highway Division of the Department of Public Works, was elected president of the Association. A. S. Gunn, M.E.I.C., of the Canadian National Railways, Moncton, was elected vice-president. B. H. Hagerman of the Bridge Department, Fredericton, and A. Gordon of the Department of Transport, Moncton, were elected to the Council of the Association.

G. G. Murdoch, vice-president of the Institute, announced S. E. Acker as the winner of the student's prize given by the Institute for the highest standing in engineering in the Junior year at the University of New Brunswick, and J. L. Belyea as the winner of the Martin Murphy prize. Messrs. Acker, Belyea and T. H. McSorley, president of the Students Engineering Society at the University of New Brunswick, came down from Fredericton to attend the meeting.

G. H. Prince, deputy minister of the Department of Lands and Mines of New Brunswick, addressed the Branch on the natural resources of the province, particularly forest produces and their place in post-war reconstruction and rehabilitation.

"Continuous scientific study and research is being carried out to prevent loss and find ways and means of utilizing all of the wood produced so that none will be wasted.

"New Brunswick has a forest area of 14,000,000 acres, or 80 per cent of its land area. The annual cut is over 300,000,000 board feet of saw logs, over 800,000 cords of pulp wood and large quantities of other forest products too numerous to mention.

"In 1942, the value of the forest production was about $60,000,000 while agriculture was $42,000,000. More than $6,000,000 was paid for freight alone on forest products as 67,000 carloads, including pulp and paper, originating in the province were moved by the railroads. In 1942 wages paid by the forest industries in New Brunswick exceeded $16,000,000 and more than 20,000 men found employment in the province's six pulp and paper mills, 300 saw mills and other types of woodworking plants.

"With the stumpage value of wood as standing timber being comparatively small compared to the value of work and wages in changing it to materials ready for use, the people as a community were even more interested than the owners in maintaining the forests in condition to produce raw material for use. The people should demand that every necessary action be taken to safeguard their future income. A new chemical age has arrived and New Brunswick has many of the natural resources necessary for it."

SASKATCHEWAN BRANCH

Stewart Young, M.E.I.C. - *Secretary-Treasurer*

A joint meeting of the Saskatchewan Branch with the Association of Professional Engineers was held in the Kitchener Hotel, Regina, on Friday evening, January 21, 1944. The meeting was preceded by a dinner at which the attendance was 53. Ten non-members were in attendance as guests. H. S. Carpenter occupied the chair and on motion of D. A. R. McCannel and H. R. MacKenzie an expression of condolence to Col. A. C.

Garner on the recent passing of Mrs. Garner was unanimously passed.

The speaker of the evening, K. G. Chisholm, addressed the meeting on the **Electron Microscope**, showing a sound film of the microscope in operation prepared by R. C. A. Victor.

Tracing the development of the microscope from the simplest form using a single glass lens Mr. Chisholm stated that the ultimate permissibility of use of this type is limited to the wave length of light. The electron type is many times more powerful, makes use of electron transmission and has a useful magnification of 100,000 or, graphically, enlargement of an object from the size of a dime to a diameter of one mile.

SAULT STE. MARIE BRANCH

A. H. Meldrum, m.e.i.c. - *Secretary-Treasurer*

The first meeting for the year 1944 of the Sault Ste. Marie Branch was held in the Windsor Hotel on Friday, January 21, twenty members and guests being present.

The speaker for the evening was Mr. R. H. Merrill, post engineer for the United States War Department at Fort Brady, Sault Ste. Marie, Michigan.

The speaker's subject was **Archaeology as an Engineer's Hobby**, but when he had concluded his excellent address it was unanimously agreed that he had not made archaeology a hobby but a profound study.

Having spent considerable time in archaeological research in Central Europe, China, Alaska, and Mexico, Mr. Merrill was well able to converse on his topic and relate many interesting field experiences outlining the engineering and geological methods involved.

One of the objects of archaeological research is to tie up the remains of ancient man with historic records. Long before iron came into production, lead pipes were in use, having bronze valves. Medical tools of ancient times are practically identical with those in use to-day.

Clay pits up the Algoma Central Railway to Hudson's Bay have been studied and a time scale produced for this region. A geological sequence along the Great Lakes has also been established. These correlate the beaches and ice advances. Mining was carried on here long before immigrant man arrived on the scene.

At the conclusion of the address, Mr. Merrill was asked many questions, much interest centering around the tracing of man's migration from China to America. Several connections have been established between the Eskimo, North and South American Indians. The Aleutian area has been subjected to recent earth movements and any fossil remains that may be the clue to the secret are probably under sea level.

The second general meeting of the branch for the year 1944 was held in the Windsor Hotel when fourteen members and guests sat down to dinner.

The speaker was W. H. M. Laughlin, chief designing engineer, Ontario Division, Dominion Bridge Co. Ltd., Toronto.

In opening his address on **Structures in Steel**, which was illustrated with slides, Mr. Laughlin gave some introductory remarks on the composition and various uses of steel.

A structural steel company consists of several departments; of these Mr. Laughlin dwelt at some length on the engineering, draughting, shop and erection departments. All loads and stresses must be known as accurately as possible before designing a structure; the approved design then goes to various departments and is finally fabricated and prepared for erection.

Several slides followed the address. These depicted head frames for mine hoists, roof trusses, aircraft hangers, dry docks, and many bridge structures including bascule, suspension, fixed arch and tied arch types.

TORONTO BRANCH

S. H. de Jong, m.e.i.c. - *Secretary-Treasurer*
G. L. White, affil.e.i.c. - *Branch News Editor*

Launching a 10,000-ton Cargo Ship was the subject of an address by Paul G. A. Brault, United Shipyards, Ltd., Montreal, before the branch meeting on January 20th. The chairman on this occasion was W. H. M. Laughlin and the vote of thanks was moved by S. R. Frost.

This paper appeared in the January issue of the *Journal.*

The Ogoki Diversion was the subject of an address by Otto Holden, chief hydraulic engineer, Hydro-Electric Power Commission of Ontario, at the meeting of the Toronto Branch, held on February 3, 1944. Mr. Holden was introduced by the chairman, W. H. M. Laughlin, and the vote of thanks was moved by S. R. Frost.

The Ogoki diversion which went into operation in July, 1943, adds to the St. Lawrence system the water from a drainage area of 5,500 sq. mi. which was formerly drained by the Ogoki river by way of the Albany into James Bay. This diversion will greatly benefit the St. Lawrence system and has already assisted in Canada's war activities, since this country was allowed to increase its diversion at Niagara in 1940 on the understanding that the Ogoki diversion would be put in hand.

On the basis of the diversion of 5,000 cu. ft. per sec., the potential power development would be 90,000 hp. on the Nipigon, 8,000 hp. at Sault Ste. Marie, 120,000 hp. at Niagara, and 70,000 hp. on the St. Lawrence.

It is expected that the paper will appear in an early issue of the *Journal.*

VANCOUVER BRANCH

P. B. Stroyan, m.e.i.c. - *Secretary-Treasurer*
J. G. D'Aoust, m.e.i.c. - *Branch News Editor*

At their first meeting of the year held January 17th, members of this branch enjoyed a most interesting and informative talk by Mr. John McHugh, formerly resident engineer for British Columbia, of the Dominion Department of Fisheries.

Mr. McHugh spoke on **Fishway Problems of British Columbia and Neighbouring Streams** as related to the salmon fisheries.

The Pacific Coast salmon, of which there are five species, starts its life in fresh water streams, and after a period varying from three to five years spent in the sea, returns to its native waters to spawn and die. If prevented from returning it dies without spawning.

The decline of the salmon fisheries on the Fraser river closely followed the development of this province. With the advent of the extensive use of fishtraps by the U.S.A. in 1897 and the obstruction of the river due to the Hell's Gate slide in 1913, following construction work on the C.N.R., the annual salmon pack began to shrink and has continued to do so until recent years.

The construction of dams on tributary streams, and log jams resulting from logging operations frequently formed impassable barriers to the ascent of the salmon. The high run-off rates experienced in logged off lands further aggravated the problem by the resulting rapid erosion of stream banks and formation of log jams.

Until recent years little was done to improve the situation, but with the formation of the International Pacific Salmon Fisheries Commission in 1937, remedial measures were undertaken. The Commission was to study the problem for eight years and it is expected that extensive improvement projects will be undertaken in the near future. These will consist of removal of existing obstructions and preventing of future ones by improved methods of logging and the planning of suitable fishways with the building of new dams.

W. N. Kelly moved a note of thanks to Mr. McHugh for his interesting discussion of this problem which is so vital to the economic life of the province.

At a meeting held February 2nd, members of the Vancouver Branch were addressed by K. G. Chisholm, Sales Engineer for Western Canada, R.C.A. Victor Company. Guests for the evening included members of The A.I.E.E., the Medical Association and Senior Engineering Students of the University of British Columbia.

Mr. Chisholm, who has had many years of experience in the practise of electronic engineering, spoke on the **Electron Microscope**, briefly tracing the development of the instrument and outlining the general principles. His talk was generously illustrated by a sound film and a number of interesting slides.

The principal field of use for this instrument lies in the study of objects whose dimensions approximate or are less than the wave length of light and the examples shown in the slides served to illustrate how quickly this microscope has found its place as an essential tool of modern science and industry. In addition to its high resolving power the instrument possesses the advantages of variable magnifying power up to 100,000 times and a much greater depth of focus than the light microscope. The latter feature permits the study of minute objects by means of stereo-micrographs.

A. Peebles occupied the chair for the evening and a vote of thanks was moved by W. N. Kelly.

Library Notes

Book notes, Additions to the Library of The Engineering Institute, Reviews of New Books and Publications

ADDITIONS TO THE LIBRARY

TECHNICAL BOOKS

Geology for Every Man:

The Late Sir Albert Charles Seward with a preface by Sir Henry Lyons. Cambridge University Press, 1943. (Canadian Representative MacMillan Company of Canada, Toronto). 5¼ x 7¾ in. $3.50.

TRANSACTIONS, PROCEEDINGS

The Junior Institute of Engineers:

Journal and record of transactions, volume liii, 1942-1943.

REPORTS

Canada, Dominion Water and Power Bureau—Water Resources Paper:

No. 84; Surface water supply of Canada, Arctic and Western Hudson Bay drainage and Mississippi drainage in Canada in British Columbia, Alberta, Saskatchewan, Manitoba, The Northwest Territories and Western Ontario, climatic years 1937-38 and 1938-39.

Canada, Department of Labour:

Labour legislation in Canada 1941-1942.

Canada, Minister of Public Works:

Report for the fiscal year ended March 31, 1943.

Canada, Department of Mines and Resources:

Report including report of soldier settlement of Canada for the fiscal year ended March 31, 1943.

Canada, Department of Transport:

Report for the fiscal year April 1, 1942, to March 31, 1943.

Ontario, Department of Mines:

Fifty-first and fifty-second annual report being Vol. LI and LII for the years 1942 and 1943.

U.S. Highway Research Board—Wartime Road Problems:

No. 8—Thickness of flexible pavements for high loads. December, 1943.

U.S. Bureau of Mines—Technical Paper:

No. 658; Production of industrial explosives in the United States during the calendar year 1942.

University of Illinois—Engineering Experiment Station—Bulletin:

No. 344; Fatigue tests of commercial butt welds in structural steel plates—No. 345; Ultimate strength of reinforced concrete beams as related to the plasticity ratio of concrete—No. 346; Highway slab-bridges with curbs; laboratory tests and proposed design method—No. 347; Fracture and ductility of lead and lead alloys for cable sheathing.

University of Illinois—Engineering Experiment Station—Reprint Series:

No. 27; A brief history of lime, cement, concrete and reinforced concrete.

Harvard University—Graduate School of Engineering—Bulletin:

No. 379; On the problem of testing hypotheses—No. 380; Radiation from vee antennas—No. 381; Transmission-line theory and its application.

University of California—Engineering Publications:

A double-speed synchronous generator.

BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet all of these books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

ABBREVS. (A Dictionary of Abbreviations)

Compiled by H. J. Stephenson. Macmillan Co., New York, 1943. 126 pp., 8½ x 5½ in., cloth, $1.75.

This dictionary brings together a great number of abbreviations commonly met with in books and papers, and frequently puzzling to the reader. Literary, scientific and industrial fields are covered.

THE AIRCRAFT ANNUAL 1944, edited by D. C. Cooke, First Annual Edition

Robert M. McBride & Company, New York 3, 1944. 288 pp., illus., charts, 9½ x 6½ in., cloth, $3.00.

This is the first of a series of annual reviews which will give a comprehensive account of current activities in aviation. The text is readable and non-technical and is accompanied by a profusion of excellent photographs. Among the topics considered are the work of the U.S. Army and Navy, the Doolittle Tokyo raid, the strategy of bombing, American air transport, and the manufacturing industry.

AIRCRAFT ELECTRICAL ENGINEERING

By F. G. Spreadbury. Sir Isaac Pitman & Sons, London; Pitman Publishing Corp., New York, 1943. 272 pp., illus., diagrs., charts, tables, 9 x 5½ in., cloth, $6.50.

The various ways in which electricity is used in aircraft are presented, with the needs of the designer in view. The chapters deal with ignition, ignition devices, direct-current generators and motors, uses of alternating current, voltage regulation, radio supply, ripple-smoothing circuits and ripple-voltage measurements, permanent magnets, and aircraft pyrometry. A reasonable amount of mathematical and electrical knowledge is presupposed.

AMERICAN PADDLE STEAMBOATS

By C. D. Lane. Coward-McCann, New York, 1943. 250 pp., illus., diagrs., 11¼ x 8½ in., cloth, $6.00.

The history of the American paddle steamboat and its development in the East, the Middle West and the Far West are described briefly in this interesting book. The text is accompanied by ninety-five plates showing drawings or photographs of interesting boats, with detailed descriptions. Students of transportation will welcome the volume.

ANALYTICAL AND APPLIED MECHANICS

By G. R. Clements and L. T. Wilson. 2 ed. McGraw-Hill Book Co., New York and London, 1943. 475 pp., diagrs., charts, tables, 8½ x 5¼ in., cloth, $3.75.

The mathematical and physical theory necessary for a thorough first course in mechanics is presented for use as a college text. A great many problems are included to demonstrate both obvious applications and logical extensions of the theory. This edition has been revised on a basis of actual classroom experience with the earlier edition and contains many new problems.

The CHEMICAL FRONT

By W. Haynes. Alfred A. Knopf, New York, 1943. 264 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $3.00.

The story of chemicals at war is told in simple, non-technical language. These chemical munitions are described with their relations to the specific activities requiring them: chemical developments which make possible the modern airplane, super-explosives, poison gases and concealing smokes, snythetic rubber, and drugs for maintaining and restoring health. The author also discusses the men and the work which made these developments possible and something of their future promise.

CHEMICAL PROCESS PRINCIPLES, Part 1, Material and Energy Balances

By O. A. Hougen and K. M. Watson. John Wiley & Sons, New York; Chapman and Hall, London, 1943. 452 pp., diagrs., charts, tables, 8¾ x 5½ in., cloth, $4.50.

This treatment of material and energy balances considers applications of general physical chemistry, thermophysics, thermochemistry and the first law of thermodynamics. Generalized procedures are elaborated for estimating vapor pressures, critical constants and heats of vaporization. New methods are presented for dealing with equilibrium problems in extraction, absorption, dissolution and crystallization. The construction and use of enthalpy-concentration charts are explained.

DESIGN OF MACHINE MEMBERS

By A. Vallance and V. L. Doughtie. 2 ed. McGraw-Hill Book Co., New York and London, 1943. 559 pp., illus., diagrs., charts, tables, 8½ x 5¼ in., cloth, $4.00.

This text has been prepared for the use of students who have had some training in kinematics, mechanics and factory processes. Upon these as a foundation the author develops the theory involved in the design of the elements of operating machines, and points out the variations from theory required by practical applications. Considerable space has been devoted to engineering materials, factors of safety, utilization factors and the selection of design stresses. Illustrative review problems are provided for each chapter.

DIESEL LOCOMOTIVES—Mechanical Equipment

By J. Draney. American Technical Society, Chicago, Ill., 1943. 472 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $4.00.

The mechanical equipment of Diesel locomotives is described in detail, with specific instructions for operation and maintenance. Following the general principles of Diesel engines come several chapters on fuel-injection, lubrication, governing, supercharging, etc. The remaining chapters deal severally with the important types of Diesel locomotives currently in use. The electrical phases will be covered in a companion volume.

ELECTRIC CIRCUITS AND FIELDS

By H. Pender and S. R. Warren. McGraw-Hill Book Co., New York and London, 1943. 534 pp., diagrs., charts, tables, 8½ x 5 in., cloth, $4.00.

This textbook gives, from an engineering viewpoint, (1) a description of the more important effects commonly described as electric and magnetic phenomena; (2) a statement in words and in mathematical formulas of the fundamental laws or principles in accordance with which these phenomena have been found to be related; and (3) the application of these principles to some of the simpler problems in connection with the generation, transmission and utilization of electric energy.

ELECTRONIC PHYSICS

By L. G. Hector, H. S. Lein and C. E. Scouten. Blakiston Co., Philadelphia, Pa., 1943. 355 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $3.75.

The object of this text is to provide the beginner with a new approach to the subject. All electrical phenomena are studied from the electron-proton point of view. Ordinary light, wireless and x-rays are shown to be closely related and to be various aspects of electrical phenomena. Photoelectricity and electron tubes are presented as a unified part of the entire subject. Natural radioactivity and transmutation of elements are also considered in the light of the electrical nature of atoms.

EXPERIMENTAL STRESS ANALYSIS, Proceedings of the Society for Experimental Stress Analysis, Vol. 1, No. 1. Papers presented at the Seventeenth Eastern Photoelasticity Conference and Experimental Stress Symposium held under the auspices of the Chrysler Institute of Engineering, Detroit, Mich., May 13th, 14th, 15th, 1943.

Published and distributed by Addison-Wesley Press Inc.. Kendall Square Bldg., Cambridge, Mass., 1943. Illus., diagrs., charts, tables, 11½ x 8½ in., cloth, $3.00.

The Society for Experimental Stress Analysis is the successor of the Eastern Photoelasticity Conferences, and this publication, the first of its proceedings, constitutes the final transactions of its predecessor. Seventeen papers are published, dealing with a wide variety of problems in the technique and applications of stress analysis.

GAS CHEMISTS' MANUAL OF DRY BOX PURIFICATION OF GAS, with an Annotated Bibliography

By G. E. Seil. American Gas Association, 420 Lexington Ave., New York, 1943. 289 pp., illus., diagrs., charts, tables, 9½ x 6 in., fabrikoid, $5.00 ($3.50 to members).

In discussing the removal of hydrogen sulfide from manufactured gas through dry box purifiers, the author has endeavored not only to explain chemically and physically what takes place but also to describe in considerable detail how these chemical and physical reactions were made to take place by various operators. Accompanying the descriptive text is a 160-page annotated bibliography which has its own index.

GEOMETRY WITH MILITARY AND NAVAL APPLICATIONS

By W. F. Kern and J. R. Bland. John Wiley & Sons, New York; Chapman & Hall, London, 1943. 152 pp., illus., diagrs., tables, 8¼ x 5 in., cloth, $1.75.

This book presents the practical essentials of solid geometry. For the development of "space intuition" a large number of exercises call for visualization of cross sections of solids in connection with reducing a problem to a number of simple problems in plane geometry. Most of the problems and illustrative examples relate to familiar objects of everyday experience or to military and naval situations.

INDUSTRIAL CHEMISTRY

By W. T. Read, 3 ed. John Wiley & Sons, New York; Chapman and Hall, London, 1943. 631 pp., illus., diagrs., tables, 8½ x 5½ in., cloth, $5.00.

The major part of this book is devoted to authoritative information on chemical raw materials, processes and products, and on typical chemical engineering operations for many purposes. Separate chapters are included dealing with chemical organizations, sources of chemical information, chemical economics, etc. The purpose of this edition is to present, as far as possible, a picture of industrial chemistry as it was at the beginning of 1942.

INTERMEDIATE COURSE IN DIFFERENTIAL EQUATIONS

By E. D. Rainville. John Wiley & Sons, New York; Chapman & Hall, London, 1943. 213 pp., tables, 8½ x 5 in., cloth, $2.75.

This book is intended as a bridge for the gap between elementary courses and really advanced courses, and affords an introduction to several topics of importance in the classical theory. Specific topics covered include Riccati equations, the hypergeometric equation, equations of the Fuchsian type, confluence of singularities and Whittaker's confluent hypergeometric equation.

INTRODUCTION TO STEEL SHIPBUILDING

By E. Baker III. McGraw-Hill Book Co., New York and London, 1943. 242 pp., illus., diagrs., charts, tables, maps, 8½ x 5 in., linen, $3.00.

An introductory textbook prepared for use in the Apprentice School of the Newport News Shipbuilding and Drydock Company, and intended to give the student an understanding of the ship's hull as a whole and of the relationship of the many shipyard trades to the finished ship. The text is adapted to students with a high-school education.

LUBRICANTS AND CUTTING OILS FOR MACHINE TOOLS

By W. G. Forbes. John Wiley & Sons, New York; Chapman & Hall, London, 1943. 90 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $1.50.

Provides, in brief form, an explanation of the fundamental principles of lubrication in relation to metal cutting and the application of various types of cutting oils to machine-tool operations. The principles of machine-tool lubrication are also discussed. The book provides practical information for the solution of problems that arise in metal cutting. The book is in part an adaptation of the author's larger book, "Lubrication of industrial and marine machinery."

LUMINESCENCE OF LIQUIDS AND SOLIDS AND ITS PRACTICAL APPLICATIONS

By P. Pringsheim and M. Vogel. Interscience Publishers, New York, 1943. 201 pp., illus., diagrs., charts, tables, 9¼ x 6 in., in., cloth, $4.00.

Part I of this volume deals with the physics of luminescence, covering the theoretical background, experimental technique and the properties of luminescent materials. Part II considers two main fields of application from a critical point of view. These two fields are fluorescence analysis for identification purposes and luminescence of various types as light sources. A tabulated list of important fluorescent materials concludes the book.

MAINTENANCE ARC WELDING

James F. Lincoln Arc Welding Foundation, Cleveland, Ohio, 1943. 234 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, 50c. in U.S.A.; 75c. foreign.

This volume contains twenty-five papers which consider the uses of arc welding in maintenance work, as a means of reclaiming broken and worn equipment and fabricating replacements. Each paper discusses work in a specific plant, describing what was done, methods and costs.

MARINE PIPING HANDBOOK for Designers—Fitters—Operators

By E. P. Gochring. Cornell Maritime Press, New York, 1944. 662 pp., illus., diagrs., charts, tables, 7½ x 5 in., cloth, $5.00.

This handbook is designed to meet the needs of designers, fitters and operating marine engineers. Every type of piping installation in a ship is considered.

MODERN AIRFIELD PLANNING AND CONCEALMENT

By M. E. De Longe. Pitman Publishing Corp., New York and Chicago, 1943. 167 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $4.00.

The problem of concealing airfields is discussed by a pilot with experience in camouflage. The distinctions between camouflage and concealment are pointed out, and methods for building in maximum concealment are considered. Proper choice of airfield locations is treated. The book is intended to guide the construction of civil airfields, as well as military ones.

MOVABLE AND LONG-SPAN STEEL BRIDGES

Compiled by a staff of specialists, edited by G. A. Hool and W. S. Kinne, revised by R. R. Zipprodt and H. E. Langley. 2 ed. McGraw-Hill Book Co., New York and London, 1943. 497 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $5.00.

This well-known text has been thoroughly revised, and new material has been added to several sections, bringing the book up to date. The book is intended for use as a reference book by engineers and students dealing with the design and construction of these bridges.

NAVIGATION

By L. M. Kells, W. F. Kern and J. R. Bland. McGraw-Hill Book Co., New York and London, 1943. 479 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $5.00

This practical textbook begins with the fundamental mathematics for pilots and descriptions of the necessary instruments and their use. Piloting methods for coastal and inland waterways are next considered together with navigation aids and rules. The latter half of the book is devoted to the principles and practice of celestial navigation as used to determine and direct ship movements. This latter section is also basically applicable to aerial navigation.

PLASTICS CATALOG 1944, Encyclopedia of Plastics

Plastics Catalogue Corporation, 122 East 42nd St., New York 17, 989 pp., illus., diagrs., charts, tables, 11½ x 8½ in., cloth, $6.00.

The 1944 edition of this Catalogue is a compendium of information upon materials, methods of engineering, molding, fabricating, finishing and assembling, and upon machinery and equipment. Other sections deal with laminates, plywood, vulcanized fiber, plastic coatings, synthetic fibers, rubber and rubber-like plastics. There is a bibliography and also a directory of sources of materials and equipment.

Principles and Applications of ELECTROCHEMISTRY, Vol. 1. Principles

By H. J. Creighton. 4th ed. John Wiley & Sons, New York; Chapman & Hall, London, 1943. 477 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $5.00.

This well-known and popular presentation of the principles and general theory of electrochemistry has been entirely revised for this edition. A number of new topics have been introduced, and old material has been deleted, and new tables of data have been included. The book is intended as a text for a systematic course of instruction and as a reference book. A large number of bibliographic footnotes are included.

Principles of MODERN INDUSTRIAL ORGANIZATION

By W. Rautenstrauch. Pitman Publishing Corp., New York and Chicago, 1943. 312 pp., diagrs., charts, tables, 9½ x 6 in., cloth, $3.75.

The proposition that production in manufacture consists of many unit operations or points of production constitutes the basis of presentation. The book as a whole deals with the problem of procedure in setting up organized relationships in the many groups of activities encountered in industrial production. Particular emphasis is placed on methods of analysis by which the activities of each department may be studied, evaluated and improved.

QUESTIONS AND ANSWERS FOR MARINE ENGINEERS —Boilers and Engines

By Capt. H. C. Dinger. Marine Engineering and Shipping Review, Simmons-Boardman Publishing Corp., New York, 1943. 377 pp., diagrs., tables, 8 x 5½ in., paper, $2.00.

In this second edition of these questions and answers, compiled from the columns of Marine Engineering and Shipping Review, the first two books have been combined. Errors have been corrected, and a few substitutions of questions made, and a fuller index added.

The SCIENCE OF EXPLOSIVES, an Introduction to their Chemistry, Production and Analysis

By M. Meyer. Thomas Y. Crowell Co., New York, 1943. 452 pp., illus., diagrs., charts, tables, 9 x 5½ in., cloth, $4.50.

The principal purpose of this work is to furnish in one book in relatively simple and readable style a comprehensive treatment of the chemistry, production and analysis of the fundamental types of explosives. The theory of explosive action is discussed, and practical initiating devices are described. Inspection, packing, shipping, storage and other phases are dealt with from the safety point of view.

SYNTHETIC RESINS AND RUBBERS

By P. O. Powers. John Wiley & Sons, New York; Chapman & Hall, London, 1943. 296 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $3.00.

The purpose of this book is to describe briefly the chemistry of synthetic resinous materials and the raw materials from which they are made. The text is divided into the following general parts: theories of polymer formation; condensation polymers; vinyl polymers; synthetic rubbers (by K. H. Weber); resins from natural products; application of synthetic resins.

THERMODYNAMICS

By J. E. Emswiler, revised by F. L. Schwartz. 5th ed., McGraw-Hill Book Co., New York and London, 1943. 335 pp., diagrs., charts, tables, 8½ x 5 in., cloth, $3.00.

The important practical topics covered are steam power, vapor refrigeration and air heat-engines. The theoretical treatment of energy, the laws of thermodynamics, permanent gases, mixtures and the flow of fluids are kept to basic considerations, the whole forming an introduction to the more abstract phases of the subject. New material on absorption refrigeration, gas turbines, gas cycles, adiabatic saturation and supersaturation has been added in this edition.

THIS FASCINATING LUMBER BUSINESS

By S. F. Horn. Bobbs-Merrill Co., Indianapolis, Ind., and New York, 1943. 328 pp., illus., diagrs., tables, 9 x 6 in., cloth, $3.75.

All phases of our lumber industry are given consideration in this informative volume. Lumbering in the West and the South, the manufacture of lumber and other forest products, methods of distribution and the economics of the industry are discussed. Other chapters treat of warfare uses of lumber, methods of wood preservation, timber engineering, etc.

PRELIMINARY NOTICE

of Applications for Admission and for Transfer

February 26th, 1944.

The By-laws provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described at the April meeting.

L. Austin Wright, General Secretary.

*The professional requirements are as follows:—

A Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science or engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainment or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

BALSHAW—FRANK EWART, of Calgary, Alberta. Born at Bolton, England, Feb. 5th, 1917; Educ.: 1938-40, Univ. of Manitoba; 1935-38, lab. asst., Imperial Oil Refinery, Calgary; 1939 (summer), furnace erection, Canada Kellogg Engineering Co.; 1940-41, sewer & constrn. engrg., City of Calgary; with the Calgary Power Co. as follows: 1941-42, surveying & constrn., Cascade power project; 1942 to date, waterworks engr., Calgary.

References: H. Randle, D. A. Hansen, W. E. Robinson, J. R. Wood, J. A. Allan, T. D. Stanley.

BICKERS—CORNELIUS WALTER, of 29 Giles Blvd., Windsor, Ont. Born at Rotterdam, Holland, Jan. 1st, 1906. (Naturalized in 1935.) Educ.: Mech. Engr., Delft Univ., Holland, 1928; 1928-29, Wilton's Engrg. & Slipway Co., Holland; 1929-30, J. & J. Taylor Safe Works, Toronto; 1930-32, Turnbull Elevator Co., Toronto; 1932-35, John Inglis Co., Toronto; 1935 to date, mech. engr., Ford Motor Co., Windsor, design of misc. plant equipment, conveyors, exhaust systems, etc.

References: G. W. Lusby, W. D. Donnelly, E. Chorolsky, J. E. Daubney, A. D. Harris, J. B. Dowler, J. F. Blowey.

BISSON—JOSEPH LEONARD, of 29 Montcalm St., Hull, Que. Born at Hull, Que., Nov. 24th, 1886. Educ.: B.Sc. (Civil), McGill University, 1912; with the Dept. of Public Works (Canada) as follows: 1912-18, asst. engr., 1918-25, senior asst. engr., design & supervising constrn. of breakwaters, wharves, laying out & supervn. of dredging wks., Fort William & Port Arthur Dists., 1925-37, senior asst. engr., design & supervising constrn. of storage dams, etc., mtce. of dams, highway bridges, wharves, etc., in Ottawa Dist., 1937 to date, dist. engr., i/c all works carried out by the Dept. of Public Works in Ottawa Dist.

References: K. M. Cameron, J. E. St. Laurent, R. Blais, G. H. Thurber, F. G. Smith, S. S. Scovil.

BOUCHARD—ANDRE, of Quebec, Que. Born at Quebec, Jan. 21st, 1907. Educ.: Ecole Polytechnique, Civil Engr., 1931, Elec. Engr., 1932; Mass. Institute of Technology, M.Sc. (Elec.), 1934; P.R.E. Que. With the Shawinigan Water & Power Co., Three Rivers, Que., as follows: 1934-40, C. & D. Dept., 1937-40, elect'l. engr., south div'n., C. & D. Dept.; 1940 to date, prof. of elect'l. engrg., Faculty of Science, Laval Univ., Blvd. de l'Entente, Quebec, Que.

References: R. Dupuis, H. Cimon, G. E. Sarault, P. Vincent, Y. R. Tassé, A. E. Paré.

BRODA—JOSEPH GEORGE, of Port Arthur, Ont. Born at Winnipeg, Man., Mar. 5th, 1907. Educ.: B.Sc. (C.E.), Univ. of Man., 1933; 1938-40, junior engr. i/c topog'l. survey parties for P.F.R.A., hdqrs., Regina, Sask.; 1941 (June to Nov.), junior engr., layout of barracks for joint hdqrs. of Armed Services with sewer & water services at Jericho Beach, Vancouver, B.C.; 1943 (April-June), instru'man. & engr., Anglin-Norcross, Ont., on foundry extension to Ford Motor Plant, Windsor; 1943 (July-Sept.), instru'man & engr., Canadian Kellogg Co., i/c job unit synthetic rubber plant, Sarnia; 1943, constrn. engr., Coast Construction Co., on Satellite Air Field in Edmonton; at present, concrete design & gen'l. dfting., C. D. Howe Co. Ltd., Port Arthur, Ont.

References: J. N. Finlayson, A. E. Macdonald, N. M. Hall, R. W. Moffatt, J. M. Fleming, G. H. Herriot.

CARSON—ELMER F., of London, Ont. Born at Westmount, Que., Oct. 20th, 1905. Educ.: 1924-28, Faculty of Commerce, McGill Univ.; with the Northern Electric Co. Ltd., as follows: 1929-35, wire & cable dept., Toronto Dist. Sales, 1935-41, street lighting & wire & cable depts., 1941-43, mgr., sub-branch Val d'Or, Que., 1943 to date, branch mgr., London, Ont. (Asks for admission as an Affiliate.)

References: V. A. McKillop, R. S. Charles, Jr., E. V. Buchanan, J. A. Vance, T. L. McManamna.

CARSWELL—JAMES MORRISON, of Toronto, Ont. Born at Uxbridge, Ont., June 23rd, 1892. Educ.: B.A.Sc., Univ. of Toronto, 1930; R.P.E. Ont.; 1910-11, mach. shop ap'tice, Fittings, Ltd., Oshawa, Ont.; 1916-19, Sgt. i/c tech. & engrg. office, H.Q., Cdn. Machine Gun Corps, France; 1919-20, asst. engr., Hydro-Electric Power Commn. of Ont.; with the Southern Sierras Power Co., as follows: 1921-26, load despatcher, at Bishop, Cal., controlling all lines & plants of assoc. cos. of the Nevada-California Power Corp'n., serving a territory of over 600 miles, 1926-28, elect'l. designer, at Riverside, Cal., designing switchbds., control & relay systems & gen'l. layout for power houses, etc.; 1928-29, designer & promoter of internal combustion engine; with the Univ. of Toronto as follows: 1929-30, instructor i/c 2nd yr. elect'l. lab., 1930-40, instructor, engrg. problems & drawing, assisting in prep. of courses in engrg. drawing, maths., statics, etc., & supervn. of dfting. room; 1940-41, senior instructor, Army Trade School, Dept. of National Defence, Ottawa; 1941 to date, chief engr., Central Inventory Records Div'n., Dept. of Munitions & Supply, Ottawa.

References: A. M. Hudson, J. R. Cockburn, J. J. Spence, C. R. Young, W. R. McCaffrey.

CHARLES—FREDERICK ROLAND, of 5285 Decarie Blvd., Montreal, Que. Born at Toronto, Ont., Feb. 5th, 1911. Educ.: B.A.Sc. (Mech.Engrg.), Univ. of Toronto, 1933; graduated in law from Osgoode Hall Law School, Toronto, 1936; 1929 (summer), machinist, Benjamin Electric Co., Toronto; 1932 (summer), mechanic, repair shop, Star Taxi Co., Toronto; 1933 & 1934 (summers), gas mileage tests, Lake Simcoe Ice Co., Toronto; 1933-36, law student & asst. dftsman., Ridout & Maybee, Patent Attorneys, Toronto; 1941, Aeronautical Engineering Officer, R.C.A.F.; 1942 (Feb. to Aug.), officer i/c Servicing Squadron, No. 12, S.F.T.S., Brandon, Man.; 1942 to date, officer i/c engine section, R.C.A.F. School of Aero. Engrg., Montreal, and at present, instructor, aero. engrg. branch, with rank of Flight-Lieut.

References: R. W. Angus, E. A. Allcut, T. R. Loudon, J. R. Cockburn, W. J. T. Wright, A. Michaud.

CHARNOCK—EDMUND THOMAS, of 1435 Cuthbertson Place, Fort William, Ont. Born at Fort William, Ont., April 13th, 1913. Educ.: B.A.Sc. (Chem.Engrg.), Univ. of Toronto, 1938; 1938-42, asst. chemist, J. R. Watkins Co., Winnipeg, lab. work dealing with testing & control, supcrv'n. of mfre. & packaging, etc.; at present, asst. sulphite supt., Great Lakes Paper Co. Ltd., Fort William, Ont.

References: W. H. Small, H. G. O'Leary, A. J. Mickelson, S. T. McCavour, J. I. Carmichael.

CLIFFORD—HAROLD LINSCOTT, of Westmount, Que. Born at Brunswick, Maine, May 1st, 1887. Educ.: B.Sc. (Civil Eng.), Univ. of Maine, 1910; 1910-14, bldg. engr., hdqrs., National Transcontinental Rly., Ottawa; 1914-16, asst. engr., Dept. of Railways & Canals, Welland Ship Canal, section No. 3, Thorold, Ont.; 1916-20, works mgr., National Shipbuilding Corp'n., Three Rivers, Que.; 1920-22, supt., W. I. Bishop, Ltd., Montreal; 1922-26, gen'l. contractor, Three Rivers; 1927-32, gen'l. supt., Robertson & Janin & Co., Montreal; 1932 to date, gen'l. supt., Dufresne Engrg. Co. Ltd., Montreal, and at present, gen'l. mgr., Quebec Shipyards, Ltd. Quebec, Que.

References: O. O. Lefebvre, E. G. Cameron, C. Lindsay, J. B. D'Aeth.

d'ALBENAS—LEONARD HENRY, of 64 King's Road, Valois, Que. Born at Montreal, April 24th, 1913. Educ.: 1938-43, Montreal Technical Institute (evening classes in applied science); with the Northern Electric Co. Ltd., as follows: 1929-30, piece part & apparatus inspr., telephone div'n., 1930, section supervisor; 1930-34, temporary work with Messrs. Haliburton & White, mach. shop., & with Messrs. R. W. Bartram & Co., Montreal, junior clerk; with the Northern Electric Co. as follows: 1934-37, millwright section, plant mtce. dept., etc., including 7 mos. in the power plant, 1937-41, special products div'n. (now electronics div'n.), with tinsmith section & later i/c raw material & stores; 1941 to date, mech. dftsman., Darling Bros. Ltd., & 1943 to date, lab. asst., Montreal Technical Institute (evening classes).

References: J. D. Alder, M. S. Nelson, E. Darling, W. McGuinness, J. H. Maude, J. B. Bladon.

DELISLE—E. ALIDE, of Shawinigan Falls, Que. Born at Yamachiche, Que., June 8th, 1892. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1918; R.P.E. Que.; 1914-18 (summers), survey & constrn., Dept. of Highways (Quebec); with the Belgo Paper Co., as follows: 1918-22, road & struct'l. constrn., 1922-24, res. engr., rly. constrn.; 1924 to date, city engr., City of Shawinigan Falls.

References: R. Dorion, T. J. Lafrenière, A. Larivière, C. Tourigny, P. Méthé, H. K. Wyman, P. Telmosse.

DESLAURIERS—ALFRED JOSEPH, of 357 Provost St., Lachine, Que. Born at Montreal, Dec. 15th, 1902. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1930; R.P.E. Que.; 1930-31, constrn. dept., Bell Telephone Co. of Canada; 1931-32, constrn. engr., Crepeau & Hunter; 1932 to date, city engr., City of Lachine, Que.

References: A. Circé, W. S. Lea, H. G. Hunter, R. Dorion, L. Roy.

DOJACK—LIONEL DAN, of Swift Current, Sask. Born at Prague, Czecho-Slovakia, Jan. 24th, 1908. Educ.: 1926-29, Univ. of Man. (completed 2nd year toward B.Sc.); with Sask. Power Commission as follows: 1929-30, asst. on misc. surveys on various transmission line constrn. projects, estimating, etc., 1929-30, gen'l. engrg., valuation, etc., engrg. office, 1930-31, supervisor i/c constrn. of irons, lines, substations & distribution systems, 1931 to date; asst. supt., i/c operation, constrn. mtce. of transmission lines, etc., and at present, dist. supervisor. (Asks for admission as an Affiliate.)

References: S. R. Parker, J. E. Mollard, J. I. Strong, R. W. Jickling.

DUMONTIER—JOSEPH EMILE, of Parent Square, Quebec, Que. Born at Levis, Que., Feb. 25th, 1904. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1935; R.P.E. Que.; with Can. National Rlys. as follows: 1924-28, chainman, Levis, Que., 1928-30, instru'man., Richmond, Que.; 1935-36, res. engr., Dept. of Roads (Quebec), Quebec; with Can. National Rlys. as follows: 1936-41, asst. div'n. engr., Cochrane, Ont., 1941-43, asst. divn. engr., Quebec, Que., 1943 to date, div'n. engr., Quebec, Que.

References: S. J. H. Waller, J. Limoges, Y. Tassé, Lucien Martin, Louis. Trudel.

ELKINS—WILLIAM HENRY PFERINGER, Major-General, of "Ravenswood," Dutch Village Road, Halifax, N.S. Born at Sherbrooke, Que., June 13th, 1883; Educ.: Diploma, R.M.C., 1905; 1908-10, with R.C.H.A. in India; 1914-19, overseas, from 1916 to end of war, commanding R.C.H.A., Brigade; 1920-26, Commandant, Royal School of Artillery; 1922-25, commanded R.C.A., Halifax, and 1925-26, commanded R.C.H.A. Brigade; 1926-30, Staff Officer Artillery, National Defence Hdqrs. (Liaison Officer with National Research Council); 1930-35 Royal Military College of Canada; 1935-38, D.O.C., M.D. No. 2, Toronto; 1938-40, Master-General of the Ordnance, National Defence Hdqrs.; 1940-43, General Officer Commanding-in-Chief, The Atlantic Command; July 1943, granted leave, pending retirement.

References: K. M. Cameron, E. L. Cousins, J. B. Hayes, H. Kennedy, H. F. G. Letson, A. G. L. McNaughton, L. A. Wright.

FARLEY—HENRY RICHARD, of 3 Third Ave., Ottawa. Born at Ottawa, Ont., June 6th, 1913. Educ.: B.Sc., St. Patrick's College, Ottawa, 1937; approximately 10 summers gen'l. civil engrg. & land surveying, Farley & Cassels, Ottawa; 1937-40, i/c waste water surveys, etc., Waterworks Dept., City of Ottawa; 1940-41, Aeronautical Engineer Officer, No. 12, Technical Detachment, R.C.A.F., Toronto, inspecting all types mfg. plants in southern Ontario, also supplies used by R.C.A.F.; 1941-42, Station Technical Officer, No. 12, Equipment Depot, Montreal, as advisor to the O.C. on technical matters, i/c inspection of goods, etc.; 1942, Chief Engineer Office, No. 10, Service Flying Training School, Dauphin, Man.; 1942-43, i/c Airframe Repair Section, No. 8 Repair Depot, Winnipeg, responsible for repairing of aircraft, etc.

References: S. E. Farley, W. L. Cassels, W. E. MacDonald, C. Wight, R. E. Hayes.

FENN—WILLIAM EDWARD, of Winnipeg, Man. Born at Bracebridge, Ont., Aug. 2nd, 1908. Educ.: B.A.Sc., Univ. of Toronto, 1933; 1927-28, final tester, Canadian General Electric Co.; 1930-37, control operator for 7 radio stations, including install'n. ; mtce. work; with the Dept. of Transport, Radio Aviation Branch, as follows: 1937-38, asst. radio engr., range station site selection, i/c constrn. ; install'n. of radio station, Shediac, N.B. & St. Hubert Airport, engrg. work, plans for new stations, Ottawa; 1938 to date, district radio engr. (Western Canada), Radio Div'n., Aviation Section, Winnipeg.

References: C. P. Edwards, J. D. Peart, E. S. Kelsey, J. E. Granich, S. Sillitoe,

GAUDETTE—EDGAR, of St. Jean, Que. Born at St. Jean, Que., May 1st. 1903. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1929; R.P.E. Que.; 1929 (May-Sept.), elect'l. dept., Montreal Tramways; 1929-37, asst. engr., bridge div'n., Dept. of Public Works, Prov. of Que.; 1937 to date, city engr., City of St. Jean, Que.

References: R. Dupuis, I. Vallée, P. A. Dupuis, P. P. Vinet, T. M. Dechêne.

GIRARD—ARNOLD THOMAS, of 89 Dentonia Park Avenue, Toronto, Ont. Born at Ottawa, Ont., October 19th, 1917. Educ.: B.A.Sc., Univ. of Toronto, 1943; 1939-42 (summers), mtce. mechanic, Falconbridge Nickel Mines, Noranda Mines, and boiler shop inspr., John Inglis Co.; at present, engr. i/c of the preparation of drawings & specifications for the manufacture of various types of air & gas compressors, ranging from small single and two stage compressors to large, horizontal and "Y" type compressors.

References: R. W. Angus, G. R. Lord, R. C. Wiren, W. J. T. Wright, C. F. Morrison.

GOUGEON—ELZEAR NAPOLEON, of 136 Benoit XV Blvd., Quebec, Que. Born at Montreal, Que., May 24th, 1901. Educ.: B.Sc. (Mech.), Mass. Inst. of Technology, 1930; R.P.E. Que.; from 1920-26, mech. dftsman. at Dominion Glass Co., Lavoie Automotive Devices, Red Star Refineries, Ltd., Dom. Bridge Co. & Dom. Engrg. Works, Ltd.; 1927-40, prof. of science, Ecole Technique de Hull; 1940-42, mtce. & tool engr., Sorel Industries, Ltd.; 1942-43, field engr., Dept. of Munitions & Supply; 1943 to date, production engr., Quebec Shipyards Ltd., Quebec, Que.

References: P. Cousineau, F. Rousseau, A. Frigon, P. Méthé, C. L. Dufort

GOW—KENELM VERE, of Arvida, Que. Born at Ottawa, Ont., Aug 29th, 1919. Educ.: B.A.Sc., Univ. of Toronto, 1943; 1937-41, summer work with B.C. Nickel Mines, Choate, B.C., East Malartic Mines, Norrie, Que., C.I.L. Paint & Varnish, Toronto, Ont., Goodyear Tire & Rubber, New Toronto, Ont.; 1942 (summer), Research Enterprises Ltd., Toronto, Ont.; 1943 to date, refractories engr., the Aluminum Co. of Canada, Arvida, Que.

References: C. R. Young, P. E. Radley, A. Cairncross, B. E. Bauman, W. J. T. Wright.

HARAKAS—PETER, of Quebec, Que. Born at Brantford, Ont., Nov. 25th, 1912. Educ.: B.A.Sc., Univ. of Toronto, 1942; 1939-40 (summer), roaster constrn.; with the Hydro-Electric Power Commn. of Ontario as follows: 1941 (summer), dfting. & surveying; 1942-43, junior engr. on constrn. of power plant, headworks & tailrace channel; 1943, senior instru'man.; at present, res. engr. on constrn. of wharf & breakwater at Forestville, Que., for the Anglo-Canadian Pulp & Paper Mills Ltd.

References: R. F. Legget, W. Jackson, J. J. Spence, C. R. Young, R. Lord, R. W. Angus.

HEBERT—CAMILLE RAYMOND, of 4700 Iberville St., Montreal, Que. Born at Montreal, Que., Dec. 20th, 1912. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1936; R.P.E. Que.; with Lord & Compagnie, Limitée, as follows: 1936-42, struct'l. steel detailer & designer, 1942 to date, chief engr. & asst. mgr.

References: A. Circé, L. Trudel, A. Frigon, G. St. Jacques, P. Cousineau, R. Matte.

HIGGINS—JOHN, of Edmonton, Alta. Born at Glasgow, Scotland, Aug. 29th, 1910. Educ.: Inst. of Technology & Art, Calgary, 1929-33; Advanced Specialist Certificate (after 10 years' practical experience as technical instructor; 1940, Grad. R.C.A.F. Engrg. School with commissioned rank; 1929-31 (summers), art foreman, Alberta Creosote Co., Calgary; 1931 (summer), lab. asst., Institute of Technology & Art, Calgary; 1931-32 (summers), asst. chemist, Regal Oil Refineries, Calgary; 1933-40, gen'l. shop instructor, Edmonton School Board & intermittently employed as asst. engr. in the office of A. Higgins, M.E.I.C., consltg. engr., Calgary; 1940, supervisor, Dominion Provincial Youth Training Centre (on loan from Edmonton Public School Board); 1941-42, Engineer Officer, attached to No. 16 A I Dist., R.C.A.F., responsible for inspection & mfg. & repair contracts in civilian plants in Alta. & Sask., also for technical inspection of Air Force Equipment Depots in this area; 1942 to date, O.C. No. 30 Aeronautical Inspection Div'n., R.C.A.F., Edmonton, responsible for quality of aircraft & aero engines repaired by Aircraft Repair Ltd., Edmonton.

References: C. W. Carry, R. M. Dingwall, A. Higgins, F. N. Rhodes, T. R. Loudon.

IDENDEN—FRANCIS STEVENSON, of Mackenzie, British Guiana, S.A. Born at Toronto, Ont., Sept. 25th, 1915. Educ.: B.A.Sc. (Mech.), Univ. of Toronto, 1941; 1931-33, actuarial clerk, North American Life Assce. Co., Toronto; 1934 (summer), mechanic, gravel crushing plant, McNamara Construction Co. Ltd.; 1934-35, miner, driller, etc., Sylvanite Gold Mines, Kirkland Lake; 1936 (summer), driller, Noranda Mines, Ltd., Noranda, Que.; 1939 (summer), i/c wholesale & retail bulk oil & gasoline plant, Thayers, Ltd., Toronto; 1940 (summer), student engr., Imperial Oil Co. Ltd., Sarnia, Ont.; 1941-42, asst. engr. to design engr., Trinidad Leaseholds, Ltd., Point-A-Pierre, Trinidad; 1942-43, mech. & advisory engr. to O.C. & i/c mech. design, U.S. Naval Operating Base, Trinidad; 1943 to date, mech. engr., i/c field mtce. at Ituni Mine, Demerara Bauxite Co. Ltd., Mackenzie, British Guiana, S.A.

References: W. G. Stuart, F. X. Granville, A. Bonnell, R. W. Angus, E. A. Allcut.

JOHNSON—OSCAR RAGNAR, of 218 Kingston Row, St. Vital, Man. Born at Lulea, Sweden, Aug. 8th, 1900. Educ.: Univ. of Man., 1919-20; 1922-24, boiler design, Port Arthur Shipbldg. Co., Port Arthur; 1924-27, grain elevator layout & concrete design, C. D. Howe Co. Ltd.; 1927-28, i/c design of concrete refinery bldgs., Standard Oil Co. of Cal. El Segundo, Cal.; 1928 concrete bldg. design, Walker & Eisen, architects & engrs., Los Angeles, Cal.; 1929, competitive concrete design, Branson Systems Inc., Chicago, Ill.; 1929 to date, asst. to chief engr., Carter-Halls-Aldinger Co. Ltd., Winnipeg.

References: A. W. Fosness, F. S. Adamson, C. V. Antenbring, J. M. Fleming, R. R. Collard.

JOHNSTON—FREDERICK SPENCER, of 92 Wemyss St., Sault Ste. Marie, Ont. Born at Sault Ste. Marie, Ont., March 19th, 1907. Educ.: General Motors Institute of Technology, 1926-28; I.C.S. course (Mech. Engrg.); with the General Motors as follows: 1926-28, co-operative management engrg. course, bench & layout work, lathe & milling machine operation, 1928-34, tracing and dfting. detail; with the Algoma Steel Corp'n. Ltd., Sault Ste. Marie, as follows: 1934-38, senior dftsman., checking, estimating and layout of steel plant equipment; 1938-40, design and superv'n. of work on tin mill equipment, open hearth furnaces, rolling mills, etc.; 1940 to date, asst. chief dftsman.

References: C. Stenbol, W. D. Adams, A. H. Russell, L. R. Brown, F. J. McDiarmid.

LAKE—HENRY MORTON, of 35 Forrest Ave., Sault Ste. Marie, Ont. Born at Toronto, Ont., July 18th, 1890. Educ.: I.C.S. course, 1905-11; 1906-09, machinist and fitter, Grand Trunk Rly., at Lindsay, Ontario Shops; 1910-14, dftsmn., Algoma Steel Co.; 1914-18, i/c struct'l. steel design and fabrication, F. H. Lake & Son; 1918-22, asst. chief dftsmn., Algoma Construction & Engineering Co.; 1923-24, i/c preliminary designs and estimates on floatation plant, International Nickel Co., Sudbury, Ont.; 1925 to date, chief dftsman and chief engr., Algoma Steel Co., Sault Ste. Marie; 1925-39, engaged on gen'l. plant mtce. and alterations; 1939 to date, design, estimates, etc., on gen'l. plant extensions, such as rolling mills, steel finishing plants, etc.

References: C. Stenbol, F Smallwood, D. L. Mekeel, W. D. Adams, L. R. Brown, F. J. McDiarmid, A. E. Macdonald.

LORD—JOSEPH HENRI, of 4700 Iberville St., Montreal, Que. Born at Mont-Carmel, Que., March 7th, 1899. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1922; 1916-22 (summers), town engr., surveying, sewer work, street and road constrn., City of Shawinigan Falls; 1922, railroad constrn. engr., Belgo Pulp & Paper Co.; 1923-24, struct'l. steel designer, John S. Metcalf; with the Dominion Bridge Co. Ltd., as follows: 1925, struct'l. steel designer, detailer; 1926-35, sales engr.; 1935 to date, gen. mgr. and sec. treasurer, Lord & Compagnie, Limitée, Montreal.

References: A. Circé, A. Lalonde, J. P. Lalonde, R. Matte, A. Frigon, L. Trudel, L. Roy.

LUPIEN—LEO, of 65 Manrese Ave., Quebec, Que. Born at St. Leon, Que., July 31st, 1907. Educ.: B.A.Sc., C.E., Ecole Polytechnique; 1932, R.P.E., Que.; 1932-35, res. engr., highway constrn., Dept. of Roads, Province of Quebec; 1936 to date, topographer engr., office of bridges, Dept. of Roads, Que.

References: R. Savary, E. Gohier, A. Gratton, J. O. Martineau, J. A. Lefebvre, C. Milot.

MacLEAN—GEORGE OSBORNE, of 38 St. Louis Road, Quebec, Que. Born at Quebec, Que., April 1st, 1887. Educ.: I.C.S.; 1905-14, rodman to res. engr., National-Transcontinental Rly.; 1914-19, in the Armed Forces; 1921-23, dftsman. and asst. engr., mech. branch, International Rly. Corp'n., Buffalo, N.Y.; 1923-27, cost engr., industrial constrn., D. P. Robinson Co., New York, N.Y.; 1927-28, plant constrn., survey & mtce., DuPont Rayon Co., Buffalo, N.Y.; 1928-29, chief acc't. and cashier, Gledhill Constrn. Co., New York, N.Y. 1930-31, highway constrn., McNamara Constrn. Co., Toronto; 1931-36, highway constrn., supt. and res. engr., Dept. of Highways, Ontario; 1936-39, constrn. engr. and supt., McNamara Constrn. Co., Toronto, on highway constrn. in Ontario and N.B.; 1939 to date, res. engr., Dept. of Highways, Quebec. (Asks for admission as an Affiliate.)

References: T. F. Francis, W. J. Bishop, C. E. Fraser, Ernest Gohier, J. Limoges.

McMEEKIN—GEORGE REX, of 2111-10th St. N.W., Calgary. Born at Calgary, Alta. Dec. 15th, 1918. Educ.: B.Sc. (Chem. Eng.), Univ. of Alta., 1941; R.P.E. Alta.; 1938-40 (summers), asphalt checker, Dept. of Public Works, Prov. of Alta.; 1940 (summer), junior engr. on airport constrn., Dom. Dept. of Transport; with Alberta Nitrogen Products Ltd., Calgary, as follows: 1941-43, plant tester, various chemical, engrg. and research problems, and at present, technical librarian and technical records chief clerk. (Technical records include chemical balances, production records, etc., and gen'l. supervision of operating and equipm't. records of the various producing plants of the Co.

References: J. V. Rogers, J. P. Svarich, J. Haddin, L. A. Thorssen.

NIX—EDMUND ALLEN, of 4546 Melrose Ave., Montreal, Que. Born at Derby, England, Aug. 9th, 1905. Educ.: 1921-26, Derby Technical College, concurrently with 1920-27, J. A. Aiton & Co., Derby, England, design and layout of high pressure piping systems, etc. for steam generating stations, warships, etc.; 1927-34, mech. designer, J. S. Metcalfe Co. Ltd., Montreal, grain elevator engrs. With Dominion Engineering Works, Ltd., as follows: 1935-39, design engr., mining dept.; 1939 to date, engr. i/c design, Dominion Hoist & Shovel Co. Ltd. (an associate of Dominion Engrg. Works Ltd.), responsible for all new designs in connection with the company's products including power shovels, locomotive cranes, hoisting equipm't., etc.

References: R. S. Eadie, J. H. Wallis, C. C. Langstroth, J. H. Maude, D. B. Armstrong.

PAUL—KENNETH ROY, of 77 Roehampton Ave., Toronto, Ont. Born at Danville, Que., Sept. 2nd, 1909. Educ.: Private study of maths. and radio engrg.; 1926-28, radio servicing; with the Canadian Marconi Co. as follows: 1928-29, radio testing; 1929-30, field broadcast operator (CFCF), 1930-32, studio operator (CFCF); 1932-34, transmitter operator (CFCF); 1934-35 technical supervisor (CFCF); 1935-40, chief engr. (CFCF);-1940-41, transmitter development engr.; 1941 (6 mos.), production engr.; with Research Enterprises Ltd. as follows: 1941-42, executive engr.; 1942-43, radio contract mgr.; at present, radio engr., Lancaster production, Victory Aircraft Ltd., Malton, Ont.

References: J. A. Kearns, F. W. R. Angus, J. Morse, E. W. Farmer, R. W. Hamilton, A. Benjamin.

PHILLIPS—W. ERIC, of "Wynyates Farm," Oriole, Ont. Born at Toronto, Ont., Jan. 3rd, 1892. Educ.: B.A.Sc., Univ. of Toronto, 1914; 1912-14, student, Phillips Manufacturing Co. Ltd., Toronto; 1922-37, pres. and gen'l. mgr., W. E. Phillips Co. Ltd., Oshawa; 1928 to date, pres. and gen'l. mgr., Duplate Canada Ltd., Oshawa; 1937 to date, pres. and gen'l. mgr., Fiberglas Canada Ltd., Oshawa; 1940 to date, pres., Research Enterprises Ltd., Leaside, responsible for constrn. of plant, selection and install'n. of equipment, organization and management; also pres. and gen. mgr., Duplate Tool & Die, Ltd., Oshawa, Duplate (Windsor) Ltd., Safety Glass Standards Ltd., Oshawa.

References: C. J. Mackenzie, C. R. Young, K. M. Cameron, L. C. Jacobs, L. A. Wright, Hon. C. D. Howe.

ROCHE—ROBERT S., of 28 Aylmer Road, Hull, Que. Born at Auckland, New Zealand, Oct. 24th, 1893. Educ.: Articled to T. J. H. Speedy, consltg. civil engr. and surveyor, 1911-1914; 1914-19, N.Z. Exp. Force; 1920-21, asst. engr., N.Y. water power investigation; 1921-25, asst. engr., petroleum development, C. F. Powell, consltg. engr.; 1925-27, asst. engr., petroleum produc'n engrg., National Petroleum Engrg. Co.; 1927-42, consltg. practice, petroleum produc'n engrg., design and constrn. of oil storage, pipe lines and pump stations, Tulsa, Oklahoma. At present, petroleum engineer, Naval Service, Ottawa i/c design pipe lines, pump stations, etc. and layout of Naval fuel oil install'ns.

References: A. A. Young, J. Dick, E. G. M. Cape, J. B. Stirling, E. H. Beck.

ROXBURGH—GERALD STEELE, of Winnipeg, Man. Born at Norwood, Ont., May 4th, 1883. Educ.: B.A.Sc., Univ. of Toronto, 1904; 1905-1942, practised as engr. and patent attorney, Winnipeg; 1942 (Oct.) to date, regional representative, Wartime Bureau of Technical Personnel, Winnipeg.

References: J. W. Sanger, E. V. Caton, E. P. Fetherstonhaugh, W. P. Brereton, W. H. Munro, H. W. Lea, L. Austin Wright.

SHARPE—THOMAS ALBERT ALEXANDER, of 337 Arthur St., Oshawa, Ont. Born at Cranbrook, B.C., April 6th, 1919; Educ.: B.A.Sc., Univ. of Toronto, 1941; 1937-38 (summers), with C.P.R. as follows: Chainman on survey party and labourer on bridge constrn., at Downie, B.C.; section man at Medstead, Sask.; 1939 (summer), mucker and timberman's helper, Trood Mine, Sudbury, Ont.; 1940 (summer), mucker and miner's helper, Hollinger Consldt. Gold Mines, Timmins, Ont.; 1941, various experience as follows: engr's asst., Siscoe Gold Mines Ltd., instru'man., No. 1 Training Command, R.C.A.F., Toronto, also on heating and steam plant layouts for air schools, later transferred to Mount Hope Air Station as instru'man.; 1941-42, tool engr., Vector Engrg. Co. Ltd., Toronto, design of tools, gages, etc.; 1942 to date, on loan from Vector Engineering Co. to General Motors of Canada, Oshawa, Ont., as estimating engr. and at present, on production and mech. engrg. and design.

References: C. A. Colpitts, T. C. McNabb, G. H. N. Monkman, V. Michie, W. M. Treadgold.

SUTHERLAND—JOHN GORDON, of 530 Grosvenor Ave., Westmount, Que. Born at Toronto, Ont., Sept. 8th, 1907. Educ.: B.A.Sc., Univ. of Toronto, 1930; grad. study, Leland Stanford Univ., Cal., 1930-33; 1927-30 (summers), rodman, transitman, Schreiber Div'n., C.P.R.; 1930-33, instructor in civil engrg., Stanford Univ., Cal.; with C.P.R. as follows: 1933-37, transitman, Sudbury Div'n.; 1937-38, asst. engr., engr. mtce. of way office, E.L.; 1938-39, div'n. engr., Schreiber Div'n.; 1939-43, div'n. engr., Smiths Falls Div'n.; 1943-44, asst. engr., chief engr's office; 1944 to date, asst. engr. of track.

References: J. E. Armstrong, R. B. Jones, A. R. Ketterson, D. Hillman, D. G. Kilburn, W. P. Dobson, J. E. Beatty.

SWANSON—ALFRED LAWRENCE, of 1113 London St., New Westminster, B.C. Born at Creeford, Man., April 6th, 1905. R.P.E., B.C.; (by exam.) 1924-34, machinist and steam operating engineer; 1934-37, engr. and dftsman., B.C. Pulp & Paper Co., Port Alice, B.C.; 1937-38, engr. and dftsman., Ross & Howard Iron Works, Vancouver, B.C.; 1938-39, engr., B.C. Sugar Refining Co., Vancouver; 1939-40, inspr., boilers and machy., Provincial Govt. of B.C.; 1940-42, inspecting officer, (fuse filling) Inspection Bd. of U.K. and Canada, Ottawa; 1942 to date, asst. supt., Heaps Engineering (1940) Ltd.

References: H. P. Archibald, W. A. Wood, A. Pearson, W. T. Fraser, J.G. D'Aoust, C. C. Ryan.

THOMPSON—GEORGE ALEXANDER, of Shipshaw, Que. Born at Chepstowe, Ont., May 30th, 1904. Educ.: B.A.Sc., Univ. of Toronto, 1934; R.P.E. Que.; with the Dept. of Highways as follows: 1937-38, instru'man; 1938-39, res. engr.; 1939 (3 mos.), job engr., Highway Paving Co., Montreal; 1939-40, res. engr., Atlas Construction Co., Montreal; 1942-44, res. engr. and supt., Foundation Co. of Canada, Ltd. At present, supt. of constrn. at Shipshaw for Aluminum Co. of Canada.

References: C. Miller, J. W. H. Ford, H. V. Serson, C. R. Young, P. C. Kirkpatrick.

TILBURY—HARRY C., of 3 Wright Ave., Halifax, N.S. Born at Hamilton, Ont., Nov. 7th, 1917. Educ.: I.C.S. course, 1937-44; 1937-40, Elect'l. apprenticeship, Can. Westinghouse Co.; 1940 (Sept.)-(June), 1941 elect'l. instructor; torpedo school, R.C.N.; 1941-42, electrician, H.M.C.S. Hamilton; 1942 (July-Nov.) elect'l. instructor, torpedo school, R.C.N.; 1942 (Dec.)-43 (Mar.), service engrg. dept., Sperry Gyroscope Co., Brooklyn, N.Y.; 1943 (Mar.)-44 (Jan.), instructor (gyro-compass), Torpedo School, R.C.N.; at present, elect'l. artificer, R.C.N., H.M.C.S. Stadacona.

References: J. Dean, M. A. Harrigan, A. R. Hannaford, D. W. Callander, J. Thwaites.

WATTS—JOHN POLLITT, of 12 Anne St., Peterborough, Ont. Born at London, England, June 14th, 1911. Educ.: B.Sc., Queen's Univ., 1936; 1933-34 (summers), geol. survey, Dominion Govt.; with the Canadian General Electric Co., as follows: 1936-37, test dept.; 1937 to date, engr. dept., and at present, asst. W. & C. engr., Peterborough.

References: G. R. Langley, V. S. Foster, J. Cameron, D. V. Canning, B.I. Burgess.

WAYLAND—RAYMOND JOSEPH, of 2979 St. Catherine Road, Montreal. Born at Montreal, Que., March 10th, 1903. Educ.: B.Sc. (Civil Eng.), Clarkson College of Technology, Potsdam, N.Y., 1928; R.P.E. Que.; 1928-29, junior engr., and 1929-31, engr. i/c repairs and mtce., Quebec Pulp & Paper Corp'n. 1931 (6 mos.), instru'man., Beauharnois Power House constrn.; with Regent Knitting Mills, Ltd., as follows: 1931-33, time study and rate setting engr.; 1933-41, engr., i/c planning, production control, etc.; 1941 to date, industrial engr., Stevenson & Kellogg, Management Engineers.

References: de G. Beaubien, P. Kellogg, T. M. Moran, H. A. Gauvin, R. Bélanger, L. A. Duchastel.

WHITE—JAMES SMITH, of 45 Hemlock Ave., Shawinigan Falls, Que. Born at Kintyre, Ont., July 10, 1892. Educ.: B.Sc., Queen's Univ., 1914; R.P.E. Que.; 1909-10, with Jones & Moore Electric Co., Toronto; 1911-13, summer work as student with Viele, Blackwell & Buck, Ontario Hydro-Electric Power Comm. of Ont. & Hope Engrg. & Supply Co.; 1914-16, junior engr., Northern Ontario Light, Heat & Power Co., Cobalt, Ont., on Montreal River storage surveys, power house and distribution engrg., covering compressed air and elec. power; 1916-17, dftsman., Canadian Electric Products Ltd., on design of Acetone plant at Shawinigan Falls, Que., for the British Munition Board; with the Canada Carbide Co., Shawinigan Falls, as follows: 1917-19, junior engr. on design and constrn. of carbide, electrode and magnesium plant extensions; 1918-28, plant engr. i/c design and constrn. and mtce. of carbide plant; 1928 to date, chief engr., Shawinigan Chemicals, Ltd., i/c design and constrn. over all divisions.

References: J. A. McCrory, R. E. Heartz, H. K. Wyman, M. Eaton, E. B. Wardle, H. J. Ward, J. H. Fregeau, C. R. Lindsey.

WILSON—ALEXANDER, of 25 Beaconsfield Ave., London, Ont. Born at Coatbridge, Scotland, Sept. 2nd, 1905. Educ.: I.C.S. course in mech. engrg., also special course in Water Supply, etc.; 1926-29, mach. shop ap'tice, to master mechanic, Page Hersey Tubes, Ltd.; 1929, millwright, Sprucolite Co.; with Canada Pumps Ltd. as follows: 1929-31, dftsman., engrg. dept.; 1931-35, sales engr.; 1935-40, dist. sales mgr. With Pumps & Softeners Ltd., as follows: 1940-41, engr. (also field engr. on water supply and sewage disposal plants Commonwealth Air Training Plan); 1942 to date, mgr., design and install'n of waterworks, pumping equipment, etc.

References: H. G. Stead, T. L. McManamna, R. S. Charles, Jr., W. M. Veitch, Geo. Morrison.

FOR TRANSFER FROM THE CLASS OF JUNIOR

CUNNINGHAM—DONALD DAVID MacCOUBREY, of Moncton, N.B. Born at Round Hill, Annapolis County, N.S., Sept. 17th, 1913. Educ.: B.Sc. (Elec.), Univ. of N.B., 1936. With N.B. Electric Power Commission as follows: 1934-35 (summers), test engr.; 1936 (summer), asst. to supt. of constrn.; 1937-38, test engr. at Grand Lake Power Plant; 1936-37, switchboard operator, Grand Lake Power Plant; 1938-41, plant engr. at Grand Lake Power Plant, responsible for operation of above mentioned equipment; Mar., 1941, joined R.C.A.F. engrg. branch as aeronautical engr; 1941-42, officer commanding a detachment, No. 17 Aeronautical Inspn. District, supervising work of civilian contractors; Sept., 1942, to date, attached to No. 17 Aeronautical Inspn. District, R.C.A.F. as chief engr. officer, supervising work of technical officers and airmen, with rank of Flight Lieutenant. (St. 1937; Jr.1938)

References: John Stephens, A. F. Baird, E. O. Turner, G. A. Vandervoort, G. L. Dickson.

GODFREY—WILLIAM R., of Moncton, N.B. Born at Chatham, N.B., April 10th, 1914. Educ.: B.Sc., Univ. of N.B., 1935; 1936-40, cost accountant and asst. to District Highway Engr., district No. 2, Prov. of N.B.; 1940-42, instru'man. with Dept. of Transport on airport constrn.; 1942 to date, water supply engr. on development of water supply for airports in eastern Canada and Newfoundland, Dept. of Transport. (Jr. 1938)

References: L. L. Thériault, T. D. Pickard, F. T. Brown, A. S. Donald.

HOLT—WILLIAM GEORGE HERBERT, of 4862 Rosedale Ave., Montreal. Born at Toronto, Dec. 29th, 1912. Educ.: B.A.Sc., Univ. of Toronto, 1936; 1934 (summer), Acton Tool & Stamping Co., Toronto; 1935 (summer), Canadian Acme Screw & Gear Co., Toronto; 1936-44, engr., designing products mfrd. by Dominion Bridge Co., Lachine, Que., including electric overhead travelling cranes, hydro-electric regulating gates, and moveable bridges. (Jr. 1937)

References: R. S. Eadie, R. H. Findlay, G. M. Midgley, W. B. Proudfoot, K. O. Whyte.

LEMIEUX—GILBERT, of 112 Abraham Hill, Quebec, Que. Born at Bienville, Que., June 7th, 1910. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1936; R.P.E. Quebec; with the Highways Department, Province of Quebec, as follows: 1936-37, chief of party, surveying, road localization, Lake St. John-Chibougamou; 1937-39, asst. res. engr., Senneterre-Mont-Laurier road; 1939-41, res. engr., road constrn., Lake St. John; 1941 (winter), chief of party, surveying, road localization, estimating, Great North shore of Gulf St. Lawrence; 1941-42, asst. divsnl. engr., La Malbaie, Que.; 1942 to date, asst. principal engr., district 6, Parliament Bldgs., Quebec. (St.1935; Jr.1938)

Reference: E. Gohier, A. Circé, R. Lemieux, L. Trudel, P. Vincent, G. St-Jacques.

MILLER—LINDSAY, of 4816 Harvard Ave., Montreal, Que. Born at Cambuslang, Scotland, Nov. 4th, 1910. Educ.: B. Eng. (Mech.), McGill Univ., 1933; 1928 (summer), Shawinigan Engrg. Co., levelman on Rapide Blanc Development; 1929-32 (summers), inspr. on constrn. work, Montreal Light, Heat & Power Cons.; 1933-36, tester and asst. to control engr., Consolidated Paper Corp., Wayagamack Divn.; 1936-37, dftsmn., International Paper Co., Hawkesbury; 1937-40, dftsmn., J. R. Booth, Ltd., Ottawa; 1940-41,

Employment Service Bureau

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.

NOTICE

Technical personnel should not reply to any of the advertisements for situations vacant unless—

1. **They are registered with the Wartime Bureau of Technical Personnel.**
2. **Their services are available.**

A person's services are considered available only if he is—

(a) unemployed;
(b) engaged in work other than of an engineering or scientific nature;
(c) has given notice as of a definite date; or
(d) has permission from his present employer to negotiate for work elsewhere while still in the service of that employer.

Applicants will help to expedite negotiations by stating in their application whether or not they have complied with tbe above regulations.

SITUATIONS VACANT

CHEMIST OR CHEMICAL ENGINEER qualified to formulate and prepare liquid resin and other glues for use in plywood manufacture. Permanent position. State experience and salary expected. Do not apply unless your services are available under regulations P.C. 246, Part III, administered by the Wartime Bureau of Technical Personnel. Apply to Box No. 2713-V.

SALESMEN, large life insurance company has opening for men, about 35 years of age. Married. Average salary of $2000 a year paid for servicing business plus commissions on all new business. Average yearly earnings $3200. Excellent prospects of advancement in sales executive work for capable men. Professional men have a high record of success in this business. Apply to Box 2715-V.

SITUATIONS WANTED

MECHANICAL ENGINEER, age 33, ten years' experience in construction and maintenance work in the pulp and paper industry. Open for engagement as plant engineer. Apply to Box No. 1396-W.

GRADUATE CIVIL ENGINEER, age 44, married, bilingual, over twenty years' experience; eight years as laboratory technician in pulp and paper and twelve years as inspecting engineer on various construction jobs including two years in charge of concrete laboratory on large hydroelectric project recently completed. Presently unemployed, desires permanent position. Apply to Box No. 1485-W.

GRADUATE MECHANICAL ENGINEER, age 31, eight years' experience which includes successful work as plant engineer and plant superintendent in small plant; organization and administrative work in production, process control and design in large war industry. Familiar with latest practice in industrial management on job methods, personnel training, quality control, job evaluation, efficient labour relations programme, etc. Specialized field is methods engineering. Principally interested in organization and administrative work with small or medium-sized industry with post-war possibilities. Apply to Box No. 1500-W.

GRADUATE ELECTRICAL ENGINEER, B.Sc.E.E., 1933, University of Manitoba. Experience in design, layout, installation, supervision of industrial electrical power, distribution systems; high tension overhead and underground transmission systems; outdoor and indoor substations. Design and layout of commercial and industrial lighting systems, covering incandescent, fluorescent and cold cathode installations. Available on short notice. Apply to Box 2099-W.

CHEMICAL ENGINEER, B.A.Sc., M.E.I.C., Canadian graduate, ready for new appointment. Married, no children, Montreal home. Fifteen years' experience in most manufacturing departments of pulp and paper industry. This covers technical development, design and mill operation, particular emphasis being placed on plant supervision, operation of mill equipment, and handling of operating personnel. Extensively travelled on business in the British Isles, Europe and throughout eastern and southern U.S.A., hence foreign appointment or contacts may be attractive. Sales and servicing of equipment is of definite interest, and this need not be restricted to pulp industry. Apply to Box No. 2257-W.

PRELIMINARY NOTICE *(Continued)*

dftsmn., Aluminum Co. of Canada, Kingston Works; 1941 to date. engr., Defence Industries, Ltd., Engrg. Dept., Montreal. (St.1932; Jr.1941)

References: C. H. Jackson, D. A. Killam, J. B. Francis, H. C. Karn, L. E. Krebser, J. R. Auld, A. G. Moore, K. H. Bjerring.

NEUMANN—THEODORE OSCAR, of 412-12th St. A, South, Lethbridge, Alta. Born at Pincher Creek, Alta., Dec. 5th, 1916. Educ.: B.Sc. (Mining), Univ. of Alta., 1941; 1939 (summer), instru'man. on roadconstrn., Dept. of Mines and Resources, Waterton Lakes; with Dept. of Transport as follows: 1940 (summer), instru'man. Macleod Aerodrome, also paving inspr. at Macleod; 1941-42, res. engr., i/c constrn. of Claresholm Airport; 1942, res. engr., i/c of preliminary surveys for airports as Glenbow Lake, Blackfalds, Stavely, Vermilion, and Ft. Smith; Sept., 1942, to date, res. engr., head office, Dept. of Transport, Lethbridge, i/c office in District Airway Engr.'s absence, prepare estimates, general supervision. (Jr.1942)

References: A. L. H. Somerville, H. T. Miard, D. F. Hamelin, P. E. Kirkpatrick, N. H. Bradley.

THOM—JAMES EDWIN, of 5068 Victoria Ave., Montreal. Born at Regina, Sask., May 28th, 1910. Educ.: B.A.Sc., Univ. of Toronto, 1932; 1928 (summer), survey, C.P.R., Foam Lake, Sask.; 1930-31 (summers), Steel Co. of Canada, Hamilton, Ont.; 1934-40, Regina refinery, Imperial Oil Ltd.; with Defence Industries, Ltd., Verdun Works, Plant Engrg. Dept., as follows: 1941-42, engr.; 1942-43, supervisor, Aug., 1943, to date, supt. (St.1932; Jr.1936)

References: H. B. Hanna, F. H. Barnes, W. O. Longworthy, D. A. R. McCannel, W. D. Farrell.

FOR TRANSFER FROM THE CLASS OF STUDENT

ATHEY—FRANK ALLAN POWELL, of 110 Bagot St., Kingston, Ont. Born at Carman, Man., Dec. 20th, 1914. Educ.: B.Sc., Univ. of Man., 1938; 1934-36 (summers), Geological Survey of Canada; 1939-41, design engr., switchgear section, engrg. dept., Canadian General Electric Co., Peterborough; 1941-43, liaison engr., for Canadian Industries Ltd., at du Pont Co. head office, Wilmington, Delaware, U.S.A.; 1943 to date, process development engr., Nylon Divn., Canadian Industries Ltd., Kingston, Ont. (St.1937)

References: I. R. Tait, R. L. Dobbin, B. I. Burgess, W. C. Tathan, R. A. Low.

BLACKETT—ROBERT LESLIE, of Chatham, N.B. Born at Moncton, N.B., Nov. 5th, 1921. Educ.: B.Sc., Queen's Univ., 1943; (summers), 1941 concentrator operations, International Nickel Co., Copper Cliff, Ont.; 1942, dftsmn. and Instru'man., Imperial Oil Ltd., Dartmouth, N.S.; 1943, senior instru'man., Dept. of National Defence, Naval Service, Coverdale Project; Aug., 1943, to date, Navigation Officer, R.C.A.F., with rank of Pilot Officer. (St.1939)

Refernces: C. Scrymgeour, K. W. Edmiston, A. Jackson, H. J. Crudge, H. W. Harkness.

BORROWMAN—RALPH WILLSON, of No. 12 Nelson Apts., Winnipeg, Man. Born at Winnipeg, April 3rd, 1917. Educ.: B.Sc., Univ. of Man., 1940. (Summers) 1938, helper, ornamental shops, Vulcan Iron Works, Winnipeg. Also Beaver Constrn. Co., Winnipeg, 1939; rodman, P.F.R.A., Manitoba; 1940, dftsmn., reinforced concrete, Dominion Bridge Co. Ltd., Winnipeg; 1940 (Aug.-Dec.), junior engr., Dept. of Works and Bldgs., R.C.A.F., constrn. of airport, Portage LaPrairie, Man. With Defence Industries Ltd., as follows: 1941, engr., Montreal; 1941-42, operations supervisor in prodn. of cordite, Winnipeg, and June, 1943, to date, bldg. mtce. engr., Winnipeg Works. (St.1941)

References: B. B. Hogarth, A. E. Macdonald, N. M. Hall, G. H. Herriot, G. R. Stephen.

CASS—LORNE OSBORNE, of Saint John, N.B. Born at Fredericton, N.B., Now. 7th, 1914. Educ.: B.Sc. (Civil), Univ. of N.B., 1939. (Summers) 1936, rodman; 1937-38, instru'man. N.B. Highway Dept. and N.B. Dept. of Lands and Mines; 1939 (4 mos.), office engr. and instru'man., N.B. Highway Dept.; 1939 (3 mos.), chief of party, transmission line location, N.B. Hydro Comm.; 1940, dftsmn. and field engr., bldg. constrn., T. Pringle & Son; 1940-41, asst. to group supt., St. Paul l'Ermite, and 1941-42, area engr., Shipshaw, for Foundation Co. of Canada; 1942-43, field engr., constrn. Naval Ordnance Depot for E.G.M. Cape & Co., at Dartmouth, N.S.; at present, asst. engr., National Harbours Board, Saint John, N.B. (St.1939)

References: E. O. Turner, A. A. Colter, G. Adams, H. V. Serson, V. Chesnut, H. Phillips, A. Gray.

McLEAN—ALEXANDER F., of 1225 Bishop St., Montreal. Born at Melbourne, Ont., Nov. 7th, 1917. Educ.: B.A.Sc., Univ. of Toronto, 1940; 1940-41, Fraser-Brace Engrg. Co. Ltd., on constrn. of D.I.L. plant at Nobel, Ont., as elect'l materials engr., expediting, allocating, and similar work at Winnipeg, Man.; 1941-43, asst. elect'l engr., responsible for genl. elect'l plant mtce., Defence Industries, Ltd., Winnipeg; at present, supervision of lect'l. instlln. work at night on frigates for R.N. and R.C.N., Canadian Vickers, Ltd., Montreal.

References: P. C. Kirkpatrick, J. R. Auld, H. C. Karn, A. G. Moore, P. Varley, D. Anderson.

NEAR—FRANK MANNING, of 39 Alexandra Blvd., Toronto. Born at St. Catharines, Ont., July 14th, 1919. Educ.: B.A.Sc., Univ. of Toronto, 1943; 1940 (summer), Airport constrn., checker and inspr., Malton Airport, Dept. of Transport; 1941 (summer), highway constrn., grades, concrete inspr., Queen Elizabeth Way, and 1942 (summer), surveyor, dftsmn., plotting maps, Department of Highways, Ont.; 1943 to date, commissioned officer, R.C.E. (St.1942)

References: A. E. Berry, R. F. Legget, W. P. Near, H. W. Tate, A. A. Smith.

SAUNDERS—JOHN BRUCE, of Stayner, Ont. Born at Pembroke, Ont., May 3rd, 1902. Educ.: B.Sc., Queen's Univ., 1922; 1920-23 (summers), student courses, Canadian General Elec. Co., Canadian Westinghouse Co., Northern Electric Co.; 1926-31, proprietor, Saunders Electric Co., Kingston, complete instllns. for various industries in Eastern Ontario; 1931 to date, rural supt., with H.E.P. Commission, in Kingston, Brockville and Stayner, building and operating rural power lines. (St.1922)

References: L. T. Rutledge, L. M. Arkley, T. A. McGinnis, R. E. Jones, W. Maclachlan.

WARREN—PIERRE, of 65 Preston Ave., Quebec, P.Q. Born at Pointe-au-Pic, Que., Aug. 1st, 1909. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1932; 1932-34, private practice, land surveying, constrn. water works; 1934-35, junior engr., Public Works of Canada at Rimouski, Que., preparation of plans, and res. engr.; 1936-39, i/c office for Zachée Langlais, cnsltg. engr., Quebec, P.Q., supervision, designing, supt. of house constrn. in Baie Comeau, reinforced concrete design, plans for hydro-electric plants, LaSarre Power and Magog; 1940-41, town engr. for Rouyn; 1941, plans and specifications filtration plant at Malartic, Abitibi; designing engr., Truscon Steel of Canada; at present asst. to mgr., Dominion Arsenal, Valcartier, Que. (St.1932)

References: A. E. Paré, H. Cimon, A. B. Normandin, P. Vincent, R. Dupuis, L. Gagnon.

Industrial News

Industrial development — new products — changes in personnel — special events — trade literature

CANADIAN REPRESENTATIVES

Renold-Coventry Limited of Montreal, Toronto and Vancouver have recently announced their appointment as sole Canadian representatives of the Fawick Airflex Company Inc., Cleveland, Ohio.

NAME CHANGED

According to a recent announcement the name of Chatham Malleable & Steel Products Limited of Chatham, Ont., has been changed to Chatco Steel Products Limited.

LELAND APPOINTMENTS

Leland Electric Canada Ltd., Guelph, Ont., has recently announced several changes in its executive staff.

J. E. Aldom, formerly manager of the Toronto branch, has been appointed sales manager; H. H. Wilson, formerly with the F. F. Barber Machinery Company, has been made manager of the Toronto branch; F. S. Bush, previously branch manager at Montreal, has been appointed assistant to the general manager; C. J. DeWitta, who has been with the company's production department for many years, is now manager of the Montreal branch.

INDUSTRIAL INSTRUMENTS

Taylor Instrument Cos. of Canada Ltd., Toronto, Ont., have issued a 24-page bulletin, No. 98170, entitled "The Taylor Guide to Correct Instrument Selection." The bulletin is prefaced by a note on the importance of correct instrumentation, followed by an outline of the interchangeable feature of Taylor instruments. For ease in use, the bulletin is divided according to the variables to be measured or controlled and gives an exposition on how the three basic types of Taylor instruments, indicating, recording and controlling, are adapted to suit these variables. The final pages are devoted to special function instruments such as time-schedule, pneumatic-set and mechanical-type ratio controllers, remote pneumatic transmission systems, expansion-type temperature controllers, precision valve action units, etc. This is followed by a brief treatment of the subject of "co-ordinated control systems."

G. A. Harris

Dr. Walter H. Kohl

NEW APPOINTMENT

The appointment was recently announced by Rogers Radio Tubes Ltd., Toronto, of Dr. Walter H. Kohl as chief engineer. Dr. Kohl was also appointed vice-president of the company and has been elected a director.

C.G.E. APPOINTMENTS

G. A. Harris, formerly manager of the appliance division of Canadian General Electric Co. Ltd., has been appointed manager of sales for the company's supply department.

Mr. Harris' record of service with the C.G.E. organization extends back more than twenty-five years, continuous except for four years of army service during the last war.

Starting his association with the company in Halifax, Mr. Harris later spent three years as a sales specialist in the Vancouver district and six years as manager of the Edmonton office.

With exceptionally wide experience in the distribution of appliances, Mr. Harris was recently selected to serve on the main advisory committee appointed by Donald Gordon, chairman of the Wartime Prices and Trades Board, to act in an advisory capacity to the government on problems affecting the appliance industry.

The appointment is also announced of E. T. Burns as assistant to manager of the supply department of Canadian General Electric Co. Ltd.

Mr. Burns joined C.G.E. after graduating from the School of Practical Science at the University of Toronto in 1930. After completing the company's test course he worked in the d.c. engineering section and was then moved to the cost accounting department in Peterborough. He was transferred to the supply department at the head office in 1934.

In the C.G.E. supply department, Mr. Burns has been associated, successively, with the domestic refrigeration section, the kitchen planning section, the G.E. home bureau, and currently heads the export and commercial research division.

PRESSURE LOCKED GRATING

Canada Ingot Iron Co. Ltd., Guelph, Ont., have for distribution a 40-page folder featuring the "Irving X-Bar Grating." This folder contains a description of its exclusive pressure locked construction. In this construction the crossbar bottoms are hydraulically pressed into dovetail recesses in the bearing bars, assuring a tight and rigid fit. Dimensional drawings are included of four standard types of bars, as well as a table of grating weights and a standard grating safe load table. Featured also is the "Irving X-Bar Safstep" having a raised, perforated plate, "Vizabledg," also a line of standard grating fasteners.

VACUUM PRIMER

Canadian Ingersoll-Rand Co. Ltd., Montreal, Que., have issued a 4-page leaflet, Form CF-453, describing the "Circo" automatic vacuum primer, which provides constant prime for efficient operation of centrifugal pumps.

The purpose of the unit, which consists essentially of a vacuum pump, a vacuum tank and motor, is to provide the constant prime required for the efficient operation of the centrifugal pump to which it is connected. It is pointed out that a "Circo" automatic primer will serve a single or multiple pump installation with equal satisfaction. The relatively small size of the vacuum pump is made possible by the fact it is only required to make up leaks in the stuffing box and suction line.

A typical installation requires the addition of an "Apco" air release valve on each of the pumps in the system to check and cut off the flow of water from the centrifugal pump which follows the evacuation of the air by the "Circo" priming unit and to prevent its being drawn into the vacuum tank.

The leaflet also contains photographs of a typical installation, connection diagram, and table of sizes and dimensions.

E. T. Burns

POST-WAR PLANNING

A paper presented at the Fifty-Eighth Annual General Professional Meeting of The Engineering Institute of Canada, at Quebec, on February 11th, 1944.

Joint Authors

JOHN E. ARMSTRONG, M.E.I.C.
Chief Engineer, Canadian Pacific Railway Company

R. M. BROPHY,
General Manager, Canadian Marconi Company

G. A. GAHERTY, M.E.I.C.
President, Calgary Power Company, Limited
President, Montreal Engineering Company, Limited

ARTHUR SURVEYER, M.E.I.C.
Consulting Engineer, Montreal

R. L. WELDON, M.E.I.C.
President, Bathurst Power & Paper Company, Limited

H. G. WELSFORD, M.E.I.C.
Vice-President and General Manager, Dominion Engineering Works, Limited

THE ENGINEERING INSTITUTE OF CANADA

2050 Mansfield Street - - Montreal

FOREWORD

The session on post-war planning, featured at the annual meeting of The Engineering Institute of Canada in Quebec was the outcome of an invitation issued by the then president, K. M. Cameron, chief engineer of the Department of Public Works, Ottawa, to a group of employers in several parts of Canada whose advice he sought on the part that the Institute might play in developing planning to meet the requirements of the post-war period. The invitation resulted in two largely attended meetings, at which it was agreed unanimously that the Institute could and should assist in stimulating and encouraging post-war planning.

While the conditions which will contribute to full and stable employment are affected by exterior factors such as those concerning world trade, it was decided, in view of the responsibility of industry to provide the main portion of post-war employment, to limit the immediate deliberations to a consideration of what industry could do and the part the Institute might play in stimulating thinking and planning in that field.

From those who attended these meetings Mr. Cameron selected six to prepare a paper to be delivered at the annual meeting and constituted them a special committee of the Institute. This action was subsequently approved by Council. The accompanying paper is the result of their joint effort. It is not complete, even in the limited field to which it applies, and the authors are thoroughly aware of the omissions.

The Council of the Institute is grateful to the authors for their splendid work and hopes with them that the paper will encourage some further contributions towards a satisfactory solution of the problem that looms so large on the horizon today.

deGASPÉ BEAUBIEN,
President

CONTENTS

Part I — What is the Post-War Problem?

Part II — What Can Industry Do to Create Full Employment?

Part III — What Can the Government Do to Assist Industry to Create Full Employment?

Part I

What Is the Post-War Problem?

The answer to the question, "What is the post-war problem" is suggested in the Atlantic Charter as the achievement of "Freedom from Want." No sane person can quarrel with that objective. Unfortunately this answer does not indicate the means of achieving that desired end.

Full employment is the best known means of attaining freedom from want. In a country abounding in undeveloped natural resources such as Canada, freedom from want, attained through the means of full employment, must be possible for all those able and willing to work.

The provision of full employment must be planned

Plans must be made for the people of Canada to shift as promptly as possible after the war from the present unstable wartime economy of over-employment to a stable peacetime economy of full employment. This is not a simple but a very complex problem. No one can forecast definitely the date of the termination of hostilities, the conditions which will then exist, or the reactions of human nature at that time to those conditions. Nevertheless, it is necessary that plans be available to meet developments as they arise.

A great deal of thought has already been given to such plans. The federal government, the provincial governments, municipal authorities, industry and others have been studying the problem. Most people agree that industry must bear the chief burden of solving it. Industry concurs and is working toward that end. Realizing the complexity of the problem, its spokesmen have so far been relatively inarticulate. Although they have hesitated to discuss specific plans publicly, it should not be concluded that they are not giving serious and thoughtful study to the problem.

In order to plan for full post-war employment it is necessary to make some assumptions as to the dates when hostilities may cease. It is perhaps a reasonable assumption that the European war will end in 1944 or 1945, and the Japanese war in 1945 or 1946. The United Nations now appear to have the upper hand in all major theatres of the war, and it seems probable that the statement made by Winston Churchill, in November 1942, was correct:

> "Now, this is not the end. It is not even the beginning of the end. But it is, perhaps, the end of the beginning."

In the months that have passed since that statement was made we have certainly progressed closer to the beginning of the end. It is desirable, therefore, that the problem of full post-war employment be stated as accurately as possible now, and that the statement be revised as necessary from time to time in the future so as to improve its accuracy as developments permit.

For what number of persons must employment be planned?

In August 1939, including 10,000 in the Armed Forces, there were employed in Canada about 4,150,000 persons, or approximately 50 per cent of the population fourteen years and over in age, and relief rolls were indicative of under-employment. In June 1941, including 306,000 in the Armed Forces, there were about 4,480,000 employed, or approximately 53 per cent of the same age group, and minimized relief rolls probably indicated a condition of full employment. In January 1943, including 650,000 in the Armed Forces, there were about 5,110,000 employed, or approximately 59 per cent of that age group, and the employment of children of school age, housewives, aged and others, and manpower shortages, were indicative of over-employment.

If we may assume that full employment exists in Canada when approximately 53 per cent of her population fourteen years and over in age is employed during summer months and slightly less than this percentage during winter months, then full employment would have existed in August 1939, if approximately 4,410,000 had been employed; in June 1941, when approximately 4,480,000 were employed; and in January 1943, if approximately 4,620,000 had been employed. On this basis the under-employment in August 1939 was about 260,000 persons, and the over-employment in January 1943, about 490,000 persons. During this period of 41 months between August 31, 1939 and January 31, 1943 there was an increase, in the number of persons normally able and willing to work, of 210,000 or approximately 60,000 per annum.

Assuming the more optimistic dates for the cessation of hostilities, 1944 in Europe and 1945 in the Far East, some forecast may be made of the probable number of persons to be employed early in 1946 and 1947 if plans for full employment are to be fulfilled. In order to allow for the increase in the number of persons able and willing to work, let it be assumed that this number was 4,620,000 in January 1943, and that an increase of 60,000 per annum may be expected. Then the number in January 1946 will be 4,800,000, and in January 1947, it will be 4,860,000.

Where will this number of persons be employed?

By January 1946, in contrast to January 1943, it seems reasonable to assume that agriculture, which is essential and is now undermanned, will have increased its manpower; employment in services now listed as unessential will have increased; the personnel in war industry will have decreased rather markedly; and that there will be some decrease in the number in the Armed Forces. Similarly it may be assumed that, in January 1947, agriculture will still further have increased its manpower at least to and perhaps beyond that of August 1939; service employment will be fully manned; war industry will be practically eliminated; and the number in the Armed Forces will be reduced to what may perhaps be regarded as future peacetime strength.

On these assumptions the approximate employment figures for August 1939, and January 1943, together with the employment forecast for January 1946, and January 1947, may be:

	Employment Approximate		Employment Forecast	
	August 1939	January 1943	January 1946	January 1947
Persons 14 years and over in age	8,315,000	8,720,000	9,080,000	9,200,000
Employed in:				
Agriculture	1,490,000	1,020,000	1,200,000	1,500,000
Industry and Services	2,650,000	2,400,000	2,580,000	3,210,000
War Industry	....	1,040,000	520,000	50,000
Armed Forces	10,000	650,000	500,000	100,000
Total Employed	4,150,000	5,110,000	4,800,000	4,860,000
Estimated Unemployed	260,000	....	....	....
Estimated Over-employed	....	490,000	....	....
Estimated Full Employment	4,410,000	4,620,000	4,800,000	4,860,000
Ratio of full employment to persons 14 years and over in age	Slightly over 53%	Slightly under 53%	Slightly under 53%	Slightly under 53%

What does this mean?

On the assumptions stated and the figures set up to fulfill those assumptions, the elements of the problem of providing full employment in January 1947, may be stated as follows:

1. *The total number of persons able and willing to work in January 1947 will be 250,000 less than the number employed in January 1943, but 710,000 more than the number employed in August 1939.*

   The reduction below January 1943 will occur as children of school age, housewives, aged and others return to their normal pursuits when the necessities of war permit. The increase over 1939 is the sum of the under-employment at that time and the normal increase in the number of persons able and willing to work.

2. *Agriculture will employ 480,000 more in January 1947 than in January 1943, but only 10,000 more than in August 1939.*

   The total of 1,500,000 agricultural workers is based on the assumption that Canada will continue to be a major exporter of agricultural products. It must be realized, however, that there will be reluctance to return to the land unless farm employment is made more attractive from both the financial and social viewpoints. The latter problem must be solved if Canada is to reach the goal of full and balanced employment.

3. ***Employment in peacetime industry and services in January 1947 will be 810,000 more than in January 1943, but only 560,000 more than in August 1939.***

   The increase over January 1943 is due principally to the shift to peacetime employment, while the increase over August 1939 is due both to the under-employment at that time and to the normal increase in the number of persons able and willing to work. The increase over August 1939 is only 21 per cent in approximately 7½ years, but the increase over January 1943 is 34 per cent in 4 years. The former percentage is not startling, but the latter percentage is indicative of the magnitude of the shift in employment which may be expected to take place within a year, or a year and a half, after hostilities cease in Europe.

Expressed in percentage of total full employment, the figures for August 1939, January 1943, and January 1947, compare as follows:

	August 1939 (Peace)	January 1943 (War)	January 1947 (Peace)
Employed in:			
Agriculture	33.8%	22.1%	30.9%
Industry and Services	60.1%	51.9%	66.0%
War Industry	.....	22.5%	1.0%
Armed Forces	0.2%	14.1%	2.1%
Total Employed	94.1%	110.6%	100.0%
Unemployed	5.9%	.....	.....
Over-employed	.....	10.6%	.....
Full Employment	100.0%	100.0%	100.0%

These percentages indicate a continuing peacetime drift from agriculture into other employment. They emphasize the magnitude of the shift from wartime to peacetime employment which will follow, and probably in part anticipate, the cessation of hostilities.

In summary and conclusion

On the assumption that the cessation of hostilities will occur sometime in 1945, full employment in January 1947 requires the absorption into peacetime employment of 710,000 more persons than were employed in August 1939, this being the sum of 260,000 persons able and willing to work but unemployed at the earlier date, and the expected increase, in the interval, of 450,000 in the number of persons able and willing to work. Between January 1943 and January 1947, it is assumed that employment will have decreased in war industry 990,000 and in the Armed Forces 550,000, and that this total of 1,540,000 will be decreased by the 490,000 over-employment at January 1943, and increased by 240,000 additional persons able and willing to work, so that a total of 1,290,000 will have changed their employment status by January 1947. It has been further assumed that of this 1,290,000 persons, 480,000 will have been absorbed into agriculture, and 810,000 into peacetime industry and services by January 1947.

These large shifts in employment constitute the major post-war problem, the successful solution of which, currently as it develops, will avoid unemployment, depression and distress. Such a successful solution requires detailed planning in advance. Each industry should, and each individual employer, whether large or small, must evaluate that portion of this major problem, and many secondary but nevertheless serious problems, with which he will be confronted under these changing conditions. He must have his solutions fully planned in advance and ready for prompt execution as required in order that the goal of freedom from want by means of full employment shall be attained and sustained after the war.

Part II

What Can Industry Do to Create Full Employment?

Post-war plans must be based on sound and proven principles

The creation of employment opportunities in the immediate post-war period is not a problem to be dealt with by temporary measures unrelated to plans for full employment in the longer range future. While it will be necessary to demobilize our Armed Forces and munitions industries in an orderly manner, there is only one employment problem for industry to deal with and that is to put people to work in gainful occupations and to keep them at work. This can best be done by basing post-war plans for full employment, both immediate and long term, on sound and proven principles.

First consider the basic objectives and purposes of industry, and then the practical measures which industry has taken and must continue to take to develop along sound and constructive lines, enabling it to provide maximum employment opportunity and raising the standard of living by producing an ever-increasing volume of goods for consumption and use at lower prices.

The basic objective of all economic activity is the ultimate acquisition by the consumer of something that satisfies his wants. It is the purpose of industry to fill these wants. A hundred years ago nearly three-quarters of the people on this continent made their living from agriculture. Today less than one-quarter provides us with all the agricultural products we require. Those who are no longer required on farms work in industrial plants and other occupations to make, sell and serve us with the many other things we use and enjoy in our daily lives.

How has this been done? It has been done through someone's initiative in inventing, developing and making machinery to do the work for us. Without the tools of industry we would have little more than the things a man can make with his own hands. It was the invention and use of one machine or process after the other that made it possible to produce the lumber, bricks, glass, furnishings, refrigerators, radios, automobiles, rails and locomotives, ships and all the other things we use, in quantity large enough for wide use to be made of them. Fewer people produce the food we require because the work has been made easier by machinery.

Capital expenditures by industry increase production and employment

Employment, wages, and salaries result from expenditures made by our industries in producing and distributing all these things which, in turn, provide us with our income as consumers. These industries are founded upon their investment of capital for buildings, machinery, equipment and for the development of their products. Therefore, the capital expenditures of our industries have a most important bearing upon full employment. The buildings, machinery and equipment they use require constant replacement to maintain the productive plant of the country in a good enough state of efficiency even to maintain their production. Our industries must do more than replace worn-out equipment to achieve an ever-rising standard of living such as we all desire. They must improve their facilities constantly so that they will be able to produce more. This means new factories, improved machinery, more power, better transportation facilities, from one end to the other of our industrial organization.

It has been estimated by competent authorities in the United States, in Great Britain and in Canada, that a minimum of 20 per cent of the total national income must be accumulated in the form of savings and must be converted each year into new capital investments in order to support full employment. This would indicate that between 20 per cent and 25 per cent of the population gainfully employed derive their immediate income directly or indirectly from capital expenditures resulting from such investments. Over the longer term future, such capital investments contribute much more to employment because it is through such expenditures that new products and new industries are created which in turn provide the new employment opportunities for our ever growing working population. The records show quite clearly that in the aggregate the capital expenditures of industry have always increased production and not employed less labour as is sometimes supposed. Unemployment only develops when capital expenditures are not being made on a large enough scale. It is the variations which have occurred from time to time in the rate of capital expenditures made by industry and by individuals which have caused employment to rise and fall.

The basis of prosperity is production

All income results from expenditures made by someone, so that a high level of expenditure is necessary to attain a high level of national income and to maintain full employment. Income is only useful in terms of the goods and services it will buy. Therefore it is better to think of income in terms of goods and services rather than in terms of money. If we do this, it becomes clearer that the basic objective of industry is a high level of production and consumption, and not merely a high income in dollars however desirable that may appear to be as well. Consequently, every industry and business, large or small, contributes to employment and to the public welfare by initiating capital expenditures which will enable them to increase their productive efficiency and to produce a greater quantity and variety of goods and services for consumption and use at lower prices.

Our industries have developed and grown and the people in this country have prospered in the past as a direct result of expenditures of capital by industry. Nothing else but the initiative and enterprise of those directing industry in making these expenditures has enabled them to give employment directly and indirectly to increasing numbers of our population and to give them an ever-increasing number of comforts and conveniences for their wages. For example, hourly wage rates have increased more than sevenfold since 1840 while wholesale prices of basic commodities have remained practically unchanged. Between 1913 and 1939 wage rates increased about 150 per cent while the cost of living only advanced 50 per cent. These are not theories but are facts which prove what industry has accomplished. They should ever be kept before us as objectives for all industrial activity in the future.

Industry plans for maximum production and employment after the war

After considering these purposes and objectives of industry it becomes much clearer what practical measures will best ensure the development of a sound national economy based upon secure and continuous employment for all with a rising standard of living. A brief outline of these measures follows. These are the fundamentals by which all successful businesses, whose names are known in every household, have been developed and expanded in the past. It is also the basis of their planning for maximum production and full employment both in the immediate and long term future. These same measures may well be followed for the development of all our industries, large and small.

(1) *Every industry should seek continually to improve its technique of production or distribution in order to supply the market with a better product at a lower price.*

Most of the equipment and facilities in use today are obsolete by modern standards. Industry should pursue an aggressive policy of initiating capital expenditures to replace obsolete and inefficient equipment and facilities.

(2) *Development and research which have been a vitalizing force in building up our industries should be extended.*

Product development and research for the creation of new and better products has always been carried on in varying degree by all our industries. The practical technician has accomplished as much as the advanced scientific research worker. Both are necessary and complementary to each other. Our industries, large and small, should initiate expenditures within their means and capabilities for the improvement of their products or their services and look for new and better ones than are now being offered.

(3) *Capital expenditures should be planned, not merely to take advantage of a situation this year or next, but on a long-term basis, in order to stabilize employment.*

Variations in the rate of capital expenditure both for replacement and for the construction of new industries, have been one of the greatest contributing causes of unemployment in the past. Management, therefore, should plan its capital expenditures both for replacement and expansion and for development and research over successive periods of at least five years at as uniform a rate as possible.

(4) *Adequate reserves should be set aside for replacement of obsolete plant and equipment, for product development, and for other contingencies.*

If these reserves are inadequate or are used for some other purposes, the planned rate of capital expenditure cannot be maintained. If at some time any large section of industry should fail to maintain its rate of capital expenditure, unemployment will result and all industry will suffer, including the investor, management and labour.

(5) *Co-operation between employers and employees, based on an understanding of their mutual dependence upon the economic factors which govern the operations of their particular industry, is necessary to attain full employment and maximum production.*

The most important relationship between employers and employees, bearing upon production and employment, is that of wages and prices. Neither industry nor labour can prosper if they pursue wage and price policies which disregard each others interests. Nor can industry and labour together prosper if they pursue policies which affect prices and wages without considering the needs of other important groups, such as agriculture. The 25 per cent or more of our population who live and work on farms are also the customers of industry. The farmer's ability to purchase manufactured products depends not upon domestic factors alone but upon the prices which his exported products will realize in world markets. The world prices of farm products, therefore, have a direct bearing upon wage levels at which full employment can be supported in manufacturing and other industries.

There are many other factors in the employment relationship bearing upon production and employment, which require co-operation and mutual understanding between employers and their employees.

Good industrial management has adopted certain practical measures for the development of sound employer-employee relations. Personnel management which seeks to do this is now recognized as being an essential part of industrial management requiring specially trained personnel, as experienced and skilled as any other branch of management. While some of our larger corporations have for many years employed efficient personnel management, its use should, and no doubt will be greatly extended in the future.

Among the practical measures which will be taken by personnel management to increase production and employment in the post-war period are:—

(a) Adequate and well supervised plans for the retraining and placement of demobilized members of the Armed Forces so that they may quickly and permanently be re-established in industry.

(b) Courses for the training of apprentices of school-leaving age in skilled occupations.

(c) Training plans to assist all employees to increase their productive efficiency and ability to earn higher wages.

(d) Proper training for foremen and supervisors in the duties and responsibilities of management, particularly in matters concerning the relations between employer and employees.

(e) Sound methods of job study and analysis so as to assure that every employee will be fairly paid for the work actually performed in relation to all other employees in the industry.

(f) Co-operative committees by which management and employees can meet and discuss matters of mutual interest which directly affect production and employment and the future welfare and development of the industry of which they are both a part.

ECONOMIC RESEARCH IS NEEDED ON SUBJECTS WHICH AFFECT EMPLOYMENT AND PRODUCTION

A bureau of economic research and development should be established immediately by the principal national organizations representing all classes of business throughout the country to study and to make available to all who are interested reports and data necessary for sound long-range planning.

Sound planning for full employment and production, and industry's ability to carry it out, depends, to a considerable degree, upon such matters as taxation and monetary policy, government controls, monopolistic practices in business and in government, the export of surplus products, price and wage levels, private and public spending, the encouragement or discouragement offered by these factors to savings and investments, and upon other factors which affect employment and production.

Detailed and analytical studies by specialists on these and related subjects are greatly needed. It is believed that through the co-operation of the many thousand businesses and corporations, members of national organizations, much needed information may be obtained which, when properly correlated and used as the basis of reports produced by the bureau, would be of great value to business throughout the country in forming their own future policies and plans. It is also believed that such a bureau, through giving leadership and education on economic matters by the dissemination of accurate information on current conditions and trends and upon matters of importance affecting business and employment, can contribute much to the maintenance of more stable conditions within the business structure itself and therefore to greater security of employment than has been realized in the past.

In setting up such a bureau it should have not only a competent and adequate permanent staff but the assistance should be sought of distinguished economists and of social scientists to act as an advisory committee and as a board of review over the work of the permanent staff, so as to assure a broad and independent point of view towards the subjects being studied by the bureau.

The work of the bureau as visualized would not duplicate the work of the Dominion Bureau of Statistics or the research departments maintained by some of the larger business organizations. There is not, at present, in Canada, an economic research bureau which concerns itself solely with questions of general interest to the future development of business and industry in this country. There are several such bureaux in the United States and in Great Britain, and they have made a valuable contribution to the public knowledge of subjects relating to business and employment in these countries.

The job ahead of business and industry, that of creating and maintaining conditions which will contribute to full and stable employment, is partly educational and partly organizational. Through the facilities of such a research bureau, and with the co-operation and combined experience of all classes of business, sound long-range policies can be developed and effective planning for full employment and high levels of production will be encouraged. All this can be done without the loss of the great benefits of individual initiative and enterprise and of competition regulated by the price mechanism, all of which are essential parts of a free democratic society.

What Can the Government Do to Assist Industry to Create Full Employment?

FISCAL POLICIES

In the first part of this paper an attempt has been made to appraise the magnitude of the post-war employment problem. This was followed by a survey of what industry has done and is planning to do in the future to provide peacetime employment for the people who will have been demobilized from the Armed Forces or released from war industries. It has been shown that in the long run the interests of labour and industry are identical, and that the standard of living of the workers cannot be raised unless the productivity of industry is increased.

Industry must find people willing to make the capital expenditures necessary to provide full employment

Very few people realize the capital investment needed in buildings, machines and other equipment to give employment to one man. According to figures recently published by the United States Chamber of Commerce, it is estimated that, for the economy as a whole, an average investment of $5,000 is required to put one man to work; manufacturing requires an investment of $6,300; mining—$8,650; the chemical industry—$17,000; and the railroads and the iron and steel industry $25,000. Public utilities and the pulp and paper industry, which are important industries in Canada, require an investment of about $35,000 for each man employed. This means that to provide the tools and equipment which will enable every man to make a living in our modern industrial system we must find individuals and corporations willing to make these necessary capital expenditures.

It was stated in the first part of this paper that, due to natural growth of population, about 60,000 new workers will be available for employment each year. Apart from the capital expenditure required to be spent to maintain or increase the productive efficiency of our industries, this growth in working population will necessitate expenditure each year of about $300,000,000 to build and equip the new plants and facilities necessary to utilize their services.

Before the depression of the 1930's the principal source of industrial capital was the accumulated profits of business enterprises and the savings of individuals. During the past several years, and more particularly since the beginning of the war, the Income and Excess Profits Taxes have made it difficult, and in some cases impossible, for companies to accumulate adequate cash reserves for this purpose. The taxes which individuals now pay can best be described as levies on capital because in many cases they take all income beyond actual living expenses, and in some cases more.

Government should encourage industry to make capital expenditures

The objective of government fiscal policy should be to encourage industry to expand production by encouraging capital expenditures. Certain features of our present taxation structure tend to curtail such expenditures. The government can best help industry to create full employment by modifying taxation as follows:

(1) *The Excess Profits Tax, being a war measure, should be eliminated as soon as the requirements of war finance permit.*

This tax discourages capital expenditure. With the Excess Profits Tax at its present rate of 100 per cent, all such profits go to the government except the refundable portion of 20 per cent which the government undertakes to repay at some indefinite time in the future. This destroys all incentive to do a larger volume of business than during the standard period. It also discourages thrift in industrial and business operations. As soon as it becomes evident that, to provide full employment, war expenditures must be replaced by private capital expenditures, the Excess Profits Tax should be abolished.

(2) *In the meantime, the Income and Excess Profits Tax Acts should be modified to permit industry to accumulate more adequate cash reserves for depreciation and obsolescence of plant, inventory loss, reconversion to peacetime production and other contingencies which industry will have to meet in the immediate post-war period. These are all items for which industry must have ready cash available in order to be in a position to make the expenditures necessary to support full employment.*

Present provisions of the Income Tax and Excess Profits Tax Acts prevent the accumulation of sufficient cash reserves. The refundable portion of the Excess Profits Tax cannot be counted upon as a source of cash. At present no definite time has been arranged for its payment and in any case it probably will not be practicable for the government to pay in cash, over any short period of time, the large refundable amounts. Therefore a more liberal policy in the matter of these reserves, both in the terms of the Act and in its administration, would help industry to support employment.

Specifically the deficiencies in the present regulations are as follows:

(a) Depreciation rates are generally established at too low a figure to cover the factors of depreciation and obsolescence. Yet in the present era of inventions, new processes and new products, obsolescence is a much more important factor in the useful life of plants and of machinery than age depreciation. An aggressive policy of replacement, such as would be necessary to assure a sufficiently high level of expenditure to maintain full employment, would be greatly encouraged if provisions for depreciation, obsolescence and operating reserves were made more liberal and if the unamortized value of assets scrapped and replaced could be written off through income account for taxation purposes.

(b) The present law only permits a reserve for inventory loss to be set up based upon the volume of inventory on hand during the standard period. Many industries engaged in war operations have necessarily expanded their inventories substantially to support a high level of war production. They are at present wholly unprotected against loss in such inventory expansion.

(c) The Income and Excess Profits Tax Acts do not permit a reserve to be set aside for plant reconversion to peacetime production. Reserves are also necessary for other contingencies which may have to be faced in the immediate post-war period. For instance, the production of certain industries has been tremendously accelerated by the war. There may be a period of several years after the war before the market for their peacetime products returns to normal proportions. In the meantime, taxes must be paid, plant must be kept from deteriorating, experienced and skilled staff must be retained and salaries paid, all during a period in which it may be quite impossible for the business to operate at a profit.

(3) *The double taxation of business profits, first as a tax upon the corporation and then as a tax upon the shareholder, should be eliminated.*

The British system of corporation income tax, in effect, uses the corporation as an agency for collection of income tax payable by individuals rather than as an object of direct taxation, thus avoiding the undesirable feature of double taxation, which is a part of our present tax system.

The double taxation of business profits discourages capital expenditure because when the corporation income tax is added to the tax on income paid by the shareholder, the government takes too large a share of the profits of the business. This discourages investment of venture capital making it difficult for industry to secure new funds.

Double taxation increases the cost and price of the products and services sold by industry.

It creates an unequal position as regards the cost and price of goods and services between a privately owned and a tax-free publicly owned corporation in the same line of business.

Further, it taxes companies financed through stock ownership more heavily than companies which have been financed largely on borrowed money.

All these objections are avoided under the British system of income taxation.

(4) *The Income Tax Act should be modified to permit, for taxation purposes, the averaging of business losses with profits, along the lines of the British Income Tax laws.*

Our present Income Tax Act, which taxes business profits on the basis of a single year, discourages capital expenditure in certain classes of industry. Business losses may only be carried forward into the succeeding year subject to certain specified limitations. In Great Britain, the taxpayer may either deduct the loss from the profit of the preceding year, thus reducing the tax for that year and leaving no liability to tax for the current year, or else he may carry forward the loss for the six following years, applying it against subsequent profits. Thus, for taxation purposes, profits are averaged over a period of 6 or 7 years.

In certain types of industry, earnings are relatively stable while in others profits fluctuate considerably according to conditions.

This is particularly so in those which depend for income upon capital expenditures for industrial equipment and building construction, which vary widely from year to year. The present method of taxing each year's profits results in a higher rate of taxation on industries with variable earnings than on those whose profits are relatively stable. This penalizes industries in which there is the greater risk, although in the past it is these industries which have contributed most to the development and expansion of production and employment.

(5) *The sales tax discourages capital expenditures by our industries and should be eliminated from our taxation structure. To the extent necessary, it should be replaced with an excise tax on selected types of goods in such manner and at such rates as will interfere least with production and employment.*

Canada adopted, after the first world war, a sales or consumption tax. The rate started at 1 per cent and by 1939 had increased to 8 per cent, where it now stands. In addition, certain provinces and municipalities have introduced sales taxes. For example, in the city of Montreal the total federal, provincial and municipal rate is now 12 per cent. This sales tax, introduced as a consumption tax, is now a direct levy upon capital expenditures made by our industries for improving or expanding their facilities, irrespective of whether or not such expenditures are profitable.

Likewise, when money is spent on development and research for the improvement of products and processes, often at considerable risk, sales tax must be paid on the materials consumed in such work and on all the patterns, jigs and other special equipment required to put the new products or processes on the market. This tax must be paid whether the new products or processes result in a profit or a loss.

Sales tax must also be paid on all the consumable tools and materials used in the processes of production or distribution, thus increasing the cost of everything manufactured.

Before the war Canada ranked fourth among the trading nations of the world, and exported about 38 per cent of her total production. We cannot expect full employment in this country without a large export business. The sales tax handicaps Canadian industry in competing for business against the products of countries which do not have a sales tax. This applies both in foreign and domestic markets.

In this connection it is important to note that the two greatest trading nations, Great Britain and the United States, on several occasions have considered imposing a general sales or turnover tax as a means of raising revenue, but neither country has adopted it.

The changes suggested above would not interfere with the ability of our governments to raise revenues; indeed, taxes can only be paid from production and income and any measures which will increase production and employment will make it easier for our governments to raise revenues.

Summarizing the benefits of the proposed tax changes, they will:

(1) Increase the reserves in the hands of employers which can be diverted into capital expenditure for the development and expansion of business and industry thus supporting additional employment.

(2) Reduce prices to consumers, giving them more money to spend for other things, thus increasing production and employment.

(3) Reduce production costs, thus bettering the competitive position of our industries in world markets, and

(4) Assist industry to secure the capital needed for expansion, thus providing the employment opportunities required for an increasing population.

THE NEED FOR A RESERVE OF PUBLIC WORKS PROJECTS

After the war about 1½ million people will be released from the Armed Forces and war industry. While this movement probably will be gradual, there may be a period when business and industry may be unable to employ them as quickly as they are released. Therefore it would be prudent to include in post-war planning a reserve of public works projects which, by being used at the right moment, will provide additional employment opportunities in the construction industry should there be any deficiency in privately financed construction work.

The amount of employment which the construction industry can absorb is necessarily limited by the number of trained specialists and skilled workers available and the time required to train additional men in these categories. A project can only employ unskilled and semi-skilled labour in proportion to the skilled labour available. A programme of public works projects would provide additional employment for skilled and unskilled labour in the building trades, and some employment in industries collateral to the construction industry. It would be of little value to provide employment for industrial workers generally.

Public works projects will not balance the whole economy

A programme of public works projects should not be planned in an attempt to balance the whole economy. Its usefulness and value would be to enable the construction and allied industries to provide as much employment as possible in the transition period. It would have additional value in the future in providing this basic industry with a stable volume of work on an agreed level throughout the year and over the years. This will require advance planning of public works, federal, provincial and municipal, and having on hand, at all times, a substantial reserve of optional projects.

In every construction project there are three main stages of preparation, which may be described briefly as follows:—

(1) General outline of the project with approximate estimate of the amount of money involved and of the benefits anticipated. Such preliminary investigation and report would require about three months for preparation.

(2) Preliminary design with estimates of probable cost; these to be sufficiently complete to permit giving the project its proper priority in relation to other projects. The time required for this would run to a year, depending upon the amount of preliminary survey required.

(3) Preparation of the final plans in sufficient detail for the calling of tenders, with revisions of the estimates. The time required for this would be from one to three years depending upon the magnitude and importance of the project.

It is, therefore, obvious that if a reserve of public works projects is to be made available to be used when needed, the preparation of such plans should be commenced immediately and carried to completion with as little delay as possible.

Smaller public works projects, well distributed throughout the country and for which plans can be completed in the shortest time, should be given preference over large projects which require the longest time for the preparation of final plans before actual construction work can be commenced.

These projects should, as far as possible, be confined to those which represent a good investment for the people of Canada, and which will make the greatest contribution to our capacity to produce, and not merely to provide employment. A reserve of public works sufficiently well studied and planned in advance will enable the projects to be chosen with discernment to obtain the greatest value for public expenditures.

In respect of wartime controls

The wartime system of licensing and controls over capital expenditures, prices, wages, material allocations, etc., has been set up to deal with scarcities of materials and labour and to prevent uncontrolled inflation. They were designed to slow down the normal processes of supply and demand. When employment must again be provided by work of a commercial character, natural trading processes must be speeded up again. This can only be brought about if the controls are removed, which should be done as soon as labour and materials are no longer in short supply.

THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 27 | MONTREAL, APRIL 1944 | NUMBER 4

"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

★ ★ ★

PUBLISHED MONTHLY BY

THE ENGINEERING INSTITUTE OF CANADA

2050 MANSFIELD STREET - MONTREAL

Price 50 cents a copy, $3.00 a year: in Canada, British Possessions, United States and Mexico. $4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, $2.00 a year. —Entered at the Post Office, Montreal, as Second Class Matter.

CONTENTS

GENERATOR ROOM AT SHIPSHAW . . . . Cover

THE ENGINEERING HISTORY OF SHIPSHAW 194
McNeely DuBose, M.E.I.C.

THE MANOUAN AND PASSE DANGEREUSE WATER STORAGE DEVELOPMENTS 200
F. L. Lawton, M.E.I.C.

THE DESIGN OF THE SHIPSHAW POWER DEVELOPMENT . 221
H. G. Acres, M.E.I.C.

CONSTRUCTION OF SHIPSHAW POWER DEVELOPMENT . 234
Walter Griesbach, M.E.I.C.

ELECTRICAL EQUIPMENT AT SHIPSHAW 250
R. A. H. Hayes, M.E.I.C.

FROM MONTH TO MONTH 261

PERSONALS 265

Obituaries 266

NEWS OF THE BRANCHES 269

LIBRARY NOTES 273

PRELIMINARY NOTICE 275

EMPLOYMENT SERVICE 276

THE ENGINEERING INSTITUTE OF CANADA

MEMBERS OF COUNCIL - 1944

PRESIDENT

deGASPÉ BEAUBIEN, Montreal, Que.

PAST-PRESIDENTS

*C. J. MACKENZIE, Ottawa, Ont.
‡K. M. CAMERON, Ottawa, Ont.
†C. R. YOUNG, Toronto, Ont.

VICE-PRESIDENTS

*W. P. BRERETON, Winnipeg, Man.
†G. L. DICKSON, Moncton, N.B.
†J. M. FLEMING, Port Arthur, Ont.
*L. F. GRANT, Kingston, Ont.
*C. K. McLEOD, Montreal, Que.
†E. B. WARDLE, Grand'Mère, Que.

COUNCILLORS

*J. E. ARMSTRONG, Montreal, Que.
*H. E. BRANDON, Toronto, Ont.
†H. L. BRIGGS, Winnipeg, Man.
‡R. S. EADIE, Montreal, Que.
†G. H. FERGUSON, Ottawa, Ont.
†E. V. GAGE, Montreal, Que.
†P. E. GAGNON, Quebec, Que.
*R. E. HEARTZ, Montreal, Que.
*A. JACKSON, Kingston, Ont.
†J. A. LALONDE, Montreal, Que.
†ALEX. LOVE, Hamilton, Ont.
†P. A. LOVETT, Halifax, N.S.
*A. M. MacGILLIVRAY, Saskatoon, Sask.
*N. B. MacROSTIE, Ottawa, Ont.
†J. McMILLAN, Calgary, Alta.
*A. W. F. McQUEEN, Niagara Falls, Ont.
†E. B. MARTIN, Moncton, N.B.
*G. E. MEDLAR, Windsor, Ont.
†W. MELDRUM, Lethbridge, Alta.
*J. P. MOONEY, Saint John, N.B.
†A. S. G. MUSGRAVE, Oak Bay, B.C.
*E. NELSON, Edmonton, Alta.
*H. G. O'LEARY, Fort William, Ont.
‡P. E. POITRAS, Montreal, Que.
†J. A. RUSSELL, Sydney, N.S.
*C. SCRYMGEOUR, Dartmouth, N.S.
†H. R. SILLS, Peterborough, Ont.
†C. STENBOL, Sault Ste. Marie, Ont.
*J. A. VANCE, Woodstock, Ont.
*H. J. WARD, Shawinigan Falls, Que.
*J. W. WARD, Arvida, Que.
*C. E. WEBB, Vancouver, B.C.
†W. S. WILSON, Toronto, Ont.

*for 1944. †For 1944-45. ‡For 1944-45-46.

TREASURER

F. C. MECHIN, Montreal, Que.

GENERAL SECRETARY

L. AUSTIN WRIGHT, Montreal, Que.

SECRETARY-EMERITUS

R. J. DURLEY, Montreal, Que.

ASSISTANT GENERAL SECRETARY

LOUIS TRUDEL, Montreal, Que.

STANDING COMMITTEES

FINANCE
C. K. McLEOD, *Chairman*
J. E. ARMSTRONG
G. A. GAHERTY
F. C. MECHIN
R. M. CALVIN

LEGISLATION
P. E. POITRAS, *Chairman*
F. J. BLAIR
R. J. DURLEY

PAPERS
L. F. GRANT, *Chairman*

LIBRARY AND HOUSE
E. V. GAGE, *Chairman*
A. T. BONE
J. S. HEWSON
M. S. NELSON
G. V. RONEY

PUBLICATION
R. S. EADIE, *Chairman*
R. DeL. FRENCH, *Vice-Chairman*
R. C. FLITTON
J. A. OUIMET
C. A. PEACHEY

SPECIAL COMMITTEES

BOARD OF EXAMINERS
R. A. SPENCER, *Chairman*
I. M. FRASER
W. E. LOVELL
A. P. LINTON
H. R. MacKENZIE
E. K. PHILLIPS

GZOWSKI MEDAL
T. H. JENKINS, *Chairman*
W. H. POWELL
V. A. McKILLOP
E. O. TURNER

DUGGAN MEDAL
W. J. W. REID, *Chairman*
R. C. FLITTON
H. M. WHITE

PLUMMER MEDAL
P. E. GAGNON, *Chairman*

LEONARD MEDAL
F. V. SEIBERT, *Chairman*
A. E. MacRAE
D. H. McDOUGALL
G. W. WADDINGTON

JULIAN C. SMITH MEDAL
deGASPÉ BEAUBIEN, *Chairman*
C. J. MACKENZIE
C. R. YOUNG

MEMBERSHIP
J. G. HALL, *Chairman*
S. R. FROST
N. MacNICOL

PROFESSIONAL INTERESTS
J. B. CHALLIES, *Chairman*
J. E. ARMSTRONG
G. A. GAHERTY,
M. J. McHENRY
H. W. McKIEL
J. A. VANCE

STUDENTS' AND JUNIORS' PRIZES

H. N. Ruttan Prize—Western Provinces
W. P. BRERETON, *Chairman*
A. M. MacGILLIVRAY
C. E. WEBB

John Galbraith Prize—Province of Ontario
J. M. FLEMING, *Chairman*
H. E. BRANDON
A. W. F. McQUEEN

Phelps Johnson Prize—Province of Quebec (English)
C. K. McLEOD, *Chairman*
E. V. GAGE
R. E. HEARTZ

Ernest Marceau Prize (French)
E. B. WARDLE, *Chairman*
P. E. GAGNON
P. E. POITRAS

Martin Murphy Prize—Maritime Provinces
G. L. DICKSON, *Chairman*
J. P. MOONEY
C. SCRYMGEOUR

INTERNATIONAL RELATIONS
M. J. McHENRY, *Chairman*
E. A. ALLCUT
A. E. BERRY
J. B. CHALLIES
C. P. EDWARDS
D. H. McDOUGALL
L. E. WESTMAN

THE YOUNG ENGINEER
H. F. BENNETT, *Chairman*
C. G. R. ARMSTRONG
J. BENOIT
J. B. deHART
RENE DUPUIS
J. N. FINLAYSON
R. F. LEGGET
A. E. FLYNN
R. DeL. FRENCH
A. JACKSON
G. R. LANGLEY
A. E. MACDONALD
H. W. McKIEL
D. A. R. McCANNEL

POST-WAR PROBLEMS
W. C. MILLER, *Chairman*
F. ALPORT
J. S. BATES
deGASPÉ BEAUBIEN
A. L. CARRUTHERS
J. M. FLEMING
E. R. JACOBSEN
G. R. LANGLEY
H. MASSUE
G. L. MacKENZIE
D. A. R. McCANNEL
A. W. F. McQUEEN
G. MacL. PITTS
P. M. SAUDER
D. C. TENNANT
H. G. WELSFORD

WESTERN WATER PROBLEMS
G. A. GAHERTY, *Chairman*
C. H. ATTWOOD
L. C. CHARLESWORTH
A. GRIFFIN
D. W. HAYS
G. N. HOUSTON
T. H. HOGG
C. J. MACKENZIE
H. J. McLEAN
F. H. PETERS
S. G. PORTER
P. M. SAUDER
J. M. WARDLE

ENGINEERING FEATURES OF CIVIL DEFENCE
J. E. ARMSTRONG, *Chairman*
P. E. ADAMS
J. N. ANDERSON
S. R. BANKS
H. F. BENNETT
W. D. BRACKEN
W. P. BRERETON
J. M. DAVIDSON
R. S. EADIE
E. V. GAGE
G. A. GAHERTY
R. J. GIBB
A. GRAY
J. GRIEVE
J. L. LANG
R. F. LEGGET
I. P. MACNAB
J. A. McCRORY
H. J. McEWEN
C. B. MUIR
W. H. MUNRO
J. A. A. PICHÉ
G. MacL. PITTS
C. J. PORTER
M. G. SAUNDERS
W. O. SCOTT
T. G. TYRER
H. K. WYMAN

INDUSTRIAL RELATIONS
WILLS MACLACHLAN, *Chairman*
E. A. ALLCUT
J. P. BRIERLEY
J. C. CAMERON
E. R. COMPLIN
J. A. COOTE
RENE DUPUIS
T. W. EADIE
S. M. GOSSAGE
F. W. GRAY
E. G. HEWSON
I. F. McRAE
W. H. MUNRO
W. J. W. REID

DETERIORATION OF CONCRETE STRUCTURES
R. B. YOUNG, *Chairman*
E. VIENS, *Vice-Chairman*
G. P. F. BOESE
A. G. FLEMING
W. G. C. GLIDDON
J. A. McCRORY
C. J. MACKENZIE
J. H. McKINNEY
R. M. SMITH

THE ENGINEERING INSTITUTE OF CANADA

OFFICERS OF BRANCHES

BORDER CITIES
Chairman, J. B. DOWLER
Vice-Chair., A. H. MacQUARRIE
Executive, G. W. LUSBY, J. M. WYLLIE, J. F. G. BLOWEY
(Ex-Officio), G. E. MEDLAR, G. G. HENDERSON
Sec.-Treas., W. R. STICKNEY, 1614 Ontario Street, Walkerville, Ont.

CALGARY
Chairman, H. B. LeBOURVEAU
Executive, J. V. ROGERS, P. F. PEELE, F. C. TEMPEST, J. LANGSTON
(Ex-Officio) J. McMILLAN, S. G. COULTIS, J. G. MacGREGOR, K. W. MITCHELL
Sec.-Treas., A. B. GEDDES, 4716 Elbow Drive, Calgary, Alta.

CAPE BRETON
Chairman, J. A. MacLEOD
Executive, J. A. RUSSELL, M. F. COSSITT
Sec.-Treas., S. C. MIFFLEN, 60 Whitney Ave., Sydney, N.S.

EDMONTON
Chairman, C. W. CARRY
Vice-Chair., B. W. PITFIELD
Executive, J. A. ALLAN, J. W. JUDGE, E. D. ROBERTSON, J. D. A. MACDONALD, I. F. MORRISON, H. W. TYE
(Ex-Officio), D. HUTCHISON, E. NELSON
Sec.-Treas., F. R. BURFIELD, Water Resources Office, Provincial Government, Edmonton, Alta.

HALIFAX
Chairman, G. J. CURRIE
Executive, R. J. BETHUNE, J. W. MARCH, J. E. CLARKE, C. D. MARTIN, K. L. DAWSON, L. E. MITCHELL, D. C. V. DUFF, H. A. RIPLEY, J. H. M. JONES, R. B. STEWART
(Ex-Officio), A. E. FLYNN, C. SCRYMGEOUR, P. A. LOVETT
Sec.-Treas., S. W. GRAY, Wartime Bureau of Technical, Personnel, 84 Hollis Street, Halifax, N.S.

HAMILTON
Chairman, H. A. COOCH
Vice-Chair., NORMAN EAGER
Executive, C. H. HUTTON, H. J. A. CHAMBERS, R. J. G. SCHOFIELD, A. R. HANNAFORD
(Ex-Officio), ALEX. LOVE, T. S. GLOVER
Sec.-Treas., W. E. BROWN, 91 Barnsdale Blvd., Hamilton, Ont.

KINGSTON
Chairman, S. D. LASH
Vice-Chair., H. W. HARKNESS
Executive, R. J. CARTER, D. C. MACPHERSON, H. R. ROGERS, F. A. ATHEY
(Ex-Officio), L. F. GRANT, A. JACKSON, K. M. WINSLOW
Sec.-Treas., R. A. LOW, Dept. of Civil Engineering, Queen's University, Kingston, Ont.

LAKEHEAD
Chairman, R. B. CHANDLER
Vice-Chair., S. T. McCAVOUR
Executive, S. E. FLOOK, O. J. KOREEN, E. L. GOODALL, J. I. CARMICHAEL, W. H. SMALL, A. D. NORTON, E. A. KELLY, J. S. WILSON
(Ex-Officio), E. M. G. MacGILL (Mrs. E. J. Soulsby), J. M. FLEMING, E. J. DAVIES, H. G. O'LEARY
Sec.-Treas., W. C. BYERS, c/o C. D. Howe Co. Ltd., Port Arthur, Ont.

LETHBRIDGE
Chairman, A. L. H. SOMERVILLE
Executive, J. M. CAMPBELL, A. G. DONALDSON, P. E. KIRKPATRICK, R. S. LAWRENCE
(Ex-Officio), W. MELDRUM
Sec.-Treas., T. O. NEUMANN, Dept. of Transport, Post Office Building, Lethbridge, Alta.

LONDON
Chairman, R. S. CHARLES
Vice-Chair., H. G. STEAD
Executive, E. B. ALLEN, F. C. BALL, H. F. BENNETT, V. A. McKILLOP, G. N. SCROGGIE
(Ex-Officio), T. L. McMANAMNA, J. A. VANCE
Sec.-Treas, A. L. FURANNA, 732 Wellington Street, London, Ont.

MONCTON
Chairman, J. A. GODFREY
Vice-Chair., A. S. DONALD
Executive, E. R. EVANS, H. W. HOLE, A. GORDON, G. C. TORRENS, G. E. SMITH
(Ex-Officio), H. J. CRUDGE, G. L. DICKSON, E. B. MARTIN
Sec.-Treas., V. C. BLACKETT, Engrg. Dept., C.N.R. Moncton, N.B.

MONTREAL
Chairman, C. C. LINDSAY
Vice-Chair., J. B. STIRLING
Executive, C. E. GÉLINAS, J. BENOIT, K. G. CAMERON, L. H. BURPEE, G. H. MIDGLEY, M. S. MACGILLIVRAY
(Ex-Officio), deGASPÉ BEAUBIEN, C. K. McLEOD, J. E. ARMSTRONG, R. S. EADIE, J. A. LALONDE, E. V. GAGE, P. E. POITRAS, R. E. HEARTZ
Sec.-Treas., L. A. DUCHASTEL, 40 Kelvin Avenue, Outremont, Que.

NIAGARA PENINSULA
Chairman, G. E. GRIFFITHS
Vice-Chair., W. D. BRACKEN
Executive, A. G. HERR, C. G. MOON, G. F. VOLLMER, H. E. BARNETT, J. W. BROOKS, G. MORRISON, D. S. SCRYMGEOUR
(Ex-Officio), C. G. CLINE, A. W. F. McQUEEN
Sec.-Treas., J. H. INGS, 2135 Culp Street, Niagara Falls, Ont.

OTTAWA
Chairman, W. L. SAUNDERS
Executive, W. H. B. BEVAN, J. H. BYRNE, D. G. KILBURN, J. M. WARDLE, C. D. WIGHT
(Ex-Officio), K. M. CAMERON, G. H. FERGUSON, N. B. MacROSTIE
Sec.-Treas., A. A. SWINNERTON, Dept. of Mines & Resources, Ottawa, Ont.

PETERBOROUGH
Chairman, A. R. JONES
Executive, R. L. DOBBIN, A. L. MALBY, F. R. POPE, C. R. WHITTEMORE
(Ex-Officio), D. J. EMERY, H. R. SILLS
Sec.-Treas., A. J. GIRDWOOD, 308 Monaghan Road, Peterborough, Ont.

QUEBEC
Life Hon.-Chair., A. R. DÉCARY
Chairman, RENÉ DUPUIS
Vice-Chair., E. D. GRAY-DONALD
Executive, S. PICARD, G. ST-JACQUES, L. GAGNON, A. E. PARÉ, G. W. WADDINGTON, Y. R. TASSÉ
(Ex-Officio), P. E. GAGNON, R. B. McDUNNOUGH, P. MÉTHÉ
Sec.-Treas., PAUL VINCENT, Colonization Department, Room 333-A, Parliament Bldgs., Quebec, Que.

SAGUENAY
Chairman, CHAS. MILLER
Vice-Chair., G. B. MOXON
Executive, J. FRISCH, W. E. COOPER, F. T. BOUTILIER
(Ex-Officio), R. H. RIMMER, J. W. WARD, ALEX. T. CAIRNCROSS
Sec.-Treas., ALEX. T. CAIRNCROSS, 8-C Brittany Row, Arvida, Que.

SAINT JOHN
Chairman, A. O. WOLFF
Vice-Chair., C. D. McALLISTER
Executive, G. M. BROWN, C. C. KIRBY
(Ex-Officio), J. P. MOONEY, D. R. SMITH, G. W. GRIFFIN
Sec.-Treas., F. A. PATRIQUEN, P. O. Box 1417, Saint John, N.B.

ST. MAURICE VALLEY
Chairman, J. H. FREGEAU
Vice-Chair., R. DORION
Executive, G. B. BAXTER, E. BUTLER, A. G. JACQUES, R. D. PACKARD, M. EATON, E. T. BUCHANAN, J. JOYAL, W. E. A. McLEISH, H. G. TIMMIS
(Ex-Officio), VIGGO JEPSEN, H. J. WARD, E. B. WARDLE
Sec.-Treas., DAVID E. ELLIS, Shawinigan Water & Power Company, P.O. Box 190, Three Rivers, Que.

SASKATCHEWAN
Chairman, J. McD. PATTON
Vice-Chair., N. B. HUTCHEON
Executive, F. C. CHRISTIE, G. W. PARKINSON, W. B. RAMSAY, F. E. ESTLIN, E. K. PHILLIPS, J. I. STRONG
(Ex-Officio) A. M. MacGILLIVRARY
Sec.-Treas., STEWART YOUNG, P.O. Box 101, Regina, Sask.

SAULT STE. MARIE
Chairman, A. M. WILSON
Vice-Chair., G. W. McLEOD
Executive, G. W. HOLDER, C. O. MADDOCK, H. W. SUTCLIFFE
(Ex-Officio), N. C. COWIE, C. STENBOL
Sce.-Treas., A. H. MELDRUM, P.O. Box 251, Sault Ste. Marie, Ont.

TORONTO
Chairman, W. H. M. LAUGHLIN
Vice-Chair., S. R. FROST
Executive, F. J. BLAIR, R. F. LEGGET, E. G. HEWSON, A. H. HULL, C. F. MORRISON, E. A. CROSS
(Ex-Officio), H. E. BRANDON, W. S. WILSON, C. R. YOUNG, J. M. VAN WINCKLE
Sec.-Treas., S. H. deJONG, Dept of Civil Engineering, University of Toronto, Toronto, Ont.

VANCOUVER
Chairman, T V. BERRY
Vice-Chair., A. PEEBLES
Executive, J. P. FRASER, F. H. BALLOU, E. S. JONES, R. C. PYBUS, G. W. ALLAN, J. A. TAMES
(Ex-Officio), C. E. WEBB, W. N. KELLY
Sec Treas., P. B. STROYAN, 2099 Beach Avenue, Vancouver, B.C.

VICTORIA
Chairman, H. L. SHERWOOD
Vice-Chair., A. L. FORD
Executive, P. B. HUGHES, C. M. TRIPP, S. R. WESTON, J. N. ANDERSON
(Ex-Officio), A. S. G. MUSGRAVE, KENNETH REID
Sec.-Treas., R. BOWERING, 41 Gorge Road West, Victoria, B.C.

WINNIPEG
Chairman, T. H KIRBY
Vice-Chair., C. P. HALTALIN
Executive, B. B. HOGARTH, N. M. HALL, R. A. SARA, W. F. RIDDELL, E. V. CATON
(Ex-Officio), W. P. BRERETON, H. L. BRIGGS, J. T. DYMENT,
Sec.-Treas., T. E. STOREY, 55 Princess Street, Winnipeg, Man.

THE ENGINEERING HISTORY OF SHIPSHAW

McNEELY DuBOSE, M.E.I.C.
Vice-president, Aluminum Company of Canada, Limited, Arvida, Que.

Paper presented before the Saguenay Branch of The Engineering Institute of Canada, at Arvida, on March 1st, 1944.

Broadly speaking, engineering is the harnessing of the powers of nature for the uses of man, and although in ordinary parlance we are inclined to restrict the term engineering to technical works, we should not forget that engineering begins further back than the study and application of mechanical processes.

Four Stages of Engineering

Every complete engineering problem involves four stages.

First, the realization that a worthwhile problem exists, in short, vision.

Second, the discovery of a way to provide the necessary labour and materials to accomplish the purpose in mind, in other words financing.

Third, the working out of the means whereby accomplishment can be reached with the time and materials available, that is design.

Fourth, the physical accomplishment of the project, which we call construction.

Seldom do we find these four parts of an engineering problem set out individually as above. Frequently the construction of some other work inspires the vision for a new job. Often, a part of the design is done before the financing is arranged and, to complicate matters, sometimes the problem to be solved changes during the years needed for the complete engineering of a large project.

The Shipshaw project is no exception to the general rule, as its engineering history will bear out.

The Saguenay

The first feature of the Shipshaw power development, historically speaking, is its setting. It is situated on the Saguenay river, which in size and importance is the second of the tributaries of the St. Lawrence river. Some 30,000 square miles of territory, mostly virgin forest, drain into Lake St. John which lies in a great depression of the Laurentian highlands and covers an area of four hundred square miles. (See Fig. 1.) From this natural reservoir, the Saguenay rushes thirty miles through rocky gorges, with a drop of three hundred and twenty feet to tidewater. Thence to the St. Lawrence, the river is wide, deep and majestic.

The Saguenay was explored in the early days of Canadian history and, for many years, was useful only as a highway—at first for trappers, and later for lumbermen and agriculturists.

Vision

Towards the close of the last century, when the first large hydroelectric power development at Niagara Falls proved that nature's hydraulic might could be effectively harnessed,the vision of a future industrial empire in the Saguenay was born in the minds of a few farsighted men.

The report of the Commissioner of Lands, Forests and Fisheries of the Province of Quebec for the year 1898 contained the first public discussion of the power possibilities of the Saguenay. It estimated that 15,000 hp. might be developed on the Grand Discharge at the outlet of Lake St. John, and the following year, C. E. Gauvin, Superintendent of Surveys for the Province of Quebec, estimated that 82,000 hp. could be produced at Chute à Caron, further down the Saguenay.

Rights Obtained

With vision aroused, no doubt, by the engineering reports of 1898 and 1899, three men obtained grants from the Crown of the right to develop power on the Saguenay river. The first grant, made on February 5th, 1900, was to T. L. Willson. It embraced that portion of the river between the head of Chute à Caron and tidewater at the mouth of the Shipshaw river. On June 22nd of the same year, L. T. Haggin obtained the rights to the portion of the river from Lake St. John to below Isle Maligne. And on the same day, B. A. Scott secured the rights in the portion of the river lying between the grant to Haggin and the grant to Willson. Roughly, each of these grants contained about one-third of the entire fall of the river.

The Government was glad to sell the power sites, for it wanted to promote the industrial prosperity of its people, and the grants provided for a forfeit if development were not promptly made. But as is so often the case, the power owners found that a power site in itself is no nearer to being a power plant than an egg is to being a hen, so, in spite of their efforts to build or sell, many years passed with no progress.

They had the vision, but the financing was beyond them.

Survey of Lake St. John

In 1901, Mr. J. Fraser made a survey of Lake St. John, for the Department of Public Works at Ottawa, in connection with navigation on the lake. His report, dated November 25th, 1902, stated that Lake St. John, called "Peguagomi" by the Indians, meaning flat lake, was roughly circular, with a perimeter of about 100 miles and lay in an immense fertile valley. Notwithstanding its large area and high water discharge estimated at 170,000 cu. ft. per sec., in the spring it rises 15 feet in a few days and, said the report, "it becomes evident that the outlets of this lake cannot be obstructed to any extent, without causing serious results detrimental to riparian interests." Regulation of the elevation of the lake could only be done by means of "moveable works."

Initial Financing

It was not until 1913 that a move was made. In that year Mr. J. B. Duke, a financier interested in hydroelectric power development in the South, and then on a quest for a large power site for the production of nitrogen for fertilizer manufacture, was persuaded by Mr. Willson to visit the Saguenay accompanied by Mr. W. S. Lee, the engineer from Charlotte, North Carolina, who had originally interested Mr. Duke in hydroelectric power.

The party came up the Saguenay by boat to the head of tidewater and then proceeded on foot to the first fall, which is now included in the Shipshaw power development. The sight was so impressive that Mr. Duke, with little more information than what his eyes gave him, and the assurance of Mr. Willson that there was a large lake at the head of the river, decided then and there to obtain and develop the Saguenay water powers. And

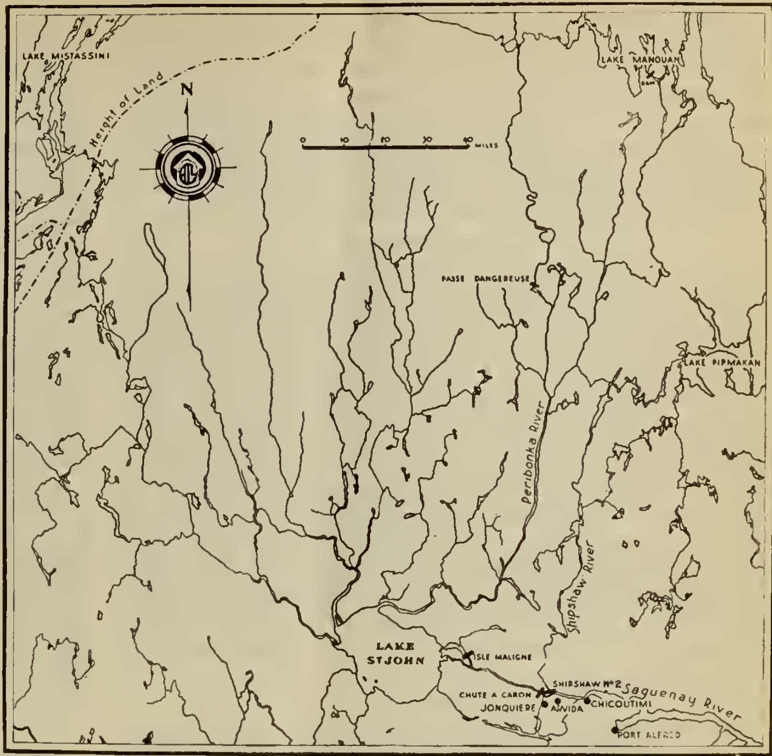


Fig. 1—Watershed of Lake St. John.

without more ado he purchased the power rights on the lower one-third of the Grand Discharge from Mr. Willson, and also the rights to the middle and upper thirds from their then-owners, for, in the meantime, they had changed hands.

Mr. Duke was sufficiently wealthy to feel that he could personally provide and risk the money required to make even so large a development, and in that way the initial financing problem was overcome.

Preliminary Design

Then came the period of preliminary design. Mr. Lee sent Mr. F. H. Cothran, M.E.I.C., in 1914, to make a detailed survey of the hydraulic possibilities of the power sites on the Saguenay, including establishing gauging stations on the Little Discharge and on the Grand Discharge below Alma Island, and commencing a daily record of the quantity of water discharged from Lake St. John.

At the insistence of Mr. Duke who vividly realized the importance of storage for any hydroelectric development, the power possibilities of the Grand Discharge were divided into two developments. One site was at Isle Maligne, near Lake St. John, where its dams would serve to utilize Lake St. John as a storage basin by maintaining the lake throughout the summer at the spring flood elevation. The water would be released during the winter to supplement the reduced winter run-off. The effective head would be about 110 ft. The other development would concentrate the remaining 210 ft. of head close to tidewater at the mouth of the Shipshaw river.

Storage Survey

While Mr. Cothran was surveying the power sites, the Quebec Streams Commission, under Dr. O. O. Lefebvre, M.E.I.C., chief engineer, had a survey of Lake St. John made by Mr. Huet Massue, M.E.I.C, to determine exactly its possibility as a storage reservoir and the area of lands to be flooded for different heights of the regulated surface. The findings were given in the Commission's Fourth Report, dated November 1915.

Based on fairly accurate determinations, it was found that the area of the lake varied from 413 sq. mi. at an arbitrary gauge reading of plus 20 to 312 sq. mi. at gauge reading minus 3. With the help of a two years' record of Lake St. John discharges, May 1st, 1913, to May 1st, 1915, made by Mr. Cothran, and a drainage area estimate of 30,000 sq. mi., obtained from measurements of existing maps, it was determined that the annual mean run-offs per square mile for those two years were 2.11 and 1.13 cu. ft. per sec., which were thought to be surprisingly high, being about 40 per cent greater than the run-off of the St. Maurice River basin during identical periods. (Note: In 1940, twenty-eight years of record have established the mean run-off to be 1.8 cu. ft. per sec. per square mile for an assumed drainage area of 28,100 sq. mi. with an average recorded precipitation of 34.8 in.)

From this information and a study of the lake shores, the Quebec Streams Commission engineers deduced that a regulated minimum flow of 22,000 cu. ft. per sec. could be obtained by means of dams which would maintain Lake St. John throughout the summer at elevation 9 on the gauge. At this elevation no damage would be done to farm lands or other water powers, and 200,000 firm hp. could be generated by a power plant at the upper site near Isle Maligne, and 400,000 hp. at the lower power site near the Shipshaw river.

For regulation to 25,000 cu. ft. per sec., the engineers calculated that water would have to be retained in Lake St. John at elevation 15 on the gauge, nine square miles of shore lands not cultivated would be flooded and potential water powers on tributary streams would be somewhat affected, but a minimum output of the two power developments of 682,000 hp. years per year would be ensured.

With regulation to 28,000 cu. ft. per sec., the water surface would have to be maintained at elevation 20.5 on the gauge; ten square miles of arable lands would be flooded throughout the summer and potential water-powers on tributaries would be considerably affected, but the firm annual power from two developments would be increased to 760,000 hp.

Regulation to 33,000 cu. ft. per sec. was ruled out as unreasonable, for Lake St. John would have to be raised to elevation 30. If so great a regulated flow were required, reservoirs must be created on the tributary rivers.

This report also commented on what was at that time considered a serious question, namely, would the greater amount of ice in Lake St. John, caused by the lake freezing at a higher level with a greater expanse, delay the coming of spring and adversely affect farming ? The report in effect said "no."

Development Delayed

But by that time the First World War had commenced, which naturally was a deterrent to starting construction. Moreover, rights had not yet been obtained from the Quebec Government to build dams at the outlet of Lake St. John. The delay was due to the fear of uncontrollable flooding of farm lands. And, last but not least, Mr. Duke's experiments to perfect a nitrogen fixation process had not worked out satisfactorily and Mr. Duke found himself without a market for the power to be produced.

Ideas current at that time that the Saguenay was within feasible transmission distance from Montreal and the New England market were, no doubt, based on optimistic anticipation of improvements in high tension transmission technique which had not materialized, and a million horse power, as Mr. Duke visualized the output of the Saguenay, without a market was about as valuable as a gold nugget on a desert island.

War Explosives

There remained one possible way for Mr. Duke's original plan to be carried out. Even though nitrogen could not be produced commercially by his process, the need of nitrogen for the manufacture of war explosives would transcend many economic laws, and some people in the United States interested themselves in the Saguenay on that account. So it happened that in 1915, Mr. Hugh L. Cooper, a well known hydroelectric engineer, arrived in the Saguenay region to make a check on the proposed power developments. After an intensive, but short, survey, his verdict was that lack of favourable foundation conditions for the hydraulic structures rendered the proposed developments unsuitable for the purpose in mind, and that put an end to nitrogen as the justification of a power development on the Saguenay.

Aluminum

But Mr. Duke was a man of ideas. For years he had watched the growing uses of aluminum. He had seen the need for electric power to produce aluminum to blaze the trail of hydroelectric development from Niagara Falls to Cedars Rapids on the St. Lawrence, to Shawinigan Falls on the St. Maurice, and he felt that aluminum would be the answer to his quest for a market for power from the Saguenay. So, with his partner, Sir William Price, who had agreed to temporarily use 200,000 hp. from the new development for paper mill operation and steam generation, he started construction work at the Isle Maligne power site, which must necessarily be built first to provide storage for itself and the Shipshaw site.

Development Starts

On December 18th, 1922, twenty-two years after the power rights were granted, the *Montreal Daily Star* carried the following announcement:

"Actual work on harnessing of the power resources of Lake St. John and the Saguenay river in the province of Quebec, Canada, was announced yesterday by a company composed of U.S. and Canadian financiers. The Company, incorporated under the laws of Canada, is capitalized at $25,000,000, the entire capital stock having been subscribed by Mr. Duke and Sir William Price. Two developments for electric power plants are provided for in the plans of the company—the first at the point where the lake feeds its waters into the head of the river, which will furnish 400,000 hp., and in due course a second development will be made which will add an additional 800,000 hp. or a total of 1,200,000 hp. The work already started is on the first development at the junction of the lake and the river. The power plant will consist of 12 units, each capable of developing 35,000 hp."

The project, which had been in mind since 1912 was made possible through the assistance of the Honourable L. A. Taschereau, Prime Minister of the Province of Quebec, who had the vision and foresight to see that this presents unlimited possibilities for the development of the natural resources of his province. It is not only the paper mills who will benefit by the development, but the entire province."

Design of Isle Maligne

The Isle Maligne powerhouse has no place in the history of the Shipshaw power development, but the hydraulic works, that is the rock excavation in the bed of the Grand Discharge at the outlet of Lake St. John to pass more water at low lake levels, the earth dam and the concrete powerhouse bulkhead and the seven concrete spillways, five equipped with Stoney type sluice gates to control Lake St. John at elevations between minus 2½ and plus 17½ in order to provide a regulated discharge of 30,000 cu. ft. per sec. and a calculated maximum discharge capacity of 469,000 cu. ft. per sec. with water at elevation 17½ at the spillways —all of these were in effect component parts of, and necessary to, the second development to be made at Shipshaw, and the obligation to maintain and operate these works for the benefit of the Shipshaw development was established as a servitude in favour of the Shipshaw power site.

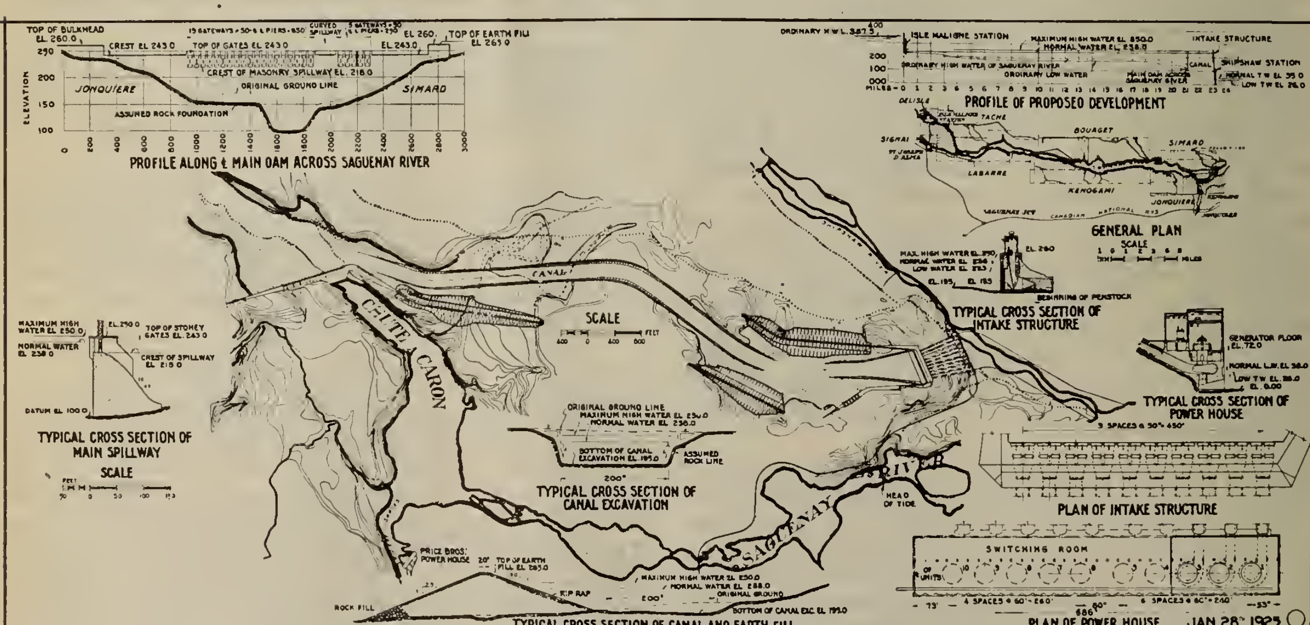


Fig. 2—Plan showing the original project for the Shipshaw development.

Construction at Isle Maligne

One construction feature at Isle Maligne should be recorded for it marked the engineers' first struggle against the power of the Saguenay.

When the time came to build cofferdam No. 6 in Barnabé channel, so that the No. 4 spillway could be thrown across the right channel to complete the final closure, trial after trial determined that although the season of minimum flow had been chosen, ordinary methods could not cope with the tremendous quantity and velocity of water encountered. The result was an engineering novelty. A canal almost completely by-passing the site for the No. 6 cofferdam was excavated in rock. Concrete piers with stop-log grooves were constructed across this canal. Then the piers were completely submerged with thousands of yards of loose sand for protection and the entrance to the canal was opened by a shot of 100 tons of dynamite placed in tunnels below the rock plug which had been left at the entrance of the canal. When this shot was fired, rocks rained down a mile away, the water from Barnabé channel rushed through the canal and cofferdam No. 6 was easily built. Then, stop-logs were put between the concrete piers in the canal and for the first time in history the Saguenay was controlled. The water was diverted into the channel leading to the powerhouse, and the No. 4 spillway, the last step in the construction, was completed in early 1926.

Shipshaw Plans

But before the job at Isle Maligne was completed, on April 17th, 1925, to be exact, plans (Fig. 2) were deposited with the Quebec Government by Mr. W. S. Lee for the construction of the second power development on the Saguenay, to be called the Shipshaw development. The application accompaning the plans described the development as located on the Saguenay river near the mouth of the Shipshaw river. The works would consist of a concrete masonry dam and bulkhead across the Saguenay river at or near Chute à Caron and a canal of rock and earth excavation with earth dams along the same extending to an intake and a powerhouse near the mouth of the Shipshaw river. The contemplated regulated flow of the river was said to be 22,000 cu. ft. per sec. and it was anticipated that 440,000 hp. would be available continuously. The powerhouse would ultimately contain ten generating units of 80,000 hp. capacity each, but only three would be initially installed. The approximate cost of the completed works was estimated to be twenty million dollars.

Aluminum Comes In

But filing plans does not always mean that construction follows. How was the Shipshaw project going to be financed, not to mention the completion of the Isle Maligne development which still required lots of money? Mr. Duke and Sir William Price had started the initial power development without outside financial help, but would they be willing to underwrite the cost of completing it? To make such an enormous investment without an adequate return would certainly have been discouraging, if not ruinous.

But about that time Mr. Duke's ideas regarding aluminum were observed to bear fruit and the problem of financing the completion of the development at Isle Maligne and the commencement of the development at Shipshaw was solved in a manner first publicly intimated in the *Electrical News* of July 15th, 1925, which stated:

"We are informed that Aluminum Company of America contemplates the expenditure of seventy-five million dollars towards the construction of a large factory for the manufacture of aluminum near Chicoutimi, P.Q. There is also a power development under consideration."

Close on the heels of that announcement, the *Electrical World* of August 1st, 1925, said:

"The proposal of Aluminum Company of America to merge with the Canadian Power & Manufacturing Company was approved by stockholders today. It is proposed to build a huge power and manufacturing plant on the Saguenay river in Canada.

"James B. Duke (president of the Canadian Power & Manufacturing Company), and Mr. A. V. Davis, president of Aluminum Company, recently acquired an 800,000 hp. site at Chute à Caron in addition to the 360,000 hp. Isle Maligne site now under construction.

"The decision of the Aluminum Company to build at the Saguenay river site will mean a ready market for all power to be developed. The combined industrial and power project will involve the expenditure of approximately $100,000,000."

With such items as a basis, it was soon public news that the Aluminum Company had obtained the controlling interest in the upper Saguenay development at Isle Maligne.

Construction Started at Shipshaw

Preliminary construction for the Shipshaw project was actually started in 1926, but made little progress for a couple of years. However, in 1928, in the optimistic atmosphere of a growing business boom, the Shipshaw development got under way in real earnest.

A project as large as Shipshaw was expected to require so many years for completion that just as construction started, Aluminum's engineers made a revision in the plans which had been worked out long before by Mr. Duke's engineers, in order to provide some power in less time. (See Fig. 1 of paper by H. G. Acres on p. 221).

The concrete dam across the Saguenay river just above Chute à Caron would be fitted with eleven Stoney type sluice gates and a free spillway section and could, in emergency, discharge up to 600,000 cu. ft. per sec. Two powerhouses would be provided instead of one. The No. 1 powerhouse would be located in the main dam across the river, called No. 1 dam, and would contain four 65,000 hp. generating units, enough to use about half of the regulated river flow. The head at the No. 1 powerhouse, sometimes called the Chute-à-Caron powerhouse due to its proximity to Chute à Caron, would be only three-fourths as great as the head at the No. 2 powerhouse located on the Shipshaw river, but it had the advantage that it could commence operation as soon as the first dam was completed and provide power during the years foreseen to be required for the completion of the canal and other works necessary for the No. 2 powerhouse. The intention was to continue right along with the construction of the No. 2 powerhouse with an installed capacity of 800,000 hp.

By that time experience indicated that Lake St. John could provide a regulated flow of 30,000 cu. ft. per sec. instead of the 22,000 cu. ft. per sec. originally contemplated, and the plan of operation was that when the No. 2 powerhouse would be completed, the generating units in the No. 1 powerhouse with the lower head would be used as spares would also be used at times when high water in the river would back up against the No. 2 powerhouse and reduce its output, and in like manner reduce the output of the upper development at Isle Maligne. In the summer, water would be plentiful and the No. 1 plant, in spite of its lower head,

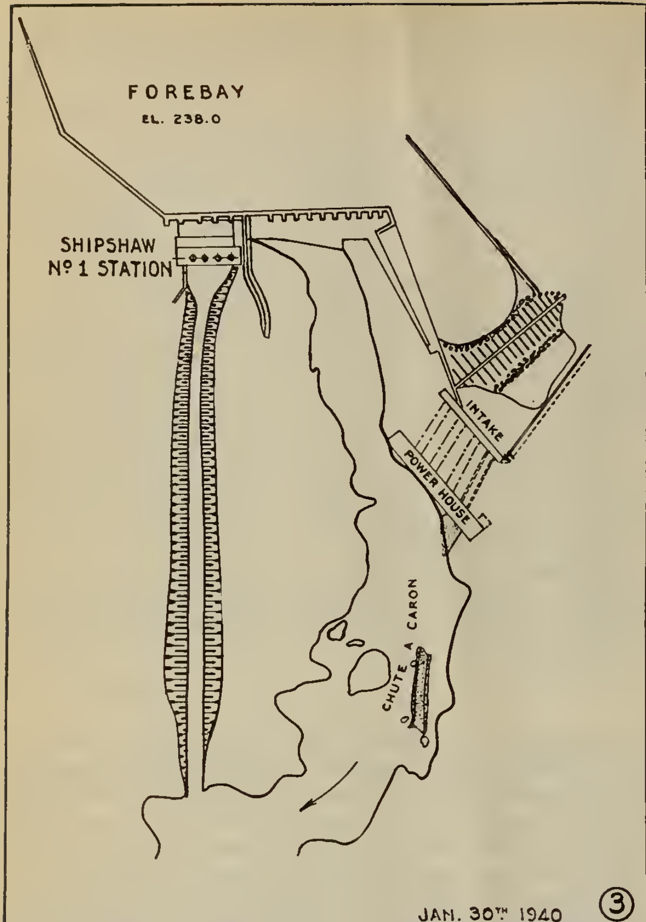


Fig. 3—Alternative project (Jan. 1940) for economical development near Chute à Caron.

could be efficiently used to maintain the expected firm output of 300,000 hp. at Isle Maligne and 600,000 hp. at Shipshaw.

Work Stopped

And then came 1930 and the depression. The demand for aluminum dropped to a point where no additional metal could be sold. An earthfill was thrown across the entrance to the future canal and the construction of Shipshaw was stopped when only the No. 1 dam across the Saguenay and the No. 1 powerhouse had been completed. The canal with its component dams and the No. 2 powerhouse had not even been started.

Shipshaw No. 1 Construction

Nothing need be recorded, historically speaking, about the initial construction at Shipshaw No. 1, except the unique use of a pre-cast concrete dam 92 ft. long, 40 ft. deep and 45 ft. thick, which was built on end and toppled into the river to divert it from its natural bed into a previously prepared by-pass canal, so that the concrete dam across the Saguenay could be completed*. For the second time, the first being the 100-ton blast at Isle Maligne, heroic methods had to be resorted to, and by the use of this obelisk the Saguenay again contributed something new to engineering history.

No Market for Years

But with construction over, Shipshaw's role for years was anything but heroic.

*See *Engineering Journal*, October 1930 and March 1931.

From 1931 to 1938, the four units of the No. 1 powerhouse were used only to make power for steam generation, and half of the water in the river ran idly over the dam the year round. A nationalistic trend was evident, impelling each country to produce its own aluminum regardless of cost; it seemed as though the Shipshaw development would never be completed, for Canada's aluminum business depended almost entirely on foreign countries for its market.

But commencing in 1937 the demand for aluminum began to increase. The aluminum plant at Arvida was expanded and Shipshaw for the first time obtained a real market for part of its power.

Then came the war. Immediately, the British Ministry of Supply wanted more aluminum, quickly. The power so fortunately available at Shipshaw was absorbed in aluminum production, and a need for even more power was foreseen by some.

New Engineering Studies

With the possible need of more power, thoughts naturally turned to the completion of Shipshaw, but no one could visualize then a demand for the 300,000 hp. or more thought necessary to justify the cost of constructing the Shipshaw canal which was essential to the completion of the Shipshaw development.

But to be prepared to meet a demand for a small amount of power, Aluminum Company of Canada, Limited, began an engineering study under Mr. F. L. Lawton, of ways to develop economically an additional 100,000 hp. or more, near Shipshaw No. 1 dam, where water was spilling the year round.

Two Plans

Two possible plans were worked out. The first (Fig. 3) eliminated the canal completely, by throwing a concrete bulkhead across its entrance. One wing of this structure would serve as the intake from which the water would drop through tunnels to a powerhouse on the bank of a pool in the river below the No. 1 dam and above Chute à Caron. The head would be only 125 ft. but the full available head of over 150 ft. could be obtained by cutting a gap through the rock ledge which forms Chute à Caron.

The other plan (Fig. 4) involved relocating the No. 2 dam, the first dam along the canal as originally planned, as far down stream as possible, building it of concrete instead of earth and using it for an intake through which the water would pass through penstocks to a powerhouse on the bank of the river just below Chute à Caron, where a head of a little over 150 ft. could be obtained.

Stone & Webster

But by the beginning of 1940, when these plans for a diminished Shipshaw No. 2 plant had been worked out, it seemed possible that as much as 300,000 additional horsepower might soon be required. Aluminium Laboratories Limited, an associated company specializing in engineering investigations, was employed to study the entire Shipshaw project and determine what improvements might be made in all previous designs.

Aluminium Laboratories employed Stone & Webster to make this study, which resulted in a new plan for an undiminished Shipshaw. (See Fig. 2 of paper by H. G. Acres on p. 222.) This plan departed from the plans deposited in 1925 with the Quebec Government as to the location of the canal, and the powerhouse bulkhead was moved to a position overlooking the Saguenay river instead of the Shipshaw river. This would place the No. 2 powerhouse on the bank of the

Saguenay river about half a mile above the mouth of the Shipshaw.

The size of the canal job would be reduced, but with no ultimate reduction in power output. There would be some subaqueous rock excavation between the powerhouse and the mouth of the Shipshaw river. Up to 300,000 hp. could be produced at once and the excavation could be carried out gradually if and when more power were needed.

H. G. Acres

The Stone & Webster report had only just been received when need for still more aluminum became apparent. Mr. H. G. Acres was therefore employed in the fall of 1940 to make a complete review of the Shipshaw scheme and determine a final design which would produce a minimum of 250,000 hp. and could be expanded to over 1,000,000 hp.

Manouan

This increase in the contemplated size of the ultimate development was due to the growing demand for aluminum for war needs, which had already moved the Aluminum Company of Canada to commence the construction of a water storage development at Lake Manouan, tributary to Lake St. John, which would increase the regulated flow of the Saguenay by 3,000 cu. ft. per sec. or more. A survey was started to determine what would be the next most advantageous site for another storage dam if the demand for aluminum should increase so far as to make even more storage necessary. And a survey was planned to determine the possibility of diverting Lake Pipmaukan and the upper reaches of the Bersimis river into Lake St. John. So an eventual regulated flow of 50,000 cu. ft. per sec. at Shipshaw had become a possibility. In July 1941, a storage reservoir at Passe Dangereuse, on the Peribonca river, tributary to Lake St. John, was commenced. This now increases the regulated flow of the Saguenay by some 10,000 cu. ft. per sec., but so far no diversions have been made. (See Fig. 1, p. 195.)

More Changes at Shipshaw

While Mr. Acres' surveyors worked at their test pits and diamond drill holes, plans kept changing, primarily due to demands to produce increased quantities of aluminum in less and less time, and partly due to discoveries by the surveyors concerning rock formations and other physical conditions at the site. Thus when the final details were put on paper, which was not far ahead of the actual placing of the final concrete in the forms, Shipshaw nad changed again. The final layout resembled the original Shipshaw plan rather than the Stone & Webster modification, but the powerhouse faced the Saguenay river, the tailrace was excavated through solid rock, the canal was cut through solid rock and all of the abutment dams at low spots along the canal were of concrete. These changes from the original plan were necessary in order to permit construction to be carried on full blast during winter as well as summer, thus greatly advancing the date of delivering power. The scheme as actually constructed is shown in Fig. 1 of the paper by Walter Griesbach, on p. 235.

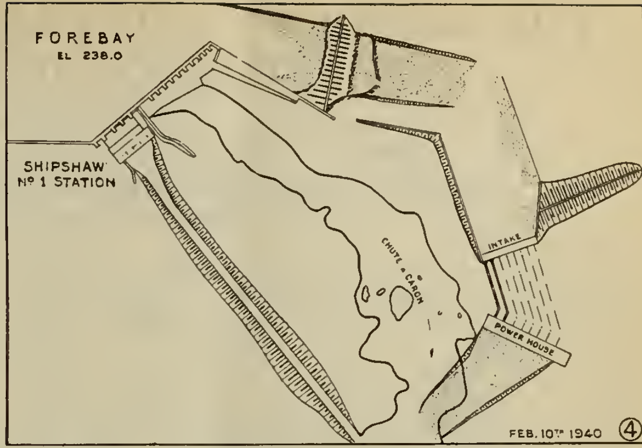


Fig. 4—Alternative project (Feb. 1940) for Shipshaw development.

Financing

With plans under way for the physical construction of the Shipshaw canal and the No. 2 powerhouse which could produce the needed power for aluminum within the required time limits, the next problem facing the Aluminum Company of Canada was to get the money to do the work. The new Shipshaw was so much larger and more rugged than the original design that its estimated cost was more than double that of the original scheme. And even if that were not the case, where could that amount of money be found ? Wartime made ordinary methods of financing impossible, but the time had come when all available power in the province had been or was being prepared for making aluminum, and Shipshaw could wait no longer. The Aluminum Company of Canada thought it saw its way clear to lay its hands on the money required, and with a promise from the Government of a 60 per cent write-off out of profits, if any, the contruction of the final stage of Shipshaw was commenced.

Construction

The story of the final construction of Shipshaw is hardly old enough to be called history. It should suffice to say that with the Foundation Company of Canada, Limited, for contractors, and the wholehearted co-operation of many Canadian manufacturers, the time schedule, impossible though it seemed, was met, and on November 20th, 1943, construction culminated in the Saguenay's third spectacular engineering exploit, which was the opening of the tailrace to the river by an 83,000 lb. dynamite shot under the rock plug which had held back the water while the powerhouse site and tailrace were excavated in the dry.

Five days later, the first two units were in operation.

Today, with four units in the No. 1 powerhouse and twelve units in the No. 2, Shipshaw delivers a firm output of 925,000 hp. and can produce a maximum of 1,500,000 hp.

THE MANOUAN AND PASSE DANGEREUSE WATER STORAGE DEVELOPMENTS

F. L. LAWTON, M.E.I.C.
Assistant Chief Engineer, Aluminum Company of Canada, Limited, Montreal, Que.

A paper presented before the Montreal and Saguenay Branches of The Engineering Institute of Canada on January 13th, and February 3rd, 1944.

Before the war, the Grand Peribonca river, the storied major tributary of Lake St. John, was itself entirely undeveloped as regards water storage. Today, four years later, well over one-half of the entire watershed has been brought under control, by the construction of the Lake Manouan and Passe Dangereuse water storage developments. See Fig. 1 of Mr. Du Bose's paper on p. 195 of this issue.

Part I of this paper deals with Lake Manouan storage, a 78.5 billion cu. ft. development built in 10 months. Located 110 miles from the nearest base attainable by ground transportation, itself 60 miles by road and water from railhead, the rockfill timber-crib Manouan dam was completed on time only by the use of air transportation.

Part II covers the Passe Dangereuse storage, a 183 billion cu. ft. reservoir brought into being in 20 months. The construction of the concrete gravity dam containing 151,000 cu. yd. concrete, 1,186 ft. long with a maximum height of 157 ft., necessitated building a 57.5 mile road through rough country and freighting over 56,000 tons of equipment, materials and supplies 135 miles from railhead.

Necessity For Storage

Lake St. John, the origin of the Saguenay river, has been controlled and used as a storage reservoir for flow regulation since the construction of the Saguenay's first hydroelectric power plant at Isle Maligne near the outlet of Lake St. John, with 110 ft. head approximately. With a useful storage capacity of 170 billion cu. ft., Lake St. John insured a minimum regulated flow in the Saguenay of close to 30,000 cu. ft. per sec. six years out of seven. This was sufficient to provide for Isle Maligne's power contracts but fell far short of permitting full utilization of the station's 540,000 hp. of installed capacity which could consume 46,000 cu. ft. per sec.

The second power plant on the Saguenay was built near Chute à Caron and is frequently called by that name. The head is approximately 150 ft. Its proper name is Shipshaw No. 1, for it was the first stage of the Shipshaw development. It was designed to use only part of the regulated river flow so it did not increase the need for improved storage capacity.

Then came the third plant on the Saguenay known as Shipshaw from its location near the mouth of the Shipshaw river. It develops about 210 ft. head. Its proper name is Shipshaw No. 2 plant and it completes the Shipshaw development. This plant was built to meet war needs and its final design was such as to provide for the efficient use of the then regulated flow of the Saguenay, plus such increase as might be obtained from additional water storage or diversion facilities. The Shipshaw No. 2 plant alone with a maximum generating capacity of 1,200,000 hp. could consume up to 48,000 cu. ft. per sec. and the Shipshaw No. 1 plant, with a maximum generating capacity of 300,000 hp. could use in addition up to 20,000 cu. ft. per sec. In principle, Shipshaw No. 1 is operated only in the event of machine outage at Shipshaw No. 2 or even at Isle Maligne, or when the generating capacity of those plants is sufficiently reduced during flood periods by high backwater. In the latter case, the lower economy at Shipshaw No. 1 is not objectionable.

When the war brought an immediate demand for more power for aluminum from the installed generating capacity at Isle Maligne and gave promise of a Shipshaw development which could use almost any amount of river flow that could be provided, a storage dam at Lake Manouan was promptly begun and shortly thereafter work was commenced on a storage dam at Passe Dangereuse. These dams now provide storage capacity of 78.5 billion cu. ft. at Manouan with a 21 ft. drawdown and 183 billion cu. ft. at Passe Dangereuse, with a 110 ft. drawdown. The total effect of the unstored runoff and the storage on the Saguenay now insures an average minimum regulated flow of 42,500 cu. ft. per sec. at Isle Maligne and Shipshaw six years out of seven.

LAKE MANOUAN STORAGE DAM

Field Investigations

Field work was carried out between 17th August and 23rd October, 1937, by a party of 15 men, with C. Miller, M.E.I.C., in charge. Some additional work was done in April 1938, also during June and July, 1940.

The party was serviced by air transportation. The operation required the movement of some 20,400 lb. of equipment, supplies and personnel, over an air route of 163 miles, and cost $2,660, or 37.4 per cent of the total cost of field work.

Characteristics of Reservoir

Lake Manouan storage dam is located at the outlet of Lake Manouan at the head of the Manouan river, the principal tributary of the Grand Peribonca. The dam is 225 miles from Lake St. John, as measured along the Peribonca and Manouan rivers.

Lake Manouan at normal low water had a surface area of some 100 sq. mi. The construction of the storage dam increased this to about 152 sq. mi. Storage capacity is 56.5 billion cu. ft. with 16 ft. of storage and 78.5 billion cu. ft. at 21 ft.

Area of the watershed tributary to Lake Manouan storage reservoir is approximately 1,850 sq. mi.

Topography of the watershed is relatively flat and rolling, with widespread marshy areas, except to the south where it is extremely rugged. The watershed is generally forested but large areas have been repeatedly burnt over. Forest cover is largely spruce with some jackpine.

Lying as it does over 1,640 ft. above sea level, precipitation is frequent. Limited records covering a period of one year from August 1942, to August 1943, show the average number of days on which precipitation occurred was 20 per month, with the maximum 27 and the minimum 18 days. In the same period the maximum mean hourly wind velocity in a month ranged from 22 to 33 m.p.h., with the mean monthly average velocity 9.4 m.p.h.

General Plan of Development

The scheme of development comprised the following factors:

(1) Diversion of discharge during construction.
(2) Increase of discharge at the lower stages.
(3) Removal of heavy or prolonged flows from the vulnerable south bank of the outlet.

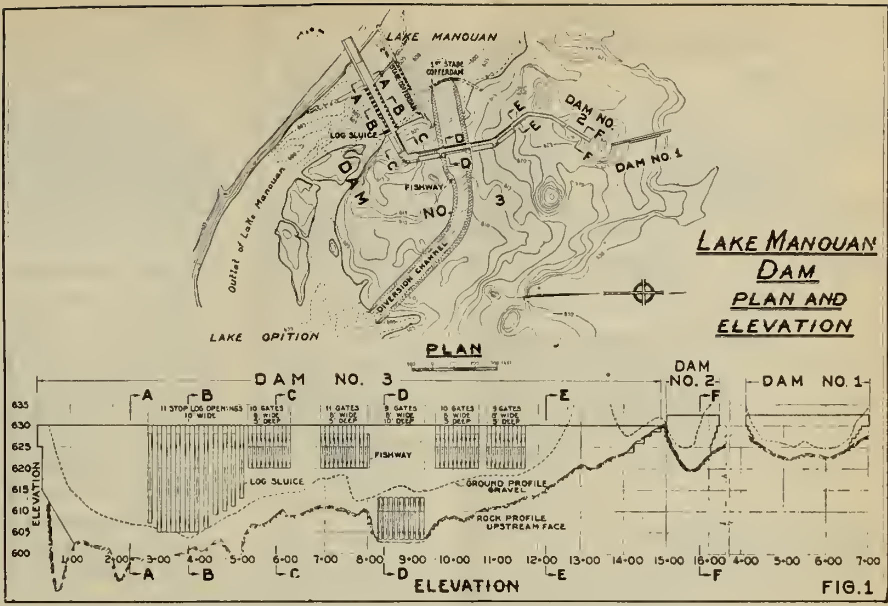


Fig. 1—Plan and elevation of Lake Manouan dam.

Because of the unconsolidated nature of the overburden in the outlet channel it was imperative the dam be founded on rock. Failing this, it was evident piping under the dam and scouring at the toe would eventually lead to its destruction by erosion and undermining. Furthermore, operating conditions demanded a rate of discharge sufficient to empty the reservoir during a drawdown period of 120 days.

The solution of the above problem was the provision of a diversion channel on the north bank, as shown by Fig. 1. Excavation of this channel provided necessary rockfill for the cribwork.

Camp Facilities

Camp buildings and facilities were the simplest possible, in view of the heavy cost of aerial transportation, constructed from unpeeled spruce logs and rough spruce lumber sawn on the site. The only material transported to the site consisted of nails, glazed windows, oakum and roofing paper.

Bunkhouses were 30 ft. by 26 ft., with unpeeled log walls, 1½ in. rough lumber floors, 1 in. rough lumber ceilings with one thickness building paper and 4 in. of sawdust, and 1 in. rough lumber roofs, with two-ply roofing. Openings between logs were chinked with oakum. Clear height between floor and ceiling was 9 ft. Two 12 by 12 in. ventilators, a partitioned-off washroom, a camp stove made up on the site from a 45 gal. oil drum and 12 double-deck beds built in the field were provided. Only the springs proper were flown in. The frames were built from lumber sawn on the job.

A log messhall and kitchen with a floor area of 4,190 sq. ft. accommodated 270 men at a sitting.

It is of interest to note that provisions and camp equipment freighted in to the job averaged 7.05 lb. per man per day.

A small hospital, 22 by 27 ft. in size, of log construction, was provided. Free medical consultation and treatment was given personnel, for which they contributed $1.00 per month, on a voluntary basis.

Camp facilities for personnel cost $38.00 per man for direct labour and material, as well as overhead, but exclusive of transportation costs between railhead and job.

The peak force engaged on Lake Manouan construction was 443, reached in March. The average force amounted to some 260 men.

Transportation

Transportation of equipment, supplies and personnel to the damsite received extensive study.

Field work had shown a 135 mile winter road would be feasible but the 10 months construction period did not permit road building. Transportation had to begin virtually the day decision was reached to construct Manouan.

The southern terminus of the air haul was Beauchesne, an existing pulpwoods operation depot of Price Brothers on Lake Onatchiway, reached by a 44-mile truck road and 16-mile water route from railhead at Chicoutimi. Roberval, on Lake St. John, served as an alternative southern base.

Aerial transportation was carried out under contract on the following basis:

Freight—Beauchesne to Manouan. . .	$ 0.07 per lb.
Roberval to Manouan.	0.12 " "
Passengers—Beauchesne to Manouan	14.00 each
Roberval to Manouan. .	24.00 "

The above rates were based on delivery of aviation gasoline, oil, parts and supplies to the air transportation organization without charge for freighting between Chicoutimi and Beauchesne. Further, there was no charge for freight or passengers moved out from Manouan on return trips of aircraft flying in loaded.

Table I shows the over-all transportation operation, which involved freighting roughly 1,970 tons into Manouan and 217 tons out. In order to move this tonnage, an additional 785 tons had to be hauled into Beauchesne. That is, servicing the air freighting organization required practically 0.38 tons per ton of useful freight hauled 110 miles. Freight hauled into the job amounted to 0.056 tons per cu. yd. of cribwork.

Major equipment flown into the job included a ¾ yd. gasoline heavy duty dragline, a ¾ yd. Diesel medium duty shovel, seven tractors up to a D7,

Item		Summer 1940	Winter 1940-41	Spring 1941
TABLE I — FREIGHTING NORTH TO BEAUCHESNE				
FREIGNT, LBS.		4,415,201	1,065,820	26,678
PASSENGERS		439		
FREIGHTING INTO MANOUAN				
FREIGHT, LBS.	EX BEAUCHESNE	1,203,870	2,434,603	99,840
DO	EX ROBERVAL	20,141		28,814
				154,046*
PASSENGERS	EX BEAUCHESNE	384	449	7
DO	EX ROBERVAL	78		7
				21*
FREIGHTING FROM MANOUAN				
FREIGHT, LBS.	TO BEAUCHESNE	7,198*	190,869*	52,370*
DO	TO ROBERVAL			161,761
				21,386
PASSENGERS	TO BEAUCHESNE	148*	495*	88*
DO	TO ROBERVAL	19*		146
				43*

* NO CHARGE

two-6 yd. Athey wagons, three-315 cu. ft. per min. Diesel air compressors, four-1½ and 2-ton trucks, etc. In addition, eight draught horses and several oxen were flown in.

The largest aircraft on the job was the so-called "Box Car," a Junkers JU 52 equipped with a 825 hp. Rolls-Royce engine developing 925 hp. on takeoff. This ship hauled in a 5,400 lb. piece during the winter.

The maximum number of aircraft in service at any time was eight, with 32 flights in one day.

The aerial transportation was most successful. There were some minor mishaps but no freight was lost and no injuries were suffered by airborne personnel.

Equipment used on the Manouan job had to be selected of such type and size as could be torn down into components within the capacity of available aircraft. For instance, the ¾ yd. dragline represented the maximum size equipment of this nature adaptable to air freighting. In some cases the chassis of a construction machine was specially sectionalized to permit loading into aircraft.

Communication Facilities

Communication between the job and Beauchesne at the southern end of the air route or Chicoutimi at railhead was provided through 50-watt radio-telephone stations at the three points.

Radiophone communication was possible some 74 per cent of the time. Radio telegraphy was resorted to about 26 per cent of the time.

Logging Operations

Due to its remote location in virgin country and the relatively low head, rockfill timber-crib construction was the logical choice for Manouan. However, provision of the necessary logs for cribwork and lumber was attended by two difficulties.

Lake Manouan lies north of Lat. 50° 30′, at an altitude of approximately 1,625 ft. above sea level. The climate is rigorous. Evidence exists to show the country was swept by forest fires about 1827. Consequently, available timber is small, although forest cover is general.

The specifications stipulated all crib timber should be spruce or first quality jackpine, cut from live trees free from loose or large knots.

In addition to logs for camp buildings, largely secured from clearing operations, the following were required:

400,000 lin. ft. crib timber.
600,000 FBM lumber for sheeting and roofing.
300 stoplogs 10 by 10 in. and 12 by 12 in.
Special timbers for stoplog check framing, etc.

The timber was secured within a radius of some two miles from the job, above the dam, except the stoplogs and special timbers which were secured about 15 miles away.

Cofferdams

Two cofferdams were required. The first-stage cofferdam permitted excavation of the diversion channel to grade, some 6 ft. below normal low water level in Lake Manouan. The second-stage cofferdam was used to unwater the river channel proper, in order to excavate the loose material and construct the dam in the dry.

The river bed at the cofferdam site consisted of a layer of boulders ranging from one-man to 3 ft. boulders, the stratum being some 3 ft. thick. Underlying the boulders was a stratum of unconsolidated or loose fine sand some 2 to 4 ft. thick, overlying a stratum of fairly well compacted gravel and small stone immediately above bedrock.

As the cofferdams were intended to serve as a roadway for the movement of the larger equipment, including the ¾ yd. shovels, the width was made 16 ft. although 10 ft. would have served otherwise.

The rock-filled timber-crib cofferdams were built in 16 ft. sections, each section being constructed upside down on the previously built cofferdam with the bottom fashioned to fit the river bed as shown by soundings. After tipping into place and aligning, the section was loaded with rock. Stoplog openings of ample capacity were provided in the two cofferdams to give full control of the flow. Sheeting consisted of two layers of one inch board driven into place with a maul after removal of as many boulders as possible under the sheeting, by a diver. Sheeting was nailed under water by a diver.

The fine sand conveniently available for toefill on the diversion cofferdam did not make a good seal when dumped in place by trucks to a width of 12 ft. Prevailing —40 deg. F. temperatures resulted in freezing of an outer shell of the fill material, 2 to 3 ft. thick. Additional toefill and consolidation with small dynamite charges was necessary to overcome the initial heavy leakage. Leakage averaged about 7 cu. ft. per sec. during the excavation of the diversion channel.

The second-stage cofferdam was constructed with a fill 20 ft. wide, the fill being thoroughly compacted during placing by repeated passes of a D-4 caterpillar tractor. Leakage amounted to less than 0.5 cu. ft. per sec.

Excavation

Excavation of the diversion channel entailed the removal of 22,600 cu. yd. solid rock, practically all utilized for cribfill. An additional 950 cu. yd. was removed in preparation of foundations. In addition to the rock, some 12,000 cu. yd. frozen overburden required blasting.

The rock at Manouan is Grenville gneiss relatively badly fractured in horizontal planes. Depth of rock removed ranged from 2 to 12 ft.

Compressor plant consisted of 3 Diesel-engine-driven compressors of 315 cu.ft. per min. capacity, each.

Jackhammers were initially used for drilling but the slabby nature of the rock and numerous seams caused considerable sticking of drill steel. Subsequently wagon drills were used for all except blockholing.

Because detachable bits entailed a very considerable saving in weight and aerial transportation costs, they were used entirely. It was found the bits could be readily re-sharpened on a bit grinder and used three times. Each bit was good for about 9 ft. drilling. Drilling cost some $0.385 per ft., exclusive of transportation, but all other overhead included.

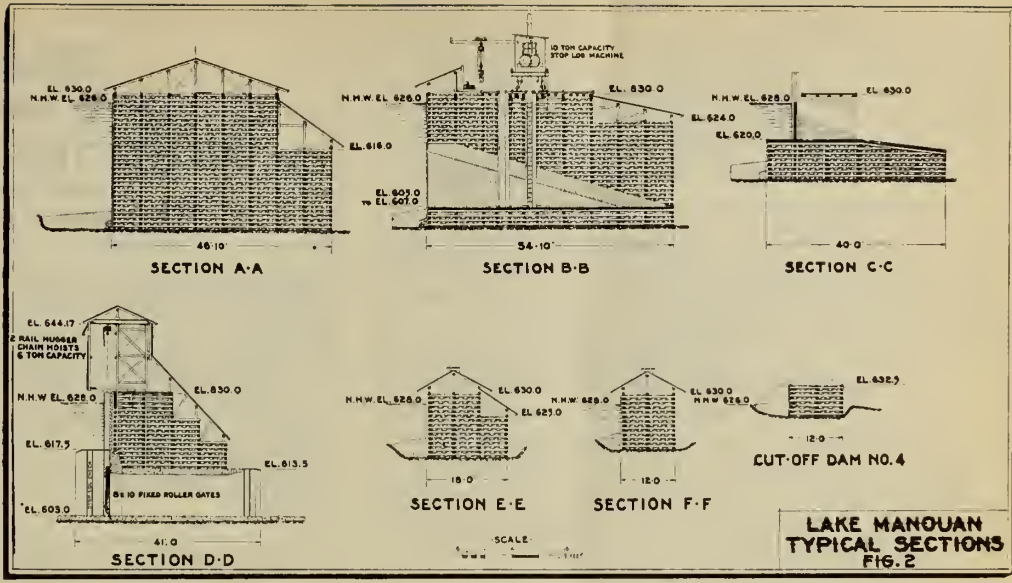


Fig. 2—Typical sections through Lake Manouan dam.

The limit size of shovels available, at ¾ cu. yd., dictated relatively heavy use of explosives. About 1.5 lb. 40 and 50 per cent polar forcite was used per cu. yd. of rock.

Haulage equipment included 6 cu. yd. Athey wagons as well as 1½ and 2-ton trucks.

Features of Dam Construction

The design of the river section of the dam, containing the stoplog openings, as per Section B-B, Figs. 1 and 2, involved the following considerations:

Unit weight of rock-filled crib in the dry	90 lb. per cu. ft.
Buoyancy of rock-filled crib	45 lb. per cu. ft.
Water level in Lake Manouan	630
Water level downstream	619

No ice pressure included, since water level at El. 630 with no ice imposes heavier loading than the designed operating condition of water level at El. 625, plus ice.

Only 50 per cent of total number of dowels assumed to act, each good for 1,000 lb.

Coefficient of friction between the rock-filled cribwork and foundation rock—0.55 max.

The choice of 90 lb. per cu. ft. as the weight of the rock-filled timber-crib, in the dry, was based on Grenville gneiss at 167 lb. per cu. ft. and about 33 per cent voids.

As constructed, and on the above premises, the factor of safety against sliding ranged between 2.42 and 2.49.

Some of the more pertinent factors of the design for the river section follow:

Pocket size	6 ft. by 5 ft. 6 in.
Max. crib width	55 ft.
Max. crib height	37 ft.
Principal timber size	Logs slabbed to 6 in. thickness 4 in. bearing face.
Actual timber content	26.4%-28.5%

Joints were carefully staggered throughout the cribwork, to eliminate concentration of joints in any one plane.

Cribwork timbers were normally secured at all points of horizontal contact with ½ in. diameter chisel point headless drift pins driven through two timbers and into a third to the extent of 2 in. In the river section, where maximum size timbers were utilized, ⅝ in. dia. drift pins were used. In the river section, also, one vertical post member was placed at each point of intersection of crib timbers, secured to every fifth timber by a ⅝ in. bolt with a plate washer at each end.

Sheeting consisted of a double thickness of 2 in. rough spruce or jackpine lumber with staggered joints. Surfaces of crib timbers to which sheeting was to be attached were slabbed. Joints in the inner layer of sheeting were tightly caulked with oakum. In the case of stoplog openings such as in Section B-B, Fig. 2, full advantage was taken of the first or inner layer of sheeting to secure maximum stiffness or ability to resist racking in the piers by running the sheeting diagonally.

In order to ensure maximum life of the cribwork, roof structures were provided protecting the timbers from rain and snow but permitting ample ventilation.

In the diversion channel section of the dam, a composite construction was devised to secure adequate discharge capacity with minimum excavation, yet provide necessary strength of structure. As shown by Section D-D, Fig. 2, a series of nine concrete sluice tubes each 9 ft. by 8 ft. minimum section are surmounted by rock-filled timber cribwork. All timber to timber contacts in this section were treated with Osmosar.

To secure water tightness at the junction between the upstream face of the dam and bedrock, a concrete seal was poured. Additional water tightness was obtained by placing toefill of selected, well graded gravelly soil, free from organic material, in layers about 6 in. thick, and thoroughly compacting by several passes of a tractor, with hand tamping next to the sheeting.

The south abutment, as previously noted, is a high bank consisting of gravel with a very high proportion of relatively fine material overlying, at ordinary water levels, a fine silty sand. It is inherently susceptible to damage by percolation through or around a faulty seal. Consequently, considerable attention was given to the problem of preventing seepage past the junction between the cribwork and the bank material. The importance of this was emphasized by the discovery, during excavation, of a water-bearing stratum of coarse gravel between El. 617 and El. 619, extending some 180 ft. upstream from the dam and some 150 ft. downstream.

The following measures were adopted:

(1) Along the upstream face of the dam, a 10 ft. width of very carefully consolidated toefill was turned upstream for a distance of some 300 ft.

(2) A roughly triangular blanketfill was placed between the upstream face of the dam, as far as the first stoplog opening, and the south bank, with necessary riprap protection in the area subject to erosion by wave action.

(3) On the downstream side of the cribwork, a fill of coarse gravel and rock varying in width from 16 ft. at the abutment to 24 ft. near stoplog opening No. 1 was provided, to drain such seepage as might take place.

(4) The free-draining gravel and rockfill was backed up by a roughly triangular fill with very flat slope, designed to increase the stability of the abutment proper.

Necessary material for the blanketfill was secured by bulldozing from the high south bank, cutting the slope to a much more stable condition.

Gates

Provision has been made for handling a large discharge, there being:

11 stoplog openings, with sills at elevations between El. 605 and El. 613. These have a clear width of 10 ft.

40 timber gates, with sills at El. 620. These have a clear width of 10 ft.

9 sluices, with sills at El. 603. These are 8 ft. by 10 ft.

For the stoplog openings, 12 by 12 in. stoplogs are used in the lower portions. Near the top, 10 by 10 in. stoplogs are used. All stoplogs are treated with Osmosar. They are handled quite easily with a 10-ton stoplog machine.

The timber gates were originally 10 ft. wide by 5 ft. high but they were increased to 10 ft. when the lake was operated up to El. 630. Normally these gates, which are of typical logging dam design, will never be used except in case of heavy floods occurring with a full reservoir. The gate slots and frames were treated with Osmosar.

The sluices are provided with 10 ft. high by 8 ft. wide fixed-roller steel gates. These gates with a dry weight of 9,400 lb. and a submerged weight of 7,050 lb. are lifted by two 8-ton (long) chain blocks.

As originally installed, these steel gates were operated with one 8-ton chain block but it was soon discovered enough small debris lodged on the roller tracks and at the seals to necessitate the additional lifting power.

At El. 625, the discharge capacity with all stoplog openings, timber gates and sluices open is about 40,000 cu. ft. per sec. At El. 630, the spilling capacity is 62,000 cu. ft. per sec., or 33.5 cu. ft. per sec. per sq. mi., a very conservative value for the Manouan watershed.

TABLE II
LAKE MANOUAN
QUANTITIES AND COSTS
YEAR 1940-41

ITEM	QUANTITY	UNIT COST
COFFERDAMS (ROCK-FILL TIMBER CRIB)	3300 C.Y.	$11.79
EARTH EXCAVATION (MOSTLY FROZEN)	41 840 C.Y.	1.44
ROCK EXCAVATION	22 630 C.Y.	5.18
PREPARATION OF FOUNDATION	1 025 C.Y.	24.70
CRIBWORK INCLUDING TIMBER	35 110 C.Y.	3.71
BUT EXCLUSIVE OF FILL,		
SHEETING, ETC.		
CRIBFILL	29 950 C.Y.	2.08
TOE FILL	4500 C.Y.	4.72
CONCRETE	1 195 C.Y.	44.80
MISCELLANEOUS FILL	31 120 C.Y.	0.71
RIPRAP	6350 C.Y.	0.98

COSTS DO NOT INCLUDE TRANSPORTATION BETWEEN RAILHEAD AND SITE

Schedule

The rapidly increasing power requirements during the first year of the war led to the decision, late in July 1940, to proceed with the construction of the Lake Manouan storage development. The schedule required completion in time to impound the 1941 spring runoff—that is, by 31st March.

As it was obviously impossible to build a portage trail into the site sufficiently early to meet the completion date, aerial transportation was decided on.

On 31st July, 1940, representatives of the owner and contractor went over the projected aerial transport route and job site. Three days later an engineering party had preliminary layout under way. By 7th August actual construction was started.

By 4th April, 1941, the gates were closed and storage commenced. The designed full reservoir level at El. 625 was reached on 23rd September, 1941.

As power demands were then increasing sharply, additional stoplogs were added and the bush-type gates altered to permit storage to El. 628, actually reached 2nd January, 1942.

Working Conditions

The temperature ranged below —20 deg. F. during a large part of the winter. Temperatures in the range −30 deg. to −40 deg. F. were quite frequent. Added to the low temperatures, the prevailing high winds and vapour from the open water of the discharge made the working conditions extremely severe.

However, only a very few accidents of relatively minor consequences were experienced. There were no fatal accidents.

Quantities and Costs

Some tangible idea of the magnitude of the Lake Manouan construction job will be secured from Table II. The unit costs given not only include direct labour and material costs, but also all overhead costs exclusive of transportation from railhead to site.

Operating Experience

Operating experience during the three-year period following completion of Lake Manouan storage dam indicates that the dam has successfully met all expectations.

The dam was placed in service in April 1941, when the gates and stoplogs were closed to store the spring flood runoff.

Conceived and designed for operation with water in Lake Manouan at El. 625, and with provision for extreme high water at El. 628, the exigencies of the power situation demanded utmost feasible storage. Accordingly, flashboards were added to permit storage to El. 628. Maximum elevation reached was 628.13, on 2nd January, 1942.

In 1942, the increasing power demand led to the necessity of impounding water to El. 630, which was reached 4th December, 1942. Maximum discharge during the drawdown period was 30,900 cu. ft. per sec.

In 1943, water was stored to El. 629.03, reached 3rd October.

Gates in the dam were first opened 28th August, 1941, for a few days, on account of extremely low run-off conditions in the lower Peribonca and remainder of the Lake St. John watershed. The fixed roller steel gates in the composite concrete and cribwork section across the diversion channel could be opened in approximately 45 min. Some difficulty was experienced with small twigs being trapped on the roller paths and under seals. This difficulty was overcome quite satisfactorily by increasing the hoisting power, using two 8-ton chain blocks instead of one.

Experience with the stoplog machine has been satisfactory although the heavy accumulation of ice on the stoplog guides necessitates the use of live steam to remove the ice prior to opening. Steam at 75 lb. pressure is secured from three vertical 50 hp. wood-burning boilers installed for construction purposes and retained for operation.

Any ice pressure occurs with a full reservoir, between date of freeze-up and opening of the gates. Once the gates are opened the ice cover quickly disappears due to the velocity of approach.

Operating experience indicates that about five days are required for Lake Manouan storage waters to reach Lake St. John. That is, the average velocity appears to be 2 miles per hour.

The south abutment seal appears to have been most

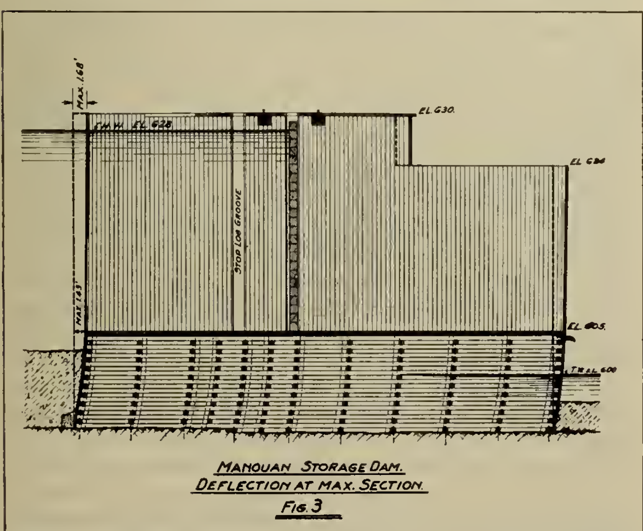


Fig. 3—Deflection at maximum section of Lake Manouan dam.

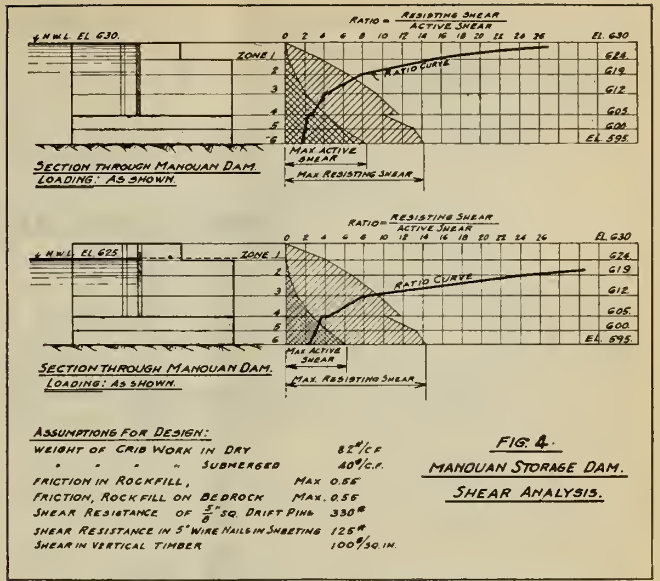


Fig. 4—Shear diagram for Lake Manouan dam.

effective. There is definitely no leakage. Some local subsidences have occurred due to the influence of heavy local surface runoff on the south bank percolating downwards through the coarse fill on the downstream side of the cribwork and carrying away fines. These appear to be of no important significance as they have developed at decreasing rates.

The most noteworthy observation is the distortion which has taken place in the cribwork. This is only noticeable in the maximum section between stoplog openings 2 and 3, and to a lesser extent throughout the river section generally. The maximum section has a height of 38 ft. and a base width of 54 ft. 10 in.

The sluice floor at El. 605 is 12 ft. above foundation rock. Although there is definitely no movement whatever of the cribwork on the rock, as by sliding, there has been some "racking" or movement of successive courses of the cribwork above the foundation course. The total effect of this, in the maximum section, is a deflection in the downstream direction of some 20 in. Between the sluice floor and the deck the deflection in a height of 25 ft. is less than 3 in. See Fig. 3.

This deflection had been anticipated, to a considerable extent, in view of the unusually small size of crib timber available. To offset it, smaller size pockets than normal were utilized and a large number of vertical timbers or posts were built into the cribwork.

Careful analysis of the horizontal shear shows the relationship between active and resisting shears, for the maximum section, to be about as indicated by Fig. 4. Curve A is the ratio of shears for storage to El. 625, whereas curve B shows conditions for storage to El. 630.

As previously remarked, it had been fully expected the distortion in the cribwork might be unusually high, in view of the small crib timber available. Consequently, continuous check was kept on it. Total distortion in the maximum section was about 10.5 in. at the end of the first year, and 20 in. at the end of the second year.

A limited amount of reinforcement, in the form of additional cribwork immediately downstream from the original cribwork, in the vicinity of the maximum section, has been added—this in view of continuing wartime operation occasionally at El. 630 instead of El. 625 as originally intended.

There has been very little vertical settlement of cribwork.

The radio-telephone equipment installed for operation, with 350 watt output on telephony and 800 watt on telegraphy, has proved entirely satisfactory at 3,270 Kc. per sec., over a distance of some 150 miles. Life of major tubes has been very good, over 3,050 hours, considering the rather high voltage regulation of the small 3,000 watt gasoline-engine-driven generator and the temperature extremes.

PASSE DANGEREUSE STORAGE DAM

Characteristics of Reservoir

The reservoir provides for storage of water to a depth of 110 ft. above normal low water at the damsite, arbitrarily chosen as El. 130. The water level with full reservoir is thus at El. 240, which is some 1,450 ft. above mean sea level, or 1,115 ft. above Lake St. John.

The reservoir when full has a surface area of 122 sq. mi., an increase of 121.7 sq. mi. over the water area at El. 130.

Visible storage is estimated at 183 billion cu. ft. The volume of ground storage is not known but is believed to be relatively high owing to the silty-sand overburden on the reservoir floor.

The reservoir owes its origin to mountain ranges on either side of the Peribonca, which roughly parallel the river, although diverging in many places, particularly around Lakes Peribonca and Onistagan as well as along the major tributaries. At the Passe there is only a narrow gap between the mountains. These mountains, as is typical of northern Quebec, have north-south axes. Sandy beaches about 15 to 25 ft. above natural low-water level form flats surrounding Lake Peribonca and generally along the river to the upper end of the reservoir. Numerous swampy or muskeg areas exist in the reservoir area and elsewhere in the watershed, but above Lake Onistagan the watershed becomes extremely rugged and mountainous. Except at the Passe, rock outcrops are mostly in evidence on only the shoulders of the mountain ridges which confine the Peribonca valley. Forest cover is mostly spruce and jackpine of fair density, except above Lake Onistagan where it thins out considerably, the rocky slopes having been denuded by forest fires. Even below Lake Onistagan, numerous old burns exist.

The watershed tributary to Passe Dangereuse reservoir is placed at 4,570 sq. mi., 38 per cent of the Peribonca watershed or 16.3 per cent of Lake St. John watershed.

Geology of Site

At the site of the main dam, the west or right-hand bank slopes upward at about 45 to 50 deg. There are numerous fracture scarps on this bank, which strike parallel to the direction of flow of the river and dip approximately 70 deg. east. The east bank slopes upward at approximately 30 deg. Fracture scarps are observable and are parallel to the direction of flow of the river. These scarps mostly face westerly and dip about 70 deg. west. Several narrow depressions and one prominent crevasse on the east bank all trend in the direction of strike of the major fractures.

Preliminary investigations were made by magnetometric methods, and this work was followed up by a thorough diamond-drill investigation of the damsite.

A brief description of the rock structure will be helpful in visualizing foundation problems. The rocks are: (a) paragneiss, including biotite gneiss and amphibolite, apparently of the Grenville series of early Precambrian age, (b) granite gneiss believed to be of the Roberval formation, and (c) subsequent dark basic dykes, both of late Precambrian age. The Grenville rocks appear to be intensely altered, with only the most resistant of their original materials remaining. They were evidently a series of sandstones, shales and limestones. The beds of sandstone and shale have become sedimentary gneiss, or paragneiss, with fine even banding. The limestones and calcareous muds have been largely silicified and otherwise altered. Whatever the process of alteration, these phases are strong rocks free from susceptibility to change under the operating requirements of the reservoir.

The Grenville rocks have actually been grouted from below by the injection of the later Roberval granite and pegmatite along the open joints and lines of weakness, cementing the two series together. A similar natural grouting action has resulted from the intrusion of the post-Roberval dark basic or lamprophyric dykes between walls of the fault described in detail later, and wherever else they have occurred.

The river itself is entrenched in a width of rock remarkably free from fractures. Numerous potholes of considerable size exist.

Many rust and sand seams exist but these, as a rule, are shallow. Some evidences of weathering, of insignificant degree, have been detected down to 100 ft. in depth.

While the general geology was quite favourable, certain features entailed considerable attention. These were:—

(1) A lens of impure crystalline dolomitic limestone found on the east bank, in dam sections 7 and 8.

(2) Extensive fracturing with some rock decomposition exists in dam sections 1, 13 and 14. That in sections 13 and 14 extends to considerable depth in otherwise sound rock.

(3) A fault on the east bank dipping in a westerly direction at an angle of 32 deg. with the horizontal.

The fault and its accompanying fractures appear to have been formed after the intrusion of the Roberval granite and near the margin of a considerable body of the granite downstream from the dam. Movement of the fault must have been small, for the rock is little disturbed.

Remedial measures adopted in connection with the limestone lens consisted of the excavation of all unsound rock. After removal of the unsound rock, very favourable rock was exposed.

The fracturing in sections 1, 13 and 14, and elsewhere to a moderate extent, was treated by thorough grouting prior to placement of concrete. This is discussed in more detail later.

The fault trace in the crevasse in section 11 was thoroughly cleaned out to solid rock. A cutoff adit was then driven along the fault plane, under the heel of the dam, for a distance of 92.5 ft. After pressure grouting along the plane of the fault, through diamond drill holes put down 100 ft. into the face of the adit, the cutoff adit was carefully plugged with concrete designed to have minimum possible shrinkage. Great care was taken to thoroughly clean the roof, walls and floor, by sandblasting and by air-water-jet washing prior to pouring concrete.

General Plan of Development

The Passe Dangereuse storage development entails a main dam (No. 1) across the Peribonca river at the Passe as well as three cutoff dams. Cutoff Dam No. 2 is required to close a gap in the flow line on the easterly side of the reservoir 5 miles from the Passe where a saddle in the hills has a low elevation of 215. Discharge from Passe Dangereuse reservoir here would re-enter the Peribonca some 8 miles downstream from No. 1 dam. Cutoff Dam No. 3 located about 16 miles from No. 1 dam is necessary to plug a low point in the flow line, through which water could escape to the Manouan river watershed. Natural ground elevation here is 237. Cutoff Dam No. 4, located about 5.5 miles from No. 1 dam, is essential to prevent the escape of water to the Brodeuse river and re-entry to the Peribonca about one mile downstream from No. 1 dam. The elevation at the low point is approximately 240.5, the divide being a narrow marshy ridge.

Considerable study was devoted to the possibility of spilling excess flow and the upper layer of impounded water through a control dam at the No. 2 site, with only storage water discharged at the No. 1 dam. The logical choice for No. 2 dam in this case was a concrete-gravity design. For No. 1 dam a straight rockfill design possessed attractive advantages, as stored water could be readily discharged through tunnels in the high west bank. These tunnels could also be utilized for river diversion during construction. A major drawback to this scheme was the absence of suitable sealing material.

The final solution provided for discharging excess flows and storage waters through No. 1 dam, with non-overflow or cutoff dams at Nos. 2, 3 and 4 locations.

River-flow records for the Peribonca, at Savanne Falls, just above Lake St. John, over a period of 13 years, analyzed in conjunction with limited data available for Passe Dangereuse indicated river control and diversion could be carried out during either of two periods:

(1) Winter — from 1st December to 30th April, with a possible peak flow of 12,500 cu. ft. per sec., and
(2) Summer — from 1st July to 1st December, with a possible peak flow of 30,000 cu. ft. per sec.

The conformation of the river bed at the selected site lent itself admirably to an economical river control and diversion during construction. As shown in Fig. 5 the first-stage cofferdam with mid-river leg just to the west of the ridge permitted placement of the first-stage concrete consisting of five temporary sluice piers and sills (later incorporated into the dam proper), while the winter flow was discharged through the westerly portion of the channel. Removal of the first-stage cofferdam permitted discharge through the four temporary sluices while the second-stage cofferdam was being placed. Finally, the temporary sluices were closed upstream and downstream by stoplogs while the river flow was handled through the 4 deep sluices in Sections 19 and 20 of the dam, located in the westerly portion of the channel.

For No. 2 cutoff dam a rock-filled timber-crib design proved most economical. Several factors governing the designs were:

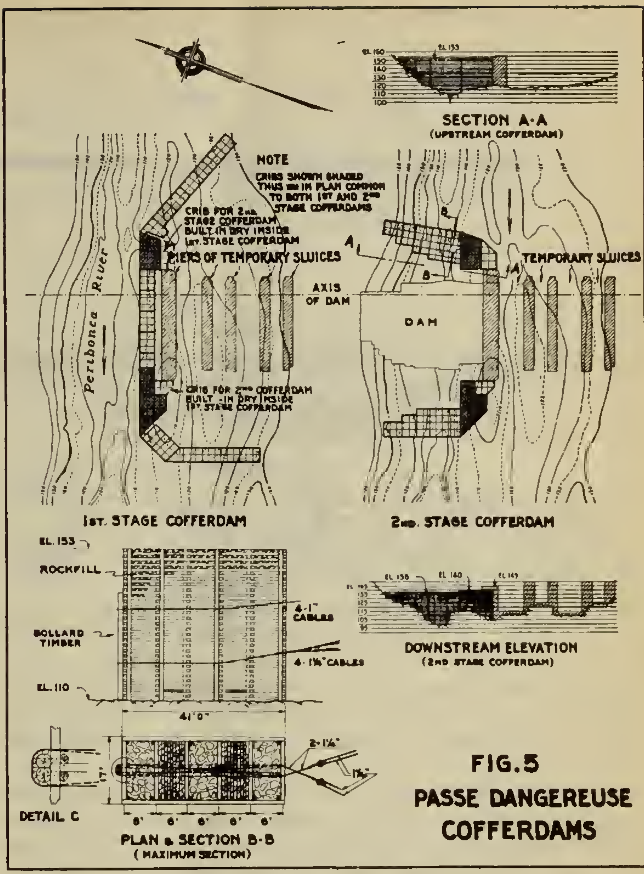


Fig. 5—Passe Dangereuse cofferdams.

(1) Difficulty of access to site.
(2) Absence of suitable concrete aggregates, except crushed rock, which would be very expensive in any case.
(3) Absence of suitable material for an earthfill dam.
(4) Although a timber-crib design would require a maximum height of 40 ft., the rock-filled timber-crib could be readily reinforced at the end of its natural life by additional rockfill placed on either side, the original dam providing both core and construction trestle. Moreover, the topography at the site favours such procedure.

Design Features

The No. 1 or main dam at Passe Dangereuse is a concrete gravity-type structure. As shown in Fig. 6, it comprises an 18-ft. east abutment section, a 448-ft. spillway section topped by 10-ft. flashboards, a 531-ft. gate section, a 177-ft. spillway section topped by 10-ft. flashboards and a 12-ft. west abutment. Overall length is 1,186 ft. Maximum height is 157 ft. Volume of concrete in this structure is 151,300 cu. yd.

The design provides for discharging excess inflows through 3 — 22 ft. wide by 37-ft. high crest gates and 1 — 22 ft. wide by 23 ft. log sluice crest gate, all with 1-ft. freeboard. These gates have a combined discharge capacity of 53,000 cu. ft. per sec. with the reservoir at El. 230, equal to 11.6 cu. ft. per sec. per sq. mi. of watershed. In the event of excessively high floods with full reservoir the flashboards can be removed, increasing the discharge capacity to 125,000 cu. ft. per sec. or 27.3 cu. ft. per sec. per sq. mi. of watershed. It is extremely unlikely it will ever be necessary to open the flashboards as the operating cycle for the reservoir will result in the reservoir being empty prior to the

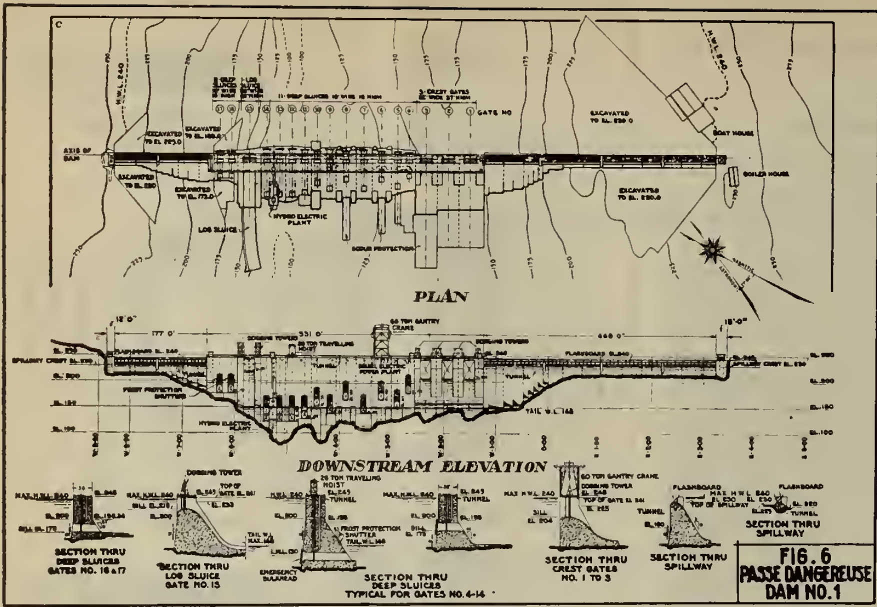


Fig. 6—Dam No. 1 at Passe Dangereuse.

Limiting shear in concrete at 375 lb. per sq. in.

Coefficient of friction for concrete on rock or on concrete 0.65, increased to 0.80 when earthquake effect considered.

Resultant of all forces must fall within the kern or middle third of the section.

Under ordinary loadings no tension occurs anywhere in the body of the dam. Under exceptional loading, due to earthquake effect, all tension, if exceeding 15 lb. per sq. in., is resisted by steel reinforcement.

Figure 7 illustrates two typical stability analyses for a deep sluice section. It will be observed that maximum vertical compressive stress is 249 lb. per sq. in. Parallel to the face the compressive stress reaches 298 lb. per sq. in. Maximum shear is 134 lb. per sq. in.

spring flood. Moreover, the storage capacity of the reservoir in proportion to the watershed is such that only excess summer inflow or fall inflow would require spilling.

It will be further noted the spillways, crest gates and log sluice gate are so located that the deep sluice gates required to discharge storage water have unobstructed entrances and utilize the cross-sectional area of the valley to best advantage. The deep sluices are disposed in tiers so that the full reservoir can be emptied in 100 days without exceeding 50 ft. head on the sills of the deep sluice gates, when opened.

Discharge capacity of the 10 ft. wide by 16 ft. high deep sluices, with 50 ft. head on the sill and gate fully open, is 6,500 cu. ft. per sec. each. There are 13 deep sluices.

Means of access to the central portion of the dam is through access tunnels in the spillway sections or along the walkways at the top of the flashboard structure.

The design is based on:

High water level in reservoir	at El. 240
Maximum tailwater	at El. 148
Crest of spillway	at El. 230
Top of flashboards	at El. 240
Concrete, as determined by test	at 156 lbs. per cu. ft.

Uplift on foundation at 100 per cent of tailwater over entire base between heel and toe plus 50 per cent of difference between reservoir water level and tailwater at heel, decreasing uniformly to zero at toe.

Uplift on joints between successive pours of concrete at 50 per cent of head due to reservoir water level at upstream face decreasing uniformly to zero at downstream face.

On certain parts of the horizontal joints in the crest gate and deep sluice sections, uplift equal to 100 per cent of head due to reservoir water level has been assumed.

Ice thrust at 10,000 lb. per lin. ft., acting at El. 230.

Earthquake effect at 5.5 per cent *g*.

Limiting compressive stress in 3,000 lb. at 28 days concrete at 750 lb. per sq. in.

A typical arrangement for the deep sluices is shown by Fig. 8. The sluice tubes are so designed as to avoid cavitation by careful bell-mouthing at the entrance and suitable proportioning throughout. At the gate, which is of the fixed roller type, the clear opening is 10 ft. wide by 16 ft. high but this is reduced to a minimum section downstream of 10 ft. by 15 ft. Adequate admission of air to ensure freedom from excessive cavitation effects is afforded by 1 — 36 in. dia. vent, branching into 2 — 12 in. outlets just downstream from the gate lintel. Proper design, good concrete and good forming are expected to ensure freedom from cavitation due to the high velocity discharge, which approaches 60 ft. per sec.

In event of damage to a deep sluice gate or inability to open it due to jamming, provision is made for closing the entrance to the sluice tube by a steel bulkhead, in the case of those sluices below El. 150. No such provision is made for the higher sluices as there would be ample time to effect repairs after emptying the reservoir during the normal drawdown.

To minimize cracking due to contraction, contraction joints have been provided at intervals of 30 to 48 ft. depending on the profile of the foundation and design requirements in respect of the gates. The contraction joints are provided with 20 oz. copper waterstops of 6 in. dia. semi-cylindrical shape with 10 in. wings, the curved portion being backed by an asphaltic filling.

To minimize uplift due to seepage under reservoir pressure, a grout curtain with minimum depth of 20 ft. was constructed immediately under the heel of the dam. Where condition of the rock necessitated, as determined by water pressure tests, this grout curtain was carried to greater depth, using 2 in. diamond drill holes up to 120 ft. in depth and 10 ft. stage grouting, with grouting pressure ranging from 50 lb. per sq. in. for the shallow holes to 100 lb. per sq. in. for the deep holes.

It has been recognized that the jets from the deep sluices, under 50 ft. head, would tend to disrupt or quarry the rock in the area of impact downstream from the dam. Consequently, where the tailwater will be of insufficient depth to cushion the impact, concrete jet breakers have been provided. Also, downstream from the crest gates, extended scour protection has been constructed.

A small hydroelectric plant has been incorporated in the design, adequate for a 200 hp. waterwheel which is supplied through a 30 in. penstock. As this plant would not have the necessary output at the lower reservoir levels for gate heating and operation, a 134 kw. Diesel-electric plant with 2—30 kw. and 1—74 kw., 550 volt, 60 cycle generators has been installed in the dam, just below the deck. Fuel oil storage tank capacity of 10,000 gal. is sufficient for a year's requirement. The oil storage is filled through a pipeline passing through the access tunnel to the west abutment.

The Diesel power plant also contains a 160 cu. ft. per min. Diesel-driven air compressor. This, with permanent piping, permits blowing out gate heater ducts and facilitates maintenance work.

The 22 ft. wide by 37 ft. high crest gates are standard fixed-roller type designed for full hydrostatic

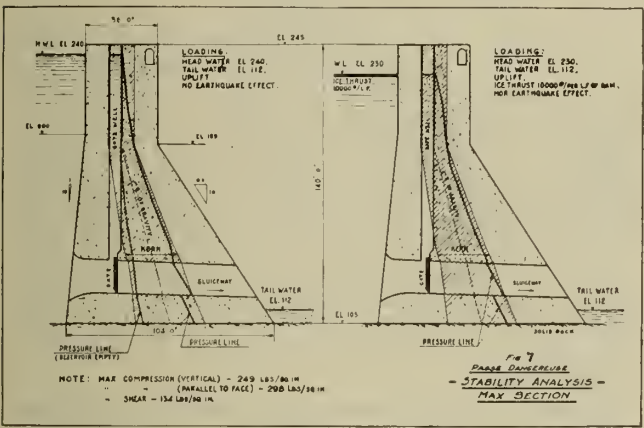


Fig. 7—Stability diagram for Passe Dangereuse dam.

pressure plus an ice pressure of 5,000 lb. per lin. ft., acting over a vertical distance of 2 ft. anywhere along the height of the gate. The gates are operated by a 60-ton travelling gantry, the connection being effected by a suitable spreader beam with pins sliding in bearings built into the spreader beam engaging in holes provided in the gate-lifting lugs.

The crest gates have provision for insulation on the downstream side, skin and gate heaters. Skin heaters are six in number, each 7.5 kw. at 550 volts. Gains are provided with 4 — 10 kw. heaters. Initially only gate No. 2 has been equipped with heaters as it is expected the current set-up by the discharging water will eliminate any difficulty with ice, on Nos. 1 and 3 gates.

Stoplog grooves have been provided upstream from all crest gates. The composite steel-beam and wood-filler stoplogs are manœuvred by means of a master log with the 60-ton gantry.

The 22 ft. wide by 23 ft. high log sluice gate is similar in design to the crest gates. To economize on water when passing logs, the gate is split into an upper 10-ft. high leaf and a lower 13-ft. leaf. The two sections are so interconnected mechanically that the upper leaf can be opened 10 ft. without disturbing the lower leaf.

The general arrangement of the fixed-roller type deep sluice gates has been shown by Fig. 8. The gates can be opened by either a 26-ton travelling hoist or the 60-ton travelling gantry. Links made up in suitable lengths, from steel angles, provide the connection between the gates and the hoist or gantry. After being opened, the gates can be dogged in the open position by a lever-operated bar engaging the links. The links are designed for a maximum tensile force of 57,000 lb.

In case of removal from the gate well, for inspection and painting, the gate is successively raised and dogged, superfluous links being removed, until the crane hook can be attached, by a shackle, directly to the gate.

The deep sluice gates are intended to be opened with a head of not over 50 ft. above the sills. They are designed to open under 65-ft. head over the sill. They will close under their weight against a 50-ft. head. The 26-ton hoist and the 60-ton gantry have ample capacity to open the deep sluice gates under any head up to 65 ft.

The gains of all deep sluice gates are provided with 4 — 10 kw. 550 volt-gate heaters.

High capacity in gate heaters has been provided because it is intended to apply heat for the minimum necessary period prior to opening a gate or gates, rather than continuously, to conserve fuel oil consumption when the Diesel plant is generating necessary gate-heating power.

Considerable attention has been given to minimizing heat losses from the deep sluice gates by providing housings over the gate wells, so designed that the gates can be opened by removing a small hatch cover in the housing roof. Moreover, heavy wooden frost-protection shutters are used to close the downstream ends of the sluice tubes, either fully as in the autumn prior to discharging storage water, or partially, to just above tailwater level. Covers are placed over the air-vent openings on the deck of the dam except when the gates are being opened or are open.

For ice removal on the deck of the dam or elsewhere, and for emergency heating of gates should such prove necessary, a 75 hp. wood-burning locomotive boiler has been installed at the east abutment. An insulated steam line is carried through the access tunnel to the deck of the gate section, where con-

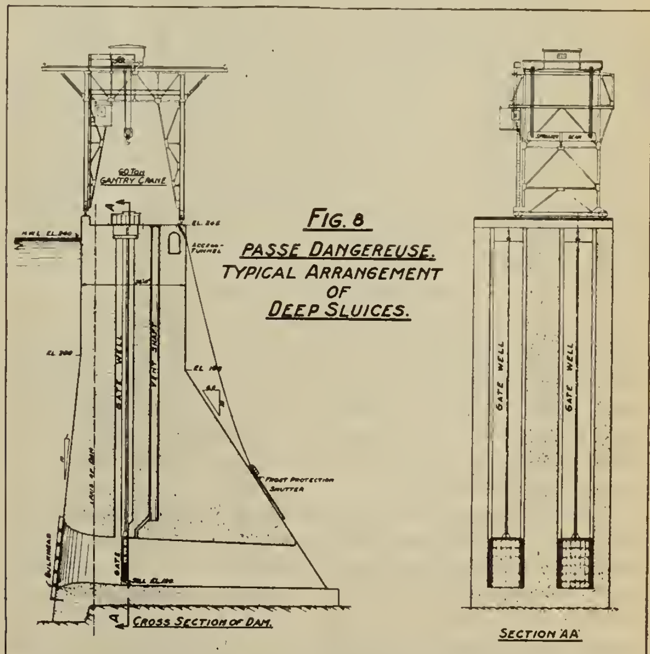


Fig. 8—Typical arrangement of deep sluices at Passe Dangereuse.

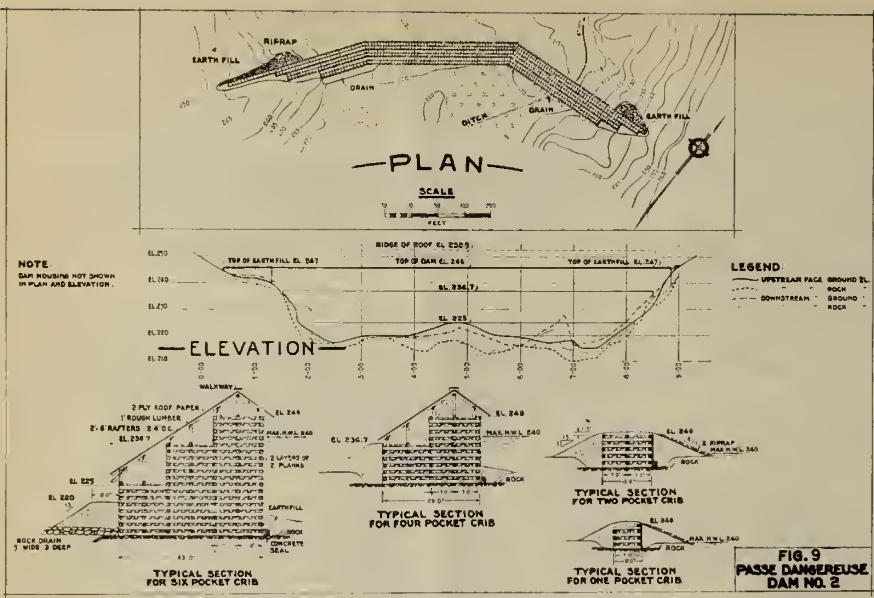


Fig. 9—Dam No. 2 at Passe Dangereuse.

nections inside the gate-well housings permit using steam hose.

The flashboards on the spillways are essentially permanent structures, as it is not anticipated they will ever be opened. Although built of timber, they have been thoroughly treated with a wood preservative. Provision is made for removal of the flashboards by blasting.

Figure 9 shows the rockfill timber-crib design adopted for Cutoff Dam No. 2. The dam is founded on solid rock. Maximum height is 36 ft. plus 6 ft. freeboard. The design is generally similar to that previously described for Manouan except that larger available timber permitted the use of larger crib pockets. Minimum thickness of crib timbers, between 4 in. bearing faces, is 7 in. All points of contact between timbers are treated with a wood preservative.

Cutoff Dam No. 3 is illustrated by Fig. 10. Built of a well-graded sandy-gravel material found close by, it contains 13,000 cu. yd. earthfill and 1,735 cu. yd. riprap. The fill material was spread in 6-in. layers by bulldozers and carefully compacted by not less than six passes of a D7 tractor. A freeboard of 13 ft. has been allowed on account of wave action due to the 7-mile reach and exposure to prevailing winds.

Cutoff Dam No. 4 is very similar in construction to No. 3. Due to the previous nature of the foundation, Wakefield piling has been driven to an impervious stratum.

Construction Schedule

On 13th August, 1941, work on the Passe Dangereuse storage development was initiated with the award of the contract for construction of the 57.5 mile access road. The over-all schedule called for completion of the entire project in time to impound the 1943 spring flood runoff — virtually by 31st March, 1943, less than 20 months later.

The regimen of the Peribonca at Passe Dangereuse fixed two of the important elements in the schedule: the first and second-stage cofferdams, and concrete work associated therewith. It was planned the road should be finished in time to get in material and temporary plant required for the first-stage cofferdam and approximately 11,000 cu. yd. concrete needed for the control and diversion sluices. River flow fixed the period during which this work could be safely done as 1st December to 30th April, throughout which a flow as high as 12,500 cu. ft. per sec. might occur.

Concurrently with the first-stage cofferdam work, camp and construction plant facilities were provided in readiness for the second-stage cofferdam, scheduled for completion after decrease of the 1942 spring flood to 15,000 cu. ft. per sec. or less.

The original schedule was based on construction of a dam providing 70 ft. storage. During the early part of the job this was changed to 100 ft. storage and still later to 110 ft., this latter being secured through the medium of 10-ft. flashboards on the open spillways.

The extremely urgent need for additional power during the winter of 1942-43 resulted in adopting a schedule looking to completion of the dam to El. 175 by 1st November, 1942, and impounding fall runoff to the maximum extent feasible, for release during the winter. This ambitious schedule was only partly achieved due to the serious general labour situation which developed during the late summer of 1942.

As soon as operating requirements of the Saguenay hydroelectric generating stations permitted, the lower tier of deep sluice gates were closed, actually on 4th May, 1943. The reservoir was filled to El. 239.69 by 19th September.

At this point it is worth noting that the Manouan and Passe Dangereuse storages prevented, in 1943, a repetition of the 1928 flood conditions on Lake St. John, when the lake reached El. 263.70, 6.2 ft. over normal. In 1943, maximum Lake St. John stage was at El. 258.37, although total runoff from the Lake St. John watershed was about the same as in 1928. In 1928, the year of maximum recorded spring runoff, the inflow to Lake St. John reached 404,700 cu. ft. per sec. In 1943, the inflow was limited to 306,200 cu. ft. per sec.

Means of Access

Investigation disclosed that access to Passe Dangereuse required the construction of a 57.5 mile road from the northerly end of an existing logging road, 9 miles east of Lake Alex. Existing public and logging roads connected with railhead at either Dolbeau or Isle Maligne, the over-all route being 135 miles long.

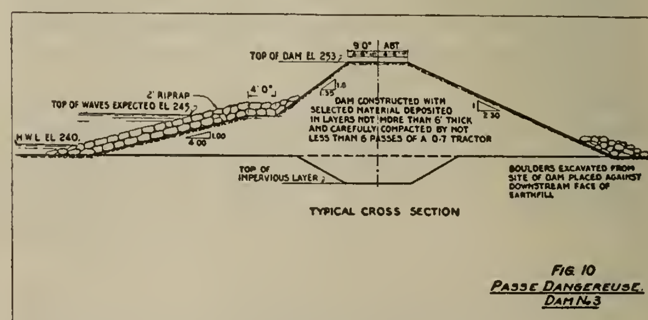


Fig. 10—Typical cross section of Dam No. 3 at Passe Dangereuse.

The access road passes mostly over glacial drift, with some 20 per cent over muskeg areas. Of nine major bridges required, the Peribonca river necessitated one over 480 ft. long.

The choice of Dolbeau as railhead, due to superior roads and more economical operating conditions, entailed strengthening 4 bridges; even with this, loads were necessarily limited to 15 tons, heavier loads being moved out of Isle Maligne.

The type of road constructed was similar to main logging roads on well-operated pulpwood limits but somewhat wider.

The bridges, built from local timber which was peeled to ensure maximum life, except below the low-water level, were designed as king-post trusses for 25-ft. spans and as queen-post trusses for 35-ft. spans, carried on rock-filled timber cribs. These cribs, with bottom scribed to fit the actual foundation, were built on shore, launched and floated to site, aligned and sunk in place. In the case of the 480-ft bridge over the Peribonca, Fig. 11, the cribs for the piers were sunk in swift water down to 14 ft. deep.

The bridges were designed for a 43,000 lb. tractor drawing 2—18-ton sleighs, with 6 ft. between tractor and/or sleighs. A net clearance of 12 ft. in width was provided at all bridges.

Construction of the access road started on 19th August. In spite of an extremely wet autumn, which seriously hindered progress, the first tractor reached Passe Dangereuse overland on 3rd December, and 19 days later regular truck transportation began. Some gravelling remained to be done the following spring.

Since all supplies and equipment could be transported by truck or tractor, the major attack on the road was made at the southerly end. As the Passe Dangereuse bridges constituted a very important factor in transportation, and formed a very sizeable job in themselves, a separate force was set up for their construction, beginning work on 5th October. In addition, advance crews were engaged on major bridges to avoid delays in effecting river crossings.

The forces engaged on the Serpent and Passe Dangereuse bridges were serviced by air transportation until freeze-up

During the construction of the access road 24 tractors, mostly equipped as bulldozers, 4 — ¾ cu. yd. or smaller shovels and 3 air compressors were in use, together with a sizeable fleet of trucks. The average force amounted to some 305 men, with a peak of 497.

Communication Facilities

Communication between Passe Dangereuse and Dolbeau was afforded by radio-telephone stations. The radio-telephone equipment at Passe Dangereuse was installed to serve both construction and operation needs, the transmitter having a capacity of 350 watts on telephony and 800 watts on telegraphy.

Majority of traffic between the two stations was concerned with transportation operations, freight and express receipts, construction operations, etc.

Operation on telephony was possible 68.0 per cent of the time at Passe Dangereuse and 75.0 per cent of the time at Dolbeau.

Transportation

The epic story of the freighting operations associated with Passe Dangereuse can only be told in very sketchy fashion due to space limitations

Construction of the Peribonca bridges and preparatory work at Passe Dangereuse, including clearing of the site and lumbering operations, which began 24th September, 1941, as well as the Serpent bridge, was serviced by ærial freighting. From Manouan, supplies and equipment were moved to Lake Peribonca and Passe Dangereuse to the extent of some 37 and 13 tons respectively From Beauchesne, freight moved totalled some 123 tons to Lake Peribonca; 187 tons to Passe Dangereuse; 16 tons to the Serpent River crossing; 32 tons to Lake Etiennish.

Fig. 11—Peribonca River bridges. Bridge in foreground has over-all length of 480 ft. between abutments, with clear span between piers 35 ft.

The freight flown into Lake Peribonca was moved to Passe Dangereuse by 22-ft. freight canoes with 22 hp. outboard motors. For ordinary package freight and small equipment, single canoes were used but for tractor transmissions and other heavy parts an assembly of 3 such canoes stoutly lashed together with poles and powered by a 22 hp. outboard motor served. A single piece weighing in excess of 3,800 lb. was transported on such an arrangement, which satisfactorily carried a total load of 3.9 tons. Cost of this freighting was $0.686 per ton mile.

Freight moved in the above manner included two 1½-ton and two 2-ton trucks from Manouan, as well as four D4 tractors from Manouan and Beauchesne. Two horses sent out overland from Manouan were moved 14 miles down the Peribonca on the assembly of 3 canoes.

Regular freighting over the access road was initiated on 22nd December, 1941, on a contract under which the contractor undertook to transport all equipment, supplies and personnel required for the construction of the storage dam, reservoir clearing and lumbering operations from railway cars at Dolbeau or Isle Maligne. The transportation contractor assumed responsibility for the safe delivery of all equipment, goods and passengers at either terminus, according to a predetermined schedule, except for conditions beyond his control. The contractor also assumed the responsibility of effecting all repairs necessary on the logging road extending to the southern end of the newly-constructed access road, negotiations with the appropriate authorities in respect of the public road and bridges between Dolbeau or Isle Maligne and undertook all winter maintenance necessary for truck operation over the entire 135 mile route as well as summer maintenance on the existing logging road and the new access road, this latter under a separate agreement. In addition to transportation, the contractor assumed the feeding and housing of personnel enroute to the job.

Handling equipment, scales and storage facilities were provided at Dolbeau, which became the headquarters for the transportation operation. The radio-

Fig. 12—140 ft., 15-ton Mistassibi river pontoon bridge.

telephone station linking with Passe Dangereuse was located conveniently adjacent to the yards. Housing, dining, gasoline and repair facilities were provided at points 33, 50, 57, 69, 95 and 118 miles from Dolbeau, the first 4 at existing depots.

For maintenance work the contractor provided:

- 1 — 135 hp., 8 ton, 4 wheel drive truck, with snowplow.
- 1 — 120 hp., 5 ton, 4 wheel drive truck with snowplow and between-wheels road leveller
- 1 — 3-ton truck with snowplow.
- 5 — Diesel tractors with snowplows, and various items of miscellaneous equipment.

During the first winter, traffic was controlled on a time-table basis by a dispatcher located at Lake Alex, the halfway point. Here truck convoys were made up for the trip north. Another dispatcher at the northern terminus had charge of assembling southbound convoys. Clerks at the intermediate depots also acted as dispatchers to clear the convoys when passing. This system required the maintenance of only a one-lane winter road. Although it functioned smoothly, it entailed loss of time and rather tedious travelling for personnel. It possessed a definite advantage in immediate help being available in case of a truck getting into difficulty.

During the second winter, the road was maintained for two lanes of traffic over the southerly 37 miles and the northerly 40 miles with a one-lane road over the intervening 58 miles. Traffic was dispatched so as to avoid conflict between northbound and southbound in the one-lane section, with northbound traffic having right-of-way.

In spite of one of the severest winters on record, with a snowfall of 176 in. at the Passe, the maximum interruption in winter traffic was 3 days.

Summer transportation functioned very smoothly and needs no particular description.

Maximum difficulties experienced with the freighting operation occurred during the spring breakup period when movement of traffic occasioned maximum damage to roads unless thoroughly curtailed. As far as possible no heavy freight was hauled during the breakup periods. Only the lightest essential or emergency transportation was attempted.

Despite the large number of vehicles on the 135-mile road, and the relative difficulty of driving on a narrow winding road through rugged country, in all sorts of weather, day and night, no accidents requiring medical attention were experienced. There were numerous mechanical mishaps but none of these were worse than anticipated.

The most serious incident was the destruction by fire of the municipally-owned 160-ft. span typical Quebec covered wooden bridge over the Mistassibi river on 26th July, 1942, which was only replaced by 2nd April, 1943. Meantime, a ferry service was placed in operation about 2 miles up the river. While it functioned reasonably well, save for several operating mishaps, it added some 4 miles to the route.

As the ferry service would not be operable in late autumn and winter, a pontoon bridge was built, having an over-all length of 140 ft. and a capacity of 15 tons. See Fig. 12. Its construction involved some 10,000 man-hours' labour and cost $20,945. This bridge proved entirely satisfactory. It was removed in April, 1943, after the steel bridge replacing the one destroyed by fire had been put in service.

The unusually early spring breakup, in 1942, rendered the movement of heavy loads impossible between 28th March and 4th June. Such irregular light freighting and transportation of personnel as proved imperative resulted in considerable damage to the softer sections of the road completed the previous autumn, and delayed resumption of regular freighting somewhat.

The extremely serious railroad situation in January and February, 1943, arising from the rigorous weather conditions beginning in December necessitated keeping very close watch on shipments in order to complete the winter hauling schedule, and the dam itself, on time.

The magnitude of the transportation operation is shown by Table III. The heaviest piece of equipment moved into Passe Dangereuse weighed 37.5 tons.

Those interested in comparing the tonnage freighted into similar outlying jobs with Passe Dangereuse can readily do so through the medium of Table IV.

Timber and Lumber

The provision of timber and lumber for the Passe Dangereuse construction work was in itself a sizeable undertaking. The Peribonca bridges, camps, construction facilities, cofferdams and form work, as well as Cutoff Dam No. 2, involved about 470,000 cu. ft. of logs of various sizes and lengths up to 12 by 12 in. by 29 ft. long. Lumber requirements aggregated almost 5,000,000 F.B.M.

The logging operations started on 24th September, 1941, and were completed 30th October, 1942.

Construction Camp

The west bank of the Peribonca at Passe Dangereuse is too steep to be economically developed for camp and plant facilities. The east bank is not particularly adaptable, the usable area being quite narrow and rugged. The effect of the above restrictive influences is seen in the construction layout shown by Fig. 13.

For housing the workmen, 64 log camps similar to those used at Manouan were provided, each accommodating 24 men. Sanitary facilities for the workmen were concentrated in 5 sanitary service camps, which proved most satisfactory and economical.

Staff personnel were housed in 4 log-construction staff camps, each housing 32 men, 2 to a room. These camps were equipped with washing facilities, 2 water closets and 2 showers. For married staff, 8 small log houses were built. Two of 3 log houses intended for use by the operating staff housed the resident engineer and the contractor's superintendent and chief engineer. The third house provided accommodation for visiting supervisory and consulting personnel.

Two log kitchen-dining camps accommodated 1,148 men and 112 staff personnel at a sitting. One of these camps housed a bakery turning out all bread required.

A well-insulated root house was built to eliminate as far as possible the necessity for freighting in perishable vegetables during severe winter weather. It also permitted advantageous buying. A refrigerated meat storage with about 14,000 cu. ft. capacity housed several carload shipments of meat at once, eliminating any possibility of shortage during the breakup periods.

A hospital of log construction contained a waiting room, dispensary for minor accident and illness cases, doctor's office, X-ray and operating room, 2 single bedrooms, a double bedroom, a 6-bed ward, small kitchen, sanitary and storage facilities. Two doctors were on duty. All but the most serious cases were readily handled.

An employees' store, official post office, laundry, barber shop and shoemaker met all the usual requirements of a large construction force. Religious services were held from time to time outdoors or in one of the dining rooms, as governed by the weather. Motion pictures were shown regularly twice a week, or oftener, depending on circumstances. During favourable weather the showing was outdoors, otherwise in a dining room. No charge was assessed. In addition, softball, croquet and hockey were encouraged. Facilities were made available, at no cost, for trout fishing about 5 miles from the job. Bridge and cribbage parties, amateur shows, etc., were all encouraged.

A chlorinated water supply with intake above No. 1 damsite was furnished to the hospital, kitchens, staff camps, permanent and family houses, sanitary service camps and all essential points. Wire-bound wood-stave pipe was used for mains almost entirely. It was boxed in and heavily insulated with sawdust for protection against freezing.

Necessary sewerage was installed, using low-pressure wood-stave pipe, discharging into the Peribonca below the site of No. 1 dam.

Electric lighting was installed throughout the camp area. A simple fire alarm system and suitably located hydrants, hose reels and other fire-protection equipment afforded the necessary security against fire hazards.

TABLE III
PASSE DANGEREUSE TRANSPORTATION

MONTH	FREIGHTING						TRANSPORTATION OF PERSONNEL					
	OOLBEAU		ISLE MALIGNE		NO OF TRUCKS		NO OF TAXIS		NO OF BUSSES		NO OF MEN	
	NORTH TONS	SOUTH TONS	NORTH TONS	SOUTH TONS	NORTH	SOUTH	NORTH	SOUTH	NORTH	SOUTH	NORTH	SOUTH
1941												
December	574.08		20 00		105	4	25		4	4	181	114
1942												
January	4,494 70	51 60	40 00		781	29	57	50	24	2	691	219
February	6,089 81	7.28	50.00		1,079	16	48	65	7	1	359	292
March	5,318 95	15.57	15.20		1,034	19	89	127	29	19	985	683
April	411.58	4 72			129	8	28	65	25	11	572	280
May	92.51	93			23	3	12	6		8	68	194
June	1,698 91	50 55			437	25	229	154	3	6	1,320	666
July	1,076 80	44 20	147 35		276	58	121	161	10	7	874	841
August	2,365 95	50 05			491	46	75	109	28	32	949	1,014
September	3,277 82	87 34			645	64	32	68	23	19	706	866
October	4,429 00	114 78			825	62	55	69	18	15	555	539
November	4,697 74	63 27			905	56	46	53	20	9	657	462
December	5,415 46	62 31			1,061	33	64	65	11	22	368	772
1943												
January	5,754 83	76 83			1,120	47	49	39	25	10	736	342
February	5,263 81	151.46			993	70	20	46	14	14	361	398
March	2,966 78	129 78			557	56	25	67	20	25	515	684
April	61 85	246 28			29	73	16	35	7	28	163	856
May	67 47	12 45			19	5	2	6	1	12	51	201
June	344 26	426 36		20.50	88	86	16	48	5	2	147	275
July	142.12	831.95		184 68	51	37	17	55	1	9	107	280
August	22.13	158 57		93.25	23	31	1	35			22	168
September	34 76	178 98			24	59	1	1	16	1	15	78
October	135.61	123 00			62	25	7	17	1		66	36
November	22.99	82 89			17	16	2	16			10	69
Totals	54,977.90	2,950.75	270.55	298 43	10,774	928	1,055	1,349	292	256	10,436	10,029

TABLE IV
FREIGHTING REQUIREMENTS FOR LARGE CONCRETE DAMS

NAME OF DAM	CONCRETE IN CUBIC YDS	TOTAL TONNAGE HAULED	TONS PER CU. YD. OF CONCRETE
Gouin	72,760	25,582	0.352
Mattawan	52,005	19,896	0.383
Island Falls*	83,500	37,000	0.443
Bitobee	64,000	34,170	0.534
Rapid 7 Upper Ottawa*	79,806	41,887	0.525
Passe Dangereuse	152,053	58,497	0.385

*DAM AND HYDRO-ELECTRIC POWER PLANT

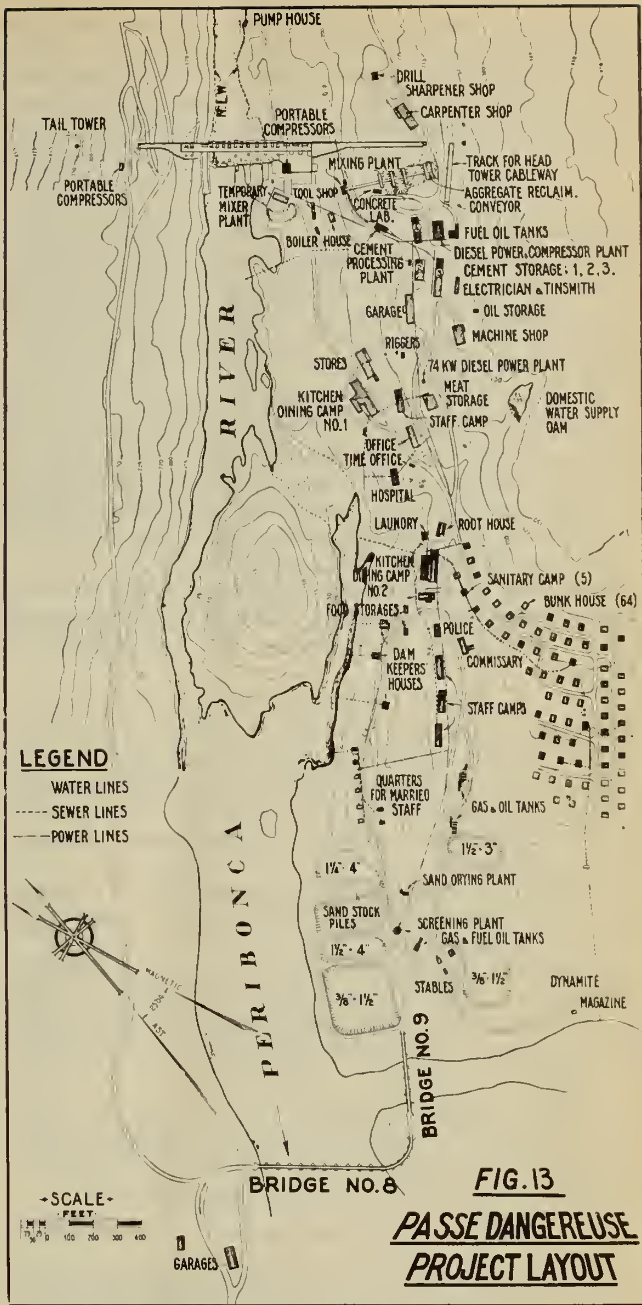


Fig. 13—Layout of Passe Dangereuse project.

It will interest many to know that camp and plant heating required 29,700 cords of firewood, in addition to approximately 5,740 tons of coal used for boilers.

Construction Plant

Layout of the construction plant was influenced by two major factors; namely, the use of a tautline cableway for concrete placement, etc., and the long but narrow area on the east bank available for construction facilities.

All concrete aggregates were obtained from 4 deposits. Stone was obtained by screening the pit run material. For this purpose, No. 1 screening plant was set up near the Peribonca bridges, with 2—4 by 10 ft. doubledeck vibrating screens. It served 3 deposits within a range of 5.5 miles. No. 2 screening plant, very similar to No. 1, was constructed at a deposit located 13 miles below the dam, on the access road.

Aggregate processing, hauling and stockpiling operations required a fleet of 35 to 45 trucks with an operating mileage in excess of 730,000 and gasoline consumption about 147,000 gallons.

The construction power plant equipment consisted of 2—400 Bhp., 514 rpm Diesel engines with direct-connected 375 kva, 300 kw., 2300 volt, 60 cycle generators operated in parallel through a bank of 3—100 kva, 550/2200 volt transformers with 1—250 Bhp., 514 rpm Diesel engine and direct-connected 170 kva, 136 kw., 550 volt generator. All 3 sets were provided with direct-connected exciters and voltage regulators.

During the job the total energy produced by the Diesel power plant was 3,302,100 kwh. with direct operating cost, exclusive of transportation and overhead, $0.021 per kwh.

Besides the usual construction motors, the most important loads were 2—152 hp., 2200 volt air-compressor motors and the 300 hp., 440 volt cableway engine drive motor. The total connected motor load was 1309 hp. Beyond a moderately stiff voltage droop, no difficulty was experienced by operation of the 300 hp. cableway engine drive motor.

To avoid flicker on the lighting system, this was normally supplied by a 30 kw. and a 74 kw. portable Diesel-electric set. Total connected lighting load was 115 kva.

The compressor plant comprised 2 motor-driven stationary air compressors with a capacity of 1754 cu. ft. per min. In addition, 8 portable and semi-portable gasoline and oil-engine-driven air compressors with a total capacity of 2265 cu. ft. per min. and suitable receiver equipment were advantageously disposed about the job.

The drill-sharpening shop contained 3 oil furnaces and 2 sharpeners, capable of handling about 4,000 pieces of steel per day.

A well-equipped machine shop capable of undertaking essentially all job repair work was necessarily provided, due to the isolated location of the job and the importance of avoiding loss of production due to outages.

A fully-equipped carpenter shop suitable for handling complicated formwork such as needed for the deep sluices, etc., was located adjacent to the lumber storage, just upstream from the east abutment.

Cableway

Two possible construction layouts received detailed study. The first provided for a construction trestle and derricks, whereas the second utilized a tautline cableway. Careful cost analyses indicated that the plant investment and operating costs would be about the same with either scheme, the evaluation of operating advantages and disadvantages governing the final choice. Such a comparison is given by Table V.

The cableway adopted consisted of a 6-wheeled carriage, reeved to a heavy fall block with 25-ton swivel hook by a 7 part line and travelling on a 2¾ in. diameter locked-coil steel track cable suspended between a movable head tower on the east bank and a short fixed tail tower on the west bank. Span, centre to centre of pins, was 1603 ft. The tail tower pin was 5 ft. lower than the head tower pin. The carriage and fall block were operated from a double-drum cableway engine with direct-connected 300 hp. wound-rotor induction motor located in the head tower.

The cableway was designed for a live load of 16.5 tons with 20 per cent allowance for impact. Carriage speed was 1200 ft. per min. and maximum hoisting speed about 170 ft. per min.

The head tower, containing some 116 tons of structural steel, was 104 ft. 3½ in. high from the track to the track cable pin. It was designed for the following loading:

(1) Total pull due to track and other cables of 365,000 lb., acting 7° 53′ down from the horizontal or coincidental with the tangent of the track cable curve at the pin.
(2) Torsion loading due to broken light or signal line, of 8,000 lb. at 25 ft. from axis of tower.
(3) Wind load at 30 lb. per sq. ft. on any face of tower and against cables. Load assumed off carrier.
(4) Wind load of 10 lb. per sq. ft. on any face of the tower and against the cables, when there is maximum load on the cables.
(5) Dead load of tower and base at 190,000 lb. and engine at 30,000 lb.
(6) Counterweight of 685,000 lb.

The design was based on loads 1, 2, 4, 5 and 6 considered acting simultaneously; also loads 2, 3, 5 and 6 acting at the same time.

The head tower was carried on a heavy structural

TABLE V
COMPARISON OF TRESTLE AND DERRICKS VS CABLEWAY

	TRESTLE AND DERRICKS	CABLEWAY
ADVANTAGES	USES 2 YD CONCRETE BUCKETS; MORE EASILY MANOEUVRED. DERRICKS AVAILABLE FOR MOVING FORMS BREAKDOWNS NOT SERIOUS. BETTER UNDERSTOOD BY CANADIAN CONSTRUCTION MEN.	SPANS ENTIRE JOB. FACILITATES MOVEMENT OF FORMS AND EQUIPMENT AS WELL AS CONCRETE. MINIMUM PERSONNEL NEEDED. SIMPLER FORMWORK POSSIBLE. MINIMUM LOSS OF WORKING TIME FOLLOWING FLOODS. LESS CHILLING OF CONCRETE WITH LARGER BUCKETS, DURING EXTREME WEATHER.
DISADVANTAGES	REQUIRES 200 TONS MORE STRUCTURAL STEEL. NECESSITATES BRIDGING WESTERLY PORTION OF CHANNEL TO WORK ECONOMICALLY ON WEST BANK UNLESS CONCRETE IN SECOND STAGE COFFERDAM COMPLETED FIRST WINTER. NECESSITATES CUTTING FORMS FOR TRESTLE POSTS AND BRACING. NECESSITATES USE CONSIDERABLE CARE IN MOVING BUCKETS AROUND TRESTLE BENTS UNABLE SECURE AS GOOD CONCRETE FINISH ON DOWNSTREAM SIDE LIMITS BUCKETS TO 2 C.Y. CAPACITY; LIKELY TO RESULT IN SPOILED BATCHES DURING HANDLING IN SEVERE WEATHER.	SERIOUS DELAYS ARE POSSIBLE AS RESULT OF BREAKAGES. POSSIBLE DIFFICULTIES DURING SEVERE WINTER WEATHER.

steel base supported on two trucks. The front or inner truck was carried through special journal boxes on 16 standard 50-ton railway freight-car-type axles and wheels; the rear truck was carried on 15 such axles and wheels. The counterweight was provided by a heavy wooden box filled with sand. In addition to the main counterweight, about 15 tons was loaded on the front truck as a precaution against heavy adverse winds with cables removed.

The head tower track consisted of 2 tracks at 51 ft. 2 in. centres, using 100 lb. rails carried on heavy ties and thoroughly tied together by special tie rods. Continuous type splice bars were utilized. Length of track was 340 ft. It was constructed on half cut in solid rock and half on fill, the latter retained by heavy cribwork well tied back to solid rock by sets of 3—1¼ in. rods spaced 6 ft. on centres horizontally.

The topography on the west bank permitted the use of a short steel structure weighing 3.2 tons. It was founded on a heavy concrete base thoroughly tied into the rock.

The cableway was operated by a 2 drum engine direct connected to a 300 hp., 440 volt, 585 rpm wound rotor induction motor with magnetic control. The engine assembly was mounted on a heavy structural frame secured to the tower base through wood cushioning members. The load-line drum was 51½ in. dia. by 42 in. wide, and grooved for a ¾ in. cable.

The endless drum was spool type, 53 in. by 11 in. wide. Both were provided with 8 in. friction bands.

The head tower was traversed by a 90 hp. motor driving a traversing engine with spool drum carrying 5 wraps of an endless 7/8 in. cable with 5-part reeving to either end of the tower base. A solenoid brake attached to the motor shaft automatically prevented movement of the tower when power was off.

Controllers for the motors and control levers for the friction clutches and brake bands were mounted in a control cabin located over the cableway engine so that the operator could keep the job in full view at all times, with limited exceptions, as well as see the cableway engine.

The locked coil 2¾ in. dia. track cable, weighing 18.3 lb. per ft. and with an ultimate strength of 420 tons, was given a fully-loaded sag equal to 5.5 per cent of the span. Both ends of this cable were socketed into ball-bearing swivel heads. At the tail tower, the track cable was secured to a 9 part 1⅛ in. takeup cable assembly attached to the tower.

About every 7 days the track cable was dressed, using recommended cable dressing applicable in summer or winter, as the case might be. About every 3 weeks the cable was given ⅛ turn to ensure uniform wear.

Originally purchased in 1935, the track cable had been used for the placement of 143,000 cu. yd. concrete, with ordinary loading of 17.5 tons and maximum loading of 25 tons, before being set up at Passe Dangereuse. At the Passe, some 140,000 cu. yd. concrete was placed with closely similar loading. Remarkably little wear was occasioned by the two jobs.

Between the tail tower and the upstream arm of the head tower a 7/8 in. steel messenger cable carried 3 No. 2/0 rubber-insulated conductors on insulated holders with 500-watt lamps supported at 75-ft. intervals. This arrangement provided general illumination at night, sufficient to facilitate movement around the job.

A 24-volt bell signal system for communication between the signalmen at points of pickup and deposition and the cableway operator was provided through heavy drop cords at 100-ft. intervals, connected to a duplex conductor supported from a steel messenger strung between head and tail towers. Operating experience indicated a low-level signal system was also needed, for movement of forms and equipment, etc.

At this point, the Passe Dangereuse cableway may be compared with other cableway installations made during the period 1930-40, as shown by Table VI. The information is taken from a discussion by Mr. A. J. Ackerman of the paper by Messrs. R. T. Colburn and L. A. Schmidt, Jr. on "Norris Dam Construction Cableways" which appeared in the December, 1939, A.S.C.E. Proceedings.

The Passe Dangereuse cableway met all expectations. Outage time was negligible aside from the regular cable dressing and inspection, etc. The few difficulties encountered were not serious.

The cableway was placed in operation 7th August, 1942, and operated until 26th June, 1943, except for 7 days at the time of the second-stage cofferdam blast when the cables were removed to avoid damage by flying debris. Concrete placed in this period was 140,423 cu. yd. estimated at 360,000 tons with the 3¼ ton bucket. Reinforcing steel, forms, gates and other equipment were also handled with tonnage probably well in excess of 3,000 tons. Power consumption amounted to 0.665 kwh. per cu. yd. of concrete. Ratio of idle hours, for whatever reason, to hours worked was 22.8 per cent. Concrete placed per hour worked was 45.7 cu. yd., for a direct operating cost of $0.53 per cu. yd.

Cofferdams

The general scheme of river control and diversion at Passe Dangereuse is evident from Fig. 5. The dam is founded on what is essentially a wide, solid rock, broad-crested weir with deep pools upstream and downstream, where the river narrows. The westerly portion of the channel is appreciably deeper.

Location of the first-stage cofferdam on the easterly side of the river, during the period of minimum flow, permitted crowding the river into the deeper part of the channel and unwatering the greater portion of the site in the river bed proper, with maximum accessibility from the job fully maintained.

Five piers constructed inside the first-stage cofferdam formed temporary sluices by which the river discharge could be readily controlled through the use of stoplogs.

TABLE VI

HEAVY-DUTY CABLEWAY INSTALLATIONS

Dam Projects	Number of Cableways	Capacity, in Tons	Span in Ft.	Track Cable Diameter, in In.	Hoist Power, HP	Head Tower Height, in Ft.	Head Tower Type*	Tail Tower Height in Ft.	Tail Tower Type*
Owyhee	1	25	1,306	3	400	65	T	45	F
Madden	1	25	1,325	3	400	100	T	100	T
Hoover	2	25	2,575	3	500	90	T	90	T
	2	25	1,405	3	500	75	T	42	T
	1	25	1,365	3	500	98	F	16	T
Morris (Pine Canyon)	2	15	960	2¼	300	100	F	35	T
Norris	2	18	1,925	3	500	75	T	110	T
Bonneville Lock And Power House	2	15	1,390	3	400	145	F	75	T
Bonnville Spillway	2	20	2,020	3	500	90	T	223	F
Parker	2	25	1,500	3	500	75	T	42	F
Conchas	2	15	1,650	2½	250	145	T	175	F
Hiwassee	1	18	1,575	3	500	75	T	110	T
Marshall Ford	1	25	2,100	3	500	75	T	177	F
Shasta	6	25	800 to 2,600	3	500	460	F	75 to 125	T
Passe Dangereuse	1	20	1,603	2¾	300	104	T	11'9"	F

* T = Traveling and F = Fixed

River conditions during the period of cofferdam construction and during the filling of the reservoir are portrayed by Fig. 14.

The first-stage cofferdam was started 27th November, 1941, unwatered 27th January, 1942, and removed by blasting on 28th April. It was constructed in the usual manner using 8 by 8 ft. pockets, and spruce logs slabbed to give a 4 in. bearing face, with a thickness of 7 to 8 in. between bearing faces. Sections were built upside down on previously placed portions of the cofferdam. These sections with bottom built up to fit the river bed were tipped over end into the water, aligned, filled with rock and sunk. The first-stage cofferdam had Wakefield sheeting in the form of 3 layers of 1 by 8 in. spruce, with a cement-sand mixture in sacks forming a seal between the river bed and the lower ends of the sheeting. Well graded gravel was used for toefill.

Figure 15 is a view of the first-stage cofferdam with the temporary sluice piers about completed.

The first-stage cofferdam was designed for a flow of 12,500 cu. ft. per sec. without overtopping. It contained a total of 6,500 cu. yd. cribwork. The upstream and downstream legs were very successfully removed by blasting, the average charge being 3.25 lb. per cu. yd. of cribwork.

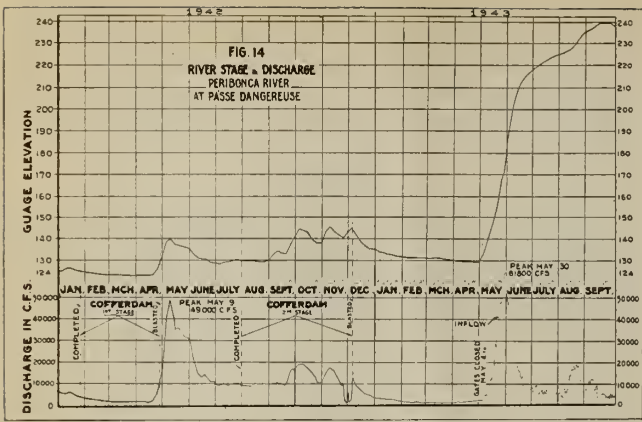


Fig. 14—Diagram showing river discharge at Passe Dangereuse for various stages of construction.

The second-stage cofferdam was started 5th June, 1942, unwatered 1st August and removed by blasting 6th December. The upstream cribs, each carefully designed and built to fit the bottom, were constructed above the site and floated into place under control of heavy lines manoeuvred by 15-ton winches. Cribs for the downstream leg were launched from the mid-river leg of the first-stage cofferdam which had been left in place. Loading and sheeting were carried out in a manner similar to the first-stage cofferdam. Both sheeting and sealing were much more difficult due to the depth and velocity of approach to the temporary sluices, even with the westerly one closed. It was necessary to use breakwaters to facilitate the work of the divers. See Fig. 16.

Considerable initial difficulty was experienced due to damage done to those portions of the first-stage cofferdam intended to remain in place and become part of the second-stage cofferdam, by the blasting operations in connection with removal of the first-stage cofferdam. This damage was naturally increased by the heavy flood flow.

The second-stage cofferdam was designed for a flow of 30,000 cu. ft. per sec. At the maximum section the cofferdam was 43 ft. in height, with a width of 41 ft.; over a narrow width the height was actually 48 ft. It contained some 7,350 cu. yd. cribwork. For removal by blasting, very careful disposition of the dynamite was made, to secure thorough breakage and dispersion of the cofferdam cribwork and fill without damaging the deep sluice inlets which were as close as 20 ft. at the nearest point. An average charge of 3.01 lb. per cu. yd. of cribwork was used, of which 2.70 lb. was placed near the bottom.

Fig. 15—First-stage cofferdam at Passe Dangereuse.

The blasting operation was quite successful in dispersing the debris from the upstream leg but did not remove it to as low a level as desired. This material was cleared away so it would not interfere with free flow to the sluices by using a heavy 5-fingered rake as a drag and moving the material into the deep pool upstream.

Leakage into the cofferdams ranged between 6.3 and 21.8 cu. ft. per sec. for the first-stage, and between 13.3 and 32.0 cu. ft. per sec. for the second.

One incident in connection with the second-stage cofferdam should be noted. When all work inside the cofferdam was virtually completed, and part of the explosive charges had been placed, fire broke out in the pumphouse on the upstream leg of the cofferdam due to carelessness in refilling the gasoline tank on an engine-driven pump. It proved necessary to flood the cofferdam, delaying the removal blasting by 9 days. Aside from the loss of time, little physical damage was suffered.

Excavation

In the foundation area for Dam No. 1, excavation consisted primarily of reaching sound rock, with a minimum removal, and minimum possible disturbance.

Fig. 16—Second-stage cofferdam cribs in place, looking downstream.

Excavation of unsound rock in the foundation area amounted to 38,760 cu. yd.

Some 26,860 cu. yd. of rock was removed in the spillway approach and discharge channels.

Concrete

Forty aggregate deposits within a radius of 3 miles from Dam No. 1 and in an area 4 miles wide stretching 15 miles along the access road were explored. Aggregate samples from the 4 most promising deposits were thoroughly examined in the laboratory. Coarse aggregate, all coarse sand and the greater part of fine sand requirements were obtained from No. 2 deposit, 2 miles from the dam.

A petrographic examination of a large number of samples from the four deposits indicated that the composition and characteristics of the material from all four deposits were generally similar, consisting almost entirely of decomposition products of igneous origin. This examination showed no rock-forming mineral, in any sample, that would contribute to the unsoundness of concrete made from them. Average composition was approximately as follows:

Feldspar	60 to 75%
Quartz	15 to 20%
Pyroxene and hornblende	5 to 12%
Biotite	3 to 8%
Other constituents	2 to 5%

TABLE VII
PASSE DANGEREUSE CONCRETE MIXES.

AGGREGATES	WEIGHT IN LBS. TO PRODUCE ONE CU. YD	
	STANDARD MIX	INTERMEDIATE MIX
CEMENT	440	477
FINE SAND	190	150
COARSE SAND	920	1100
INTERMEDIATE GRAVEL	1355	2165
COARSE GRAVEL	1085	—
WATER (TOTAL)	220	246
WEIGHT PER CUBIC YARD	4210	4138
SLUMP	1½"	1½"
W/C RATIO, BY WEIGHT	.50	.515
SAND FRACTION (-4 MESH) AS PERCENT OF TOTAL AGGREGATE	29.0	33.0
PERCENT ABSORPTION, 5 HRS. BOILING	3.65%	3.82%
AVERAGE COMPRESSIVE STRENGTH: 3 DAYS	2184	1900
7 DAYS	3153	3115
28 DAYS	4150	4030
90 DAYS	5130	5005
ABSOLUTE VOLUME OF CONSTITUENTS PER CU. YD		
CEMENT, SP. GRAVITY 3.12	2.26	2.45
FINE SAND " 2.68	1.13	.90
COASE SAND " 2.645	5.56	6.66
INTERM. GRAVEL " 2.665	8.13	13.00
COARSE GRAVEL " 2.665	6.51	—
WATER, " 1.00	3.25	3.68
TOTAL ABSOLUTE VOLUME PER CUBIC YARD OF CONCRETE	26.84 CU. FT	26.69 CU. FT.

Freezing tests, carried out by A.S.T.M. Method C88-41T, on representative samples of the material from the four deposits, showed it possessed satisfactory resistance to damage. The weighted average loss of all samples, for ten cycles of the test, was 2.57 per cent for material coarser than the four-mesh screen and 1.60 per cent for the sand fraction.

The coarse gravel fraction of all four deposits was quite well graded up to about 4 in. in size, with occasional cobbles larger than this. As the percentage of cobbles was too small to warrant installation of a crushing unit, material which passed over a 4 in. grizzly was discarded. The gravel for coarse aggregate was screened into two sizes, ⅜-1½ in. and 1½-4 in. The pea gravel between 4 mesh and ⅜ in. went into the coarse sand fraction, as it could be handled there with less danger of segregation.

The coarse sand from the gravel screening operation was deficient in fines to produce optimum grading. This was corrected by blending in a proportion of fine sand, and since the grading of the sand fraction of Deposit 2 varied widely, the fine sand was handled to the mixers as a separate material and proportioned there by weight. This was found to be a very satisfactory method of handling the problem, affording at the same time adequate control and great flexibility.

Investigations of aggregate materials carried out prior to the actual start of concrete operations indicated that a dense impermeable concrete, with a unit weight of 156 lb. per cu. ft. or better and low porosity, and a strength in excess of 4,000 lb. per sq. in. under normal curing conditions at 28 days could be obtained with a water cement ratio of .50 and 440 lb. of cement per cu. yd. The mass of the concrete placed was of this class though for a small proportion of the total, placed in restricted locations in sluiceways and heavily reinforced parts of the dam, the larger coarse aggregate size was eliminated, the sand content slightly increased, and the cement content increased to 477 lb. per cu. yd. Average proportions and characteristics of both mixes are as shown in Table VII.

Average gradings of the aggregate fractions and of the combined aggregate for the standard mix during the month of February, 1943, were as given by Table VIII.

Preliminary tests of the aggregate materials, by the accelerated sodium sulphate freezing method, had indicated that the aggregate possessed very satisfactory resistance to frost action. Further tests on aggregate-cement mixtures seemed desirable, and since cement is readily attacked by sodium sulphate in solution, these tests were carried out by direct freezing and thawing, whereby the specimens after being first saturated by immersion in water, were alternately frozen and then thawed by immersion in water.

The initial series of tests was carried out on 2 by 4 in. cylinders of 1-3 mortar, using, in comparison with standard sand, two sands from Passe Dangereuse. Screen analyses and characteristics of these sands, and results of tests on 1-3 mortar mixtures were as given in Table IX.

In the above tests, freezing was accomplished by means of dry ice refrigeration at an average temperature of —35 deg. F. and thawing was carried out by immersion in water at 100 deg. F. Apparently the method yielded exaggerated values, and in further tests the freezing was carried out in a thermostatically controlled freezing chamber at —20 deg. F. and the thawing by immersion in water at 40 to 50 deg. F.

A second series of tests was carried out on 3 by 6 in. cylinders of 1-3 mortar, using sands from Passe Dangereuse, in comparison with standard sand, with results as indicated by Table X.

As the capacity of the freezing chamber was limited, at 200 cycles all cylinders had been broken in compression. Results obtained illustrate the advantage to be derived from good grading, and support the results obtained from the previous tests. Mix C showed progressive increase in strength at all test periods; Mix D had apparently reached a maximum at 100 to 200 cycles; while the mix with the standard sand aggregate showed definite retrogression in strength after 200 cycles of freezing and thawing.

The increase in strength of Mix C is undoubtedly the result of additional curing during the thawing periods.

It seemed desirable to carry out some tests on the concrete as actually mixed on the work. Accordingly ten 6 by 12 in. cylinders were cast from a single batch of concrete during a normal run, cured for 28 days and shipped to Montreal for a freezing test. This test is still being carried on. Results so far obtained are:

Compressive strength:

Start of test...........	3,530 lb. per sq. in.	
After 50 cycles........	3,605	"
After 100 cycles.......	3,925	"
After 150 cycles.......	4,450	"

The remaining cylinders are now approaching 200 cycles of the test. They do not appear to be affected in any way, and the original density has not altered.

TABLE VIII

PASSE DANGEREUSE AGGREGATE GRADING

PASSING	HELD ON	COARSE GRAVEL	INT. GRAVEL	BLENDED SAND	COMBINED AGGREGATE	SAND FRACTION -4 MESH
	3"	30.0			9.2	
3"	1½"	67.0	6.3		22.8	
1½"	¾"	3.0	46.6		18.7	
¾"	⅜"		43.0	3.0	17.3	
⅜"	4		2.3	9.2	3.9	
4	8		.8	13.0	4.4	15.8
8	16		.3	18.0	5.7	20.3
16	30		.2	21.8	6.9	24.5
30	50		.1	19.8	6.2	22.0
50	100		.1	11.0	3.4	12.1
100			.3	4.2	1.5	5.3
TOTALS		100.0	100.0	100.0	100.0	100.0
FINENESS MODULUS		9.27	7.51	3.29	6.73	2.90

Cement came from three different mills. Because of the long indeterminate period during the spring when the road from railhead was closed to freighting, a large amount of cement had, at times, to be stored at Passe Dangereuse. During February and March, 1942, sufficient cement to cover all possible requirements until the end of June of that year was stored at the work. Orders of the Paper Controller prevented compliance with the specification requirement that cement should be shipped in six-ply waterproof bags, and a great deal of the cement supplied was furnished in four and even three-ply bags, not waterproofed. Some of this cement became damp in transit from railhead, and an additional amount was dampened through partial collapse of two of the storage sheds, arising from heavy loading on green timber cribbing and an early spring breakup.

At the end of June 1942, there were 140,000 bags of cement in storage at Passe Dangereuse most of which had suffered some degree of hardening. Examination of representative samples showed that the condition was fairly general, with 12 per cent of the cement present as partially hydrated lumps which were not broken up by handscreening on a 12 mesh screen, and 3 per cent present in the form of hard lumps, apparently fairly well hydrated.

Subsequent laboratory tests showed that the cement from these samples, reground so that the amount retained on the 100 mesh screen approximated that of the original samples, yielded a material with a weighted average tensile strength, at 28 days, of 88 per cent of that obtained from the original samples at time of shipment.

In view of the fact the cement in storage varied widely in the proportion of hydrated or partially hydrated material present, and that further time must elapse before all of it could be used in the work, it was decided to reprocess all of this cement at the site before use.

A processing plant, comprising a 14 by 10 in. swing hammermill, bucket elevator, storage bin and a small bag loader, was designed and erected at the site of the work. All of the old cement in storage as of July 1st, 1942, was processed before use in the work. Processing cost 26.9 cents per sack.

Tests were made weekly of 1-3 mortar mixtures for compressive strength, and weekly samples were forwarded to Montreal for testing in accordance with C.E.S.A. standard requirements for Portland cement. All samples tested showed satisfactory results, exceeding in all cases the minimum requirements of the current C.E.S.A. specification.

In addition, careful record was kept of the compressive strength test results, as determined from daily job cylinders taken from the mixtures placed. Concrete made with the processed cement frequently exceeded the strength of similar concrete made during the same shift with newly delivered cement.

Forms were constructed of 1¼ in. dressed spruce, using a cantilever design. Ports were provided on the upstream side for drainage of wash water, this being facilitated by the 5 per cent slope given the lift joints.

After securing sound rock in the foundation area of any section in which concrete was to be placed, the rock was thoroughly cleaned by wet sandblasting combined with high-velocity air-water jet washing to ensure freedom from any residue whatever. All rock surfaces were thoroughly moistened before placement of a ¾ in. layer of mortar with cement and sand proportioned as in the regular concrete mixture, and having a water-cement ratio not higher than the concrete. This mortar was thoroughly worked into all irregularities and the rock surfaces and then covered by concrete.

Concrete was placed in 5 ft. lifts. Lift joints were prepared for the next lift by an initial high-velocity air-water jet during an optimum time determined as 4 to 12 hours after placing. This initial clean-up exposed clean sound concrete with removal of the greater part of laitance and other surface deposits. Just prior to a new pour, after completing all other pre-

TABLE IX

EFFECT OF FREEZING AND THAWING ON 2"x 4" CYLINDERS OF 1:3 MORTAR PASSE DANGEREUSE SANDS

PASSING	HELD ON	A.	B.	STANDARD SAND
4 MESH	8 MESH	18.5 %	16.9 %	
8	16	27.5	16.9	
16	30	30.0	22.2	100.0 %
30	50	17.3	27.0	
50	100	4.3	11.5	
100		2.4	5.5	
TOTAL		100.0 %	100.0 %	100.0 %
FINENESS MODULUS		3.3	2.84	3.00
WEIGHTED AVERAGE LOSS ON ACCELERATED FREEZING TEST OF AGGREGATE.		1.44 %	2.63 %	
DENSITY OF 1:3 MORTAR.		2.330	2.345	2.24
W/C RATIO		.414	.428	.40
AVERAGE COMPRESSIVE STRENGTH, 1:3 MORTAR 28 DAYS.		4,200	4,730	3,145
NO. OF CYCLES OF FREEZING AND THAWING TO DESINTEGRATE MORTAR CYLINDER		35	113	6

TABLE X

EFFECT OF FREEZING AND THAWING ON 3"x6" CYLINDERS OF 1-3 MORTAR PASSE DANGEREUSE SANDS

PASSING	HELD ON	C.	D.	STANDARD SAND
4 mesh	8 mesh	14.8%	14.1%	
8	16	20.3	22.2	
16	30	26.9	35.4	100.0%
30	50	23.4	18.7	
50	100	10.9	6.6	
100		3.7	3.0	
Total		100.0%	100.0%	100.0%
Fineness Modulus		2.94	3.10	3.00
Density of 1-3 Mortar		2.36	2.32	2.25
Average Compressive Strength	28 Days	4145	3875	3520
After	25 Cycles	4415	4250	3670
	50 Cycles	4410	4270	3565
	100 Cycles	4620	4350	3415
	200 Cycles	4770	4280	2935

paratory work, laitance and other contaminants were removed by wet sandblasting and thorough flushing with air-water jets.

A ½-inch layer of mortar as previously described was then worked thoroughly into the irregularities of the surface, before proceeding to placement of the new lift.

Concrete to the extent of 11,000 cu. yd. for the first-stage operations was mixed in a temporary plant near the cofferdam, housing 2—1 cu. yd. mixers. Mixed for a minimum of 2 minutes, the concrete was transferred in 2 cu. yd. bottom dump buckets by truck or narrow-gauge railway and derricks to its location.

The remainder of the concrete was mixed in a plant set up on the east bank, comprising 2—2 cu. yd. and 1—1½ cu. yd. mixers, overloaded about 10 per cent to produce a batch unit of 6.0 cu. yd. The 7 cu. yd. Blaw-Knox bottom dump buckets carried the batch unit of 6.0 cu. yd., being transported by the cableway to point of placement. Maximum rate of production of this plant was 70 cu. yd. per hour. Average rate was 46 cu. yd. per hour over a period in which 136,692 cu. yd. concrete was placed.

Aggregate materials were brought to the plant by truck from the various stockpiles, and during winter operation by a 24-in. belt conveyor from heating and reclaiming stockpiles adjacent to the mixing plant. All aggregate materials and water were proportioned by weight; cement was proportioned by the bag, since bulk shipment and handling was impracticable on account of the long truck haul from Dolbeau.

Concrete was mixed with a slump of 1 in. or less, and thoroughly compacted with suitable high-frequency electric vibrators.

The use of natural aggregates produced a thoroughly workable, smooth concrete.

In general, adequate curing was ensured by protecting permanently exposed finished surfaces from the direct rays of the sun for at least the first three days after the concrete was placed, and keeping such surfaces continuously moist by sprays for two weeks. Concrete placed during the winter was kept under a continuous spray as soon as the danger of freezing was past, in the spring.

In freezing weather, care was taken to maintain freshly placed concrete at 50 deg. F. for at least 72 hours after placing or until well after the initial set had occurred. Three measures were adopted to ensure this:

(a) Heated aggregate stockpiles.

(b) Perforated steam pipes around the lower part of the forms, just below the lift joint.

(c) Enclosure of forms by tarpaulins.

Tests with resistance thermometers in the outer skin of a newly-placed lift of concrete during severe weather indicated that the objective was reached, after ironing out some initial difficulties. Practically no concrete whatever was frozen, with the exception of one or two thin wedges at lift joints.

A test laboratory was maintained on the work. This was equipped with screens, scales and all other necessary implements; moulds for casting test cylinders; and a 200,000 lb. capacity hydraulic test machine for carrying out compressive strength tests on samples of concrete.

A chief inspector in charge of concrete control, with a staff of seven inspectors under him, supervised all phases of proportioning, mixing and placing. The schedule called for one mixing inspector, one placing inspector and one laboratory technician on each shift. The spare man assisted the chief inspector, carried out special duties as required, and was available as relief for the other inspectors should they be absent from the work for any reason.

Quantities

Table XI indicates the principal components involved in the construction of the several dams necessary in the Passe Dangereuse storage development. Transportation quantities have been given in the discussion of that phase.

Working Conditions

Generally speaking, working conditions on the Passe Dangereuse job were excellent, aside from factors beyond control. These were three in number:

(a) Precipitation.

(b) Temperatures.

(c) Fog.

Snowfall was particularly heavy during the period from 1st October, 1942, to 30th April, 1943, in which 120,480 cu. yd. or 79.3 per cent of all concrete was placed, reaching a total of 176 in.

The extreme winter temperatures resulted in heavy ice formation on the upstream side of the dam, and it was necessary to combat ice formation on scaffolding and formwork generally.

It can be readily understood that placing warm concrete at temperatures of − 20 to − 40 deg. F. was productive of fog formation in the working area, even though substantially totally enclosed.

The discharge of the river flow, plus some storage achieved in the fall of 1942, through the deep sluices resulted in very heavy fog formation during extreme weather, which tended to blanket the entire job. On a few nights it was necessary to cease concreting operations because visibility was practically nil.

In spite of severe working conditions, poor quality of labour and high turnover, careful job management kept the accident rate low. There were only 4 fatalities on the entire Passe Dangereuse job.

Labour

In spite of good housing and excellent food, the quality and availability of construction labour gradually deteriorated not only on construction of the Passe Dangereuse storage development but, as is well known to construction men, throughout Canada generally. The situation became particularly serious during the last half of 1942, just when requirements at Passe Dangereuse were reaching the critical stage.

TABLE XI PASSE DANGEREUSE QUANTITIES		
DAM	ITEM	QUANTITIES
NO. 1	CLEARING SITE	333 ACRES
	1ST. STAGE COFFERDAM	6,498 C.Y.
	2ND. " "	7,337 C.Y.
	EXCAVATION, LOOSE	13,649 C.Y.
	" , ROCK	65,625 C.Y.
	FOUNDATION PREPARATION	100,000 SQ.FT.
	FORMWORK	403,749 SQ.FT.
	REINFORCING STEEL	1,796,970 LBS.
	CONCRETE	151,300 C.Y.
NO. 2	CONSTRUCTION ROAD	2 MILES
	CLEARING SITE	41.5 ACRES
	EXCAVATION	9,831 C.Y.
	CRIBWORK	20,365 C.Y.
	SHEETING	86,000 FBM
	BACKFILL	4,919 C.Y.
	CONCRETE SEAL	100 C.Y.
	TOEFILL	90 C.Y.
	RIPRAP	358 SQ.YDS
NO. 3	CONSTRUCTION ROAD	2 MILES
	CLEARING SITE	27 ACRES
	REMOVAL OF OVERBURDEN	2,645 C.Y.
	EARTHFILL	13,080 C.Y.
	RIPRAP	1,735 C.Y.
NO. 4	CONSTRUCTION ROAD	3.5 MILES
	CLEARING SITE	37 ACRES
	EXCAVATION	2,065 C.Y.
	WAKEFIELD PILING	19,500 FBM
	EARTHFILL	8,185 C.Y.
	RIPRAP	1,894 C.Y.

To combat this, efforts were made to keep personnel interested in the progress of the job, by bonusing concrete placement through competition between day and night shifts, use of a concrete-pouring scoreboard, etc.

The deterioration in quality of labour available for the construction of Dams 1, 3 and 4 at Passe Dangereuse during 1942 and the first half of 1943 is shown in Fig. 17 in comparison with the labour turnover for Manouan during the period September 1940, to July 1941, where conditions were much less favourable.

Operating Experience

The water level in the Passe Dangereuse reservoir reached El. 239.69 on 19th September, 1943. The reservoir was maintained full until the drawdown season was entered on 2nd October. Close observation of the several dams in respect of seepage through the foundations, leakage, etc. was made until the beginning of the drawdown season.

No leakage through the foundation rock or abutments of No. 1 dam, at Passe Dangereuse, could be detected. A small amount of leakage past gate seals was recorded, this totalling about 1.0 cu. ft. per sec. No leakage at contraction joints was detectable, except for a slight weep in one of the crest gate piers, about gate sill level.

A slight amount of contraction cracking was noticeable, as anticipated, but this is apparently less than ordinarily experienced.

Performance of the crest and deep sluice gates has been fully up to expectations. Behaviour of the deep sluice jets has been as anticipated, with practically no vibration or cavitation noise noticeable.

Limited operating data indicates the discharge from Passe Dangereuse is first noted at Lake St. John, 121 miles down the Peribonca, in 2 days and fully felt in 4 to 5 days.

Acknowledgments

Design and construction of Lake Manouan and Passe Dangereuse water storage developments were carried out by the General Engineering Department of Aluminum Company of Canada, Limited, under the immediate direction of the author. The Shawinigan Engineering Company, Limited, acted as general consulting engineers on both developments. Dr. E. C. Harder, of Aluminium Laboratories Limited, and Dr. John A. Dresser advised on the geology of Passe Dangereuse. Mr. Charles Miller, M.E.I.C., contributed substantially to the design of Lake Manouan, while Mr. R. J. Mattson, M.E.I.C., played a leading role in design of the Passe Dangereuse storage. Mr. J. B. D'Aeth, M.E.I.C., chief engineer of Dufresne Engineering Company, Limited, was largely responsible for construction plant layout at Passe Dangereuse.

Aggregate investigations were made in the laboratories of, and concrete control and inspection services were furnished by, Milton Hersey Company, Limited. Particular acknowledgment is due Mr. M. F. Macnaughton, M.E.I.C., for his contribution relative to phases of the job dealing with concrete.

Acknowledgment is due Canada Cement Company, Limited, for invaluable assistance in connection with cement processing.

Mr. Charles Miller, M.E.I.C., was resident engineer on Manouan, while Mr. R. F. Ogilvy, M.E.I.C., was resident at Passe Dangereuse.

The Atlas Construction Company, Limited, were general contractors for construction of Lake Manouan, while Dufresne Engineering Company, Limited, functioned in the same capacity at Passe Dangereuse on the construction of the access road and dams 1, 3 and 4. G. H. Lavoie constructed dam No. 2 in the Passe Dangereuse development, as well as carrying out logging and lumbering operations.

Transportation from railhead to Beauchesne, for the Manouan job, and to Passe Dangereuse was furnished by Price Brothers & Company, Limited. Canadian Airways Limited, now Canadian Pacific Air Lines Limited, provided aerial transportation for both developments.

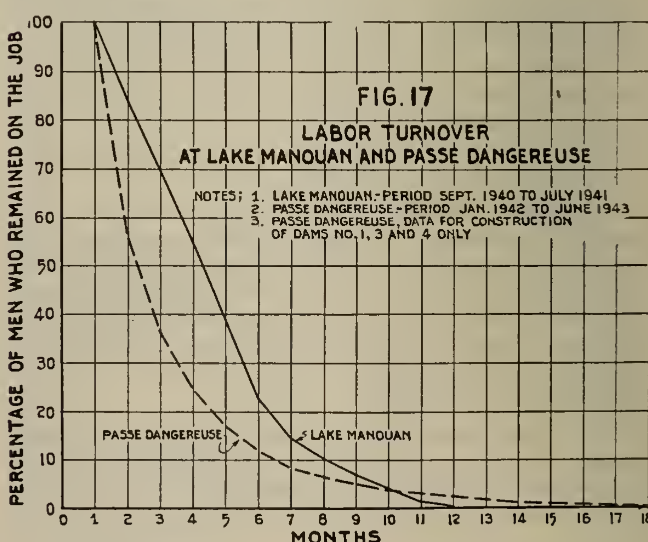


Fig. 17—Diagram showing labour turnover of the water storage projects.

THE DESIGN OF THE SHIPSHAW POWER DEVELOPMENT

H. G. ACRES, M.E.I.C.
President, H. G. Acres and Company, Consulting Engineers, Niagara Falls, Ont.
Consulting Engineer to Aluminium Laboratories Limited

Paper presented at the Fifty-Eighth Annual General Professional Meeting of The Engineering Institute of Canada, at Quebec, on February 10th, 1944.

NOTE: While all of the layout, detail and working plans, equipment specifications, material lists and purchase requisitions were prepared in the engineering office of H. G. Acres & Company at Niagara Falls, it has been obviously impossible, if only by reason of space limitations, for the author to cover the whole range of design associated with the Shipshaw power development. The scope of this paper has therefore necessarily been limited to the consideration of a set of established or prescribed facts and conditions. It is characteristic of hydroelectric design that such basic facts and conditions, when rationally weighed and inter-related, have the result of making the specific problem more or less unique, as compared with other problems of the same class. The author has therefore attempted, in this paper, to set forth the basic premises, to explain why certain things were or were not done, or could not be done, and to resolve from these considerations the framework of a design scheme into which the varied elements of detail could in due course and sequence be effectively fitted. It is the intention to have these matters covered later by a series of special papers on details of hydraulic, electrical, mechanical and structural design, which will be published in the *Journal*, probably subsequent to presentation at a branch meeting.

Genesis

The power reach of the Saguenay river extends from tidewater, about a mile above the mouth of the Shipshaw river, to Lake St. John, and in considering a development scheme the basic conception of its sponsors was to concentrate the whole of the available gross head in two successive stages. The first stage of head concentration was at Isle Maligne, immediately below the outlet of Lake St. John, and at this point the Isle Maligne plant of the Saguenay Power Company was built. This plant operates under a normal regulated head of approximately 110 ft.; has 420,000 kva. of generating capacity installed, and commenced commercial operation in the year 1925.

The site chosen for the second stage of head concentration was immediately above the Chute-à-Caron rapids, where a dam was built by the Alcoa Power Company Limited, now the Aluminum Power Company, Limited, which ponded the water to the level of the Isle Maligne tailwater, about 22 miles upstream. This dam controlled a normal regulated head of approximately 155 ft., and integral with the dam, a powerhouse was built which now has installed 200,000 kva. of generating capacity. This plant commenced commercial operation in the year 1930.

The location of the Chute-à-Caron dam and plant was such that there remained about 53 ft. of free head, between Chute-à-Caron tailwater and the head of tide, which it was proposed ultimately to pick up by a diversion canal outletting from the Chute-à-Caron headpond and discharging through a powerhouse and tailrace located in the valley of the Shipshaw river, about half a mile above its junction with the Saguenay.

Figure 1 illustrates the salient features of this original conception, and rather extensive surface and subsurface surveys were made in connection with it.

As will be seen, this illustration shows a diversion canal supplied from the Chute-à-Caron headpond through a free outlet, and passing through a dividing ridge of rock in a deep cut to a headblock location on

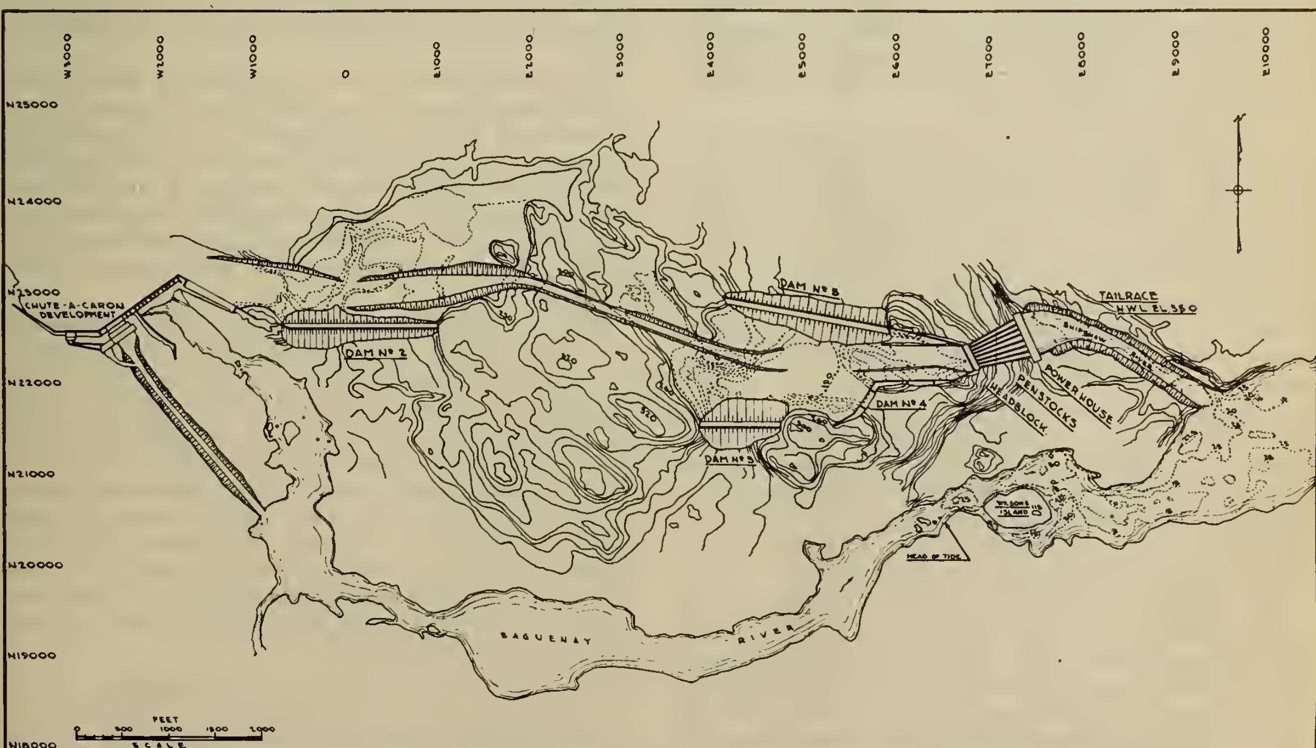


Fig. 1—General layout of the original Shipshaw Development scheme.

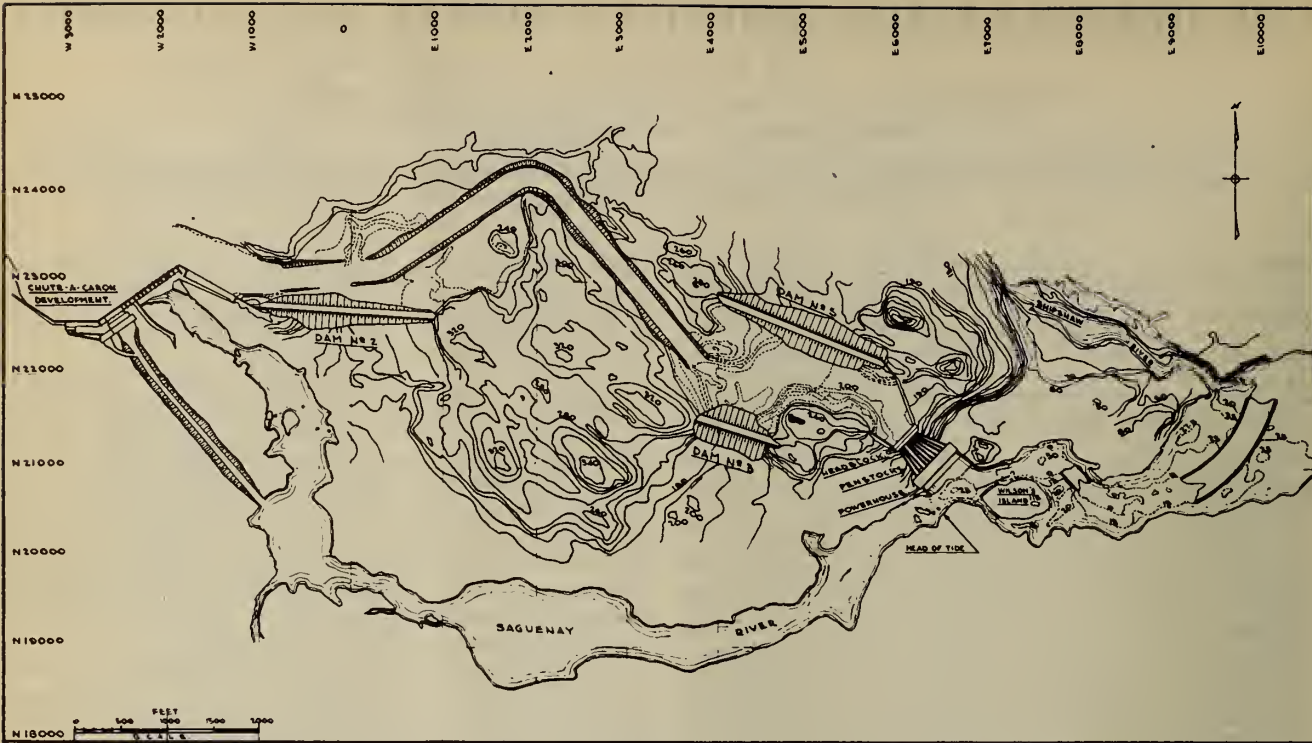


Fig. 2—General layout of later modification of the Shipshaw Development scheme.

the rim of the Shipshaw River valley, and thence through exposed steel penstocks, involving the use of an estimated 12,000 tons of heavy plate, to a powerhouse which in turn discharges the spent water into an enlargement of the channel of the Shipshaw river, as shown.

It was proposed to fix the dimensions and gradient of the tailrace so that the tailbay water level would be at Elevation 35 under normal regulated flow conditions, while at the same time it was proposed to carry the headwater at a regulated static level of Elevation 243, thus realizing a gross head of 208 ft. This consummated the whole of the second stage of head concentration involved in the original conception of power development on the Saguenay river.

No further active steps were taken until about the year 1938, when the project was re-examined, and in due course additional surface and subsurface surveys undertaken, which, early in the year 1940 culminated in a schematic layout upon the basis of which preliminary estimates were made of the capital cost of developing an ultimate 800,000 hp.

This later development of the original conception is shown in Fig. 2, and involves two important modifications.

As before, the canal off-takes from the Chute-à-Caron headpond through a free entrance, but the canal, instead of carrying straight through the ridge in a deep rock cut, makes a fairly sharp detour through a low spot in the ledge composing this ridge, and substitutes, for rock, a considerable volume of earth excavation, of which a large percentage is wet muskeg.

The second modification was the shifting of the powerhouse location from the Shipshaw River valley to the shore of the main river immediately above an island, locally known as Wilson's Island, as the illustration shows. This shift had the joint effect of changing the location of the north headblock wing-wall and of placing the headblock itself on the site originally proposed to be occupied by a concrete dam.

This revised scheme also contemplated the development of an output of 800,000 hp. under a normal gross static head of approximately 208 ft.

The Shipshaw project again became active when, in November of 1940, instructions were received to make a complete review of the Shipshaw scheme in the light of then-existing and immediately-anticipated conditions, and on the basis of such review to prepare complete plans, specifications, and detailed working drawings for a hydroelectric plant of roundly 1,000,000 installed hp. of rated capacity, passing a prescribed ultimate volume of 50,000 cu. ft. per sec. of regulated flow.

An unusual element of the Shipshaw scheme was that it was proposed to pass all of the ultimate volume of regulated flow of the Saguenay river through the Shipshaw wheels; the result being that whenever sufficient wheel capacity became available in the Shipshaw plant to pass all of the then-available regulated flow, the Chute-à-Caron plant would be completely bypassed, so far as concerned the production of prime power.

The starting point for this further investigation was a large-scale plan of the whole area involved in the development scheme, surface contoured in five-foot intervals and accompanied by a large number of test-pit and boring records, the bulk of which were carried down to what was presumed to be underlying ledge.

Following an examination of the superficial features of the site, arrangements were made to extend the subsurface exploratory work, and two diamond drill crews worked through the winter season of 1940-41, driving casings to presumed ledge at specified points, and proving up by drilling at least ten feet into what the cores indicated to be sound rock.

While this exploratory work was still under way and the scheme, as a whole, still under review in the engineering office, war conditions became so acute that the consulting engineer was given tentative instructions, which were later confirmed in May of 1941, to make ready for the immediate construction of permanent works for the ultimate total of 1,000,000 hp., together with powerhouse substructure and superstructure space for the installation of six main units, at least three of which were to be installed immediately.

At the same time the question was asked as to the earliest date upon which commercial power would be available from this development, and the answer was that it might be reasonably assumed that the first unit could be turned over on January 1, 1943, with succeeding units turning over thereafter at intervals of one month to six weeks, contingent upon (a) the subsurface exploratory work then under way showing results as favourable as had so far been realized; and (b) that earth excavation on the sites of the various major structures could be commenced not later than the beginning of July, 1941.

Fortunately, the subsurface exploratory work revealed quite satisfactory results upon final completion. In the critical area, which was finally chosen for the location of the headblock and water passages, the diamond drills put down vertical and inclined holes to depths ranging up to a maximum of about 200 ft., with core recoveries averaging better then 95 per cent. This indication of sound rock was subsequently confirmed in the course of construction.

Finally, in the late spring of 1942, tentative instructions were received to prepare working drawings for the complete ultimate installation, with the probable intention of carrying on the construction as a continuous and uninterrupted operation.

Elements of Final Design

By May of 1941, the estimated future requirements of the Allied Nations for aluminum indicated a condition of critical urgency which made necessary the consideration of large firm contracts, with specific dates, covering delivery of a progressively-increasing tonnage of aluminum pig for four years in advance.

The unavoidable consideration relative to these proposed contracts was the supply of power in sufficient quantity and *in time* to definitely assure the delivery of the specified tonnages of metal in accordance with the prescribed contract date schedule. The contracts were therefore executed on the understanding, among others, that the first unit at Shipshaw would turn over not later than January 1, 1943, with others, if and as required, at intervals of one month to six weeks, up to the ultimate limit of installed capacity.

Incidental to this obligation, and to fill the intervening gap as effectively as possible, two additional generating units were added to the Chute-à-Caron plant. Actual work was commenced on the construction of this extension in the middle of May, 1941, and both of the additional units were continuously on load by April 8, 1942. These additional units were designed so that the generators and the transferable parts of the turbines could be re-installed in the Shipshaw plant, where they are now in place and in operation.

The basic element of the design problem was therefore to reconcile this condition of compelling urgency with what would be considered a rational and sound design under more nearly normal circumstances.

Secondary to the above general limitation, there were two other abnormal and uncontrollable factors associated with the problem of designing within the limits of sound conception. One was the growing scarcity of metal products for other than direct war purposes, and more particularly steel plate, in its relation to the vast programme of Canadian and United States' war and merchant ship construction, as then projected. The other had its origin in the fact that the Shipshaw plant, as geographically located, would be definitely subject to the hazard of enemy bombing attack. A hydroelectric plant makes a particularly good target for bombing, by reason of the fact that the waterways approaching and leaving it cannot be hidden or camouflaged, and a bomb hit in any part of the area between the forebay and the tailrace would be almost certain to cause vital damage.

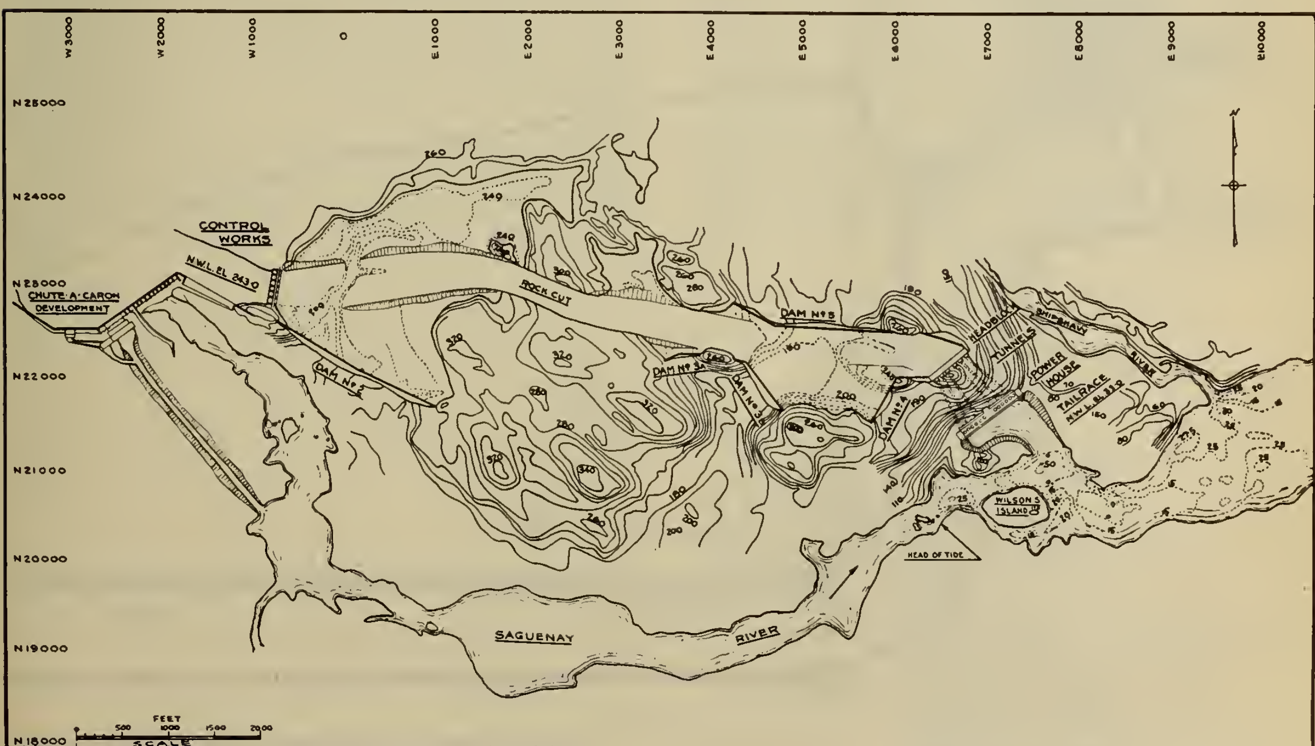


Fig. 3—General layout of Shipshaw Development scheme as actually constructed.

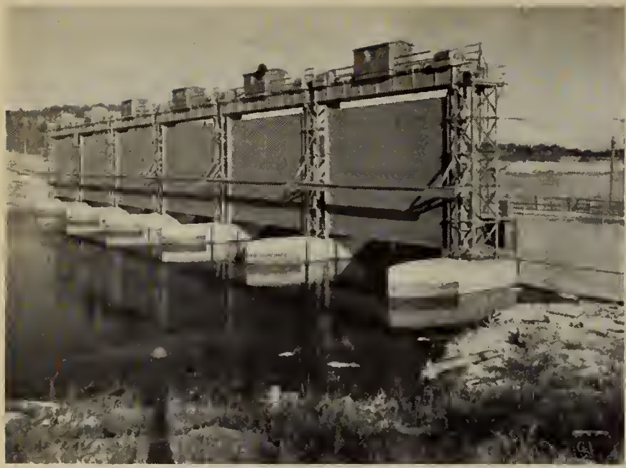


Fig. 4—View of the completed control works looking downstream.

In the light of the above background, the argument leading up to the design, as finally fixed, may now be elaborated. The final layout, as constructed, is shown in Fig. 3, which is directly comparable with Figs. 1 and 2, up to this point.

Canal and Forebay

As Fig. 1 shows, the fixing of the static headwater level at Elevation 243 involved several contour closures —numbered 1 to 5, inclusive, and of which No. 1 was the already-existing dam at Chute à Caron. With the exception of Dam No. 4, which is more or less of a simple concrete extension of the south headblock wing-wall, these contour closures were proposed to be effected by earth embankments, designated Dam No. 2; Dam No. 3 and Dam No. 5, as the illustration indicates.

Figure 2 shows that while the shifting of the powerhouse location eliminated Dam No. 4 and lengthened the north headblock wing-wall, the balance of contour closures were effected by the same three earth embankments as before, designated Dams Nos. 2, 3 and 5 on Figs. 1 and 2.

As the illustrations so far referred to indicate, the drainage through the sites of Dams Nos. 2 and 3 is toward the Saguenay, and the drainage through Dam No. 5 is toward the Shipshaw river, and the contours they close make part of a canal alignment which diverts the flow from the Chute-à-Caron headpond across a flat bend in the Saguenay river to the powerhouse and tailrace location at tide head.

The gorges in which Dams Nos. 2 and 3 are placed consequently drain into the river over a comparatively short path and at a steep gradient, both as to natural surface and underlying ledge.

As Fig. 1 shows, each embankment is located in the throat of a gorge at the crest of the steep gradients above mentioned, and the subsurface surveys showed overburden under embankment No. 2 to a maximum of 82 ft., and under No. 3 to a maximum depth of 60 ft. In each case the borings showed that this overburden consisted of successive and alternating layers of clays, silt, coarse and fine sand, gravel and boulders, with gravel and boulders the predominating material adjacent to bed-rock. A considerable volume of ground water was encountered, some of it under pressure, this being particularly the case at and adjacent to the site of embankment No. 3.

The conditions above described did not constitute a very encouraging basis for the consideration of earth embankments for the two contour closures in question.

The situation was somewhat different at the site of embankment No. 5, where the drainage gradient is into

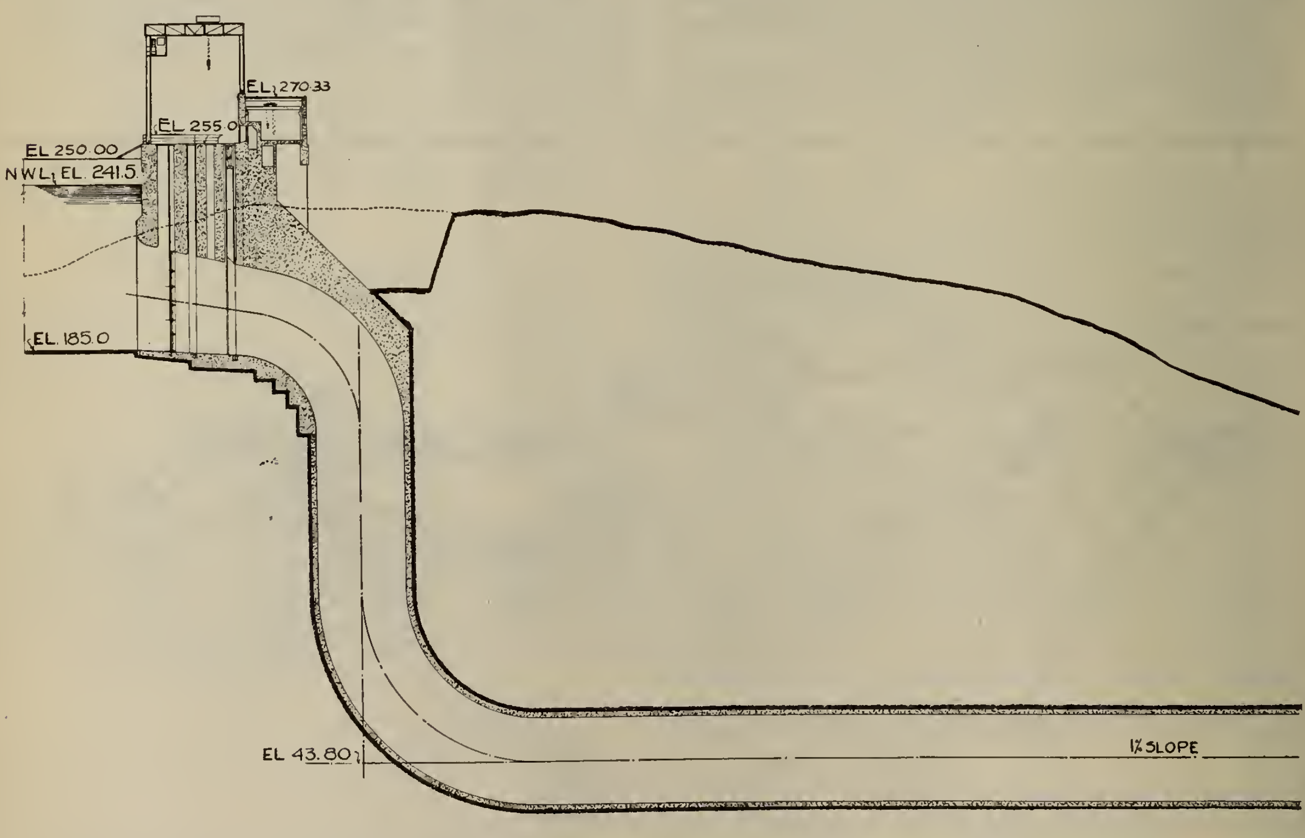


Fig. 5—Cross-section of Shipshaw plant through

the Shipshaw river, and the seepage gradient comparatively long and flat. The overburden at the base of the structure did not vary in any great degree from that associated with Dams Nos. 2 and 3, but the average depth of overburden was much less than in the case of the other two embankments, and reached its maximum depth of 58 ft. in one short section only.

As a matter of fact, the fundamental consideration in connection with the problem of Dams Nos. 2 and 3 was the proposition that the holding contours on the river side of the canal alignment were exclusively in exposed ledge throughout the whole length of the waterway, with the exception, of course, of the depressions in which these two dams were to be built. Therefore, having in mind the steep overburden and ledge gradients through which these depressions outletted to the river, it was rational to assume that the more-or-less saturated overburden actually in place was about all of this class of material that these depressions could hold with a reasonable degree of stability, and that, such being the case, any steps taken to artificially raise the holding contours in these depressions should be through the medium of a material having characteristics more similar to the adjacent exposed ledge than compacted earth.

Meanwhile, during the spring and early summer of 1941, soil surveys had been under way and analyses made of the overburden material on and adjacent to the site of the development, and material was actually found that was suitable for the construction of the impermeable core of a dry-rolled fill. The available yardage, however, fell far short of what would have been required for the three dams in question, and by coincidence was found to be sufficient in quantity only to cover the estimated yardage required for Dam No. 5.

For the above reason alone the problem of Dams Nos. 2 and 3 solved itself, and on Fig. 3 they are shown as concrete structures bonded throughout to the underlying ledge. This change made it possible to shift Dams Nos. 2 and 3 to much more favourable locations from the standpoint of depth of overburden and the elevation of solid ledge. This advantage was realized in the case of Dam No. 2 by shifting it bodily downstream from the original location, and in the case of Dam No. 3 by shifting it upstream toward the centre-line of the canal and building it in two separate sections—3A and 3B—as shown on Fig. 3.

Dam No. 5 was actually designed as an embankment with an impermeable core of dry-rolled fill, and with a core-wall bonded to rock and extending slightly above the natural elevation of the saturated overburden at the site. This design was prepared incidental to the risk that there would be two summers (1941 and 1942) sufficiently warm and dry to allow the structure to be completed before the fall freeze-up of 1942, and the stripping of the overburden and excavation for the corewall were actually commenced on the basis of this design.

As the season of 1941 advanced, however, three adverse conditions manifested themselves relative to the working schedule for this embankment.

In the first place, an acute shortage of earth excavating and handling equipment manifested itself as a result of the mounting requirements for this class of machinery in connection with airports, war factories and the Alaska Highway.

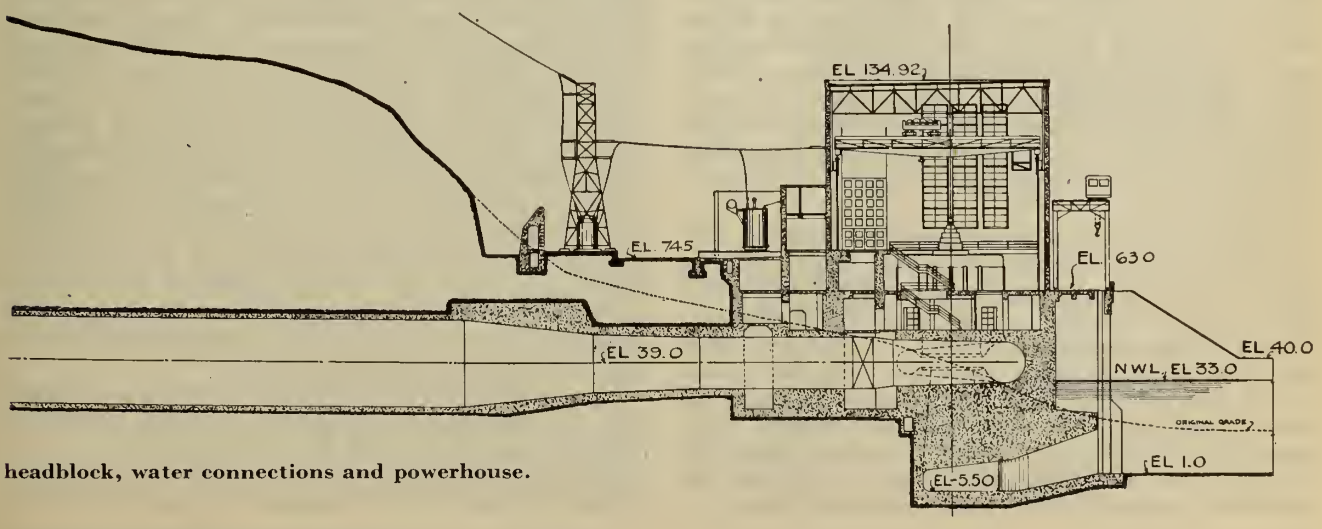
In the second place, and largely consequent upon the lack of sufficient equipment, it transpired that the dry-rolled fill material would have to be removed before it could be placed in No. 5 Dam, in order to get forward with the equally-important rock excavation schedule in the canal prism, thus making it necessary to store this overburden material in a specially-prepared dump and thereafter to re-handle it if it were to be used at all.

Thirdly, it was found that the most suitable location for one of the largest central mixing-plants ever built must be immediately adjacent to the site of No. 5 Dam, and that, with its auxiliaries and approaches, it would actually encroach upon the site of the embankment.

The final result was that the embankment design was superseded on short notice and No. 5 Dam was built in the form of a concrete bulkhead, as Fig. 3 indicates. None of the excavation work that had previously been done in connection with the embankment was lost, as the concrete structure was built on the same site and the removal of the overburden was necessary in any event to expose the ledge for the base of the dam.

If a normal thirty-month schedule had been permissible, instead of the fifteen-month schedule under which the work as a whole was actually constructed, Dam No. 5 would have been an earth embankment, as originally designed. This represents one of three instances in which a concession was made to urgency at the expense of rational and economic design.

In the two previously-considered schemes of development, and as Figs. 1 and 2 show, the canal outletted from the Chute-à-Caron headpond through a free entrance which was excavated and plugged with a temporary earth and rock fill, when the Chute-à-Caron plant was built. As will be seen from Fig. 3, this entrance section and the section through the rock ridge



headblock, water connections and powerhouse.

Fig. 6—View of tunnel portal, showing development of 34-ft. diameter circular heading.

are the only two regular prism sections in the whole waterway, and the design, as now constituted, provided for a control structure in the upper prism section immediately behind the above-mentioned temporary earth and rock fill.

Figure 4 is a view of the completed control structure as now operating, looking downstream.

The fundamental consideration relative to the inclusion of this control structure in the design was that if for any reason it was ever necessary to unwater the Shipshaw canal, lack of the control, as now provided, would make it necessary to pull down the Chute-à-Caron headpond level by about 35 ft., with the joint result of wasting about four billion cubic-feet of expensively stored water and destroying the production of the Chute-à-Caron power plant, when presumably it would be most urgently required to help make good the deficiency arising from a consequent total shutdown at Shipshaw.

It was considered that there were at least three happenings which might make it necessary to unwater the canal; first, a dangerous leak toward the river through the underlying ledge; second, the necessity for future repairs to the concrete work in the zone of the water line; and third, a bomb hit on the headblock.

Before the canal was actually filled with water there was no definite assurance that the underlying ledge throughout the critical area was absolutely tight. In view of the comparatively short path from the canal to the river, and the relatively high elevation of the water in the canal, there was the possibility of leakage along a short direct path which would not create sufficiently high throttling losses within itself, so that a comparatively small fissure, heading in the floor of the canal, might create a condition requiring immediate treatment, and the consequent complete unwatering of the waterway.

In northern latitudes where partially-saturated concrete faces are subjected to acute frost action, there is always deterioration along the zone of the water line which will ultimately require remedial treatment. There are approximately 6,800 lin. ft. of concrete-faced water line in the Shipshaw canal, and, with the control as now installed, the level of the canal itself can be lowered sufficiently to make this deteriorated zone accessible, without the necessity of drawing down the Chute-à-Caron headpond and thereby reducing the productive capacity of two plants, instead of one.

Finally, and most important under conditions which were imminent until only recently, there was the possibility of a bomb hit on the headblock which would be sufficiently destructive to destroy the head-gates or make them inoperative. Such a happening would make the complete unwatering of the canal imperative at a time when it would be disastrous to destroy the production capacity of the Chute-à-Caron plant and to wait until 22 miles of headpond had been pulled down 35 ft. before commencing repairs to the headblock.

Incidental to this element of the design, the control works' structure was adapted to serve the two other following purposes—

(1) A log-slide across the canal area which it was necessary to maintain, and the only practical means of so doing was to divert it and carry it across the narrow section at the canal entrance.

(2) There was also a provincial highway which crossed the canal and which it was required to maintain, and similarly the only practical means of so doing was to carry it across the narrow section at the canal entrance on a bridge.

Under the circumstances it was necessary, in any event, to build a substantial and permanent highway bridge and a similarly substantial and expensive crossing structure for the log-flume.

The structure as shown in the view, Fig. 4, provides not only for the support and operation of the regulating gates, but deck space also for the provincial highway and for the log-flume; the result being that, as a matter of economics, only about 60 per cent of the cost of the structure, as a whole, is directly chargeable to water control.

The primary purpose of sluicing ice is to maintain unimpaired, if possible, the demand capacity of the plant, and its utility and economic effectiveness are a maximum when, as in the case of the Cedars, for instance, the flow diverted for conversion is only a fraction of the total flow available at the point of intake. It is a minimum when *all* of the available flow is required for production and is storage regulated, as is the case at Shipshaw. Between these two extremes is a middle ground of varying degrees of operational futility, governed primarily by the amount of unusable surplus flow, if any, and in a secondary sense by the relative importance of temporarily maintaining demand capacity, as against conservation of the energy inherent in expensively-stored water.

In the case of Shipshaw, there is no surplus water available for the sluicing of floe ice or frazil. There is a continuous ice-cover throughout the winter on the 22-mile reach of headpond between Chute-à-Caron and Isle Maligne, and consequently no frazil, and not sufficient velocity to move any large volume of ice-cover during the spring break-up; such ice as does move out of the headpond being disposed of through sluices in the Chute-à-Caron dam during the spring freshet, when surplus flow is available for the purpose. This means that, so far as the ice problem is concerned, only a 7,350-ft. reach of waterway between the Shipshaw control works and the headblock is involved. A large part of the area of this reach will also have a permanent ice-cover, with open water areas, along the medial thread of the prism sections, which will vary in size with air and water temperature.

In view of the above, the only ice problem at Shipshaw concerns the breaking-loose of cakes and small fields of marginal ice from the canal walls.

Under the circumstances, no provision was made for sluicing ice out of the Shipshaw forebay, and three openings only were left—one in the crest of No. 2 Dam, one in the crest of No. 5 Dam, and the other in the crest of the north wing-wall, for the purpose only of disposing of occasional accumulations of pulpwood and other floating debris.

Tailrace and Powerhouse Location

As a general proposition, the problem of adjusting the two original schemes of development, as above described, to presently-existing circumstances, divided itself more or less naturally into two main divisions. The first concerned the connecting waterway between the headblock and the Chute-à-Caron headpond, which has already been considered. The second involved the interlocking factors relative to the fixing of the sites for the headblock, water connections, powerhouse and tailrace.

The two original schemes, as illustrated by Figs. 1 and 2, had in common a definitely unfavourable feature, in that in both cases the bulk of the heavy yardage of tailrace excavation would have been subaqueous. In the case of the original scheme an effort was made to devise some means of unwatering the tailrace and powerhouse area by diverting the Shipshaw river above the tailrace location, and carrying the discharge into the Saguenay river at some point below the tailrace outlet, but the conformation of the ground on the north bank of the river made this scheme impossible within any reasonable limit of time and cost.

In the case of the Wilson's Island scheme, the realization of a gross head of 208 ft. made necessary the excavation of approximately 168,000 cu. yds of solid tailrace rock in the bed of the Saguenay river opposite Wilson's island, at a similarly unreasonable expenditure of time and money.

Furthermore, apart altogether from the matter of inherent engineering economics, the fact that neither of these tailrace excavation operations could have been carried on effectively during the winter season would have made the promised initial turn-over date of January 1, 1943, an impossibility, so that as far as the time schedule was concerned it was imperative to find some other location for the tailrace if at the same time the originally-conceived gross head of 208 ft. was to be realized.

In the meantime the core-drilling operations had brought to light the fact that the previously-mentioned contour survey of the site was accurate to an unusual degree, and it was decided to construct from this survey a natural-scale model of the whole area involved in the development scheme. The scale of this model, 100 ft. to the inch, was sufficient to give good relief and made it possible to study the contour layout in detail. This study showed that, approximately midway between the respective headblock locations shown in Figs. 1 and 2, there was an outcrop of exposed ledge which lay directly opposite, and close to a short reach of the main river in which the water level stood normally at Elevation 33 to Elevation 35, which meant that if a headblock structure could be located on the above-mentioned ledge outcrop, so as to maintain a static headwater level of Elevation 243, the same gross head could be obtained as in the case of the original Shipshaw, or the subsequent Wilson's Island scheme. Previously there had been no detailed subsurface exploration of this area, and when the drilling operations were finished the results revealed themselves as being unexpectedly favourable.

In the first place, as already mentioned, the drills showed that the exposed ledge outcrop consisted throughout of sound rock, apparently free of voids and fissures within its mass, and furthermore that the flat area, at the foot of the steep river slope of this outcrop, covered an old-water-course in which the ledge elevation was from 11 to 25 ft. below normal water level in the adjacent reach of the main river, and that the north-east corner of the powerhouse, as finally located, was found to be only 19 ft. above the elevation fixed for the sills of the draft-tube outlets. The channel of this water-course had later been filled in with clean, loose, dry and well-drained moraine gravel to an average depth of about 60 ft.

This area provided space within which there was ample room for a powerhouse substructure and a considerable part of the tailrace. This was a matter of vital importance, because the promised completion schedule made it absolutely necessary to have the powerhouse foundations excavated to draft-tube invert elevation in time to have the successive increments of the powerhouse substructure completed, to machine-room floor level, so that, in turn, the steel superstructure and powerhouse cranes could be erected, without fail, in time to meet the earliest possible assembly dates for the main units that the respective manufacturers could promise. It meant that the whole area of the powerhouse location, and about 98 per cent of the tailrace earth and rock could be taken out in the dry, independent of season, with only the easiest type of earth excavation involved, and with only a comparatively small amount of rock excavation being required to prepare the powerhouse foundations for the pouring of the substructure concrete. These elements of the situation, associated with the previously-discussed tailrace problem, would have constituted a preponderating factor in the ultimate choice of the powerhouse site, even if a normal construction schedule only had been involved. They were a fundamental consideration as related to the accelerated schedule which was dictated by war conditions.

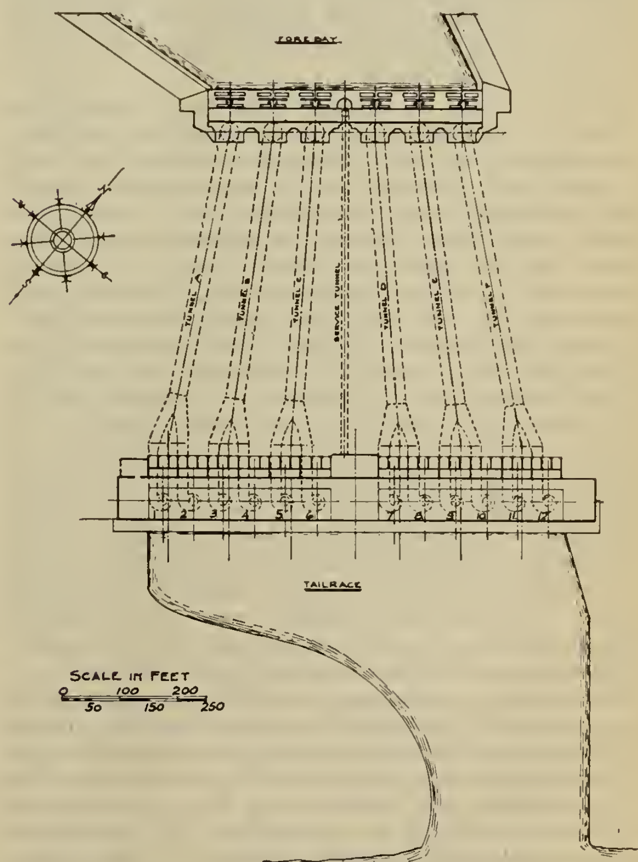


Fig. 7—Diagrammatic layout of shafts and tunnels.

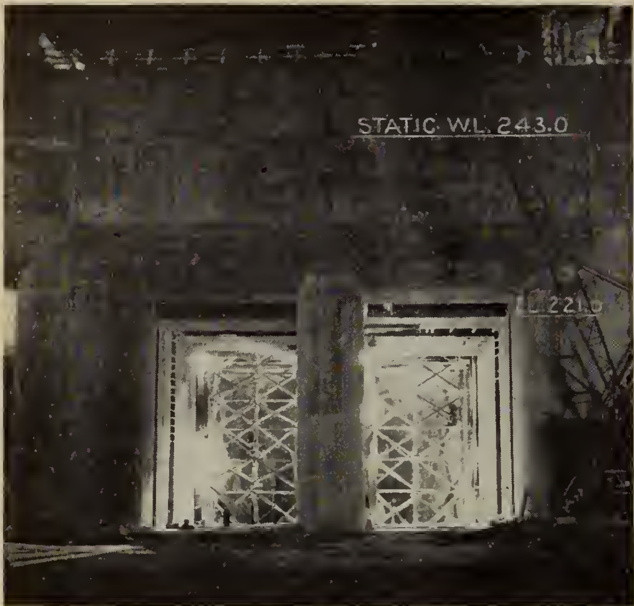


Fig. 8—View of breast wall of headblock with one shaft intake.

Headblock and Water Passages

Up to this point it will be seen that the study of the general design had not materially changed the position and alignment of the canal from the original conception. It did, however, change the location and relative positions of the powerhouse and tailrace, as above explained, and the conclusions in the premises still required to be tested by the availability, or otherwise, of a rational location and type of water connection between the forebay and the powerhouse.

The basic consideration involved in the study of this phase of the problem had to do with the conformation of the previously-described escarpment and the nature of the rock composing it.

The rim of the escarpment immediately above the tailrace location juts out over the valley in the form of a hogback ridge with a steep drop towards the river, its south flank dropping into a ravine and its north flank dropping down beneath the heavy overburden which slopes down towards the Shipshaw river. This meant that the headblock would have to be placed transversely across the crest of this ridge at some point where there was sufficient lateral space to accommodate the intakes of whatever design of water passages might be adopted. The location of the headblock, on the basis of this limitation, would therefore be a controlling factor in determining the length of these water passages.

As to the nature of the rock itself, an exploratory shaft put down to 180-ft. depth on the site of the headblock confirmed the evidence of the diamond drills as to soundness and freedom from voids and open seams.

It further confirmed what the weathered faces of the escarpment had already partially indicated; namely, that the rock was hard and brittle, that it had a tendency to break in cubes, and that the undisturbed seams within its mass were close and tight.

The primary conclusion deducible from the above facts was that if safe and effective use were to be made of this section of the escarpment to accommodate what had previously been found to be the best location for the powerhouse and tailrace, the first consideration would be to shake up the exposed face and inner mass of the rock as little as possible, in order to avoid (a) the progressive and accelerated disintegration of the exposed face, and (b) the opening-up of seepage and leakage seams from the forebay through the inner mass. The prevention of the first was primarily a function of the position of the powerhouse structure relative to the toe of the escarpment and the adopted type of water connection. The prevention of the second was also a function of the adopted type of water connection, jointly with the position of the headblock relative to the crest-line of the escarpment.

Obviously, there were only two types of water connection to be considered; namely, exposed steel penstocks and a combination of shaft and tunnel.

As to the headblock itself, the prescribed fundamental was that it should pass an ultimate possible maximum of 50,000 cu. ft. per sec. of regulated flow, and the problem was to determine whether or not a headblock structure, located on the escarpment ridge, could accommodate a sufficient number of intakes, of sufficient cross-sectional entrance area, to effectively discharge this function. It was found that sufficient lateral space was available if the number of intakes were limited to six, and that head loss would be within permissible limits if these intakes were connected to water passages having an inside diameter not exceeding 30 ft.

It was at once evident that if these water passages took the form of exposed steel penstocks, the whole crest and face of the escarpment would be shattered and broken up to such an extent that it would probably be necessary to protect the whole of the exposed surface with concrete, and also to provide expensive frost protection.

Furthermore, as related to critical war materials, these penstocks would require about 8,000 tons of steel plate, priority deliveries would be unpredictable, and as to war risk, they would be particularly vulnerable to bombing attack.

The other alternative was, of course, to install the water connections wholly in rock. All known conditions were favourable to this alternative, in the form of vertical shafts and horizontal tunnels. The hard brittle rock was suitable for the pattern drilling and comparatively light shooting which is customary in connection with this class of work; neat lines would be preserved with a minimum of overbreak, and with an absence of "squeeze." These advantages were likely to be accentuated because there was to be sufficient working room to use circular headings.

Figure 5 is a typical cross-sectional view of the headblock, tunnels and powerhouse as built, showing the adopted alternative of combined circular shafts and tunnels for the connecting water passages. There were six of these, concrete lined, each of 30-ft. finished inside diameter.

The excavation and lining of these tunnels and shafts fully confirmed expectations. Except in the immediate vicinity of the shaft collars and tunnel portals, there was no shattering or lifting of the seams and a negligible number of "falls." The completed tunnels and shafts showed no measurable evidence of "squeeze," and after the linings were poured there was nowhere any evidence of pressure cracks or spalling.

Figure 6 is a representative view of one of the tunnel portals, from which may be seen the shallow depth in the outer ledge at which the clean circular lines of the heading developed.

Figure 7 shows a plan layout of the shafts, tunnels and connections to the main units. As will be seen, all shafts are vertical and have the same lateral spacing, but the tunnels fan out from the lower shaft elbows to accommodate the main-unit spacing in the powerhouse.

Thirty-foot diameter steel plate liners, in lengths varying with the natural contours of the overlying ledge, were inserted in each portal and sealed in with concrete. These liners were inserted to a distance which would give the inner end not less than 40-ft. coverage of undisturbed ledge.

The outer extremities of these liners terminated in a wye, with two 18-ft. diameter branches, from which short lengths of 18-ft. diameter penstock extended to the point of connection with the turbine scroll-cases.

All of this steel plate work was welded and subsequently embedded in a reinforced-concrete envelope, with footings on solid rock.

The average length of water passage from headblock to scroll-case is approximately 740 ft., as fixed by the above-explained limitations in the matter of the position of the headblock, and the position of the powerhouse relative to the rock contours at the base of the escarpment.

Incidental to the matter of urgency, the layout above described obviated the necessity of purchasing approximately 4,000 tons of heavy steel plate, and of employing highly-skilled labour under adverse weather conditions; while on the other hand it involved a type of construction which could be carried on entirely independent of season, with much more easily procurable classes of labour and material. As an operating proposition it eliminated the frost hazard and reduced maintenance, and lastly and most important, under then-existing circumstances, it provided an absolute maximum of immunity against bombing attack.

Figure 8 is a view of one of the headblock intakes, the two openings shown serving one shaft and tunnel.

Supplementing the discussion in the preceding section in connection with the handling of ice in the forebay, it will be seen from the elevations marked on the picture that the curtain-wall has a submergence of 22 ft. at static level in the forebay. Under conditions of peak draft this submergence will not ordinarily be less than 20 ft. Having in mind the forebay ice conditions to be expected, as previously explained, any small amount of ice which finally reaches the forebay will be in such condition that it will have sufficient buoyancy impulse to resist the down-draft of the intakes until it has disintegrated or become sufficiently saturated to either melt on the surface or to pass through the racks without building up an obstruction.

Back of each of the openings shown in Fig. 8 is a steel gate with a sill at Elevation 183, thus sustaining a static head of 60 ft.

Figure 9 is a view of the completed forebay and headblock in operation, with a gantry crane for handling racks and lifting the head-gates out of their checks for repairs and maintenance. The hoisting mechanism of the head-gates is housed in the headblock superstructure.

On the date this photograph was taken there were nine main units on load, pulling about 900,000 hp. at full gate.

Generating Equipment

It has already been explained that all water to be ultimately available for power production was to be passed through six tunnels, each of which had two penstock connections at its outlet. This meant, of course, that twelve main units would constitute the ultimate limit of installed capacity and that each turbine would have a rating of 85,000 hp. in round figures.

The matter of the number of units, and of individual unit capacities had, of necessity, to be associated with the fact that the by-passed Chute-à-Caron plant could

Fig. 9—View of forebay, control works, and south wingwall with nine main units in operation.

be considered as a spare unit having a capacity of 200,000 kva. This assumption, however, was subject to the reservation that the Chute-à-Caron plant could not function effectively as a spare on short-period outages unless some considerable portion of its installed capacity was kept warmed up and turning on speed-no-load. This would involve not only the permanent maintenance of an operating staff at Chute-à-Caron, but also the usage of stored water under a 50-ft. loss of head and at an extremely low efficiency.

On the other hand, Chute-à-Caron could function as a spare with full effectiveness on arranged outages at Shipshaw, such as periodic shutdowns for re-fitting and overhauling, and for minor running repairs.

These two considerations relative to the use of Chute-à-Caron as a spare had the following reactions. In the first place it made it advisable, independent of Chute-à-Caron, to have sufficient capacity in the individual units at Shipshaw to bridge a short-period single-unit outage by temporarily overloading the other units. In the second place the availability of 200,000 kva. of spare capacity at Chute-à-Caron made it permissible to consider arranged outages in terms of pairs, instead of single units.

This latter consideration was important, because it thereby became permissible to take a unit out by dropping the head-gates and unwatering the whole connecting system. Furthermore, it obviated the necessity of installing penstock valves, thereby eliminating a certain amount of hydraulic loss, a troublesome item of maintenance, and a very material element of capital cost.

On the basis of the proposition that individual unit capacities should be about 10 per cent of the total installation, the rated unit capacity at Shipshaw would be 100,000 hp. An accidental pull-off of a 100,000 hp. unit would make it necessary for the remaining nine units to each pull approximately 111,000 hp., in order to maintain an existing demand rate of 1,000,000 hp. A pull-off of one 85,000 hp. unit would make it necessary for the remaining eleven units to pull only 91,000 hp. each under like circumstances. This latter margin is well within what can be expected between rating at the gate-opening of best efficiency and full gate.

Added to the above considerations was the practical fact that 100,000 hp. units would have required longer water connections, larger tunnel and shaft diameters, heavier penstock and scroll-case plate, and deeper and more difficult powerhouse substructure excavation. All of these latter considerations had as well their reaction on the matter of urgency, in a particularly critical area.

Accordingly, the turbine specifications called for vertical shaft, single runner, Francis type units of 85,000

Fig. 10—View of main turbine scroll-case in process of being welded.

hp. capacity at or near best gate, operating at a 60-cycle speed of 128.6 r.p.m.

The specifications, as issued, called for prices on one, two and three units installed complete with auxiliaries. However, as previously explained, this order was subsequently extended, first to six, and ultimately to ten new units. The remaining two units were new only to the extent of providing the non-transferable parts of units five and six at Chute-à-Caron.

Of the new units purchased, two more were supplied by S. Morgan Smith-Inglis and eight by Canadian Allis-Chalmers. The S. Morgan Smith-Inglis Company also provided the non-transferable parts of the two units from Chute à Caron, which were of their manufacture.

Figure 10 is a view of one of the turbine scroll-cases bucked up ready for welding, this being the first occasion upon which a completely-welded scroll-case had been installed in the field, including the connection of the plates to the cast steel flanges of the speed-ring. The inlet diameter of this scroll-case is 16 ft. and its maximum out-to-out diameter 49 ft. 8 in.

Corresponding specifications were issued calling for 60-cycle, 3 phase, 13.2 kv. generators, having a capacity of 75,000 kva. at 80 per cent power-factor and 60 deg. C. maximum temperature rise. Thrust bearings were placed on the upper bearing bracket and above them were direct-connected main and pilot exciters. As in the case of the turbines, the specifications called for separate prices, completely installed, on one, two and three generators alternatively.

One special requirement of the specifications was that these generators should be ventilated by a closed system of water-cooled air, for two reasons.

Owing to the large capacity of these generators it was desirable that they should have the advantage of an artificially-controlled ambient, on account of the wide range of natural temperature variation prevalent in the Lake St. John district, and the more so because of the comparatively low summer temperature of the water supply drawn from the deep 22-mile reach of the Chute-à-Caron headpond. If, for instance, the summer ambient can be kept down to a maximum of 70 deg. F. by water-cooled recirculated air, as compared with a natural ambient of, say, 80 deg. F., an additional 377 amperes per phase can be carried within the limit of the guaranteed maximum temperature rise of 60 deg. C. This would add 8,615 kva. to the output of each generator, and a total of 99,150 kva. for the twelve units, thus realizing a material gain in dependable station output by reason of an effective reduction in the winter-summer temperature differential.

A secondary reason under this head has to do with the fact that a closed system of ventilation is free of dust, grit, insects and other matter light enough to be moved. In an open system this matter has a tendency to lodge in the smaller ducts and on heat-softened insulation, so that in the course of time the heat-dispersal efficiency of the generator becomes impaired to a point where it suffers an appreciable reduction in output, for any permissible limit of temperature rise. This gradual process of deterioration may extend over a long period before corrective measures become definitely necessary and during this period, particularly in the case of very large generators in a big station like Shipshaw, the accumulative energy loss might well be very considerable.

The use of water-cooled generators had as well an important reaction from the purely structural viewpoint, because it would have been necessary to lengthen the turbine shafts about 8 ft., and to install an additional reinforced concrete floor over the whole area occupied by the main units, in order to accommodate the duct system which must otherwise have been provided for.

The alternative, as actually adopted, cleaned up and simplified the whole layout of the machine-room floor and what was immediately beneath it, thereby realizing a saving which more or less balanced out the added increment of generator cost.

Figure 11 is a view of the interior of the powerhouse, with the complete installation of twelve units, looking north from unit No. 1. The scale is indicated by the figure beside the generator in the right foreground and the figures at the edge of the gallery in the left middle distance.

The Canadian Westinghouse Company and the Canadian General Electric Company were the only two manufacturers in Canada capable of building these generators, and, for a reason to be later explained, the order for the ten new generators was divided equally between them, on the understanding that all differences in electrical design and characteristics would be satisfactorily compromised, and that—when installed—all generators would be visually identical in outline and exterior dimensions.

The generators shown in Fig. 11 have housings 36 ft. square, and the height from the floor level to the top of the pilot exciter is 23 ft. 1 in. The water-cooling units are located in each of the four corners of the square housings.

Auxiliary Equipment and Services

The overhead travelling cranes in the machine-room were the most important item under this head, particularly by reason of their essential function relative to the initial assembly of the turbines and generators. There were two of these cranes, each having a rated capacity of 185 tons, with the customary motor-driven main propulsion, bridge travel, and main and auxiliary hoists; also an equalizer beam for the purpose of hooking the two main hoists to a fully-assembled rotor.

Each main unit was provided with an oil pressure governor, with a permanent-magnet-generator actuated head. These governors are interconnected in pairs, so that in the event of a failure of oil supply on one unit it can be temporarily supplied from the remaining unit in operation.

Two passenger elevators were provided, one in the shaft rising from machine-room level to the hoist-room floor in the headblock, and another for communication between the various floors of the control annex of the powerhouse building.

A storage-battery installation was provided in duplicate for the primary purpose of station control. In addition to operating the closing and tripping circuits of the circuit breakers throughout the station, these batteries supplied a limited amount of power for emergency lighting service. Charging sets, rated at 7½ kw., were also provided in duplicate.

All powerhouse drainage was handled by an installation of two 12-in. and one 8-in. vertical, single suction, closed impeller type sump pumps, installed in a centrally-located sump and discharging into the tailrace.

Compressed air service to the powerhouse and headblock was supplied through the agency of two stationary compressors having an aggregate capacity of 275 cu. ft. of air per minute at 100 lb. pressure, and one small portable unit for replenishing the governor pressure tanks on the machine-room floor.

The basic consideration underlying the layout and design of the auxiliary services was the length of the powerhouse, which as designed was 837 ft. On this account it was obvious that all auxiliary services involving the pressure or gravity flow of oil, water, air and electricity should have their origin or outlet, as the case might be, as near as possible to the transverse centre-line of the powerhouse building. The primary element of the design was therefore the location of a control section, centering on the transverse powerhouse centre-line, and the control board, control wiring, relays, sump pumps, compressors, storage batteries, transformer and switch-oil transfer and filtering equipment, service water strainers, powerhouse service board, ventilating equipment, elevators and operating staff offices were all installed in this control section, with the main units spaced right and left in groups of six each. Similarly, all gravity water drainage was outletted into a main sump installed in the basement of the control section.

By this means the layout of all piping, and control and service wiring, was very materially simplified, and the weight and diameter of an extensive piping installation were also greatly reduced.

The section of machine-room floor opposite the control section became an erection bay, with two pits and sufficient slab thickness to accommodate two rotors, each weighing 791,000 lb., fully assembled.

One feature of the auxiliary service layout was the elimination of all brass and other pipe for oil pressure supply and gravity drainage. In place of the usual oil piping system, four steel tanks were provided, each of 20 barrels' capacity; one pair being used exclusively for clean oil and the other pair exclusively for dirty oil. These tanks were provided with bails so that the auxiliary hook of the powerhouse crane could pick them up and drop them through a hatch onto the turbine deck beside any of the twelve main units. When so deposited, the clean-oil tank would be full and the dirty-oil tank empty. Thereafter the procedure for changing oil would be to attach a flexible hose to a drain outlet in the bottom of either a generator thrust bearing or guide bearing, and drain the oil into the dirty-oil tank. The next step would then be to make use of a small pump attached to the clean-oil tank to pump the clean re-fill back into the bearing. In the case of a turbine guide bearing the procedure would, of course, be reversed. The dirty oil would require to be pumped out and clean oil run in by gravity.

Operating Tests

Water was admitted into the canal on November 20, 1942, and it was filled to equalized level with the Chute-à-Caron headpond in the ensuing twenty-four hours. This level has never since been drawn down, except through the normal process of increased draft as additional units were put in operation at Shipshaw.

Fig. 11—View of interior of powerhouse, with complete installation of twelve units, looking north from unit No. 1.

There has been no visible evidence of leakage through the sides or bottom of the canal, nor through the zone of the bond between concrete and ledge rock in the bases of the dams. There has been a small amount of leakage through construction joints in the upper courses of the dams and wing-walls, but in some cases this leakage has taken up, and elsewhere it has shown no tendency to increase since the canal was first filled. The following tabulation shows the status of this leakage as of January 14, 1944.

Structure	Leakage in c.f.s.
Dam No. 2	0.100
Dam No. 3-A	Negligible
Dam No. 3-B	0.0050
Dam No. 4	Negligible
South wing-wall	Negligible
North wing-wall	0.0635
Dam No. 5	0.2176
Total visible leakage in canal	0.3861 c.f.s.

On the face of the escarpment, at the rear of the powerhouse where the intervening rock is subjected to the static pressure of forebay water level, there is no appreciable leakage except around the periphery of some of the tunnel liners, where there are some trickling leaks which, so far, have shown no evidence of increasing in volume. Back in the tunnels themselves there were several leakages under pressure, which indicated that they had their source in the forebay, and during the coming summer the intention is to unwater the tunnels when they can be spared, trace this leakage to its source, and take appropriate measures to stop it.

There were several low-pressure leakages in the powerhouse substructure, which proved to have their source in the tailrace. These have already been stopped with grout.

Immediately subsequent to dry-out, operating and

Fig. 12—View of completed powerhouse and headblock from tailrace outlet, with Dam No. 4 in left background.

capacity tests were made on each unit as installed. The first unit so tested was so free of vibration, resonance, and other evidence of overstressing that the manufacturer offered to increase the full-gate capacity of the turbines still going through the shop, by opening up the runners. He estimated that by cutting back the inlet edges of the buckets he could increase the full-gate capacity of each turbine by about 5,000 hp., and by cutting back the trailing edges a further increase of 3,000 hp. could be realized, making an estimated 8,000 hp. in all. The manufacturer further expressed the opinion that this increase in full-gate capacity would not adversely affect maximum efficiency, but was of course not able to offer any conclusive assurance relative to vibration, resonance, and the effect of the suggested modification upon the pitting guarantee in his contract.

It was decided, however, to experiment with two turbines still to be delivered; the runner of one to be cut back on the inlet edge of the bucket only, and the other to be cut back on both the inlet and trailing edges.

Efficiency tests were made immediately following the placing of the two altered units in operation.

These efficiency tests were made by the Gibson method in strict conformity with the testing code, and the results, relative to the above-mentioned experiment, are tabulated hereunder, pro-rated to a net head of 208 ft.

	(a) Unit No. 8	(b) Unit No. 10	(c) Unit No. 9
1. Output rate at best-gate	82,000 hp.	88,000 hp.	86,000 hp.
2. Output rate at full-gate	96,600 hp.	101,360 hp.	105,160 hp.
3. Efficiency at best-gate	92.5%	94.4%	94.5%
4. Efficiency at full-gate	83.9%	85.3%	86.4%
5. Water usage at best-gate	3,760 c.f.s.	3,953 c.f.s.	3,859 c.f.s.
6. Water usage at full-gate	4,880 c.f.s.	5,039 c.f.s.	5,164 c.f.s.

(a) Original runner without alterations.
(b) Inlet edges of buckets cut back.
(c) Inlet and trailing edges of buckets cut back.

Item 1 of the above tabulation indicates that the specification requirement of 85,000 hp. at or near best gate has been met within reasonable limits.

Item 2 indicates, first, that the unaltered runner has met the expectation, with some margin to spare, of a 10 per cent increment of capacity between best gate and full gate; and secondly, that the manufacturer's original estimate of the additional output to be derived from the proposed alterations in the runners was confirmed by a similarly liberal margin.

As to water usage, item 5 indicates that for any one of the three wheels tested, the total water usage of twelve such units would produce 1,000,000 hp. at best gate with an aggregate water usage well below the maximum regulated flow of 50,000 cu. ft. per sec. estimated to be ultimately available.

As to items 3 and 4, the efficiencies shown are not directly comparable, because there was no opportunity, before unit No. 8 was tested, to check the piezometer locations, and the length and diameter of the penstock, by field measurement. Even if these check measurements, when made, show that the efficiency of No. 8 unit is really higher than the present test shows, it is hardly conceivable that this will account for a difference of 2 per cent in best-gate efficiency as compared with units Nos. 9 and 10. If this surmise is confirmed in the actual event, the best-gate efficiencies of units Nos. 9 and 10, as shown above, will constitute an interesting and unexpected outcome of the runner alterations. Subject to one reservation only, this combination of increased output, coincident with increased best-gate efficiency, would justify a material increase in the best-gate rating of either of the turbines with the altered runners, because in actual operation under full load they showed no evidence of undue vibration or other distress.

The one factor remaining to be ascertained is the degree of susceptibility to pitting which one or other, or both, of these altered runners will show as compared with the unaltered original. It seems reasonable to assume, in any event, that if these altered runners are held at their gate opening of best efficiency, their susceptibility to pitting will not be materially increased, even though the cutting-back of the buckets may have increased the pressure differential between the front and rear surfaces.

Construction and Installation Schedule

In January of 1942, by which time the type of development and basic elements of design had been fixed, a construction and installation schedule was prepared, which not only assigned starting and finishing dates to 218 items of construction and installation, but corresponding dates also to the starting and completion of the design and the issue of working plans associated with these items. This schedule also assigned dates for the shipment and delivery, at the site of the work, of all shop-manufactured or shop-assembled equipment and apparatus.

This schedule was framed on the basis of an assumption that the fabrication, delivery and erection of the main units would be the most critical consideration relative to the undertaking to have the first main unit turned over on January 1, 1943, and additional units in any quantity at intervals of one month to six weeks thereafter. As a matter of fact, the delivery schedule for the main units indicated that the first unit could be turned over as early as November 20, 1942, and all structural work at the site was organized to meet this date.

Turbine tenders had meanwhile been received in May of 1941. The accepted tender met the delivery and complete erection dates called for in the specifications, and eight units were ultimately purchased in connection with it. As previously explained, there was no restricted time element involved in the later purchase of two more units from the S. Morgan Smith-Inglis Company, or in connection with the transfer of the two units from Chute à Caron.

In June of 1941 generator tenders had also been received from the Canadian Westinghouse Company and the Canadian General Electric Company, and by this time it had become evident that the initial order would be for not less than six units. The delivery and completion dates in both tenders were entirely out of synchronism with the erection schedule of the turbine contractor. They showed that if the whole of the six-unit order were given to either manufacturer, the generator completion dates would be late in all cases but the first, beginning with one month for the second machine; two months for the third; nearly four months for the fourth; over five months for the fifth, and seven months for the sixth.

To overcome this difficulty the generator completion dates were re-negotiated on the basis of dividing the order equally between the two bidders, and providing for the delivery of units from each source on alternate dates. Under this arrangement the Canadian General Electric Company undertook to deliver the first unit, the Canadian Westinghouse Company the second, and so on. This arrangement continued in force until all of the ten new units were ultimately installed.

The matter of dividing the order involved only a trifling differential in capital cost, while on the other hand the accelerated completion dates of the first six units, as a result of the divided order, permitted the production of some 72,000,000 lb. more of aluminum, at a particularly critical period of the war, than would otherwise have been possible.

As the shop work and erection procedure on the turbines and generators became organized, it was evident that the re-negotiated schedule could be even further improved, and a revised general schedule was prepared to meet this condition. The tabulation hereunder, relative to the first six units installed, shows the results obtained, as compared with the original schedule, in meeting one of the most emergent and vital elements of war materials' production.

Turn-over Dates—Scheduled and Actual

Generator	*Scheduled Date*	*Actual Date*
General Electric No. 7	Nov. 20, 1942	Nov. 23, 1942
Westinghouse No. 8	Feb. 1, 1943	Nov. 25, 1942
General Electric No. 9	Mar. 1, 1943	Mar. 25, 1943
Westinghouse No. 10	June 1, 1943	Feb. 1, 1943
General Electric No. 11	May 10, 1943	Apr. 12, 1943
Westinghouse No. 12	Aug. 20, 1943	June 15, 1943

As will be seen from the above, the completion date of the first generator installed was realized within a three-day margin, while if the dates are considered in successive pairs it will be found that the installation of the first pair of units is about two months; the second pair about three months, and the third pair about two and one-half months ahead of schedule. This was primarily the result of the divided order.

Figure 12 is an exterior view of the completed powerhouse of the Shipshaw development taken from the north side of the tailrace outlet, with the headblock showing in the middle background and Dam No. 4 to the left. Up to the present time at least, this powerhouse contains the largest concentration of hydroelectric power ever installed as a single operation under one roof.

The above results are a most emphatic tribute to the turbine, generator and general contractors in particular, and in hardly lesser measure to all of the shop and field agencies that contributed to this result.

In conclusion, grateful acknowledgment must be made to the owner's executives and engineers, not only for their sustained co-operation but for freely-offered help and encouragement throughout all stages of the work. Similar acknowledgment is also due to the executives and field forces of the general contractor. This three-way relationship constitutes the basic reason why a working schedule, which by all normal standards seemed fantastic, was actually realized. More specific acknowledgments have been omitted for two reasons; first, because they are too numerous for the available space, and secondly, because acknowledgments will be made in papers to be presented later by other authors, covering specific divisions of the work in more detail.

CONSTRUCTION OF SHIPSHAW No. 2 POWER DEVELOPMENT

WALTER GRIESBACH, M.E.I.C.
Chief Engineer, The Foundation Company of Canada, Limited, Montreal.

Paper presented before the Montreal Branch of The Engineering Institute of Canada, on March 2nd, 1944.

One of Canada's major contributions to the war effort has been made by the Aluminum Company of Canada, Ltd., in the completion of the Shipshaw power development. The site is on the Saguenay river, a few miles upstream from the Aluminum Company's main plant at Arvida, Que.

Preliminary studies were made sixteen years ago, when a two-stage development, comprising both the Shipshaw No. 1, or Chute-à-Caron, and Shipshaw No. 2 developments, was contemplated. At that time, during the construction of the plant at Chute-à-Caron, the forebay east of the sluiceway section was excavated to a suitable width and grade to provide an entrance to the head channel of the proposed Shipshaw No. 2 development. This cut was carried about 1,000 ft. downstream from the sluiceway, and was closed by an earthfill dam.

Soon after the war began, it was apparent that additional power would be required to meet the increasing wartime demand for aluminum, and arrangements were made to complete the Shipshaw development. It was also apparent that some additional power would be required before the No. 2 development would reach the production stage, and that the initial requirements could best be met by extending the existing No. 1 plant. Accordingly, construction was started in April 1941, on the installation of two additional units (Nos. 5 and 6) at Chute-à-Caron, to develop about 65,000 hp. each under a normal operating head of 150 ft. The work included a powerhouse substructure and superstructure; two intakes 25 ft. wide in the west bulkhead wall, requiring a cofferdam in 40 ft. of water; two 17 ft. diameter steel penstocks 380 ft. long, and a new tailrace 340 ft. long, 102 ft. wide at the powerhouse and 45 ft. wide at the entrance to the existing tailrace. Total quantities included 96,000 cu. yd. of earth excavation, 79,000 cu. yd. of rock excavation, and 32,000 cu. yd. of concrete.

Power was delivered from unit No. 5 on February 8th, 1942, and from unit No. 6 on April 1st, 1942. These two units were later removed and installed in the Shipshaw No. 2 powerhouse as units Nos. 1 and 2.

Authority to proceed with the construction of the No. 2 development was granted to the general contractor on May 15th, 1941. Figure 1 shows the general layout of the complete development including:

1. Control Works. This is the first structure below the old earthfill dam and contains six steel sluice gates for controlling the flow from the forebay to the head channel. It is 384 ft. long, and has a maximum height of 50 ft. It consists of a concrete sill, five reinforced concrete piers, and two abutments with 50 ft. clear openings, and a reinforced concrete deck carrying a 20 ft. roadway, a sidewalk and a log flume.

2. Head Channel. The channel is about 7,500 ft. long from the control works to the headblock, and has a minimum bottom width of 500 ft. in earth cuts, and 300 ft. in rock cuts. The depth of water varies from 27 to 33 ft. with normal operating level at Elevation 243.

3. Dams. There are five gravity type concrete cut-off dams between the control works and the headblock, to confine the flow within definite limits in the head channel. The dams are known as Nos. 2, 3A, 3B, 4 and 5. The lengths vary from 375 to 2,031 ft., and the maximum height is 120 ft.

4. Headblock. This structure is located at the lower end of the head channel, and forms the intake for the six 30 ft. diameter shafts and tunnels, which carry the water from the head channel to the turbines in the powerhouse. There are twelve sets of steel gates and trash racks about 23 ft. wide and 31 ft. high. The substructure is 70 ft. high and 479 ft. long, and has a gravity type, concrete wing wall extending from each end a distance of 347 ft. and 590 ft. to high rock points near the ends of Dam No. 4 and Dam No. 5 respectively. The one-storey superstructure is of reinforced concrete construction.

5. Shafts and Tunnels. There are six main shafts and tunnels, "A" to "F" inclusive, and one small access shaft and tunnel. The main shafts are 141 ft. deep from head channel grade to the centre line of tunnels, and have a minimum diameter of 30 ft. inside of concrete lining. The tunnels are 30 ft. in diameter inside of concrete lining, and average about 468 ft. in length from the centre of the shaft to the portals back of the powerhouse. They slope down from the shafts to the portals on a one per cent grade.

6. Tunnel Liners, Wyes and Penstocks. The water is carried from each tunnel to two turbines through 30 ft. diameter steel tunnel liners and wyes which divide the flow through two 18 ft. diameter steel penstocks. The steel liners vary from 29 to 200 ft. in length inside the tunnels, and wyes and penstocks have an average length of about 150 ft. The wyes and penstocks are encased in reinforced concrete, and are covered with 23 ft. of backfill.

7. Powerhouse. The powerhouse, 73 feet wide and 837 ft. long, houses twelve units, originally designed to be rated at 85,000 hp. each and subsequently stepped up by alterations to the runners to a maximum output for the 12 units of 1,200,000 hp. under a normal operating head of 208 ft. The substructure is 75 ft. high, and the superstructure, of structural steel frame and reinforced concrete construction, is 72 ft. high. There are two overhead cranes each having a capacity of 185 tons. The transformers and switching structures are located at the rear of the powerhouse.

8. Tailrace. The tailrace is about 650 ft. long, 730 ft. wide at the powerhouse, and 300 ft. wide at the entrance to the Saguenay river. The floor is at Elevation +1 at the powerhouse, and +5 from a line 100 ft. downstream, to the mouth. Normal water level is at Elevation 35 at the powerhouse.

Construction Schedule

The initial contract called for the construction of the complete development from the control works to the headblock inclusive, but only three of the main shafts and tunnels, and the east half of the power-

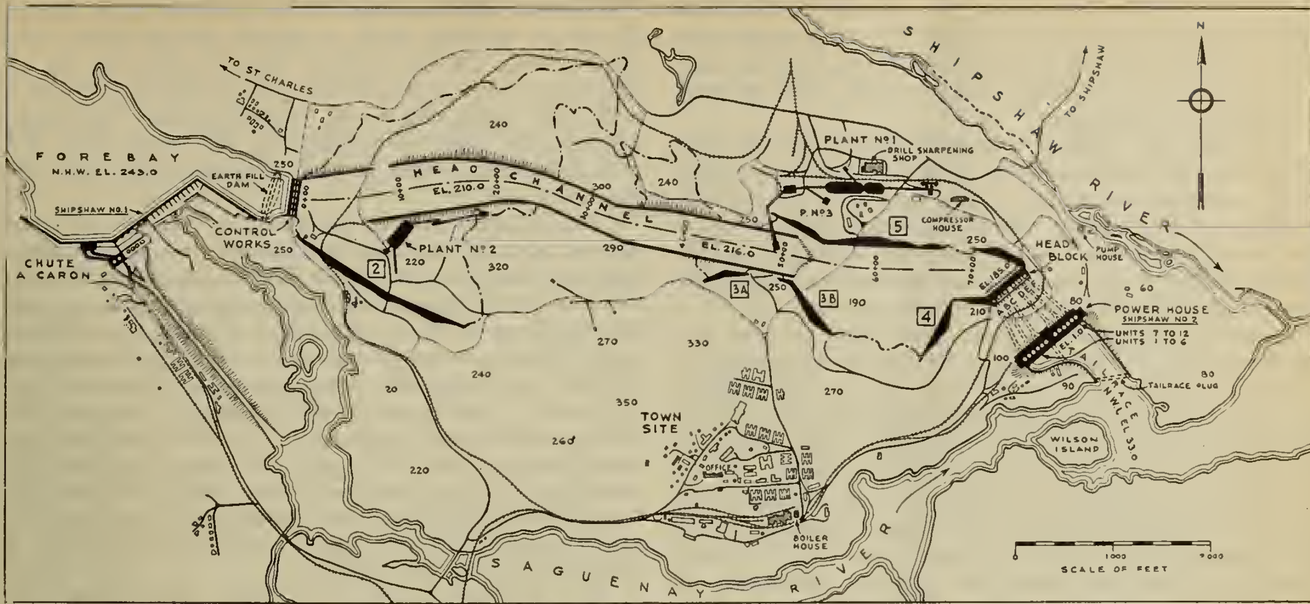


Fig. 1—General layout of Shipshaw development.

house, including units Nos. 7 to 12, and the central erection bay and control section. The schedule called for power to be delivered from units Nos. 7 and 8 on January 1st, and February 15th, 1943. In the spring of 1942, it was found that one of the manufacturers could deliver a unit ahead of his original promise, and the construction schedule was advanced to show the first unit "on power" on November 20th, 1942. At about the same time, it was decided to proceed with the construction of the west half of the powerhouse including units Nos. 1 to 6. The revised schedule called for all work to be completed by December 1943.

The construction schedule was an exceedingly fast one, even for normal times, and called for much careful planning and organizing to overcome the difficult conditions of the wartime labour and material markets.

Preliminary Work

All branches of preliminary work, including the clearing of the site and building of roads and railroads, a town-site, service buildings and machine shops, compressor house and air lines, pump house and water lines, heating plant and steam lines, transformer installations and electric power lines, and rock-crushing and concrete mixing plants, were carried out simultaneously in order to expedite actual construction operations.

Clearing and Roads. Four hundred and thirty acres of the site were cleared, and a total of 16 miles of roads and 17 miles of standard gauge railroads were built to provide highway and rail connections and ready access to all parts of the work.

Townsite. The townsite was centrally located on the north bank of the Saguenay river, and included administration buildings and housing and feeding accommodations on an upper level, and service buildings and yards on a lower level along the river bank.

The administrative group included a two-storey office building 187 ft. long, with a total floor area of 14,800 sq. ft. which housed the general job staffs of the owners, the consulting engineers and the general contractor; a large two-storey building allotted to police and fire protection service; a branch of the Royal Bank of Canada; a post office with the general contractor's office manager installed as the authorized Government postmaster; a school house; a well-equipped concrete testing laboratory; a sixteen-bed general hospital with a separate five-bed isolation hospital, with a resident doctor in charge, and a seven-room nurses' residence.

The residential section included 20 individual cottages and 34 apartments in three separate buildings for renting to married employees and their families; a women's staff house and a men's staff house, accommodating 24 and 74 respectively.

The general camps consisted of two-storey, three-wing cubicles, with wash rooms in the connecting sections. There were both single and double room accommodations with one, two and four persons per room, capable of housing from 184 to 336 men per building. In all, there was accommodation at the site for about 3,900 workmen. The staff dining room had a seating capacity of 156, and there were four separate dining rooms for the workmen, having a total seating capacity of 2,740. In conjunction with the camps, there were also the usual fruit storage, bakery, blanket, lunch-box and commissary buildings. A five-chair barber shop and laundry were also provided for the convenience of the residents. The recreation building contained an auditorium with a seating capacity of 600, a card room, a canteen, and wash rooms. Moving pictures and wrestling and boxing shows provided entertainment through the week, and on Sundays, both Roman Catholic and Protestant services were held in this building. An open-air rink, a ball park, and tennis and croquet courts served for outside sports and amusements.

All boarding, housing and commissary accommodations were operated by Crawley and McCracken Company, Limited.

An automatic fire alarm system, developed by A. J. F. Montabone, consulting electrical engineer, was installed in all apartment buildings, staff houses and cubicles. The system consisted of a low temperature fusible link, 180 deg. F., mounted on the ceiling, a double contact relay, and loud ringing gongs located in the corridors. In case of fire, a gong was also set ringing in the fire station, and the location of the building in which the fire started was indicated.

The service buildings and yards on the lower level included the main warehouse, machine shop, electrical shop, carpenter's shop, truck and tractor garages and repair shops, tire storage buildings, oil and gas storage tanks, coal and lumber storage yards, and general railway yard facilities.

All buildings were of standard timber frame construction with outside 7/8 in. T. & G. sheeting covered with asphalt brick siding, ready roofing or galvanized corrugated iron siding. All living quarters were lined inside with fibre board or gyproc, and cottages, apartments, staff houses, staff dining rooms, hospitals and the Nurse's Home were insulated with rockwool.

Mechanical Department. The work of this department was a most important factor in making it possible to meet the construction schedule. The problem of keeping all the plant and equipment in operating condition was a big one on account of the scarcity of plant and the speed of operations required.

The machine shop was equipped with 28 pieces of modern equipment including lathes, presses, drills, welding outfits, grinders, a planer, a shaper, a milling machine, a shearing machine, a power hacksaw, a bolt-threading machine, and a 600 lb. steam hammer.

To effect economy in the use of tires, two vulcanizing machines were installed in the tire repair shop, one handling the ordinary run of automobile and truck tires; the other was used exclusively to repair the large 12 by 24 in. and 14 by 24 in. tires for the Euclid trucks.

To expedite the work, five trucks, with a mechanic in charge of each, were equipped with miscellaneous spare parts for shovels, trucks, tractors, pumps, electrical installations, etc., and made minor repairs to equipment in the field. Also a large percentage of the gasoline and fuel oil used was delivered by truck tank to equipment at the site of operations.

During the peak period, about two hundred trucks were engaged in delivering materials from storerooms and yards, transferring men and attending to L.C.L. and express shipments.

Eight 40-ton steam locomotives were used in yard service for placing cars of materials and equipment and handling empty cars.

Roads were maintained in the summertime by truck-drawn drags and tractor-drawn graders, and in the wintertime by D-8 tractors with caterpillar snowplows, and trucks with snow blade attachments.

As many as 750 men were engaged in the mechanical department.

Sewers. A complete sanitary sewerage system was installed in the townsite. All sewage was disposed of in the Saguenay river.

Water Supply. Two electrically operated pumps, one 12 by 10 in. Allis-Chalmers and one 8 by 6 in. Cameron, and one gas-driven 8 by 6 in. Fairbanks-Morse pump, installed in a temporary pump house on the west bank of the Shipshaw river, provided for all domestic, fire and construction purposes. The water was chlorinated in the pump house and pumped to two elevated storage tanks, each having a capacity of 100,000 gal. To increase the flow and pressure at the townsite when required, a 1,200 gal. per min. at 220 ft. head, gas-driven Fairbanks-Morse pump was installed in the line near one of the storage tanks. The distribution system involved about 38,000 lin. ft. of cast iron pipe varying in diameter from 12 to 3 in.

An intake for water supply was included in Dam No. 3B, and a permanent pump house was built adjacent to the downstream side. This installation was used after the flooding of the head channel.

Heating. All buildings in the townsite were heated by steam supplied from a central heating plant containing four 150-hp. boilers. Other boilers set up at convenient points around the job for heating concrete, concrete aggregates and miscellaneous buildings, brought the total up to 3,300 hp. All steam lines and returns, about 19,000 lin. ft., were insulated and carried overhead.

Compressed Air. A preliminary study of compressed air requirements was based on using Canadian Ingersoll Rand wagon drills, N-82 sinkers, JA-55 and JA-45 jack hammers, with assumed drilling capacities for each type of drill, and assumed lineal feet of drilling required per cubic yard of rock to be excavated. Orders for equipment were placed immediately on the basis of minimum requirements, and as soon as definite data were available, a detailed analysis was made, and orders for equipment were adjusted accordingly. A separate study was made for each section of the work based on the estimated quantity of rock excavation, and on the time allotted for it according to the schedule.

The following analysis illustrates the method used to arrive at the drilling equipment and compressor capacity required:

Rock excavation, January 15th to September 30th, 1942.

Working time	=212 days (two 10 hr. shifts per day)
Total yardage	=500,000
Daily yardage, 500,000÷212	=2360
Drilling per cu. yd.	=2 ft.
Total feet to be drilled per day	=2360 x 2=4720

Drilling equipment required.

4 FM-2 wagon drills @ 320 ft. per 20 hrs.	=1280 ft.
12 N-82 sinkers @ 160 ft. per 20 hrs.	=2080 ft.
6 JA-45 jack hammers @ 125 ft. per 20 hrs.	= 760 ft.
4 well drills (equivalent to)	= 640 ft.
Total	4760 ft. per day

Air Consumption.

4 FM-2 wagon drills @ 265 x 3.6	= 955 cu. ft. per min.
12 N-82 sinkers @ 210 x 9	=1890 "
6 JA-45 jack hammers @ 100 x 5.07	= 507 "
Total	3352 "

The lineal feet of drilling required per cubic yard of rock varied from 1.5 in heavy cuts, to 3.5 in shallow cuts. By plotting the requirements for each month corresponding to the time schedule for each section of the work, the maximum number of each type of drill, and the maximum cu. ft. per min. of compressed air was obtained for each month. Theoretically, a maximum compressor capacity of 32,000 cu. ft. per min. was required. As the work progressed, it was found advantageous to use a greater number of well drills in the heavy cuts, and provision was made for a peak requirement of 31,000 cu. ft. per min. The main compressor plant was located near the east end of the head channel, and included 7

Canadian Ingersoll Rand—XVHE2, 3,330 cu. ft. per min. compressors, having a total capacity of 23.310 cu. ft. per min. An additional 4,000 cu. ft. per min. from motor driven compressors located near the west end of the rock work, was connected into a loop from the main plant, and a further additional 4,000 cu. ft. per min. was supplied by 16 portable and semi-portable compressors located at advantageous points on the site. Air was delivered to the lines at 100 lb. per square inch, and was protected from freezing by the use of tanner gas. To surround the areas to be drilled with cross connections to provide suitable loops, required a total of 33,400 lin. ft. of pipe. Standard weight steel pipe varying in diameter from 12 to 3 in. was used. With the exception of a few dresser couplings, all joints were welded.

Drill Sharpening. A central drill sharpening and drill repair shop containing 13 Canadian Ingersoll Rand model 550B and 2 model 34 drill sharpeners, 12 model 45-SP shank and bit punches, 13 model 27-F oil furnaces, one model K500 shank-end grinder, 6 model CV-8 pedestal grinders, 2 quenching tanks, 2 Gill and 2 Bucyrus-Erie bit dressers, and miscellaneous accessory equipment took care of all requirements. An average of 12,000 drill steels were handled per day, which amounted to 40 steels per hours per sharpener. One bit dresser took care of six well drills.

Electric Power. Temporary electric power for motor driven equipment and lighting was supplied from the Chute-à-Caron plant, through one mile of 66,000 volt transmission line, from an existing line to the main substation located on the river bank opposite the centre of the townsite. The substation consisted of a bank of three 10,500 kva., 66,000 to 13,200 volts, single phase, outdoor type transformers. From here, 13,200 volt, 3-phase current was distributed in a 19-mile loop around the townsite and construction area. From ten separate substations on this line, 3-phase current was distributed at 2,200 volts to the various power and lighting points, using 7 miles of lines. From these points, approximately 17 miles of 3-phase, 550 volt lines, 3 miles of 3-phase, 440 volt lines, and 25 miles of 110-220 volts, single-phase lines, were required. There was a total motor connected load of 11,692 hp. The peak load was 6,380, and the average about 5,280 hp., making the load factor about 45 per cent.

Telephones. The telephone system consisted of two switchboards connected to outside lines, with five trunk lines capable of taking care of 185 telephones around the job, and two automatic exchanges with 20 lines each for local use only. A total of about 55 miles of telephone wire was used.

Rock Crushing and Concrete Mixing Plants. The on-power date of November 20th, 1942, for unit No. 7 established the limiting date for time in determining the capacity required for the rock-crushing and concrete-mixing plants. The net time available for concreting depended upon delivery of equipment, and the time required to install it, and to make the necessary adjustments for efficient operation. After a careful study it appeared that a minimum of 640,000 cu. yd. of concrete would have to be poured in about seven months, and on account of the layout of the work it was decided to build two plants, Nos. 1 and 2.

Over two-thirds of the volume of concrete was concentrated in the area at the east end of the head channel, and No. 1 plant was located in this vicinity. With the exception of the primary crushers, it was outside of the flooded area. The primary crushers were located at the end of a heavy rock cut in the head channel to facilitate the supply of crusher feed from the rock excavation. No. 2 plant, equipped to provide about one-third of the total volume of concrete, was located at the west end of the head channel. (See Fig. 1.)

After the completion of the Chute-à-Caron extension, the concrete mixing plant was moved over to Shipshaw and set up as No. 3 plant at a convenient point to receive aggregates from No. 1 plant. It was used during the peak period to supplement the main plant in supplying special mixes for certain parts of the work.

No. 1 Plant. To assure a daily average of about 2,500 cu. yd. from the No. 1 plant, it was decided to use four 2-cu. yd. mixers to provide ample capacity to take care of unforeseen delays, and to meet peak demands. The section from the primary crushers, through to and including the classifying bins, was duplicated to provide for repairs and screen replacements, and to provide sufficient capacity to maintain an ample supply of aggregates in the stock piles. Each half was designed to produce about two-thirds of the mixer requirements. Four sizes of coarse aggregate were required, 1/4 to 3/4 in., 3/4 to 1 1/2 in., 1 1/2 to 3 in., and 3 to 6 in. The percentages of these sizes were, 20, 14, 18 and 22 respectively. Twenty-six per cent of sand completed the average requirements.

The crushers were set below grade so that there would be a minimum of demolition work required after their removal, and prior to the flooding of the head channel.

As shown in Fig. 2, the rock was dumped into hoppers having provision for delivery to either the sides or ends of the Stevens-Adamson 60 in. giant feeders which fed the two primary crushers. These were 42 by 48 in. Traylor Bulldog jaw crushers set with 7 1/2 to 8 in. openings, and having a rated capacity of 260 tons per hour each. The actual gross average production per crusher obtained over a period of five months was about 145 tons per hour, and the net average production of crushed aggregates amounted to about 110 tons per hour, crusher fines and foreign matter amounting to an average of 24 per cent. The amount of crushed rock required to take care of the average output of the mixers was about 120 tons per hour.

The conveyors carrying the output of the primary crushers to the secondary crushers were in two sections, C1 and C1A, to provide for a necessary change in directions for the most economical layout. Provision was made at the junction of these two conveyors for an intermediate takeoff for storing surplus rock from the primary crushers. This rock was available for use after the head channel was flooded.

After the crushers were removed from their original location, only one was set up, and conveyor C1 was re-arranged to suit C1A for the remainder of the concreting.

Conveyors C1A were provided with magnetic pulleys to remove tramp iron before it reached the secondary crushers. It was necessary, however, to remove dipper teeth by hand, as these were manganese steel and non-magnetic. These conveyors discharged over grizzlies which separated the feed for the secondary crushers. Each grizzly was 4 ft. wide and 8 ft. 5 in. long, set on a 35 deg. slope, and was composed of steel bars 4 in. deep, and tapering in thickness from

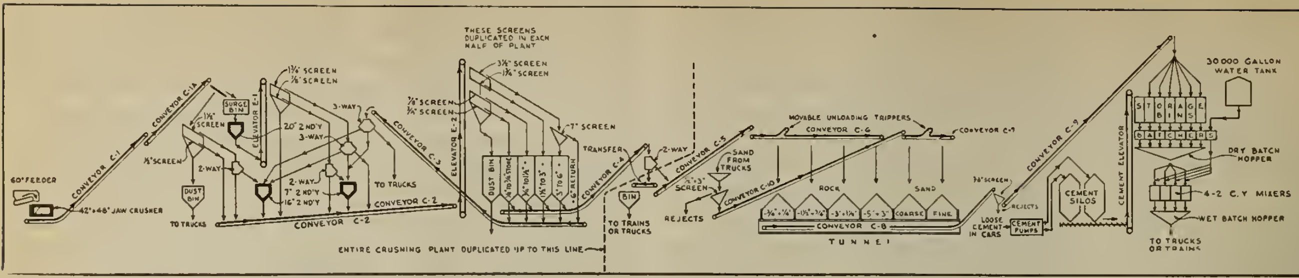


Fig. 2—Diagram showing the flow of aggregates at crushing and mixing plant No. 1.

1 in. at the top to 5/16 in. at the bottom, with ⅞ in. square manganese steel bars welded on top. The bars were spaced 7½ in. clear at the upper end, and diverged to 8½ in. at the lower end.

The rock passing over the grizzlies discharged into a common surge bin, and that passing through was conveyed by chutes to a pair of scalping screens to remove as much as possible of the fines and foreign material before reaching the secondary crushers. The scalping screens were equipped with 1½ in. mesh on the top deck, and ½ in. mesh on the lower deck. The function of the top deck was to remove the larger pieces and to protect the bottom deck. Material passing the ½ in. screen was diverted to a hopper and disposed of from there by truck. The rock retained on the top screen travelled by chute to the secondary crushers, and that retained on the lower screen was conveyed to the classifying bins.

The rock from the surge bin was fed by chute to the 20 in. secondary crushers, and from there was raised in elevator E-1 and discharged over a set of screens, and then passed through two or three-way chutes to smaller secondary crushers or direct to the classifying bins as required to produce the necessary proportions of the four different sizes of aggregates.

Allis-Chalmers secondary crushers were used, and each set consisted of one 20 in. and one 16 in. Superior McCully, and one 7 in. Newhouse.

The crushed rock was transported from the secondary crushing plant to the classifying bins by belt conveyors C-2 and bucket elevators E-2. From the bucket elevator it passed over a series of double deck screens which separated it into the required sizes, and fed it by chute to the bins. The capacities of the bins were in proportion to the percentages of each size required, and varied from 250 to 350 cu. yd. each. All material passing the ⅜ in. screen was collected in a dust bin, and was disposed of by truck. Gates were provided at the bottom of the classifying bins containing the three larger sizes for return of rock by conveyors C-3 for re-crushing or for loading on to trucks. Over-size rock was by-passed to this conveyor and returned to the 16 in. crusher.

Screen feeds were arranged so that rock was fed on to the screen in the opposite direction to that in which it travelled in passing over the screen. The mesh openings used to produce the required sizes of rock were as follows:—7 in. for 3 to 6 in.; 3½ in. for 1½ to 3 in.; 1¾ in. for ¾ to 1½ in.; ⅞ in. for ¼ in. to ¾ in.; ⅜ in. for ¼ in. and under.

Duplicate conveyors C-4 carried each size of crushed rock, separately, from the classifying bins to a common inclined conveyor C-5, which fed the horizontal conveyor C-6 over the stock piles. At the junction of conveyors C-4 and C-5, a horizontal, reversible cross conveyor was built to supply crushed rock to No. 3 mixing plant at one end, or to load cars or trucks at the other end.

Two grades of sand, one fine and one coarse, were used in the mix to produce the required results. Thirty per cent of fine and 70 per cent of coarse generally were required. The sand was hauled by trucks from near-by pits and dumped in hoppers close to the aggregate storage piles. It was passed through vibrating screens with ½ by 3 in. transverse openings to remove any clay lumps or refuse, and carried up an inclined conveyor C-10 to a horizontal conveyor C-7 over to the stock piles. Both conveyors over the stock piles were equipped with unloading trippers for depositing the aggregates in separate stock piles, four of rock and two of sand. A storage capacity varying from 5,700 to 6,700 cu. yd. for each size of coarse aggregate, 12,000 cu. yd. of coarse sand, and 6,800 cu. yd. of fine sand was provided. This was calculated to be sufficient to keep the mixing plant operating for about one week.

The aggregates were reclaimed from the storage piles through a tunnel 632 ft. long, provided with gates at 15 ft. centres. The gate openings were 20 by 20 in. except for the 3 to 6 in. rock, where they were 24 by 24 in. The aggregates discharged by chutes to a horizontal belt conveyor C-8, which fed the inclined conveyor C-9 leading to the storage bins over the mixing plant.

A standard Link-Belt screen, with ⅜ in. mesh, was installed at the junction of conveyors C-8 and C-9 to remove any dust and foreign matter which might have accumulated in the aggregates over the reclaiming tunnel.

To provide for efficient operation, signal lights were installed at the following strategic points:—

1. Light at the feeder, operated by switch at primary crusher discharge, to warn feeder operator that conveyor C-1 had stopped.
2. Light at head end conveyor C-1, operated by switch at primary crusher discharge, to warn operator at head of C-1 to stop the conveyor for clearing the chute under the jaws.
3. Light at head end of C-1A, operated by switch in secondary crusher house, to stop C-1A, C-1 section, in case of trouble in the secondary crusher house.
4. Light in secondary crusher house at crusher feed level, operated by switch in classifying bins, to warn operator to stop feeding crushers in case of trouble in the classifying bins.
5. Light at each gate feeding C-4 over classifying bins to indicate to operator that bin, indicated by light, needed emptying.
6. Light over each stock pile operated by switch at corresponding classifying bin gate to warn tripper operator what size rock was being sent, so that he might get tripper in position.

7. Answering lights at each classifying bin gate, operated by tripper operator when tripper was in position to distribute the size rock being sent.
8. A system between No. 3 mixing plant and the classifying bins similar to 6 and 7, except that the signal was relayed from the operator at the head end of C-4 in order that he might have control over the setting of the gates for No. 3 mixer, or the main stock pile.

In addition to the signal lights, an automatic dial telephone system was installed with telephones located at eight different important points: the primary crusher house, the secondary crusher house, screen floor of classifying bins, conveyor C-4 at classifying bins, conveyor C-4 at junction with No. 3 plant, conveyor C-6, conveyor C-3, and crusher superintendent's office. The telephones were installed in sound-proof booths, and the calling signal was given by lights.

Of great value in preventing damage to equipment through stoppage of any one of the conveyors, was the provision of an interlocking system. Conveyors and elevators were interlocked in groups so that it was necessary to start them in the order indicated in the flow diagram, the conveyor furthest along the line starting first, with the others following in proper sequence. The following grouping was used:—

1. C-1A, C-1, and feeder (each half of plant separate).
2. E-2, C-2 and C-3 (each half of plant separate).
3. C-6, C-5 and C-4 (both C-4's connected in the group).
4. C-7 and C-10; 5. C-9 and C-8.

If any single conveyor in a group stopped, all units behind it stopped also, but all units ahead of it kept operating. The crushers were not included in the interlocking system in order to eliminate lost time in cleaning out a crusher if stopped under load.

All motors in one group could be stopped immediately by emergency control buttons, and the whole plant could be stopped from several points by master controls.

All conveyor trestles, crusher house and classifying bins were of timber construction carried on concrete foundations. The superstructures were sheeted with corrugated galvanized iron. The tunnel under the stock piles was of reinforced concrete construction.

All conveyors and screens were of Link-Belt manufacture, except over the sand hoppers, where Allis-Chalmers screens were used. The rock screens were 4 by 8 ft. double-deck, vibrating screens, and were set at an inclination of from 22 to 28 deg. To eliminate vibration in the building, the motors were mounted on a bracket welded to the screen base, and the screens were suspended by four ⅝ in. cables through 5½ by 6 in. helical springs.

All chutes were built " stepped " to reduce the wear on the steel plating, and were set at an inclination of 45 deg. The step at conveyor discharge points was built as a box of sufficient size to allow rock from the conveyor to fall on a bed of rock in the chute. All inclined conveyors were set at an inclination of 15 deg. The belts were 5 to 7 ply, rubber-covered, and generally were 42 in. wide. Belts in return conveyors C-3 from classifying bins and in sand conveyors, were 30 in. wide.

Enclosed roller-bearing motors were used and gave very little trouble, if blown free of dust at least once a week. It would have been desirable to have used dust-proof motors throughout, but they were not available. At the primary crushers, as much as possible of the dust was removed by installing hoods over each conveyor C-1, as it left the crusher foundation. An air jet was used to induce a draught in stacks leading to the outside.

In the secondary crusher house, ducts led from each crusher discharge spout and elevator to a Canadian Blower and Forge fan having a capacity of 11,000 cu. ft. per min. Each half of the plant had its own exhaust system.

Specifications called for concrete placed when the outdoor temperatures were lower than 40 deg. F., to have a temperature of about 80 deg. F. when it arrived at the forms. To obtain this, it was necessary to heat the aggregates as well as the mixing water. Steam was led into the reclaiming tunnel at the centre and at one end in 5 in. diameter mains. Feeders of 2 in. diameter at 45 ft. centres were carried through the roof of the tunnel, and steam was distributed through 2 in. headers into jetting units resting on the roof and extending about 22 ft. on either side of the headers. The units consisted of three lengths of 1½ in. diameter pipe, with saw cuts ⅛ to ⅜ in. deep at 3 ft.-9 in. centres, to permit the escape of live steam to the stock piles.

The vertical-flow type of concrete mixing plant, as manufactured by the C. S. Johnson Company of Champaign, Illinois, with four concentrically arranged 2 cubic yard, 60 deg. tilt Smith mixers, was chosen because of favourable production records established on similar large jobs. This type of plant is so designed that the aggregates flow by gravity from the storage bins through the batchers, collecting hopper, mixers, and finally through a hopper into the transfer buckets. The mixers are carried on a separate foundation structure so that any vibration set up by them is not transmitted to the batching and weighing mechanisms.

From conveyor C-9, the different aggregates, four of rock and two of sand, were fed through a swivel type hopper into six separate bins at the top of the mixing plant. The cement bin was in the centre and the aggregate bins were arranged symmetrically about it. The cement bin had a capacity of 750 barrels, and each of the aggregate bins had a capacity of 100 cu. yd. The bottoms of the bins sloped towards the centre where the batcher gates were arranged in a circle around the cement batcher. All aggregates were weigh-batched simultaneously, and directed to one of the four mixers, in sequence, through a revolving chute. Water was introduced to the mixers through a water batcher connected to a 370-gallon steel tank. Cement and water storage were provided in two 3,000-barrel steel silos and a 30,000-gallon elevated wood stave water tank located close to the mixing plant.

Fuller-Kinyon pumps were used to handle the bulk cement from the railway cars to the silos, and directly to the storage bin over the mixing plant. There were two 6 in. pipe lines to each storage location, and four pumps were used, two Type B manually controlled, and two Type C automatically remote controlled. Up to 20 cars of cement were handled per day. Each silo was provided with a 12 in. diameter ventilator to permit the escape of compressed air used in conveying the cement to them. The silos were also equipped with bin-dicators connected to lights in the mixing plant to indicate when the silos were full of cement. The cement was carried from the two silos through 12 in. diameter screw conveyors to a common bucket elevator having a capacity of 420 barrels per hour. The cement was elevated to the top of the mixing plant by the bucket elevator and discharged into the cement bin through a 10 in. diameter steel chute.

The four mixers were mounted on a heavy reinforced concrete slab at 90 deg. intervals around a central batch hopper. The mixers were both charged and discharged from the front end. All batching, mixing and dumping operations were automatically controlled by one operator from the operator's control panel on the floor above the mixers. A system of coloured lights indicated the various operations.

The operations were continued in rotation for all four mixers, and as soon as any one mixer was dumped and returned to normal position, a new batch of aggregate would be ready to charge it again. The speed of operation was limited by the mixing time set on the timer. To this time must be added a minimum of seven seconds to charge, dump and recover each mixer.

An important feature of the Johnson batching setup was the "mix selector" on the control panel. By means of this, the general batcher circuit could be instantly changed from one to another of the three mixes set up on the three-weigh beams in the weighing assemblies of the individual batchers.

Concrete was discharged from the wet batch hopper to buckets by an operator located below the mixer floor where he had full view of the transfer truck movements.

The mixing plant was completely housed-in above the mixer floor level and was steam heated. A dust-collector boot was mounted on the floor at the back of each mixer, and Canadian Blower and Forge Type 23 exhaust fans discharged the dust through openings in the floor slab into ducts leading down to enclosed dustbins attached to the columns supporting the slab, for disposal by trucks. An exhaust fan was also used to remove dust from the head house over the storage bins.

This plant was operated from March 16th, 1942, to November 6th, 1943, and produced 654,000 cu. yd. of concrete. Up to November 1st, 1942, when about two-thirds of this amount had been poured, the average daily production was 2,234 cu. yd., and the maximum 4,389 cu. yd.

No. 2 Plant. The design of the rock-crushing and concrete-mixing plant No. 2 was generally similar to plant No. 1, but use was made of such equipment as was available whether new or used. It was located clear of any work required in the head channel with the primary crusher end near a rock cut in the head channel, and the mixer end near the centre line of Dam No. 2.

The crushing plant consisted of two primary jaw crushers, a 30 by 60 in. Traylor and a 24 by 36 in. Superior, and four secondaries including a 14 in. and 20 in. Traylor gyratory, a 6 K Gates gyratory, and a 3 ft. Symons cone crusher.

The rock was crushed and conveyed over a series of screens and separated into four different sizes of aggregate, and distributed from classifying bins to separate stock piles. Coarse sand was obtained from a pit adjacent to the plant, while fine sand was trucked in from the same pit which supplied plant No. 1.

Bulk cement was used and was handled by two Fuller-Kinyon Type C pumps, directly to a 1,000-barrel cement bin over the mixers, or into a 2,000-barrel storage building at track level and, when required, from this storage back to the cement bin.

Two 2-cu. yd., 45 deg. tilt, Smith mixers were installed back to back.

In this plant, batchers were installed in the reclaiming tunnel, and all six batchers discharged on to the conveyor belt simultaneously. The charge was conveyed to a 2-cu. yd. collecting hopper over the mixers and below the cement batcher. Cement was fed by gravity from the 1,000-barrel bin to the cement batcher which discharged into the collecting hopper. Water was supplied by a water batcher fed from the water tank. The mixes were discharged from the collecting hopper through a tilting chute which alternated from one mixer to the other, and were discharged from the mixers into chutes at opposite sides of the plant directly into 2-cu. yd. buckets on trucks below.

All batching, mixing and dumping operations were automatically controlled from the operator's control panel located on the batching floor. On account of the aggregate batches being located in the reclaiming tunnel, a remote control indicator was set up at the control panel.

Production started on April 28th, 1942, and finished on August 1st, 1942. A total of 131,361 cu. yd. of concrete were poured from this plant, the average per day being 1,263 cu. yd., and the maximum 1,860 cu. yd.

No. 3 Plant. This plant consisted of two 1-cu. yd. Jaeger non-tilting type mixers, batching apparatus and steel storage bins. It operated from May 27th, 1942 to October 29th, 1942, and produced 32,000 cu. yd. of concrete in which the two smaller sizes of coarse aggregate only were used. Crushed rock and sand were taken from the No. 1 plant. Rock was supplied by belt from conveyor C-4 and sand was trucked from the stock piles and deposited in the storage bins by a bucket elevator. Cement was handled by a Fuller-Kinyon pump. The average production was 246 cu. yd., and the maximum 752 cu. yd. per day.

Earth Excavation

Earth excavation was started on August 15th, 1941, and was carried on simultaneously on different parts of the work as soon as suitable equipment was available. Sections were sub-let wherever this could be done to advantage, to sub-contractors having the necessary equipment and organization to take care of some particular class of work. The total earth excavation amounted to 3,265,000 cu. yd.

Head Channel and Dams. In the head channel a large earth cut amounting to 700,000 cu. yd. extended from the control works downstream for a distance of 2,600 ft. On account of the soil being of a sandy nature and ideal for scraper work, this section was sub-let to Roy and Brassard, a road contracting firm. Letourneau scrapers and D7 tractors with bulldozers were used on this work.

Other earth excavation in the vicinity of the head channel consisted of the removal of about 100,000 cu. yd. of which 275,000 cu. yd. were sub-let to C. V. Billie & Son. The excavation included the stripping of overburden in the head channel and at dam sites as well as the digging of several drainage ditches. Over the areas where rock was used for crusher feed, the rock surface was cleaned by hand. The different kinds of soil encountered included sand, humus, blue-clay, sand and gravel, and gravel and boulders.

Unwatering of the foundations was not a major problem, but considerable pumping was required in addition to the digging of several drainage ditches.

The excavation was done with 1½ to 2½-cu. yd. drag lines or shovels, and disposal was made by trucks or Athey wagons to low areas adjacent to the head channel. At Dam No. 5, a 4-cu. yd. drag line loading into 20 cu. yd. standard gauge side dump cars was used. All side slopes in the head channel were rip-rapped with 3 to 6 in. crushed rock or run of primary crusher rock spread to an average thickness of 9 in. by bulldozers and by hand.

Powerhouse and Tailrace. In this area the greater part of the earth excavation amounting to over 1,200,000 cu. yd., consisted of sand and gravel, and was sub-let to D.W. & R.A. Mills Reg'd. who owned some suitable dragline equipment. Two Bucyrus-Erie drag lines, one No. 24 with a 100-ft. boom and 4-cu. yd. bucket, and one No. 320 with a 138-ft. boom and 6-cu. yd. bucket, were used to remove the overburden to a depth of about 50 ft. The material was loaded into 20-cu. yd. standard gauge side dump cars, and hauled to disposal areas adjacent to the tailrace by 40-ton steam locomotives. Working two 10-hour shifts, these two machines averaged 6,000 cu. yd. per day.

To expedite the work, other shovel and drag line equipment was turned over to the sub-contractor to prepare ramps leading down to the lower areas, and to handle the excavation below the main drag line cuts. In certain areas there was a considerable depth of a hard boulder clay formation over the rock which had to be drilled and shot before it could be excavated. All shovel excavation was disposed of in 2 to 4-cu. yd. trucks and 10 and 13-cu. yd. Athey wagons.

Earthfill Dam. Before power could be delivered on November 20th, 1942, it was necessary to remove sufficient of the earthfill dam, containing 135,500 cu. yd., to provide for the flow through the head channel. This work was sub-let to Mills Bros., and was started on August 25th, 1942, with the No. 320 drag line. The first cut was made in the dry, on the downstream slope, prior to the completion of the erection of the gates in the control works. When all six gates were completed, about the end of August 1942, water was pumped from the forebay into the area between the earth dam and the control works to equalize the head on the dam, and the final cut to grade was started. The material was disposed of in the flooded area below the control works, clear of the head channel, in 20 cu. yd. standard gauge railway side dump cars carried on a timber trestle.

Rock Excavation

The rock is an anorthosite, a coarse grained igneous rock composed essentially of plagioclase feldspar. On account of the typical jointing, joints parallel to three or more intersecting planes, it had a tendency to break in large angular blocks when blasted. On account of its crystalline structure, it had a slight tendency to break in long pieces in the primary crusher, but made good concrete aggregate. It is slightly softer than granite, but is considerably harder than limestone.

Open Cuts. There were 2,486,000 cu. yd. of rock excavation in all open cut work. Of this amount 990,000 cu. yd. and 153,000 cu. yd. were sub-let to C. A. Pitts and C. V. Billie and Son, in sections in the head channel, on the basis of all air, drills, drill steel and blasting materials being supplied by the general contractor.

In the head channel and powerhouse and tailrace areas, where the maximum depth of rock to be removed was as much as 105 ft, two or more cuts were made. Under the control works, dams and wing walls, where there was only a minor amount of loose and weathered rock, a cut of from 2 to 5 ft. was sufficient to reach a satisfactory foundation. At one point in the north wing wall it was necessary to excavate to a

Fig. 3—Removal of temporary earthfill dam upstream from the control works.

depth of 32 ft. on account of a fault which cut across the foundation.

The drilling equipment consisted of various makes of well drills. Canadian Ingersoll Rand FM2 wagon drills, N82 sinkers, various makes of lighter jack hammers, and diamond drills which were used on special work in the tailrace only. The spacing of well drill holes varied from 8 to 10 ft., and of jack hammer and wagon drill holes from 3 to 5 ft., depending upon the depth of the face. In general, well drill holes were used where the face was 18 ft. or over, wagon drills and N82 sinkers for cuts from 8 to 18 ft., and jack hammers for the shallower cuts and secondary drilling. Wagon drills were also used for drilling horizontal lifter holes at the bottom of deep cuts. (See Fig. 4).

Two types of hollow drill steel were used, $1\frac{1}{4}$ in. diameter in the wagon drills and N82 sinkers, and 1 in. hexagon in the jack hammers. The $1\frac{1}{4}$ in. diameter steel was made up in sets, varying in length by 2 ft., up to 18 ft. long. The bit diameter of the starter was $2\frac{5}{8}$ in. and, for each succeeding steel, the diameter was reduced by $\frac{1}{8}$ in. The 1 in. hexagon steel was made up in similar sets up to 8 ft. long with a 2 in. diameter starter bit.

The average depth of drilling between changes of drill steel and well drill bits varied from 18 to 24 in. The over-all average footage drilled per hour was as follows:—Well drills 1 ft.-6 in. to 2 ft.-0 in.; wagon drills 16ft.; N82 sinkers 8 ft.; jack hammers 6 to 8 ft.; diamond drills 2 ft.

Exclusive of the tailrace plug, an average of one pound of dynamite was consumed per cubic yard of rock excavated. Seventy-five per cent dynamite was used in well drill holes and 60 per cent in other blast holes. Except in shallow cuts and trenches rock excavation was done with $1\frac{1}{2}$ to $2\frac{1}{2}$ cu yd. shovels loading into 2 to 4 cu. yd. standard dump trucks, 10 cu. yd. Euclid trucks and 10 and 13 cu. yd. Athey wagons. Most of the rock from the control works, dams, wing walls and the trench adjacent to the tailrace plug was loaded by hand into skips which were handled by crawler cranes. All general excavation, with the exception of that from the head channel, which was required for crusher feed, was wasted in disposal areas adjacent to the head channel and tailrace.

Line Drilling. It was the original intention to use wagon drills for line drilling the vertical channel sides of all rock cuts in about 20 ft. lifts with a 10 in. bench between lifts. Unloaded line drill holes were to be spaced at 6 in. centres, and the first row of blast holes 12 in. in from the line drill holes were to be spaced at

Fig. 4—Rock excavation in the head channel.

30 in. centres. This method was followed in some sections of the head channel, but due to the time and equipment required, and also to the character of the rock, most of the line drilling in the head channel was done with wagon drill holes at 12 in. centres, and with 6 in. diameter well drill holes up to 40 ft. deep, spaced from 3 to 5 ft. apart, and loaded to within 4 ft. of the collar.

Diamond drills were used for line drilling the walls of the tailrace. The holes were 1 7/16 in. diameter, and were spaced at 1 ft. centres for depths up to 20 ft. and at 3 ft. centres for greater depths, up to 100 ft. The holes at 1 ft. centres were unloaded, and those at 3 ft. centres were deck loaded.

Shafts and Tunnels. Shafts D, E and F were sunk full size by the conventional mining method using timber head frames, Wabi Iron Works shaft equipment, and Canadian Ingersoll Rand mine hoists.

Due to the fractured condition of the rock at shafts A, B and C, these were excavated down full size to safe depths without the use of head frames, and immediately lined with concrete. Pilot shafts 10 by 12 ft. were then carried down to tunnel grade, and the head works over these shafts were completed in preparation for the flooding of the head channel.

Except during freezing weather at the start, all drilling was done wet, with Canadian Ingersoll Rand N82 sinker drills. In shafts D, E and F where head frames were used, the muck was hoisted in 2-ton buckets and dumped down a chute to a hopper on the head frame for disposal by trucks. In the upper full section and pilots in shafts A, B and C, the muck was handled direct to trucks in 2-ton buckets hoisted by crawler cranes. For sinking the service shaft, a small head frame was set up and the muck was handled into the hopper by an air hoist and ½-cu. yd. buckets.

As tunnels A, B and C were completed, shafts A, B and C were slashed down to full size, and the muck was handled with the tunnel shovels. The shaft excavation amounted to 34,000 cu. yd. and an average of 2.3 lb. of 60 per cent. dynamite was used per cubic yard of excavation.

To facilitate operations in the powerhouse area and particularly in the tunnel work, a 35 ft. roadway was excavated down to tunnel grade at the rear of the powerhouse, with a ramp leading to the upper levels at each end. (See Fig. 6). At the portals, the rock was cut back from the roadway to provide at least 30 ft. of vertical face over the tunnels, and sufficient width to accommodate the steel wyes and penstocks. The tunnels were driven by the full-face method, with the exception of 3 to 6 ft. of invert left in place to provide a temporary level roadway. The drilling was done wet from a drill carriage or jumbo with a battery of 24 Canadian Ingersoll Rand N82 power feed drifters mounted on the front end. (See Fig. 7). Each machine was mounted on a swing dump on a universal column arm. Three working platforms provided ready access to the face and sides of the tunnel and served as storage areas for both sharpened and dull drill steels. Cantilevered extensions were provided at each side, which could be removed when moving the jumbo in or out of the tunnel. The complete carriage was mounted on the frame by a D8 tractor. The total weight, including 50 sets of drill steel, but exclusive of the weight of caterpillars, was 23 tons. The jumbo was also used as a platform for scaling the surface of the tunnel.

The loading of the holes was done from a wood frame structure mounted on a 2-ton truck.

The muck was disposed of by a 1¾ cu. yd. Marion electric shovel and 10 cu. yd. tractor-drawn Athey wagons.

The inverts were drilled vertically by jack hammers, and the muck was bulldozed into convenient piles and disposed of by the electric shovel and Athey wagons.

The access tunnel was also driven full face. An air tugger hoist was used in scraping the muck to a pile outside of the portal, from where it was disposed of by shovel and trucks.

Ventilation was required after advancing about 150 ft. from the portals. Fifteen thousand cu. ft. per min. Canadian Blower and Forge fans were installed in

Fig. 5—Shaft excavation in upstream face of head rock.

niches outside the six main tunnel portals and were connected to 30 in. diameter ducts made of 14-gauge sheet metal. The ducts were installed along a side of the tunnels, and kept to within 75 ft. of the working face. A tunnel could be cleared satisfactorily after a blast in 20 to 35 minutes by blowing only. A 5,300 cu. ft. per min. fan and 20 in. diameter, 16-gauge, sheet metal duct was used in the access tunnel.

In the full face work in the main tunnel, 140 holes were drilled at each setup with the 24 drills, using one set of steels per hole. Up to 12 ft. long, the steels varied in length by 2 ft. In V-cut holes, 15-ft. steels were used beyond the 12 ft. length. One and one-quarter in. diameter hollow drill steel was used, and each machine drilled an average of 23 ft. 4 in. per

Fig. 6—Tailrace excavation and tunnel portal excavation in the background.

hour. Three and a half lb. of 60 per cent polar forcite gelatin was used per cubic yard of rock. A complete cycle was made in 18 hours as follows:

Engineering	1 hr.
Moving jumbo in, drilling and moving jumbo out..................	4 hrs.
Loading and shooting............	1 hr. 15 mins.
Ventilating	30 mins.
Mucking	9 hrs.
Scaling	2 hrs. 15 mins.
	18 hrs.

The depth of round pulled per shot was 11 ft-6 in. The average advance per 24-hour day was 13.4 ft. when working in one face only, and 30 ft. when working two tunnels simultaneously. One jumbo and two 1¾-cu. yd. electric shovels handled a total of 110,000 cu. yd. of rock.

Shaft and tunnel excavation was sublet to Patrick Harrison on the basis of all equipment and materials being supplied by the general contractor.

Tailrace Plug. After making careful studies of various ways of taking care of the final break-through from the tailrace to the river, considering the steep sloping river bank and the depth of water to contend with, it was decided to leave in place a natural rock barrier or plug, as it was commonly called, and blast it instantaneously after all work was completed in the east half of the tailrace.

The rock in the whole tailrace area was first levelled off to Elevation +50, and then taken out to grade, working from the powerhouse towards the mouth of the tailrace. On account of the seamy nature of the rock, it was decided to excavate to grade, +5, to within about 130 ft. of the downstream face of the plug, and to provide a secondary plug as a safety measure against excessive leakage, by excavating a trench down to grade immediately upstream of the final plug. It was also decided to excavate a sump below the tailrace floor on the upstream side of the plug for the purpose of retaining as much as possible of the final shot below tailrace grade. Advantage was taken of the existing low water in the river to reduce the final volumes by excavating the area over the main plug and trench down to Elevation +40. A concrete retaining wall with crest at Elevation +45 was then built along the centre of the plug to take care of the fall floods. After a trench 16 ft. wide was excavated down to Elevation − 10, with very little trouble from leakage, the secondary plug was removed, and the sump was excavated down to Elevation −10 for a distance of 40 ft. back from the plug, and then carried up on a 20 per cent slope to meet the tailrace floor. This sump provided a storage space having a volume of approximately 13,000 cu. yd. (See Fig. 8).

The plug contained about 18,000 cu. yd. It was 310 ft. long with the east end about 75 ft. south of a line normal to the tailrace wall at the west end. It was 35 ft. high, and the top width varied from 22 to 52 ft. The downstream face sloped at an angle of about 45 deg. A careful survey was made of this face to serve as a guide in drilling the plug. (See Fig. 9).

Most of the drilling was done with diamond drills, using 1⅞ in. diameter bits. Vertical holes were drilled at 5 ft. centres and up to 8 diagonal holes were drilled from each setup at 5 ft. intervals along the downstream edge. The ends of the plug were close drilled with vertical and fanned holes. Well drills were used in the wider section at the west end. Twelve coyote holes 3 ft. wide by 4 ft. 6 in. deep were tunnelled into the plug at about 25 ft. centres, with bottoms at Elevation +2. The holes varied in length from 15 to 40 ft., and contained up to three sets of loading pockets on either side. Additional drill holes, extending out to near the sloping face of the rock, were fanned out from the ends of the coyotes.

Loading of the holes was started November 17th, a day before the completion of the drilling, and was completed on November 19th, 1942. An average crew of 80 men placed a total of 81,750 lb. of dynamite which consisted of 5,000 lb. of 75 per cent polar forcite in a portion of the well drill holes, and 76,750 lb. of 80 per cent giant gelatin in all other blast holes and coyotes. 4.5 lb. of dynamite were used per cu. yd. of rock and 26,800 lin. ft. of primacord detonating fuse were used in connecting up the complete charge.

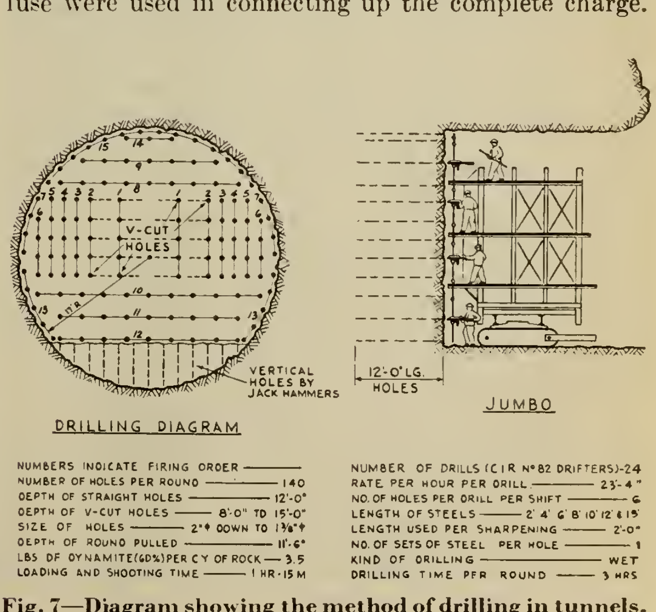


Fig. 7—Diagram showing the method of drilling in tunnels.

Fig. 8—Excavation of trench behind tailrace rock plug.

Prior to the blast, the tailrace was flooded to Elevation +12 only, or to about 5 ft. 6 in. above the top of the coyote holes. While it was desired to have some cushioning effect against flying rock from the coyotes, the water on the other side of the plug was down to Elevation 33.5, and it was believed that the greater the difference in head, the greater would be the volume of blasted rock which would be carried into the sump. The shot was fired at 11.07 a.m. on November 21st, 1942, and although there was some slight damage done to both temporary and permanent work at the east end of the powerhouse, it was considered a very successful one, as subsequent soundings indicated less than 500 cu. yd. of blasted rock to be removed. This material has since been removed by means of a 2-cu. yd. Sauerman scraper.

Total Quantities. About 600,000 lb. of drill steel and 3,360 000 lb. of dynamite were used in removing 2,630,000 cu. yd. of rock.

Equipment. The equipment used in connection with earth and rock excavation included the following:—Forty 1½ to 2½-cu. yd. shovels, cranes or draglines; two 4-cu. yd. and one 6-cu. yd. draglines; two Jordan spreaders; eight 12-cu. yd. Letourneau scrapers; fifty D7 and D8 caterpillar tractors; sixty 20-cu. yd. standard gauge side dump cars; sixteen standard gauge 40-ton locomotives; twenty 10 and 13-ton Athey wagons; twenty-one 10-cu. yd. Euclid trucks; one hundred 2 to 4-cu. yd. dump trucks; thirty-eight Canadian Ingersoll Rand, FM2 wagon drills; 124 Canadian Ingersoll Rand, N82 sinkers; one hundred and ninety-eight light jack hammers of various makes; thirty-nine 6 and 7-in. diameter well drills of various makes, and eighty pumps of various makes and capacities.

Tailrace Cofferdam. Early in 1942, when it was decided to advance the "on power" dates, and to proceed with the construction of the west half of the powerhouse, studies were made to determine how the powerhouse and tailrace work could be carried out to meet the revised schedule.

It was apparent that it would be necessary to separate the east half from the west half, and that work would have to be concentrated on the east half. On account of the shape of the tailrace, and because the work could be done in the dry, it was a comparatively easy matter to build a cofferdam of the magnitude required from the sub-structure of the central erection bay of the powerhouse to the south wall of the tailrace, a distance of 259 ft. (See Fig. 10).

When the rock in the cofferdam area was excavated to grade, a cut-off trench about 2 ft. wide and 9 in. deep was excavated on the line of the upstream face, and filled with concrete to form a seal and a level base for the timber crib work. The tailrace floor slopes up from Elevation +1 at the powerhouse to +5 in a distance of 100 ft.; and the width of the cofferdam varied accordingly. To facilitate its removal, it was decided to use five separate cribs, two 50 ft. wide and three 46 ft. wide up to Elevation 35. From this elevation to the top, Elevation 55, the width of all five cribs was reduced to 31 ft.

B.C. fir was used for all principal members. The face timbers were 10 by 12 in. in the lower section and 8 by 12 in. in the upper section. Cross and longitudinal ties at about 10 ft. centres were 8 by 12 in., and binder posts were 8 by 8 in. Double posts were required in the upstream and downstream faces of the lower section. Round ⅞ in. drift bolts, ¾ in. machine bolts, and 4 by 4 by ⅜ in. plate washers were used. Flat spike grid connectors were used to provide the necessary strength in the lower section. All bottom courses were carried on concrete sills or grout to eliminate the necessity of scribing timbers to fit the uneven bottom, and to provide additional friction value. Only one longitudinal row of pockets along the upstream face was floored. The upstream face was sheeted with 2¾ in. T. & G., B.C. fir, which was carried up 2 feet above the top of the crib work. The sheeting was set in a groove formed in the concrete sill and was sealed with plastic elastigum. A similar seal was provided in the vertical rock face at the south end of the cofferdam. The vertical seal at the powerhouse end consisted of a bevelled 10 by 12 in. timber bolted to the crib work, and a 1½ in. diameter hose held in place vertically in the bevel between the timber and the concrete. All exterior faces were lined inside with 1 in. rough boards, and all pockets were filled with stone dust waste from No. 1 crusher plant. In the lower section, the fill was clammed into the pockets by crawler cranes working at tailrace level. In the upper narrow section, the fill was lowered to a hopper by chute from the high level at the south end and transported to place by a truck working on top of the crib work. The fill was compacted by sluicing.

The cofferdam was designed to have the resultant pass within the middle third and to have a factor of safety of 1.23 against sliding under a head of 54 ft., which represented the highest recorded water level up to that time. The weight of fill was taken as 105 lb.

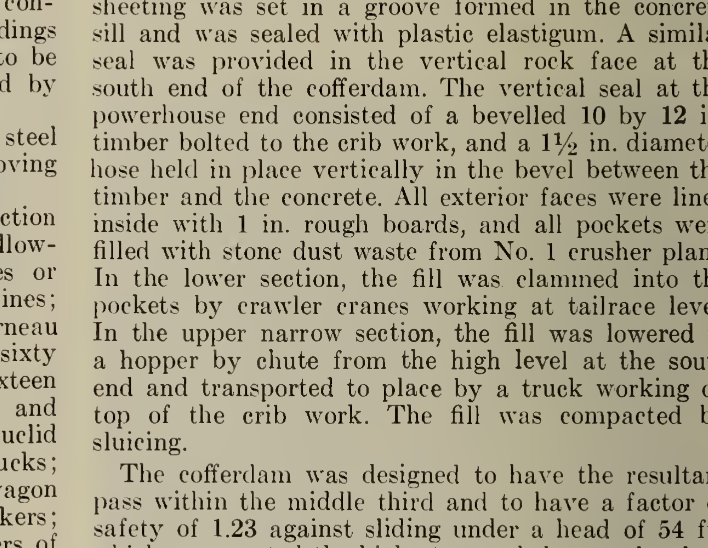


Fig. 9—Drilling diagram for the rock plug.

per cu. ft. and coefficient of friction factors of 0.55 for timber on concrete, and 0.40 for stone dust fill on rock, were used. The maximum head reached during the 1943 spring flood was 48 ft.

The cofferdam was completed in time to permit the flooding of the east half of the tailrace according to schedule, and work in the west half was carried on in the dry. There was very little trouble from leakage. The removal of the cofferdam was started when work on the powerhouse substructure for units Nos. 1 to 6 permitted the flooding of the west half. The cribs were removed, as required, to allow the passage of sufficient water for the delivery of power from units Nos 1 to 6.

Fig. 10—Looking northwest toward downstream face of powerhouse and tailrace cofferdam from east side of plug.

The fill was removed by clamshell handled by a crawler crane working on top of the cofferdam. It was loaded into 4-cu. yd. skips and carried by truck to the south end where it was hoisted by a derrick and loaded into dump trucks for disposal. After unloading and removing the upper crib work, the cribs, one at a time, were clammed out and pulled around to quiet water and completely dismantled. About 95 per cent of the B.C. fir timber was salvaged.

Concrete

On account of the nature of the topography, most of the concrete was transferred from the mixing plants to its destination by trucks. Two types of buckets were used for carrying the concrete, 2-cu.yd. Johnson controllable bottom dump buckets, and 2-cu. yd. Steubner bottom dump buckets. 4 by 6 in. timbers were bolted to the truck bodies to hold the buckets in place. For dumping directly into hoppers, where the concrete was conveyed to place in the forms by elephant trunks, or buggies, the concrete was carried in 2 by 2 by 8 ft. steel boxes mounted on steel-body trucks. These boxes were provided with a top-hinged door on the rear end for discharging the concrete from the raised body. Some of the concrete was delivered on flat cars carrying two 4-cu. yd. Steubner buckets to Dam No. 5, where a convenient track had previously been laid at the time the crushers were installed in the head channel.

The buckets were handled from trucks or cars by crawler cranes or derricks. From 4 to 6 trucks were required per handling unit, and up to 400 cu. yd. per unit were placed in one 10-hour shift.

Control Works. The first concrete was poured in the control works from the Chute-à-Caron plant. It was necessary to divert the highway and log flume over this structure by May 1942, and concrete from plant No. 2 would not be available until late in April. The concrete amounted to 24,600 cu. yd., and was placed by buggying from hoppers and by 2-cu. yd. buckets handled by a crawler crane.

The piers were poured in three lifts, the sills were poured in sections between the piers, and the deck was carried over a distance of 3 ft.-3 in. on each side of the piers. Panel forms with 5/8 in. diameter tie rods and Williams form clamps were used for the piers. The deck forms were supported by log posts resting on the concrete sill.

Dams and Wing Walls. In the dams and wing walls, a total of 467,000 cu. yd. of concrete was handled directly into place in buckets by derricks and crawler cranes, from March 16th to November 3rd, 1942. (Fig 11). Concrete was poured in 5-ft. vertical lifts in alternate blocks 38 and 40 ft. long, with a five-day time interval between pours. The 5-ft. lifts were poured by building up layers of full length of section to the full height, working away from the up-stream face, as the joints are on a 5 per cent grade, sloping up from this face. (Fig. 12).

Within a few hours after completion of a pour, the top surface was cleaned off with an air-water jet, and was kept wet for a period of five days. Prior to the next pour, the surface was sand-blasted, where required, to prepare a satisfactory bonding surface. A ½ in. layer of grout was applied to the surface in advance of the concrete.

Panel forms to suit the 5-ft. lifts, with Williams form clamps and 5/8 in. diameter mild steel tie rods, were used throughout. Except in the top section with vertical sides, where horizontal ties were used, the tops of panels were held in place by form clamps and rods set at 4 ft. centres and sloped at 45 deg. The tie rods were attached by sleeve nuts to crimped anchor rods set 24 in. into the previous pour. The bottoms were held by clamps attached to the tie rods left in place in the previous pour. On the vertical face, it was found necessary to support the bottoms of the panels by horizontal anchors set near the top of the previous pour to overcome a bulging tendency caused by dumping the 2-cu. yd. buckets close to the forms. On the sloping side, the ties at the top of the panel were nearly normal to the face, and no trouble was experienced in using these for anchoring the bottoms of the panels in the succeeding pour. Two-in. pipe braces, sloped at 45 deg. adjacent to the tie rods, were used to support the top of the panels. The upper end was separated from the face of the form by a wood block which was removed when the concrete reached a sufficient height. A horizontal panelling effect was provided on the upstream face by means of a "V" strip attached to the top of the panel forms. The forms

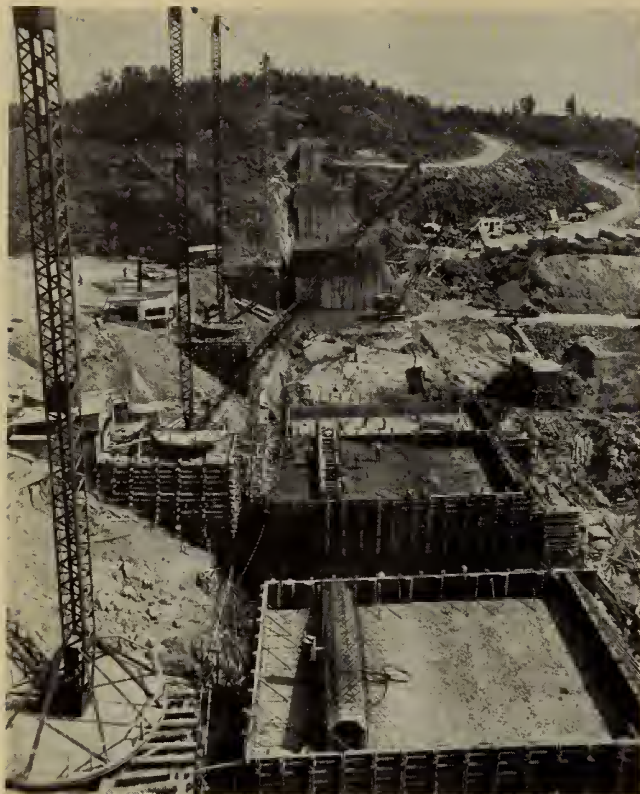


Fig. 11—Pouring concrete at dam No. 3B.

were removed within three to five days after the concrete was poured.

Head Block. The head block contained a total of 80,000 cu. yd. of concrete, 78,700 cu. yd. in the substructure and 1,300 cu. yd. in the superstructure. The substructure was divided into 75-ft. sections by vertical construction joints at the centres of the piers separating the intakes to the shafts and tunnels. Each section of substructure was sub-divided into 10 pours, the maximum amounting to 3,200 cu. yd. The piers, which were 35 ft. high, were poured monolithically through elephant trunks suspended from hoppers at the top of the forms. All other substructure concrete was handled by derricks and buckets. Forms were built in place except for piers and intake elbows, where panel forms were used. The superstructure was built to correspond with the superstructure of the powerhouse, which is described under that heading.

Shafts. Concrete for main shaft lining, amounting to 17,000 cu. yd. was poured from a hopper at the top through elephant trunks leading to the top of the forms, or to doors provided in the form work. Heavily constructed panels were built at the carpenter's shop and assembled in place. Wedges were provided at suitable points in the interior bracing to facilitate the releasing and removing of the forms. Two-in. diameter pipe supports were provided at about 8 ft. centres each way to hold the forms in place. One end was grouted into the rock and the other end was attached to the main vertical members of the interior bracing supporting the segments.

Tunnels. The lining of the main tunnels was done in two operations, including a 90 deg. invert and 270 deg. arch, with a 1-cu. yd. Press-Weld pneumatic concrete placer. From a hopper equipped with a pneumatic control gate at the top of shafts D, E, and F, the concrete was lowered through a 10 in. diameter pipe and elephant trunks to another hopper immediately over the placer. (Fig. 13). For tunnels A, B, and C, which were lined after the head channel was flooded, the concrete was delivered to hoppers placed at the portals of the tunnels.

For placing the inverts, a 40 ft.-long traveller was used. It consisted of a working platform carrying a hopper above, and having steel side forms suspended from the underside. It was moved when required, by means of an air hoist, on a track placed clear of the invert. From the pneumatic placer, the concrete was shot through a 6 in. pipe to the hopper, and was handled to place in buggies. A baffle box attached to the end of the pipe line, deflected the concrete into the hopper.

A Blaw-Knox steel form 60 ft. long was used for the arch sections. It was provided with an adequate number of access doors, and was equipped for travelling on a 15 ft. gauge track anchored to the invert. It was moved ahead for the next pour, after a period of 24 hours, by means of an air tugger hoist. At each setup, the open end was closed with a wooden bulkhead fitted between the form and the rock.

The 1-cu. yd. pneumatic placer required 650 cu. ft. per min. of compressed air at 90 to 100 lb. pressure for a 100-ft. shot, and an additional 100 cu. ft. per min. for each additional 100 ft. of pipe line, which necessitated having an air storage capacity of about 950 cu. ft. per min. The placer was set at a suitable elevation to provide for a minimum head of 3 ft. in the line adjacent to the placer for efficient operation, and to eliminate excessive wear in bends in the pipe line. A 9 ft.-length of special Goodall pneumatic placer hose was used between the placer and the 6-in. standard weight steel pipe line. The line was carried on a light wooden trestle to the hopper on the invert traveller, or to the arch form. Standard pipe lengths, with victaulic couplings were used, except over the arch form, where 5-ft. lengths were required to provide sufficient flexibility to swing the discharge end of the line about 6 ft. on each side of the centre line, and to maintain a suitable distance between the end of the line and the face, as sections of pipe were removed. At the beginning of a pour, it was found that best results were obtained by keeping the pipe back about 16 ft. from the face of the previous pour. As the lining approached the end of the pipe, a 5-ft. section was removed through an opening in the bulkhead at the

Fig. 12—Dam No. 3B, illustrating the method of pouring concrete in vertical lifts and alternate blocks.

end of the form. To minimize wear on the steel plates, the discharge end of the pipe line was kept about 10 in. above the form. Concrete, with maximum size of aggregates of 1½ in. and having a slump of 5 to 5½ in., was used.

Five rows of grout pipes, at 10-ft. intervals, were provided in the arches but only a comparatively small amount of grout was required to fill the voids.

Based on elapsed time, the average daily pour was 77 cu. yd. in the inverts, and 221 cu. yd. in the arches, which represented an average daily advance of 22 lin. ft. in both inverts and arches, or about 11 lin. ft. of completed tunnel. Total tunnel lining amounted to 35,000 cu. yd.

Powerhouse. Concreting was started in the powerhouse on May 15th, 1942, in the central control section and erection bay, and was carried on towards the east end in units Nos. 7 to 12 inclusive. (See Fig. 10).

In planning the method of handling the concrete and other materials, with the top of the substructure about 75 ft. above the excavated level, and considering the volume of other work to be done at the lower levels, it was decided to use a two-boom derrick, equipped to travel on a steel trestle, with the operating deck about 3 ft. above the generator room floor level, as the basic scheme. The bents, consisting of two columns and sway bracing, were 40 ft. wide, and were located mid-way between units at 54 ft. centres. The longitudinal girders carried the traveller, and a truck roadway for the delivery of materials was provided on either side on brackets cantilevered out from the girders. Separate cross-overs were also provided to facilitate the handling of the trucks. A timber trestle required for delivery of the units to the erection bay from the west end, also served as a roadway connection to the steel trestle. As rock excavation progressed towards the east end, the steel trestle was extended. Finally, access to this end was also provided by timber trestles. The deck of the steel trestle was salvaged and re-used in the west half of the powerhouse, working from unit No. 6 to unit No. 1 at the west end. The trestle and derrick were detailed, fabricated and erected by the Dominion Bridge Company, Limited.

The concrete was handled to place either by the derrick, in 2-cu. yd. buckets or through elephant trunks from hoppers located in the truck runways. There were 27 separate pours for each unit, the largest amounting to 2,300 cu. yd.

Draft tube forms, one for each unit, were fabricated at the carpenter's shop, and delivered to the powerhouse in convenient sections. All other substructure forms were built in place.

The concrete in the superstructure walls and roof was hoisted in material towers and buggied to place in the forms. On account of the steel columns being at 27 ft. centres, and there being a vertical expansion joint at each column, the walls were poured in sections 7 ft. high and 27 ft. long. Panel forms 7 ft. high by 13 ft.-6 in. long were used. Forms for the exterior surface were lined with rough boards placed vertically and horizontally in alternate panels. Lining material was used only once and was sand-blasted to bring out the grain of the wood. A " V " section attached to the forms was used to accentuate the outline of the panels. Hollow precast concrete spreaders with removable wood cones at the ends, and ⅝ in. diameter tie rods were used. The forms were left in place for a minimum period of three days.

The total concrete in the powerhouse amounted to 187,400 cu. yd., 172,000 in the substructure and 15,400 in the superstructure.

Miscellaneous. Other concrete work, including encasement of steel penstocks, foundations for the switching structure at the rear of the powerhouse, and tailrace retaining walls, accounted for 48,800 cu. yd.

Plant No. 1 was closed down on November 6th, 1943, and the remainder of the concrete amounting to 1,510 cu. yd. was provided by two ½ cu. yd. portable mixers stationed at the west end of the powerhouse.

Included in the complete development were 874,000 cu. yd. of concrete, 7,700 tons of reinforcing steel, and 28,500 lin. ft. of 16 oz., 12 in. wide, copper water stops which were used at vertical construction joints.

In the dams, concrete having a 2 in. slump, and about 5¼ bags of cement per cu. yd. was used. Concrete with higher slumps up to 5½ in., and having up to 6½ bags of cement per cu. yd., was used in shaft and tunnel lining and superstructure walls. Seven-day tests indicated compressive strengths of from 3,000 to 4,000 lb. per sq. in.

Prior to pouring concrete, all rock surfaces were thoroughly cleaned and given a coat of grout.

Exposed surfaces in mass work were kept moist for a minimum period of three days. Where slabs were exposed to the sun, they were covered with a layer of sand and kept sprinkled as required.

Concrete poured during the winter months was protected by tarpaulins and heated by steam to 50 deg. F. for a period of 72 hours.

The following types of vibrators were used:—No. 518 two-man pneumatic, weighing 83 lb., and No. 519 two-man electric, weighing 103 lb., manufactured by the Chicago Pneumatic Tool Company; No. 120 Viber one-man electric, weighing 13¾ lb., manufactured by the Viber Company, and VS4-A with vise, manufactured by the Electric Tamper and Equipment Company. The latter were attached to the ribs of the steel tunnel forms and used for vibrating the tunnel lining.

The plant used in connection with concreting consisted of the following:—Six 2-cu. yd., two 1-cu. yd. and two ½-cu. yd. concrete mixers; eighteen 3-ton cab over engine Ford trucks; twenty KS6 International platform trucks; twenty-six KS7 International steel body dump trucks, equipped with 32-cu. ft. steel boxes; forty-eight C.S. Johnson 2-cu. yd. controllable

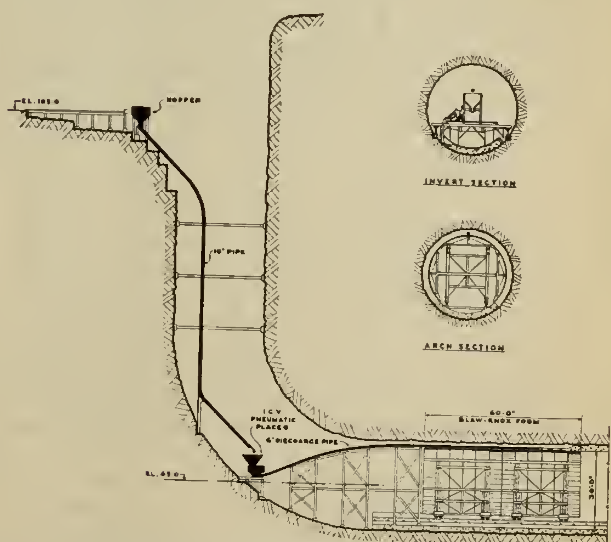


Fig. 13—Diagram showing the method of lining the tunnels with concrete.

bottom dump buckets; thirty-five 2-cu. yd. and seventeen 4-cu. yd. Steubner bottom dump buckets; six Fuller-Kinyon cement pumps; forty 9-cu. ft. concrete buggies; two 1-cu. yd. Press-Weld pneumatic placers; seventy-three vibrators, including twelve of No. 518, twelve of No. 519, forty-seven of No. 120, and two of VS4-A; twenty-three guy derricks; twelve stiffleg derricks and twelve crawler cranes.

Structural Steel

Tunnels Liners, Wyes and Penstocks. A 30-ft. inside diameter steel plate liner was provided in each of the main tunnels from the wye outside of the portal to a point in the tunnel where the depth of rock above the top of the tunnel was about 80 ft. Lengths varied from 29 to 200 ft. Sections up to 80 ft. long and weighing 130 tons were assembled and welded outside of the portals and moved into final position on small trucks running on a 12 ft. gauge track.

For assembling the sections, three 12 by 12 in. timbers were blocked up to the required grades to take the bottom plate. Two timber spiders of 4 by 8 in. B.C. fir were erected on this plate, and then the remaining plates required to complete the circle were assembled and trued up to 30 ft. inside diameter. One additional spider was erected with each additional ring. Twelve-point spiders were used at jacking and rotator points, at about 24 ft. centres, with 8-point spiders at about 12 ft. centres at intermediate points. After bolting up the joint spacer plates, lining up and tack-welding the joints, the section was lowered by means of 35-ton jacks onto 4 or more rotators, each consisting of a small wheel set at the proper elevation. A 20-ton guy derrick set at a higher elevation above the general working level, handled the plates and assisted in rotating the sections for downhand welding. When the welding was completed the section was moved into place and set to correct grade and anchored to pairs of concrete piers which were spaced at 12 ft. centres and dowelled to the rock. The spiders were left in place until the liners were encased in concrete.

The connection from the liner to the scroll-case varying in length from 145 to 157 ft., consisted of a wye with a 30-ft. diameter stem and two legs 20 ft. in diameter at the downstream end, each leading to a scroll case through a section of penstock tapering from 20 to 18 ft. in diameter, and a straight 18-ft. diameter section. On account of their shape, the wye and tapered section of penstock were assembled and welded in the fixed position. The 18-ft. diameter straight section containing the expansion joint was rotated. Six and eight-point timber spiders made of 4 by 8 in. B.C. fir were used. The wyes and penstocks were also anchored to concrete piers dowelled to the rock. The final closure was made in a tapered section about 6 ft.-8 in. long between the 18-ft. diameter penstock and the 16-ft. diameter inlet to the scroll case. This section was shop fabricated to actual measurements made in the field. The heaviest single pieces to be handled in the field were the wye diaphragms and the expansion joints which weighed 16 and 15 tons each respectively. The complete system, involving 3,700 tons of steel and 60 tons of welding rods, was fabricated and erected by the Dominion Bridge Company, Limited.

Powerhouse Superstructure. Structural steel amounting to 842 tons was fabricated and erected by The Canadian Bridge Company, Limited. The two-boom derrick traveller, operating at generator room floor level, was used for the erection, both booms being required to handle a column. The columns were spaced at 27 ft. centres longitudinally and 73 ft.-2½ in. transversely, and weighed 11 tons each. All field connections were made by rivetting.

Erection of Transmission Lines

According to accepted practice and classification of the Quebec Public Service Board, transmission lines are not considered part of the generating station, but since the construction of the transmission lines, in this case, was entrusted to the general contractor, a brief description of them is in order.

There are six double circuit 154,000 volt steel tower transmission lines carrying power away from Shipshaw, four independent lines 3½ miles long, to the sub-station at Arvida, and two tapped into the lines from Chute-à-Caron, at Shipshaw.

The erection included the clearing of a right-of-way 375 ft. wide and approximately 2½ miles long, the building of roads for the distribution of materials, the erection of 800 tons of steel towers at 88 different locations, and the stringing of 80 miles of 477,000 C.M. ACSR. conductors. About one-third of the footings were in solid rock requiring blasting and the drilling of anchor bolt holes.

The work was done in the fall of 1942 by the Canadian Hoosier Engineering Company of Montreal. Upwards of 100 men were employed over certain periods.

Power

The head channel and tailrace were flooded on November 21st, and unit No. 7 went on the line on November 24th, and No. 8 on November 27th, 1942, 18 months after the award of the contract. Units Nos. 9 to 12 in the east half, and Nos. 1 to 6 in the west half of the powerhouse, were brought on the line at regular intervals, the last being unit No. 1, on December 24th, 1943. It was a great satisfaction to all concerned to have met the schedule, almost to a matter of days, for all 12 units. Particulars of the design, manufacture and installation of the equipment are given in other papers covering this subject.

Miscellaneous

The volume of backfill around all structures amounted to 314,000 cu. yd., including 58,000 cu. yd. of crushed rock over the penstocks.

Two permanent lines of tracks were laid off the main railway siding at the west end of the powerhouse, one to the track platform at Elevation 77 in the powerhouse, and one at Elevation 74 parallel to the line of transformers at the rear of the powerhouse.

General

The security staff consisted of one chief of police, one sergeant in charge of the fire department, and seventy-five constables and firemen. The construction area was enclosed by a barbed-wire-topped fence.

A safety engineer and staff of seven were instrumental in eliminating hazards and reducing accidents to a minimum.

Every Tuesday afternoon, representatives of the owners, consulting engineers, general contractor and sub-contractors held a meeting in the main job office and discussed all problems pertaining to the work. A weekly meeting of the general contractor's forces only, was also held on Friday afternoons.

An average of 3,960 men were employed per day in two ten-hour shifts. The daily peak was reached in June 1942, when 9,863 employees were included on the general contractor's and sub-contractors' payrolls.

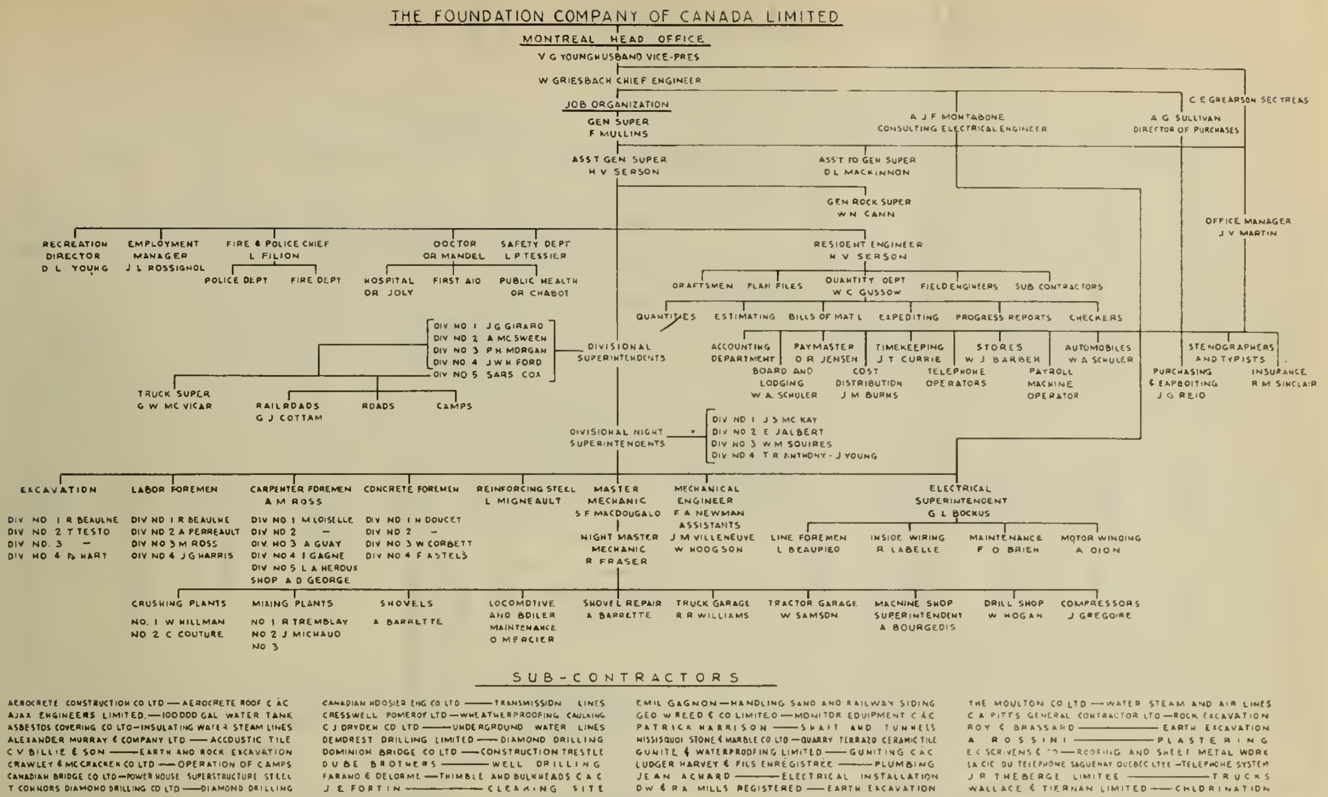


Fig. 14—Organization chart for construction of Shipshaw No. 2.

The total number of employees hired, 47,747, indicates one of the labour difficulties which had to be contended with.

At the beginning, the work carried an A1A priority, which was a very high one, but unsatisfactory on account of the great number holding this rating. Later, when AA ratings were created, the job was given an AA1 standing on materials going into the work, but any work for the armed forces got the preference on equipment.

Acknowledgments

Acknowledgment is gratefully made to the organization of the Aluminum Company of Canada, Limited, for their considerate co-operation throughout the course of the work; to Aluminium Laboratories Limited, and their consulting engineer H. G. Acres responsible for the design and engineering, for their efficiency and co-operation in preparing and issuing drawings to meet the fast construction schedule; to all sub-contractors for their co-operation; to all manufacturers and suppliers of materials and equipment for their expeditious handling of orders under wartime conditions, and to the Canadian Ingersoll Rand Company Limited and the Canadian Industries Limited for their valuable assistance in planning the rock work.

The Foundation Company of Canada Limited was the general contractor, and the work was carried out by the organization shown on the accompanying chart, under the direction of V. G. Younghusband, vice-president. A. O. Hawes was resident engineer and Charles Miller, M.E.I.C., assistant resident engineer for the Aluminum Company of Canada, Limited, and P. C. Kirkpatrick, M.E.I.C., was resident engineer for H. G. Acres, M.E.I.C., consulting engineer to Aluminium Laboratories Limited.

ELECTRICAL EQUIPMENT AT SHIPSHAW

R. A. H. HAYES, M.E.I.C.
Acting Chief Engineer, Aluminium Laboratories Limited, Montreal, Que.

Paper presented before the Montreal Branch of The Engineering Institute of Canada on March 9th, 1944

General

The Saguenay system, extending over the Lake St. John area of Quebec, has three main hydroelectric generating stations located on the Saguenay river, namely, Isle Maligne, Shipshaw No. 1 (Chute-à-Caron) and Shipshaw No. 2.

Isle Maligne, the oldest of these stations, constructed 1924-1925, is only a few miles from Lake St. John, the source of the Saguenay river, and serves as the water storage control station. It consists of twelve 35,000 kva. generators with a nominal head for the station of 114 ft.

Shipshaw No. 1 (Chute-à-Caron), about thirty miles below Isle Maligne, was built during the late twenties and early thirties and consists of four 50,000 kva. generators. Oversized turbines installed here will generate about 51,000 kw. under a head of 155 ft. This station takes water from the same point on the river as Shipshaw No. 2 and hence serves now as standby capacity, as firming capacity in flood periods, or as synchronous condenser capacity for voltage control purposes.

Shipshaw No. 2 station, situated approximately one and one-half miles downstream and constructed in 1941-1943, operates at a nominal head of 208 ft. and has ten 75,000 kva. and two 65,000 kva. generators.

The transmission system connecting the generating stations and main substations consists of 154,000 volt, double-circuit, steel-tower transmission lines. The focal point of the transmission system is the 154-kv. bus at the substation serving the Arvida works of the Aluminum Company of Canada, Limited. This substation is about four miles from Shipshaw No. 1 (Chute-à-Caron) and two miles from Shipshaw No. 2. These two generating stations operate on the unit system, that is, one generator, one transformer bank and one transmission line to Arvida. The two double-circuit tower lines to Isle Maligne have high tension busses at both ends and Isle Maligne has a 13.2-kv. generator bus. All the transformer banks on the system are 13.2-kv. delta-connected on the low tension side, and range from 138.5-kv. to 162-kv. star-connected on the high tension side. All high tension neutral points at the generating stations are solidly grounded.

At Arvida, to decrease the short circuit kva. and hence the circuit breaker duty, the sixteen incoming lines and fifteen outgoing banks connect to three sections of a high tension bus and only one transformer bank on each section has its high tension neutral point solidly grounded. The three bus sections are paralleled through three transformer banks and a 13.2-kv. transfer bus.

At Shipshaw No. 1 (Chute-à-Caron), a low tension bus is also available as a system tie point, when the transformer bank capacity of the station is not required to transmit power from the generators to the system.

From Isle Maligne a 187-kv., double-circuit, steel-tower, transmission line, 135 miles long, connects with the Quebec terminal of the Shawinigan system.

According to accepted practice and classification of the Quebec Public Service Board, transmission lines, transformers and high tension switching are considered part of the distribution system and not part of the generating station, but for the purposes of this paper and because the relaying, metering and control spans not only generation but transformer and high tension switching equipment as well, we include it as a unit.

In the foregoing we have referred to the transmission from Shipshaw to Arvida as 154-kv., which might be questioned as the distance is only two miles. The following explanation may be offered: At Arvida the existing high tension substation was 154-kv. and there were also 13.2-kv. low tension busses. To bring in an inter-

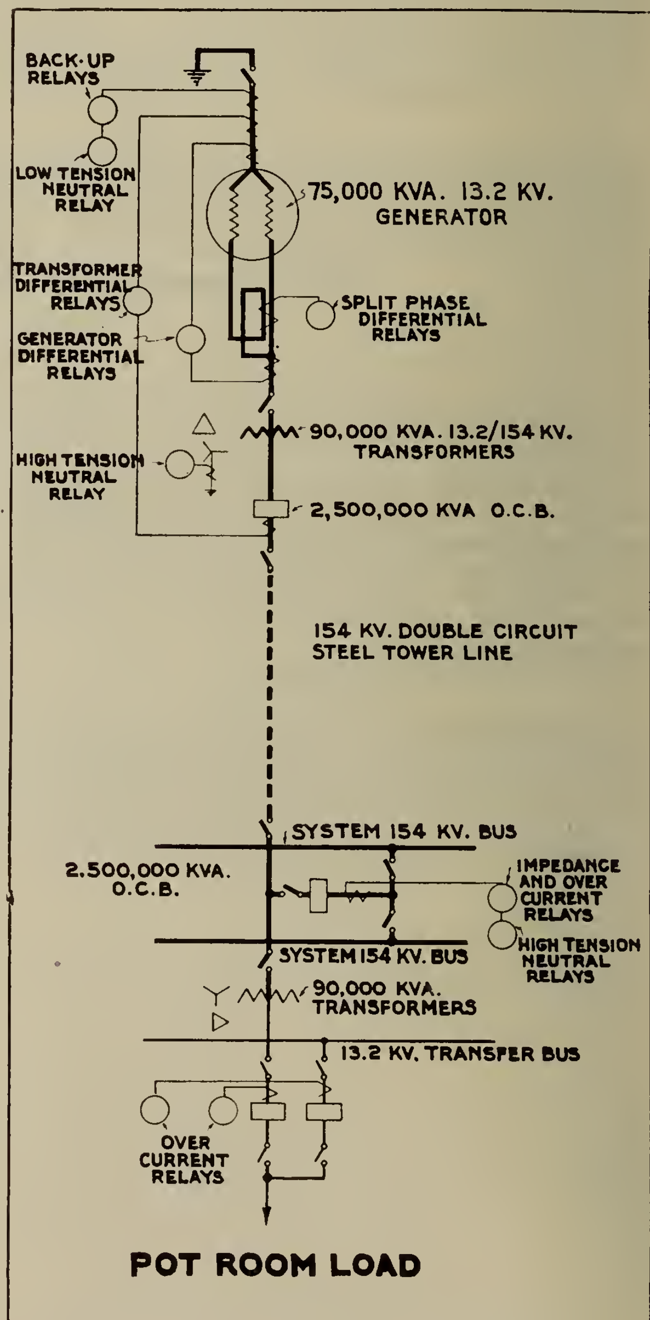


Fig. 1—Single line diagram of the unit setup.

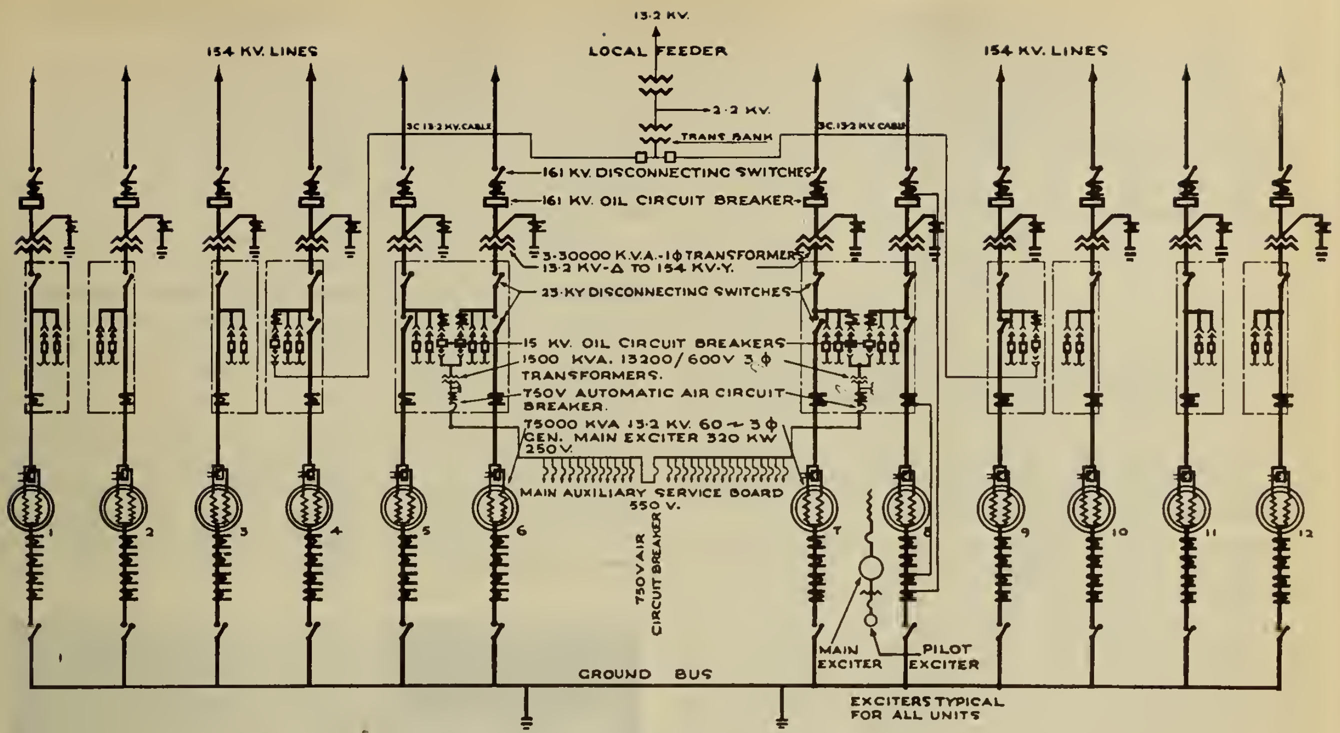


Fig. 2—Single line diagram of the Shipshaw station.

mediate voltage would mean that the whole substation setup would have to be rebuilt and an additional high tension bus provided, which would be a costly proposition. It was therefore decided that the transmission voltage would have to be either 154-kv. or 13.2-kv. The 13.2-kv. seemed possible, if one did not recognize the fact that about 1,000,000 hp. would have to be transmitted with a 1,600-ft. river crossing. As far as cost was concerned, there was not much differential between the two voltages and the choice rested on the saving of materials, listed as follows:

		13.2-Kv. (Generator Voltage Transmission)	154-Kv.
Copper	Line	2,826 tons	106 tons
	Transformers	100 tons	396 tons
Steel	Towers	1,520 tons	828 tons
	Messenger	956 tons	0 tons
Insulators		21,760 units	8,316 units

If for no other reason than the difficulty in obtaining the strategic and important metals, copper and steel, the 154-kv. transmission was justified. While the above table shows copper conductor, aluminum was actually used, but the proportion of weights remains the same.

As already referred to, the focal point of the transmission system is the substation serving the Arvida works of the Aluminum Company of Canada, which is the largest load, and it should be mentioned here that the sub-division units of the Arvida high tension load are approximately 60,000 to 70,000 kw. Therefore, for a unit system, Shipshaw generators should deliver 60,000 to 70,000 kw. each in order to minimize load transfer.

Figure 1 shows the unit setup—the generator, transformer and oil circuit breaker at Shipshaw No. 2, the transmission line leading into Arvida and connected directly without high tension breaker to the 154/13.2-kv. transformer, through the low tension disconnects and breaker to the 13.2-kv. low distribution bus serving unit load. This transmission line can also be connected through a 161-kv. oil circuit breaker (similar to those at Shipshaw No. 2) and disconnect switches to either of the Arvida high tension busses. These busses afford the synchronizing as well as power transfer tie, but, as pointed out previously, in this system the power transfer is kept to a minimum.

Shipshaw No. 2

The general layout of Shipshaw No. 2 was somewhat simplified, due to the short distance of transmission to the Arvida substation and the uniformity of the Arvida load units. That is, Shipshaw No. 2 was laid out on a unit basis with no low tension bus or low tension breaker, the synchronizing tie being at Arvida, with the synchronizing carried out by means of the high tension breakers at Shipshaw.

Figure 2 shows the general one-line diagram of this station.

Figure 3 shows a typical cross section through the units, "T" being the turbine floor, Elevation 50; "G", the generator room floor, Elevation 63; "D", the delta bus room; "H", the transformer stalls; "S", the high tension switching station, and "R", the retaining wall which was originally conceived to protect the high tension switching equipment against falling debris from the bluff immediately in the rear. This retaining wall serves

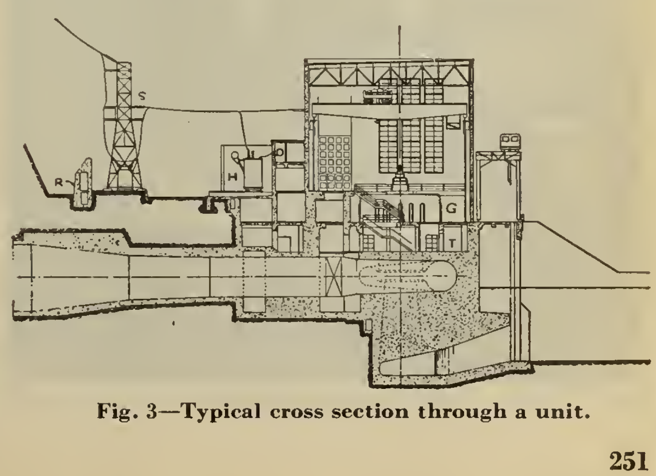


Fig. 3—Typical cross section through a unit.

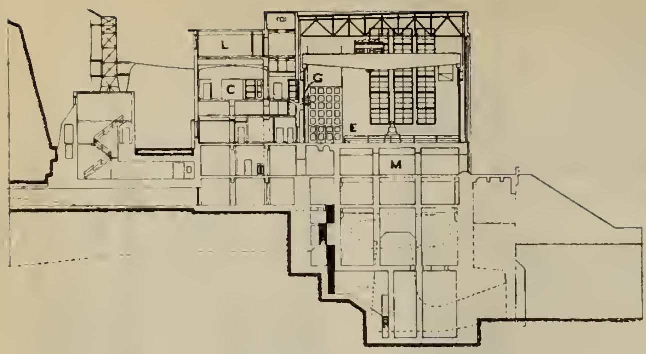


Fig. 4—Typical cross section of the powerhouse through central erection bay and control section.

as a service tunnel for the oil circuit breakers, carrying not only oil lines, but also control cables for the switching equipment, telephone lines, etc.

Figure 4 shows a typical section of the powerhouse through the central erection bay and control section. "E" represents the erection bay at Elevation 77; "M" the future machine shop at Elevation 63; "C" the control room at Elevation 96; "G" the gallery, readily accessible from the control room and overlooking the generator room and "L" the system office and load dispatcher's quarters. The general offices are immediately below the control room.

Generators

In his paper "Design of the Shipshaw Power Development" appearing in this same issue, Dr. Acres states that with approximately 1,000,000 hp. to be generated there would be twelve turbines each capable of delivering 91,000 hp. at maximum gate.

The main load operates at a power factor of from 88 to 93 per cent. This resolved to a power factor of the order of 80 per cent at the generator terminals. It was therefore decided to install ten generators of 75,000-kva. capacity and move two existing 65,000-kva. machines from Shipshaw No. 1 (Chute-à-Caron).

The new machines were rated as follows—75,000-kva., 13,200-kv., 80 per cent power factor, 3-phase, with eight parallel circuits per phase, 60-cycle, 56-pole, 128.6 r.p.m. with a 60 deg. C. full load temperature rise. They were designed so that they could run continuously without load or without field at 244 r.p.m.

Fig. 5—Generator A.

without causing injury or strain to the unit mechanically or electrically.

The two 65,000-kva. generators were rated as 13,200-kv., 90 per cent power factor, 3-phase, with four parallel circuits per phase, 60-cycle, 120 r.p.m., 60-pole machines. These generators were rebuilt to be 128.6 r.p.m., 56-pole, to agree with the other ten machines.

All generators are star-connected and two groups of equal number of phase parallels are brought through the stator for the purpose of split-phase differential protection. The neutral ends of these windings, after passing through the current transformers, are bussed together and connected to the ground bus through a disconnecting switch.

Each generator is equipped with a main exciter and a 250-volt pilot exciter and is designed to operate without main field rheostats, but having a motor-operated exciter field rheostats. The generators are totally enclosed by means of a square steel housing which has two vertical surface coolers in each corner with water

Fig. 6—Generator B.

supplied to the coolers at approximately 55-lb. pressure (see cover picture).

It was estimated that each machine would require 135,000 cu. ft. of air per minute for cooling purposes. As this immediately led to complications in supplying adequate air ducts, it was considered advisable to enclose the generators. The saving in powerhouse construction and air ducts balanced the increased cost of the air housing and coolers, the latter giving an advantage of some degree of temperature control. The result of this was that the generators were spaced on 54-ft. centres, this dimension being set by the turbine scroll cases. The air housing was arranged so that two doors on each corner could be opened, closing off the adjacent coolers and deflecting the hot air to the generator room, to be used, if required, for heating in cold weather. The air circulating system, while not exactly novel, is somewhat different from that generally being used in the United States today. It is the practice there to seal off the generator, whereas at Shipshaw all entrances were sealed off by means of doors to the turbine pit. This circulates the air from the generator rotor and stator through the coolers, thence to the turbine pit from where it is drawn back through the rotor to the stator. The advantage of this method is accessibility to the lower end turns of the stator winding, or the rotor guide bearing, etc., without having to remove sealing pans normally fixed to the generator lower

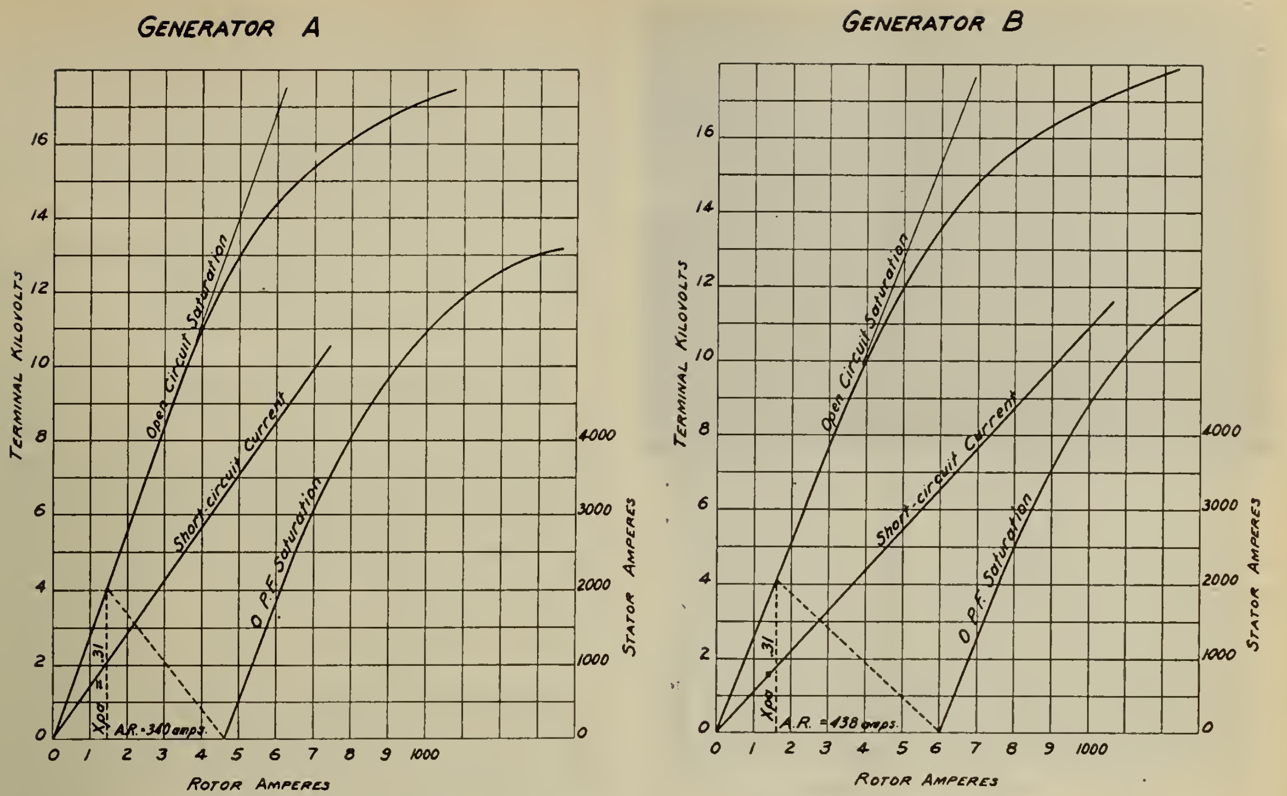


Fig. 7—Curves showing the characteristics of the two types of generators.

bracket. In the case of the machines of one type, these lower end turns are readily accessible in case of fire without having to remove the baffles. Under actual conditions, one type required 135,000 cu. ft. per min., while the other required 200,000 cu. ft. per min. The latter machine, however, had ample thermal capacity and in all probability around 150,000 cu. ft. would have been a better balance.

The combined rotating parts of the generator and turbine are carried on a single thrust bearing with two generator and one turbine guide bearing. Two types of thrust bearings are used, namely Kingsbury bearings and spring thrust bearings. All thrust bearings, except one, are tin base babbitt. On one thrust bearing, owing to the difficulty in obtaining tin, it was decided to try an arsenic lead babbitt, which has so far proved satisfactory.

The generators were supplied by two companies, which for the purpose of convenience will be designated as A and B. Manufacturer A used the conventional generator design with spider-type upper bracket and semi-depressed oil pot (Fig. 5) around which the air casing was built and the coolers installed. The rotor was of standard design with cast spider and conventional baffles. The other manufacturer, B, employed a stator design which resulted in an open machine providing free circulation of air and by shaping the spacer plates, tended to control the direction of air flow towards the coolers. He used a depressed bridge-type girder upper bracket arrangement with fully-depressed thrust-bearing oil pot (Fig. 6). A totally fabricated rotor was used, with the sections built by welding steel plate. By means of specially designed slot wedges in the stator and special fan plates on the rotor, circulating air flow was controlled through the stator without the use of baffles, leaving a very open machine on which the end turns, both upper and lower, were readily accessible.

The two different designs resulted in considerable difference in weight of materials as shown in Table I.

TABLE I

WEIGHTS OF COMPONENT PARTS OF GENERATORS

	Generator A	*Generator B*
Exciter armature	12,800 lb.	11,500 lb.
Exciter stator	19,900 lb.	15,000 lb.
Air casing, louvres, etc.	35,000 lb.	35,000 lb.
Upper guide bearing and bracket	96,450 lb.	105,000 lb.
Lower guide bearing and bracket	18,600 lb.	35,000 lb.
Shaft, 35 in. diameter	76,000 lb.	63,000 lb.
Rotor, spider	121,850 lb.	60,000 lb.
Rotor, poles and coils	200,500 lb.	173,000 lb.
Rotor, copper	96,700 lb.	53,000 lb.
Rotor, net	766,300 lb.	623,000 lb.
Stator copper	33,500 lb.	39,000 lb.
Stator lamination	144,000 lb.	125,000 lb.

The characteristics of these machines could best be illustrated by the saturation and short circuit curves (Fig. 7). Table II shows the actual field test results.

TABLE II

COMPARISON OF GENERATORS A AND B OPERATING UNDER FULL LOAD AT UNITY POWER FACTOR

	Generator A	*Generator B*
Kva and kilowatts	75,000	75,000
Stator current, amperes	3,280	3,280
Field current, amperes	740	855
Stator I^2R, kilowatts	244	199
Field I^2R, kilowatts	110	125
Open circuit core loss, kilowatts	290	465
Short circuit core loss, kilowatts	190	220
Windage and friction, kilowatts	325	555
Total losses, kilowatts	1,159	1,564
Output, kilowatts	75,000	75,000
Input, kilowatts	76,159	76,564
Efficiency, per cent	98.48	97.98

It is interesting to note that an efficiency of 98.4 per cent at full load, 100 per cent power factor, was obtained for the conventional machine, while approximately 98 per cent was obtained under the same conditions for the machine manufactured by the other supplier. Both

Fig. 8—One of the two generators temporarily installed at Shipshaw No. 1.

these machines are performing satisfactorily and temperature conditions might be represented as follows:

Max. Coil Temp.	Max. Kva.	Max. Kw.	Max. Voltage	Cooling Water	Ambient Air	Outside Temp.
"A"—84C	82,000	70,000	13,200	18°C	31°C	84°F
"B"—81C	83,000	72,000	13,200	18°C	30°C	84°F

It will also be noted that both machines have ample reserve capacity as far as thermal conditions are concerned.

As previously mentioned, there are two generators rated at 65,000-kva. which were originally temporarily installed at Shipshaw No. 1 (Chute-à-Caron) in order to meet the early demand for additional power. These generators were designed so that they could be over excited to be used as synchronous condensers. They were of the conventional type, (Fig. 8), the stators being slightly smaller in diameter than the 75,000 kva. generators, but from the base ring to the pilot exciter they were about four feet higher. This feature presented a slight problem from the aesthetic standpoint so it was decided to depress the base rings approximately four feet into the floor in order that the height would be the same as the 75,000-kva. machines and to rebuild them, chiefly by adding coolers and a steel housing, so that they would present a similar appearance to the 75,000-kva. machines. By the addition of the housing and coolers, it was estimated that the temperature of the cooling air could be reduced approximately ten degrees and, for the same thermal rating, approximately 10 per cent more load could be carried.

Owing to difficulties in obtaining 35-in. steel shafts, it was decided to salvage the turbine shaft. This meant that the existing shaft had to be shortened approximately four feet and the only feasible way of doing this was by cutting the required amount from the generator end of the shaft and affixing a new coupling. It was first suggested to weld a new coupling to the shortened shaft, but it was later decided to affix a new cast steel coupling to the shaft by shrinking and keying, the reason for this being the hazard of distortion, as welding had never before been attempted on a shaft of 35-in. diameter.

When these two machines from Shipshaw No. 1 were removed to Shipshaw No. 2, the speed was changed to agree with the other machines, namely, 128.6 r.p.m. This necessitated a new rotor rim designed for 56 poles. The rotor of the original machines weighed approximately 350 tons but, because of its size (approximately 26 ft. in diameter) it was physically impossible on account of bridge and road clearances to move it from one powerhouse to the other without dismantling. Therefore changing the speed did not affect the installation time. These machines are in operation, and, while they have not been in service long enough to judge their capacity during high ambient temperature periods, the following is representative of their daily log:

Max. Coil Temp.	Max. Kva.	Max. Kw.	Max. Voltage	Cooling Water	Ambient Air	Outside Temp.
68°C	75,000	60,000	13,500	0°C	No record	−1°F

Note; Conductor temperature over cooling water 68°C.

In the installation of the generators, overtime was worked where necessary and in many instances three shifts were employed. Some indication of the installation times per machine are as follows: The average time required from the start of rotor erection to completion of rotor stacking was twenty-one days with a minimum of nine days. The average time for adding the field poles to the rotor was fourteen days, with a minimum of eight days, while an average of eighty-two days elapsed from the start of erection to synchronizing the machines on the line with a minimum of sixty-one days.

The 13.2-kv. bus, from the generator terminals to the transformers, consists of 5-in. copper channel. Each phase has two of these channels, clamped in the conventional box form, with suitable expansion joints in the long horizontal runs. Accidental contact with this bus is prevented by a screen enclosure on the generator room floor, and by electrical interlocks which prevent access to the delta bus compartment until the bus is de-energized.

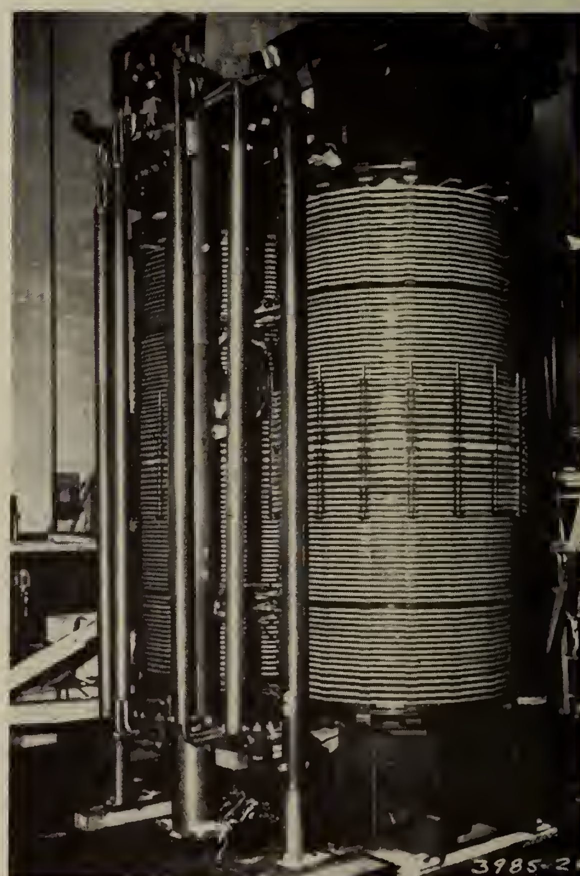


Fig. 9—Showing high tension winding of the double disc construction. Type A transformer.

Transformers

There are approximately one hundred 30,000-kva., 13.2-kv. to 154-kv. transformers on the system as a whole, the majority of which were supplied by one manufacturer. It was therefore reasonable to keep as closely as possible to the same type of transformer, especially because of the fact that, with a system so compact, the interchangeability of the transformers was most desirable. For that reason the transformers at Shipshaw were specified as follows:

Single phase, shielded, oil-immersed, water-cooled, outdoor type,

30,000 kva., 55°C, temperature rise,

High voltage 154,000 grounded Wye with full capacity taps for operation at 161,700/157550/150150/146300 Grounded Y,

Low voltage 13,200.

The transformers were provided with 161-kv. high voltage graded insulation and the neutral end of the high voltage winding was insulated for 34,500 volts, and each transformer was assembled in the standard all-welded steel plate tank. The following accessories were provided:

Standard conservator and pressure relief equipment with magnetic oil gauge,

High voltage tap changer operating mechanism at ground level. Means to be provided for locking the mechanism in any position,

Flanged wheel truck with bronze bushed bearings for a track gauge of 6 ft. 5-13/16 in. and a direction of motion in line at right angles to major axis of tank,

Oil thermometer with alarm gauge,

23-kv. low voltage bushings,

Winding hot spot temperature indicating equipment for remote mounting,

Necessary oil gauges, oil drain valves, sampling cock, filter press connections, weather-proof breathers, air release vents but no 3-way cocks for cooling coils,

Gas detector relay with alarm circuit for remote indication.

The transformers were supplied by two manufacturers on the condition that one transformer of one manufacturer would operate satisfactorily with two transformers of the other manufacturer in a 3-phase transformer bank. This point apparently has been adjusted quite satisfactorily, as for many months one bank of transformers has been operating in this fashion, giving virtually full rated output with no apparent difficulty.

One manufacturer, A, supplied transformers of the two-legged cruciform section core with circular coil and concentrically-assembled windings on both legs of the core. The core was built of high-grade, non-ageing silicon steel laminations, bolted at frequent intervals to reinforcing side plates and held by sturdy structural steel clamps top and bottom. By means of a cruciform cross section and by the use of parallel and transverse ducts, low uniform core temperatures were achieved.

The high-voltage windings were of twin section disc construction while the low voltage windings were of the helical coil construction. The coils were liberally provided with oil ducts. Over the high tension coils was placed an electrostatic shield. Figure 9 shows the transformer untanked without the shield. Figure 10 shows the tanked transformer.

The other manufacturer, B, supplied two-legged cruciform section core with windings on each leg. The high-voltage winding was of the distributed concentric type and consisted of a group of series-connected circular coils enveloped by the electro-static shield and assembled concentrically over each leg, each coil being of the helical type, having a radial build of approxi-

Fig. 10—Tanked transformer of Fig. 9.

mately one-half each and consisting of several transposed paper-insulated rectangular conductors wound and assembled directly on a composition cylinder. Axial spacing strips were assembled over the outer surface of each coil to provide adequate oil circulation. Efficient cooling resulting from the relatively large vertical coil areas directly exposed to axial cooling ducts, made possible the elimination of radial spacers within the coil. Thus was provided a continuous circumferential bearing surface between the turns and the coil ends.

The high-voltage cylindrical coils being physically independent, each coil may be handled, clamped, assembled or dis-assembled individually (Fig. 11). Full shielding was provided throughout the winding by means of a simple cylindrical shield at line potential, located directly over the outer high-voltage coils (Fig. 12). Fig. 13 shows tanked transformer.

The tanks supplied by both manufacturers, while not of identical dimensions, had the same major dimensions, namely, height of high tension connection over top of transformer rail, height of low voltage connection over top of transformer rail, spacing and location of low voltage terminals, location of high voltage terminals, similar cooling water connections and dimensions, similar oil drain connections and dimensions. The dimensions of the horizontal minor and major axis of the tank, however, were considerably different, as were also the shape and dimensions of the conservator.

These transformers were installed in individual cells which were equipped with mulsifier nozzles. Transformer drain valves were connected to a sewer connection, or to an oil line feeding back to an oil storage tank specifically set apart for unfiltered oil. The transformers were so arranged that, if necessary, the oil could be filtered while the transformer was in operation.

Table III shows the characteristics and efficiencies of the transformers as obtained by actual tests, as well as weight and oil capacity.

Table III

Shipshaw Power Transformers

O.I.W.C., outdoor, single-phase, 60-cycle, 30,000 Kva., 88900/154000Y to 13200 volts delta, with H.V. full-capacity taps of 93350/161700-91140/157850-86700/150150 and 84465/146300 volts.

Characteristics	*Transformer A*	*Transformer B*
Per cent resistance	.580	.560
Per cent reactance	13.01	13.95
Per cent impedance	13.02	13.96
Resistance Measurement		
Temperature, °C	75	75
H.V. winding (88900-volt tap), ohms	.649	.513
L.V. winding (13200-volt tap), ohms	.01346	.01346
No Load Losses		
Volts	13,200	13,200
Amperes	29.3	16.7
Kilowatts	51.3	51.23
Load Loss		
Temperature, °C	28.8	27.4
Connection short-circuited	13,200-volt	13,200
Connection energized	88,900-volt	88,900
Short-circuit amperes	337	337.6
Impedance volts	11,575	12,412
Measured kilowatts	158.2	155.96
Calculated kilowatts at 75°C	225.2	219.32
Efficiencies		
5/4 load	—	99.16
4/4 load	99.25	99.27
3/4 load	99.34	99.35
2/4 load	99.37	99.38
1/4 load	99.18	99.19
Regulation		
At unity power factor, per cent	1.43	1.53
At .80 power factor, per cent	8.77	9.40
Weights and Oil		
Oil, imperial gallons	4,350	5,870
Weight of oil, pounds	38,700	52,000
Weight of core and coils, pounds	58,800	59,000
Weight of tank and fittings	24,100	28,000
Total weight, pounds	121,600	139,000

Circuit Breakers

The main oil circuit breakers, twelve in number, were standard three-tank, outdoor type, 161-kv., 600 ampere, 2,500,000-kva. rupturing capacity, having an interrupting current rating of 20,000 r.m.s. total amperes. The closing time in cycles (60-cycle basis) is contact touch 30 cycles, contact fully closed 45 cycles. The opening time is contact part 3.5 cycles, arc extinguished 8 cycles, contact fully open 25 cycles. The tanks were all of arc-welded steel plate. Tubular sheaths were provided in the bottom for heaters. Arcing horns were not provided, as the bushings were capable of withstanding repeated flashover without damage. Bushing-type current transformers were designed to keep reasonable ratio characteristics at abnormal primary currents, such as those experienced during faults, and were used for protection and line current measurements.

Each bushing was equipped with a capacitance tap to furnish high tension metering indication and also for synchronizing. These breakers were connected to the outgoing transmission lines through vertically mounted, 600 ampere, 161-kv., triple-pole, motor operated, gang-connected disconnect switches. The motor mechanism was supplied from the main 250-volt station battery.

Powerhouse Service

Quite early in the engineering design the question of electrical service arose. Considerable thought had been given to low tension bus arrangement, independent hydraulic service units, or tap-off arrangements from one or more units. The final outcome was to tap the 13-kv. feeders on four generators (Fig. 3). As mentioned before, generators and transformers up to the high tension oil circuit breaker were considered electrically as a unit, but for test purposes, manually operated disconnects were installed between the generator terminals on the low tension transformer terminals. On Units 5, 6, 7 and 8, by installing two disconnect switches in series with a tap-off between the two switches, the electrical service was available from eight points of supply, namely, four generators, or by feed-back from the Arvida bus over four transmission lines.

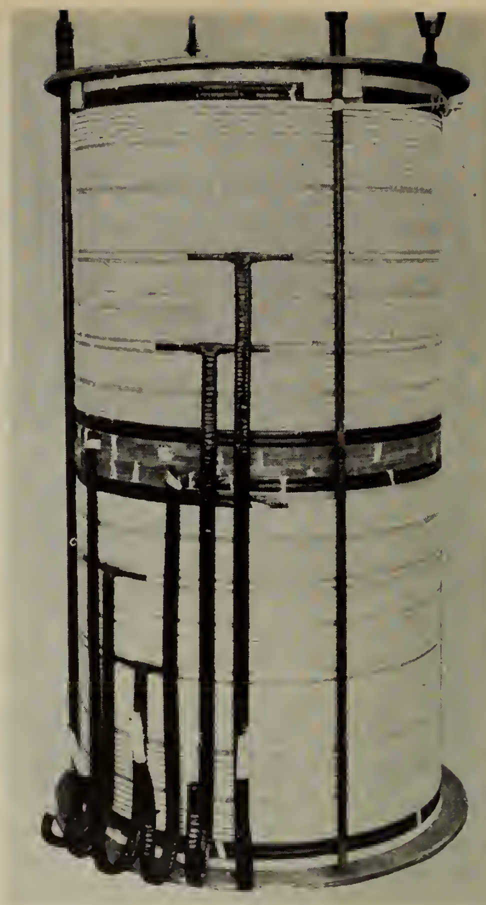


Fig. 11—Showing a high tension coil of the helically wound construction. Type B transformer.

It was decided to use two service busses that could be tied together if necessary by the 1,600-ampere, 750-volt, 3-pole, air circuit breaker. Each section of the bus was supplied with 600-volt energy through a 2,000-ampere, 750-volt, 3-pole, solenoid-operated automatic air circuit-breaker, by means of a 3-phase, 1,500-kva., 13,200/600 volt Pyranol-filled service transformer. In turn, each transformer was fed by connections through 600-ampere, 15-kv., 3-pole, electrically-operated oil-immersed disconnects, connected to each of two generators. These oil-immersed disconnects were so designed that they could be closed against a 3-phase short circuit.

In the general paragraph it was stated that, with the exception of Isle Maligne, Shipshaw No. 1 and Shipshaw No. 2 were laid out on unit basis, the system being synchronized on the Arvida bus, which, as mentioned previously, has three sections. For that reason it is quite easy to operate as three non-synchronized systems, or to operate one generator not synchronized with the rest of the system. Therefore, if two generators—each operating on a separate system—happened to be tied together on the service feeder, that feeder would become a synchronizing bus. To overcome this, the oil-immersed disconnects connecting the two generators to each service transformer were so interlocked that only one generator could be connected to each service transformer at one time and the 1,600-ampere air circuit-breaker was so interlocked with the two 2,000-ampere circuit-breakers on the 600-volt side of the service transformers, that it could not be closed when both of the 2,000-ampere breakers were closed, but could be closed if either one or the other of the transformer breakers were open.

Under normal conditions, one generator (either No. 5 or No. 6) would be connected to that service transformer and supply one-half of the main service bus, and one generator (either No. 7 or No. 8) would be connected through the other service transformer to supply the other half of the service bus, and the tie breaker between the two busses would be normally open. In case of a fault that would cause loss of energy on one service transformer only, one-half of the service bus would be de-energized and the 2,000-ampere, 750-volt transformer or circuit-breaker would automatically open and the bus tie breaker could be manually closed, restoring full powerhouse service. All service feeders were so arranged, where possible, that they would be taken off the service bus sections alternately. This applied particularly to the governor oil pressure pumps which had been arranged so that pumps and tanks of two adjacent units were connected together and, consequently, by this arrangement, in the event of the loss of one service transformer or one section of the bus, governor oil pressure would be maintained. Likewise the same thing applies to lighting: alternate circuits were taken off each section of the bus and, in the event of failure of one section of the bus, the powerhouse was not thrown into total darkness and the chances of a total loss of service were small.

The service bus and the above-mentioned feeders were contained in a cubicle service board. All 600-volt feeders for the head block, service tunnels, etc., were taken from this board. Lighting circuits were provided with transformers located at strategical points throughout the powerhouse, tunnel and head block. These transformers were 550/220/110 volt, supplied by circuits from the main service switchboard.

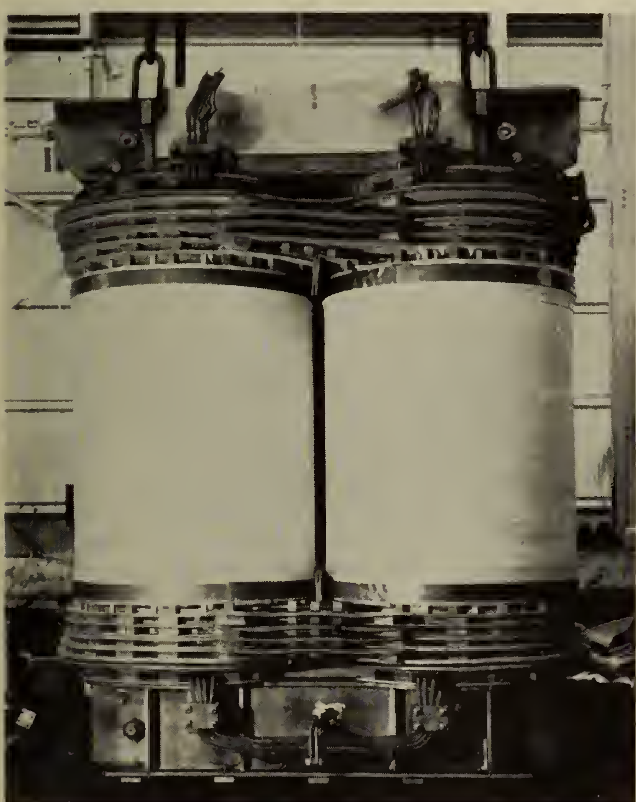


Fig. 12—Showing the cylindrical shield over the distributed concentric high-voltage coils of Type B transformer.

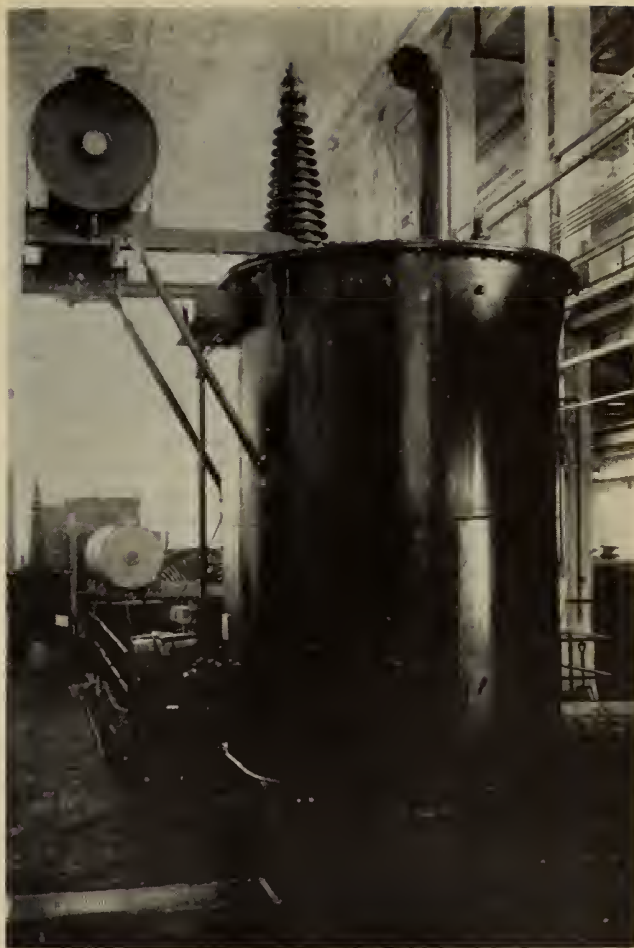


Fig. 13—Tanked transformer of Figs. 11 and 12.

Power for any outside feed should not be taken from the service board on which the satisfactory operation of the station as a whole is dependent. A certain amount of power is always required around a powerhouse and townsite. Therefore, a similar set-up to the station service feed was taken from Units 4 and 9, this connection being similar up to and including the 15-kv. oil-immersed disconnects. From that point, connection was made by means of a 3-conductor, 15-kv. cable to an outdoor substation where permanent 2.2-kv. and temporary 13.2-kv. connections were available.

Control

The control room is approximately 30 ft. wide by 60 ft. long and is located on the 96.25 elevation in the centre section rear of the powerhouse (see Fig. 4). It is flanked by the chief operator's office and telephone switchboard room at the east end and on the west end by storage room, operator's room, lunch room and wash room. Installed in the control room are the control board, meter boards, relay boards, regulator panels, etc., as shown in Fig. 14. At the back will be seen the meter cubicles, on the back of which are mounted the relays. In front of the meter cubicle is the benchboard, a central section lying parallel with the rear of the control room and two wing sections at an angle of about 30 deg. The meter cubicles lie parallel with the bench-

Fig. 14—Control room.

board. This affords the operator, standing in any position, a clear view of all meters. In front of the benchboard is located the chief operator's desk, on which is mounted the signal system between the generating room floor and the control room, together with telephone connections to the switchboard and independent telephone connections with the load dispatcher's office located on the floor above.

On the central section of the benchboard is located the annunciator system which ties in with all relay operations, thermal indications, etc., for all equipment from the high tension oil circuit breaker to the generator neutral. On the vertical sloping section of the wedge-shaped fillets, between the central section and the wings, are located the synchroscopes, which can be revolved to point in either direction. Immediately below the synchroscopes are mounted the emergency head-gate trips. On the wing section of the control board are the controls for four generators, and on the central section immediately in front of the annunciator are the controls for the station service, on either side of which are the controls for two generators. Generator and line voltmeters for synchronizing are located on the sloping portion of the benchboard. Installed on the central portion of the meter cubicle are the totalizing indicating graphic watt meter for the station load, and indicating graphic frequency meter, temperature recorders, two tailrace elevation indicators, and one forebay elevation indicator. On either side of this are the meters for two generators and on each wing section are the meters for four generators. The meters for each generator are as follows: line and generator ammeters, watt meter, varmeter in place of the regular power factor meter, frequency meter, field ammeter, gate-position indicator, exciter field voltmeter, temperature indicator, watthour meter and the necessary meter test blocks. A tailrace elevation recorder is located on the 63 elevation. The gate-position indicators are Selsyn connections with the actuator gate-position indicator. All meters are of the flush-mounted type. On the rear of these cubicles are mounted the relays for the protection of all the circuits. As these cubicles are approximately 42 in. in depth, all connections are readily accessible by means of entrances from the end of each cubicle section.

There is the usual control of voltage for the generators, the usual control of the actuator for regulating the final adjustment of the turbine speed and load changes, the control for all breakers, including field breakers, motor-operated disconnects, etc. There are also two emergency shutdown controls, one for the head gates and the other for the units. The latter automatically clears the generator from the system, opens the field breakers and closes down the turbine through the actuator. All controls are direct current, being supplied from a station service battery. There are two of these batteries, each consisting of 120 cells, with a capacity of 330 ampere-hours for three hours and 440 ampere-hours for eight hours. To keep these batteries charged, two 7½-kw., 250-volt, motor generator sets are provided.

Voltage Regulator Equipment

The voltage regulator equipment is housed in two groups of cubicles, one for Units 1 to 6 and the other for Units 7 to 12. These cubicles are set into the side walls of the control room, one at the left hand side of the control board and the other at the right, in such a position that their functioning can be readily viewed by the operator at the desk. Rear doors give access to the equipment from the adjacent rooms. Regulators were supplied by the respective generator manufacturers, as were also the motor-operated exciter field rheostats. They are of the indirect-acting type with high-speed features and provide rapid exciter response to voltage fluctuations.

The motor-operated rheostats supplied with A's machine are connected directly in series with the main exciter field, while those supplied with B's machine operate on the Wheatstone Bridge principle, which permits of a slight reversal of exciter field current to neutralize residual flux in the event of large sustained overvoltages. High-speed accelerating contactors are employed by both manufacturers, acting on fixed sections of resistance for the rapid forcing up or down of the exciter field in the event of wide voltage swings. Power supply for operating the regulators is normally taken from the exciter of the unit, but provision is also made for taking from the control battery for testing the regulator equipment if the unit is shut down. Voltage-adjusting rheostats are motor-operated from switches at the control board, with provision for hand operat on in the event of motor trouble. Lamps are provided on each regulator panel to indicate the functioning of the control element, to enable the operator to make proper adjustments when transferring from manual to regulator operation, and to safeguard against making a transfer to manual operation during periods of excitation change. No cross-current compensation has been provided in these regulators, since the generators are parallel on the high tension bus at Arvida. The inclusion of the reactance of the transformer banks between machines is sufficient to ensure proper distribution of reactive current. Main and pilot exciters are rated at 250 volts. Back-up protection for the voltage regulation system is provided by self-resetting overvoltage relays, set to operate at 15,000 volts, that is, 114 per cent of rated generator voltage. By means of suitable auxiliary equipment, resistance is added to the main exciter field circuit, holding the generator and exciter voltages to safe values. A signal lamp and single stroke bell operated from these relays indicate on which generator overspeed has occurred, the lamp remaining lit until the relay resets. The pilot exciters are also provided with generally similar overvoltage protection, the relays in this case being set to operate at 300 volts, that is, 120 percent of normal pilot exciter voltage. Sufficient resistance is thereby introduced into the pilot exciter field circuit to hold the voltage to 300 with an overspeed of 190 per cent normal. These relays prevent dangerous pyramiding of voltage due to overspeed, and provide for the automatic restoration of voltage control to the regulators when normal voltage conditions are re-established. In addition to the above, each actuator is provided with a centrifugal overspeed switch set to operate at 125 per cent normal speed, which is arranged to close the turbine gates and trip the field breaker and the main oil circuit-breaker. A field ground relay with indicating lamps is also mounted in each regulator cubicle.

Protection

The basic relay protection, Fig. 1, of the transmission system consists of neutral relays located in the current transformers on the high-tension oil circuit-breakers and in the transformer bank high-tension neutral connections. Proper relay selectivity in operation in most important locations can be obtained by current magnitude only, hence instantaneous relaying is obtained. In some locations time overcurrent relays must be used.

At Shipshaw, wherever practicable, modern high-speed type relays are used in the generator protection. The generator current differential extends from the neutral ends of the generator phases to the 13.2-kv. leads going to the transformer bank. The relays are of the instantaneous balanced-beam type having an operating coil which unbalances a beam against the force of a restraint coil. These generators have an eight-parallel star-connected winding with nine leads brought out, six at the 13.2-kv. end, so that the current in each half of a phase is balanced against that in the other half of the same phase by means of special current transformers having a double primary and a single secondary winding. The relays used in this split-phase differential scheme are balanced-beam instantaneous overcurrent relays. A single relay element identical to those mentioned above is connected in the neutral lead of a set of current transformers located on the neutral ends of the generator windings. This provides instantaneous overcurrent protection in the case of ground faults in the winding of the generator or the low-tension winding of the transformer bank.

The transformer bank current differential protection extends from the neutral end of the generator winding, as this is a convenient point to locate the current transformers, to the line side of the high-tension or line circuit-breaker, there being no low-tension or generator circuit-breaker. The current transformers on the neutral end are tapped to match the taps of the main transformer bank and have such a ratio that no auxiliary current transformers are necessary. The relays used are inverse-time, low-energy, over-current relays having instantaneous trip attachments. Thus, for a fault drawing about 20 per cent of full load current, the relay time is 1 or 2 cycles, while for a fault below this value, the inverse time element must operate.

Transmission line protection against ground faults is provided by an inverse-time overcurrent relay energized by a current transformer in the high-tension neutral connection of the main transformer bank. The protection against phase-to-phase or three-phase faults and back-up protection for the generator and transformer bank is provided by inverse-time overcurrent relays having a voltage restraint feature. The relays are energized from current transformers in the generator neutral leads and from generator 13.2-kv. potential transformers. The voltage restraint feature permits setting the current pick-up value at about full load current on the generator but has practically no effect on the time of operation in the case of a severe fault.

None of these protective schemes trip directly any circuit-breakers. The generator differential, the split-phase differential, and the generator low-tension neutral relay all operate one trip relay, while the transformer bank differential relays, the high-tension neutral relay and the stand-by protection all operate another trip relay. Both trip relays operate to trip the following: the high-tension or line oil circuit-breaker, the generator

Fig. 15—70-ton hoists for operating intake gates.

field switch, the exciter field switch, and the governor shut-down solenoid.

To protect against grounds on the generator field or the associated direct current connections, including the armature of the main exciter, 110 volts at 60 cycles are applied between ground and the centre tap of a high resistance which is connected across the generator field leads. In the ground connection, a relay is located to sound an alarm in the event of ground current.

Lighting

High lighting levels were maintained for this project. The generator room proper was lighted by ceiling-mounted prismatic units giving a general intensity of 20 to 25 foot-candles. The turbine pits were lighted by commercial reflectors giving an intensity of 30 to 35 foot-candles. All offices were lighted with fluorescent units giving an intensity of 30 to 35 foot-candles

In the control room a system of totally indirect cove lighting was used. By means of small floodlights and projector-type reflectors, the arched ceiling was illuminated from one side only. A very uniform lighting intensity of 30 to 35-foot candles was obtained.

All service cables, control wires, lighting conductors and communication cables were carried in open trays through service tunnels and cable shafts, where possible, and conduit runs were kept to a minimum.

System Office

A full floor, consisting of six offices located over the control room, (Fig. 4), has been set apart for a system office in which load-dispatching facilities will be set up. This office is the focal point of the system's communications, including short wave communication with the storage dams. In it will be installed in the future the telemetering equipment, involving all Saguenay generation, incoming or outgoing lines for The Shawinigan Water and Power Company's system and the Arvida load centre.

Shipshaw Headworks

The electrical equipment of the Shipshaw No. 2 intake headblock consists of twelve 70-ton hoists, one 50-ton gantry crane, two 8.5-ton shop cranes, one elevator and one service-water pump, together with various heaters and general lighting.

Each intake gate is 20 ft. wide by 31 ft. high, and weighs 47 tons. The weight of the gate in water is 36 tons, plus an estimated friction load of 38.5 tons, requiring a total lifting force of 69.5 tons. The 70-ton hoists, (Fig. 15), for these gates are operated by 20-hp., 550-volt, 3-phase, 60-cycle, high-torque, squirrel-cage induction motors, with solenoid brakes, and equipped with fan brakes to check lowering speed. The gates are raised by the hoists at the rate of 3 ft. per min. and lowered either by the motor at 4 ft. per min. or by the fan brake at 10 ft. per min.

Each trash rack is 23 ft. wide by 35 ft. high, divided into three horizontal sections. The racks are handled by the 50-ton gantry crane, which runs the length of the headblock deck. The crane hoist is driven by a 50-hp., 550-volt, wound-rotor induction motor with solenoid brake, controlled by a drum controller and having a geared switch to limit hoist travel. The hoisting speed is 10 ft. per min. The gantry crane bridge is operated through shafts and bevel gearing by a 40-hp. wound-rotor induction motor with solenoid brake and drum controller, and operates at a speed of 100 ft. per min. along the headblock deck.

The gantry crane trolley is operated at a speed of 45 ft. per min. by a 7.5-hp. wound-rotor induction motor with solenoid brake and drum controller. In addition to this trolley, provision is being made for a trailer, which will house a 15-ton auxiliary hook for raking the racks, driven by a 40-hp. motor at a speed of 22.5 ft. per min.

The gantry crane cab is heated by a 4-kw., 550-volt unit heater, with current for lighting provided by a 3-kva., 550/110-220-volt dry-type transformer. Power for hoists, travel, heating and lighting is supplied to the crane through a reeled cable, which can be attached to various outlets along the parapet of the headblock.

Heating for the rack and gate checks is provided by twelve 20-kw., 550-volt air heaters, mounted in the hoist gallery, with ducts leading to the spaces above the racks and gates. These heaters are controlled by magnetic contactors actuated by thermostats, the bulbs of the latter being located in protected outdoor recesses. The hoist gallery is heated by twelve 20-kw. unit heaters, controlled by thermostats in the gallery itself. Heating for the observation room is provided by two 15-kw. unit heaters, with smaller heaters in the lobby, wash rooms and passages, elevator pent-house and service-water pump space.

The headblock superstructure is connected to the access tunnel from the powerhouse by a combined passenger and freight elevator having a capacity of 2,500 lb. The travel of this elevator is 205 ft., and it is operated at a speed of 200 ft. per min. by a 15-hp. motor.

Lighting for the headworks is provided by two 7.5-kva., 550/110-220-volt dry-type transformers, and the electric requirements for power, heating and lighting are taken care of by two 550-volt, 3-phase cables from the station service board in the powerhouse. These cables are carried on racks in a gallery adjacent to the access tunnel, which also carry the 250-volt direct-current circuits from the control room for releasing the solenoid brakes on the head gates, a circuit from the water-level gauge in the headblock to the water-level indicator on the control board, and the necessary telephone circuits between the control room and personnel operating the head gates.

Water is admitted to the head channel of the Shipshaw No. 2 plant through six steel sluice gates, (see Dr. Acres paper, Fig. 4, in this same issue), located near the east end of the free spillway of No. 1 dam, about a mile and a half upstream from the Shipshaw No. 2 headblock and intake. These gates are set between concrete piers, and are operated by hoists installed on bridges between steel towers mounted on the piers. In addition to the gates with their towers and bridges, the piers support a highway bridge and walkway across the head channel, as well as a log flume to the local pulp mill. The overall length of the sluice works is 384 ft., and the individual gates are 50 ft. wide by 35.5 ft. high.

Each gate is operated independently, by means of a drum hoist installed in a machinery house on the bridge above. The hoist is geared to a 25-hp., 550-volt, 3-phase, 60-cycle, high-torque, squirrel-cage induction motor, with a solenoid brake to hold the gate at any position of travel and a fan brake to govern lowering speed. The gates are raised by the hoists at the rate of 2 ft. per min. and lowered by gravity at 6 ft. per min. The motors and solenoid brakes are controlled by magnetic starters and contactors, energized by raise, lower, stop and jog pushbuttons in each machinery house, with a geared switch to limit gate travel.

To prevent the formation of ice in the gate gains, electric heaters are provided, encased in watertight steel tubes set in the concrete adjacent to the gains. Each gate has six 2.5-kw., 160-volt heaters, three in each gain, two of these being in series on each phase of a 550-volt wye connection. The gain heaters are controlled manually by circuit-breakers in a panel in each house, and provision has been made for the future installation of heaters on the gates themselves.

Illumination for the highway bridge and walkway over the sluice gates is provided by seven 300-watt, 110-volt roadway lighting units, supported on the gate towers. Current for these fixtures, as well as for lights and convenience outlets in the hoist houses, is supplied by a 5-kw., 550/110-220-volt dry-type transformer, and the highway lighting is controlled automatically by a photo-electric cell mounted outdoors on one of the hoist houses.

Power for operating the hoists and supplying the heaters and lighting is supplied at 550 volts, 3-phase, 60 cycles, from the nearby Shipshaw No. 1 plant. This plant also operates the spillway gates of Dam No. 1 adjacent to it, which control the river flow to both plants. The chief function of the Shipshaw No. 2 head channel sluice gates is to cut off the flow to the latter plant in the event of major modifications or repairs to its headworks.

Acknowledgments

While Foundation Company of Canada, Limited, were the general contractors, the Canadian Comstock Company, Limited, of Montreal, were the electrical contractors who carried out the installation and erection of all electrical equipment which was not bought under installed contract. The major equipment bought under installed contract was supplied by Canadian Westinghouse Company, Limited, Canadian General Electric Company, Limited, English Electric Company of Canada, Canadian Allis-Chalmers Limited, S. Morgan Smith (Canada) Limited.

From Month to Month

News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

THE SAGA OF THE SAGUENAY

The story of Shipshaw, the great adventure in engineering, is told herewith for the first time. Previously there have been occasional outbursts of publicity of a non-technical nature consisting of pictures and scant general descriptions, but these papers are a complete record in detail. This number of the *Journal* brings to engineers throughout Canada the story for which they have been waiting.

Since the beginning of engineering history in Canada, the Institute has been the repository of the records of the achievements of the profession. Therefore it is appropriate that the brilliant story of Shipshaw should be presented by *The Engineering Journal*. To record the story properly, both for immediate reading and for future reference, it was agreed that all parts should appear together, as they do in this April issue.

It has not been a simple thing to accomplish. The arrangements began over 16 months ago. There have been complications of various kinds, not least of which was censorship, but "all's well that ends well"—and this has ended very well indeed.

To the Aluminum Company of Canada, and to the authors, the Institute is greatly indebted for this monumental co-operative effort. It constitutes the largest and finest record of engineering accomplishment that has been presented to Canadian engineers. The completion of the story itself is a great accomplishment, worthy of the great work it describes and records.

NEW LABOUR LEGISLATION EMBRACES THE PROFESSIONS

With the announcement of Order-in-Council 1003 in March, Canada moved into compulsory collective bargaining in a big way. This order, under the definition of "employee," includes all the professions. It states also that "If the majority of the employees affected are members of one trade union, that trade union may elect or appoint its officers or other persons as bargaining representatives on behalf of *all employees* affected," and in another section "A collective agreement negotiated by such representatives shall be binding on *every employee* in the specified unit of employees." (Italics ours).

Certain exemptions are permitted such as "a person employed in a confidential capacity or having authority to employ or discharge employees," but there is still a substantial group of professional people who may be seriously affected by this legislation.

Two meetings have been held in Montreal at which representatives of several societies gathered to consider the order. It was agreed that every effort should be made to have the order amended to exempt the "learned and scientific professions." Messages were exchanged with the Minister of Labour, the chairman of the Wartime Labour Relations Board and the professional group and at this writing arrangements are being made, at the suggestion of the Minister, for a representative group to appear before the Board.

It may be that the Board intends to interpret the order in such a way that it will be acceptable to the professions, but from an examination of the order itself and a study of what has taken place under similar circumstances in the United States, it appears there is every prospect of trouble ahead. The Council of the Institute at its March meeting endorsed the steps that are being taken towards the elimination of the professions from the legislation.

Members may hear a great deal about the subject within the next few months. It may alter the course of the profession for years to come, so that serious thought should be given to it. The officers of the Institute are giving it priority over all other matters until some satisfactory basis is agreed upon. Copies of the order may be obtained from the Department of Labour, Ottawa.

The organizations represented at the Montreal meetings were the Canadian Institute of Mining and Metallurgy, the Canadian Institute of Chemistry, the Dominion Council of Professional Engineers, Canadian Society of Forest Engineers, The Royal Architectural Institute of Canada, the Corporation of Professional Engineers of Quebec, the Association of Professional Chemists of Quebec, and The Engineering Institute of Canada.

CANADIAN ELECTRICAL AND MECHANICAL ENGINEERS (C.E.M.E.)

At long last, steps have been taken to give Canadian engineers in the Army the same opportunity to manage their own affairs as was given almost two years ago to engineers in the British Army. Public announcement was made on March 27th by the Department of National Defence that the engineering services formerly included in the Royal Canadian Ordnance Corps were to be re-established in a corps of their own known as the *Canadian Electrical and Mechanical Engineers* (C.E.M.E.).

This news will be welcomed by Canadian engineers everywhere. There is nothing to be gained by further criticism now, but one cannot withhold the comment that it is difficult to understand why it took so long to bring about a reform which every engineer in the service saw as essential at least a year ago, and which had proved itself so clearly in the North Africa and Sicily campaigns.

It is too bad that in drawing up the order C.A.R.O. 4230 nothing was included to indicate that the officers of the new engineering corps were to be professional engineers. If the commissions, particularly the senior appointments, are to be given to non-technical persons, the situation may well be no better than it was when the work was carried out in Ordnance. Surely this mistake is not going to be repeated. In the Royal Electrical and Mechanical Engineers (R.E.M.E.) of the Imperial Army, which is the pattern for the C.E.M.E., the specifications for a graded officer are as follows: "Candidates must have undergone an apprenticeship of at least three years' duration and, in addition, (a) must possess a degree in engineering of any recognized university, or (b) be a Graduate member of the Institution of Mechanical Engineers or of the Institution of Electrical Engineers, or have qualifications exempting them from the examinations of these institutions." In order No. 4230 it is stated simply "C.E.M.E. officers will consist of electrical and mechanical engineers of appropriate ranks and of ungraded engineering officers."

In February of last year, the then president of the Institute, K. M. Cameron, appointed a committee to study reported grievances of the engineers in the active services. This committee has met several times and has examined carefully into situations and procedures which were brought to its attention. There have been preliminary interviews with officials of the Department of National Defence, and finally a brief was presented to the Minister, the Hon. Colonel J. L. Ralston, by the committee. It is reproduced herewith in full for the information of members of the Institute.

Point number one (related to R.C.O.C.) has now been gained. Number two (the appointment of technical persons to technical positions) may never be achieved fully but it should be pressed continually. Number three (professional pay as is given to other professions) has been turned down flat! No one argues against the logic of it. Engineers resent discrimination against their profession. To overcome this particular example it looks as though a dignified but persistent policy will have to be followed until someone sees the sense of it and has the courage to grant equality of recognition for equality of service.

March 13, 1944.

The Hon. J. L. Ralston,
Minister of National Defence,
Ottawa, Canada.

Sir:

Re: *Engineers in the Active Services*

The engineers in the services have been a special interest of The Engineering Institute of Canada since the start of the war. At different times representations on their behalf have been made to government departments, but there has been no amelioration of the conditions of which complaint was made, although on one of these occasions your department, in replying, said, "I wish to candidly state that we recognize with you that the present situation as regards the Ordnance Mechanical Engineers is not satisfactory." Once again the Institute comes to you to repeat and to emphasize its claim that the treatment of engineers in certain technical services is neither fair to the individuals nor conducive to the best results in the services.

These protests are prompted by the number of complaints that come to the Institute, both from members and non-members who are in the services experiencing the evil effects of the conditions and practices to which we call your attention. It is these people who tell us of the difficulties encountered, the inefficiencies developed and the frustrations experienced because of what they refer to as stupidities, prejudices, and ignorance. We believe they are in positions to see what is going on, and are competent to judge of the consequences.

Please be assured that we have some realization of the difficulties that attach to your high office, and that we appreciate the outstanding work that you have done for the nation as Minister of National Defence. It is not our desire that our petition should make your already difficult task more difficult, but rather that we may be of assistance in presenting clearly, informed opinion which we believe will be helpful to you. We are still confident that your broad knowledge of the affairs of your department, your understanding of human nature, and your sense of justice will prompt you to institute the changes which we feel are so justified and so necessary.

In continuing our efforts we believe we are acting in the best interests of efficiency and the conduct of the war. The things of which we complain have had the effect of turning away from the technical services many well qualified persons who desired to serve there. Up until recently there has been a decided shortage of such persons, which we believe was quite unnecessary. Others in the services have been unable to do their best work because of incompetent direction from non-technical superiors, and still others have been discouraged because of slow recognition of merit in the form of promotion to senior positions.

The points which we desire to bring to your attention may be stated briefly as follows:

Item No. 1. The failure of the Royal Canadian Ordnance Corps to give engineers senior appointments whereby they might be in charge of the engineering work done by the Corps.

Item No. 2. The appointment of non-technical persons to positions which call for technical knowledge and experience.

Item No. 3. The failure to give engineers rank or pay as a professional recognition, as contrasted with the treatment given certain other professions.

May we enlarge on the above items to illustrate what we have in mind.

Item No. 1

The outstanding success of the Royal Electrical Mechanical Engineers in the Imperial Army is a clear demonstration of the efficiency which follows the practice of putting engineers in charge of engineering work. There has never been any argument about using technical persons on the execution of technical work, but in some active service circles there still persists the peculiar tendency to give the senior or supervising positions to non-technically trained persons. No single group of citizens in North America holds as many executive or administrative positions as do engineers. The attainment of the rank of Major-General and Lieut.-General (but not in Ordnance) by so many Canadian engineers amply proves this point. It seems strange that the corps employing most engineers is the only one that does not give them senior administrative positions. Industry long ago recognized that the engineers' training and disposition fitted them for such work. Surely the efficiencies demanded by competitive civilian enterprise have a place in the organization of this branch of the fighting forces.

In the R.C.O.C. (Engineers) almost without exception all senior appointments go to non-technical men, and yet the work of that division is almost entirely a part of mechanical and electrical engineering. Engineer-officers seldom are given staff courses, so all staff appointments have to go to lawyers, brokers, accountants, motor car salesmen, retail store managers and so on. The failure of such persons to be familiar with the work under their jurisdiction must result in inefficiencies and confusion that should have no place in the prosecution of the war. This committee has been informed of many such experiences.

The engineer is an administrator, and in those fields involving engineering work is, beyond the shadow of a doubt, the only person who should be put in charge. No one would consider putting a medical man at the head of a legal activity, or vice versa. If engineers are not given more consideration in the Ordnance Corps, the tendency to seek appointments in other services which has already developed substantially will expand to the point that the Corps will never attain the level of efficiency that is required by modern warfare.

This committee recommends that the engineering work now done in the R.C.O.C. be given over to a corps of engineers under the command of technical personnel, similar to the Royal Electrical Mechanical Engineers.

Item No. 2

It would seem to be unnecessary to argue for the appointment of technical persons to technical positions, and yet so many cases appear before us where this axiom of good business has been abandoned that we bring it to your attention. The trouble seems to be that some positions of this type are seen by officials of the departments as purely administrative, and apparently in their minds anyone can be an administrator of anything. Nothing else would explain it.

There are innumerable examples in many places, including the active services and the civilian organizations supporting them, but we do not care to mention names in an open communication of this kind. If illustrations are wanted we will be glad to give them, but we are more interested in the principle involved than in the individuals.

It is the opinion of this committee that only technical persons should be appointed to technical positions, including those that are also administrative. There are plenty of such persons who could be made available for these positions, and there are competent agencies ready to assist in finding them if they are not known to the authorities making the appointments.

Item No. 3

As you know, some of the other professions, such as doctors and dentists, get a special pay allowance when practising their professions in the services. They also start off at least one rank higher than engineers. We hesitate to introduce financial considerations in relationship to one's service to his country, but the matter is important from another point of view as well.

The young engineers claim that this pay and rank discrimination is a slight to their profession. Any group is a profession only as the public recognizes it as such. The failure of the Department of National Defence to make the same recognition of engineers as is made of these other professions appears to them to be a denial of their professional status, and they fear that this will have a detrimental effect on the entire profession in civilian occupation. In this the committee agrees with them.

The committee cannot see why a young doctor right out of college should be taken into the Navy as a Lieutenant at $6.00 per day plus $1.50 per day professional allowance, whereas a young engineer with equivalent education and experience is rated only as a Provisional Sub-Lieutenant at $4.00 per day and no professional allowance. Similar discriminations apply in the Army and the Air Force. Such things are not good for the professional consciousness or the morale of the young engineer. So far we have been able to find no justification for them.

We believe all the professions should be treated alike. Certainly we cannot see why the only professional group that is combatant should be the one to be denied these privileges. We believe that all professional men practising their professions in the services should receive the same professional pay or that none of them should receive it.

We would be grateful to you if you would consider the logic, justice and wisdom of the points we have raised. We are proud of the record of the engineers in this war. We feel it is a solemn obligation to support them here at home in these matters which they cannot advocate for themselves. They have been long suffering, for the matters of which we complain have existed for many years. It is still not too late to wipe out injustices and to remove anomalies that may injure a profession and affect the conduct of the war. May we count on your sympathetic interest in these matters?

Yours sincerely,

D. S. Ellis, Lieut.-Col. (late R.C.E.),
Dean of Engineering, Queen's Univ.,
Kingston, Ont., *Chairman of Committee.*

D. M. Jemmett, Lieut.-Col. (late R.C.E.),
Kingston, Ont.

C. C. Lindsay, Lieut.-Col. (Hon.), R.C.E.,
Montreal, Que.

E. D. Gray-Donald, Major, R.C.O.C. (R),
Quebec, Que.

L. Austin Wright, *General Secretary*,
The Engineering Institute of Canada.

REMUNERATION OF ENGINEERS IN QUEBEC CIVIL SERVICE

Better remuneration for the engineers in the service of the Province of Quebec was advocated by the Corporation of Professional Engineers of Quebec before the Civil Service Commission established a few months ago by the provincial government. On March 22nd, a delegation headed by the president, A. O. Dufresne, met the three members of the Commission at Quebec and presented a brief summarizing the findings of a committee which, for the past few months, had been carrying out a survey of the salaries of members of the Corporation.

With the help of charts, the brief showed that the average salaries engineers employed by the provincial government are substantially lower than those paid by the federal and municipal governments and far below the remuneration of engineers employed in private enterprise. The Corporation submitted what it thought was an adequate scale of salaries graded according to the number of years of experience, and providing for classification of positions. It also recommended that only engineers professionally qualified be appointed to positions involving engineering responsibilities and that the methods of appointment be such that the better qualified candidates will be selected.

The brief also made certain recommendations regarding working conditions and compensations in particular cases.

The members of the Commission showed a keen interest in the brief, and the questions raised in the discussion indicated that they were aware of the unfair treatment accorded engineers in the civil service of the province.

Besides the president of the Corporation, the delegation included: C. C. Lindsay, vice-president: A. D. Ross, secretary-treasurer; Councillors J. O. Martineau, J. A. McCrory, P. E. Poitras; E. A. Ryan, chairman of the committee; David Clerk, T. M. Dechene, P. A. Dupuis, C. E. Gelinas, Ernest Lavigne. The Institute having been invited to join the delegation, was represented by the assistant general secretary, Louis Trudel.

DISCUSSIONS

Papers were published in the March number of the Journal that seem likely to promote discussion, particularly the two dealing with the post-war period. Such discussions will be very welcome and will be printed in the *Journal* if they make a real contribution to the subject.

It should be emphasized that paper is hard to get these days and that readers want their reading material condensed. It may be necessary to do considerable editing on the contributions in order to eliminate duplication, etc., but every endeavour will be made to give each contributor a fair deal.

Please keep your discussion strictly to the field of the paper you are writing about. Sometimes writers use a paper simply as a spring board from which to launch opinions about some other subject near and dear to their hearts. No material will be published as a discussion unless it ties in definitely to the specific paper it mentions.

ELECTIONS AND TRANSFERS

Members

Antenbring, Gordon Arthur, B.Sc., (Civil), (Univ. of Man.), B.Sc., (Mining), (Queen's), supervisor, No. 3 Ore Plant, Aluminum Company of Canada, Arvida, Que.

Chadwick, Walter Wyburn, B.A.Sc., (Univ. of Toronto), pres. and gen. mgr., Chadwick-Carroll Brass & Fixtures Ltd., Hamilton, Ont.

Chernick, Alexander, B.Sc., (Univ. of Man.), chief expediting engr., British American Oil Co., Toronto, Ont.

Chisholm, Kenneth Gordon, B.Eng., (McGill), sales engr., engrg. products divn., western Canada, R.C.A. Victor Co. Ltd., Winnipeg, Man.

Dalton, William Reginald, B Sc., (Queen's), head of draughting dept., Sault Ste. Marie Technical School, Sault Ste. Marie, Ont.

Fleming, Donald Corbett, B.Sc., (Univ. of Alta.), radio instructor, Institute of Technology & Art, Calgary, Alta.

Gorman, John Alvin. B.Sc., (Univ. of N.B.), dftsmn. and res. engr., Grand Lake Power station, N.B. Electric Power Commission, Minto, N.B.

Kennedy, Taylor James, B.Eng., M.Eng., (McGill), asst. supt., Canada Cement Co. Ltd., Plant No. 1, Montreal East, Que.

Klempner, Harold, B.Sc., (Univ. of Man.), engr., National Research Council, Winnipeg, Man.

Lynch, James Allan, B.Sc., (Univ. of Man.), engr. officer, R.C.A.F. Headquarters, Ottawa, Ont.

McCarthy, Douglas Findlay, B.A.Sc., (Univ. of Toronto), asst. struct'l. engr., General Engrg. Co. (Canada) Ltd., Toronto, Ont.

McLaren, Leo Gerard, B.Sc. (Civil), (McGill), senior asst.engr. to district engr., Dept. of Public Works (Canada), Rimouski, Que.

Newton, Leslie James, B.Sc., (Queen's), plant engr., Building Products, Ltd., Pont Rouge, Que.

Orr, Leslie Gallagher, B.Sc., (Univ. of Man.), junior engr. (acting district engr.), Dept. of Agriculture, P.F.R.A., Winnipeg, Man.

Sankoff, Abbey, B.Sc., (Univ. of Pittsburgh), industrial engr., Canadian Vickers, Ltd., Montreal, Que.

Juniors

Briden, Leonard Dutten, B.Sc., (Michigan Coll. of Mining & Technology), engr., Newfoundland Light & Power Co. Ltd., Tors Cove, Nfld.

Coverdale, Harold Milton, B.A.Sc., (Univ. of B.C.), Sub-Lieut. (E), R.C.N.V.R., Experimental Section, National Research Council, Halifax, N.S.

Cowan, George Archibald, B.Eng., (Univ. of Sask.), sales engr., Railway & Power Engineering Corp. Ltd., Winnipeg, Man.

Cram, James Donald, B.Sc., (Univ. of Sask.), mech. engr., Stewart-Warner-Alemite Corp. of Canada, Belleville, Ont.

Transferred from the class of Junior to that of Member

Berger, Bernard Avrom, B.Sc., (Mech.), (McGill), consltg. mech. engr., Montreal, Que.

Campbell, Gerald Arthur, B.Sc., (Univ. of N.B.), cadet in R.C.E., at A5, C.E.T.C., Petawawa, Ont.

Porteous, John Wardlaw, B.Sc., M.Sc., (Univ. of Alta.), assoc. professor, University of Alberta, Edmonton, Alta.

Howe, Harold Bertram, B.Sc., (Queen's), supt., Canada Cement Co., Montreal East, Que.

Martin, Arthur L., B.Sc., (Univ. of Man.), dftsmn., general engrg. dept., Aluminum Co. of Canada, Montreal, Que.

Thoman, Russell K., B.Se., (Queen's Univ.), supt., engrg. divn., Canadian Vickers, Ltd., Montreal, Que.

Woermke, Orville Reuben, B.Sc., (Queen's), plant designing engr., Electric Reduction Co. of Canada, Ltd., Buckingham, Que.

Transferred from the class of Student to that of Member

Stapleton, David Outram, B.Eng., (McGill), lab. technician, Canadian Car & Foundry Co. Ltd., Propeller Divn., Montreal, Que.

Transferred from the class of Student to that of Junior

Colby, Alan Rutherford, B.Sc., (Univ. of N.B.), water and power engr., Dept. of Mines & Resources, Vancouver, B.C.

Hart, Erwin Edward, B.A.Sc., (Univ. of Toronto), supervisor of material standards, ordnance divn., John Inglis Co. Ltd., Toronto, Ont.

Luscombe, William Charles Murray, B.Sc., (Queen's), mtce. engr., Aluminum Co. of Canada, Ltd., Arvida, Que.

Martel, Pierre, B.A.Sc., C.E., (Ecole Polytechnique), lieut., R.C.A., N.D.H.Q., Ottawa, Ont.

Timms, Reginald Harold, B.A.Sc., (Univ. of Toronto), sub-lieut., R.C.N.V.R., Fonthill, Ont.

Admitted as Students

Haliburton, James, B.Sc., (Queen's), 2nd Lieut., Chemical Warfare Laboratories, Dept. of National Defence, Ottawa, Ont.

Lewis, Hymie, (Univ. of Man.), 743 Selkirk Ave., Winnipeg, Man.

McArthur, John Charles, (McGill), constrn. mgr., National Research Council, Quebec, Que.

Seline, Walter George, (Univ. of Man.), Pointe du Bois, Man.

Zweig, Joseph Philip, (Sir George Williams College), 4156 DeBullion St., Montreal, Que.

Students at Nova Scotia Technical College

Ball, William Henry Warren, Pine Hill Residence, Halifax, N.S.

Colpitts, Rolfe Reynolds, 173 Church St. Moncton, N.B.

Dunham, Donald Francis, 17 Williams St., Halifax, N.S.

Forbes, Cyril Robert, Pine Hill Residence, Halifax, N.S.

Gillis, Harold G., Octogon Terrace, Crichton Ave., Dartmouth, N.S.

Horne, Lawrence Fraser, P.O. Box 354, Dartmouth, N.S.

MacKinlay, Russell Anthony, Albion St., Trenton, N.S.

More, John Frederick, 8 Jennings St., Halifax, N.S.

Poirier, Leo Joseph, Petit Etang, Cheticamp, Cape Breton.

Trenholm, Carman Lawrence, Fort Lawrence, N.S.

Students at Queen's University

Campion, William Kingsley, 102 Queen St., St. Catharines, Ont.

Merrill, Robert James, 185 University Ave., Kingston, Ont.

Orr, James Campbell, 262 Frontenac St., Kingston, Ont.

Pearson, George Beverley, 298 Victoria Ave., Kingston, Ont.

Stinson, William Geoffrey, Victoria St., Cobourg, Ont.

Waghorne, Murray Ashton, 1772 Lincoln Rd., Windsor, Ont.

Students at McGill University

Bilodeau, Francis James Donald, 256 Wood Ave., Westmount, Que.

Gingras, Marcel, 313 Principal St., Ville St. Laurent, Que.

Hendershott, Frederick William, 127 Ballantyne Ave. North, Montreal West, Que.

Levinoff, Samuel, 876 Rockland Ave., Outremont, Que.

Scarth, Robert Lloyd, Box 268, Macdonald College, Que.

Students at Ecole Polytechnique

Fortin, Bernard, 2086 Darling St., Montreal, Que.

Monette, G. Albert, 28 Ste. Anne St., Pointe-aux-Trembles, Montreal, Que.

Noiseux, Denis, Ecole Polytechnique, Montreal, Que.

Poitras, Guy, 289 west St. Joseph Blvd., Montreal, Que.

Provencher, Léo-Paul, 5058 Chambord St., Montreal, Que.

Students at University of Toronto

Cherry, Harold John, 111 Main St. West, North Bay, Ont.

Cline, Richard Carl, 88 St. George St., Toronto, Ont.

Dewhurst, James Buchanan, Port Nelson, Ont.

Peacock, Edward Massie, 16 Lytton Blvd., Toronto, Ont.

Ward, J., 538 Roselawn Ave., Toronto, Ont.

Ward, Jack Herbert, P.O. Box 92, Picton, Ont.

Students at University of New Brunswick

Fairley, Randolph Douglas, Beaverbrook Residence, Fredericton, N.B.

Overend, A. Vincent, 682 George St., Fredericton, N.B.

Reid, Edwin Charles, 271 Regent St., Fredericton, N.B.

Simpson, Douglas Beverley, 418 University Avenue, Fredericton, N.B.

By virtue of the co-operative agreements between the Institute and the provincial associations of professional engineers, the following elections and transfers have become effective:

ALBERTA

Transferred from the class of Junior to that of Member

Hogg, Allan Douglas, B.E., M.A.Sc., Ph.D., (Univ. of Sask.), (Univ. of Toronto), lecturer in mechanical engrg., Univ. of Alta., Edmonton, Alta.

Transferred from the class of Student to that of Junior

McDougall, George Edward, B.Sc., (Univ. of Alta.), junior bridge engr., Public Roads Administration, Edmonton, Alta.

Smith, LeRoy Elsworth, B.Sc., (Univ. of Alta.), instr'mn., Dept. of Transport, Whitecourt, Alta.

NEW BRUNSWICK

Transferred from the class of Junior to that of Member

Campbell, Duncan Chester, B.Sc., (Univ. of N.B.), res. engr., Dept. of Transport, Gander, Nfld.

Transferred from the class of Student to that of Junior

Kennedy, J. F., B.Sc., (Univ. of N.B.), 234 Brunswick St., Fredericton, N.B.

NOVA SCOTIA (as of Feb. 24th, 1944)

Members

Deehman, Walter Fairchild, B.Sc., (N.S. Tech. Coll.), town engr., Town of Liverpool, N.S.

Fraser, William Leo, B.Sc. (Elec.), (N.S. Tech. Coll.), operation engr., Nova Scotia Power Commission, Halifax, N.S.

Kelly, James Frederick B.Sc., (McGill), Dept. of Public Works, Halifax, N.S.

Loring, Harold Churchill, Ph.B., (Brown Univ., Providence, R.I.), president, Harold C. Loring Associates, Brooklyn, N.Y.

SASKATCHEWAN (as of Feb. 18th, 1944)

Transferred from the class of Student to that of Junior

Auld, Frank Mantle, B.Sc., (Univ. of Sask.), 2nd Lieut., C.O.C.T.C., Barriefield, Ont. (Home: 2830 Retallack St., Regina, Sask.)

McLeod, Lloyd Robert, B.Sc., (Univ. of Sask.), lecturer and lab. instructor, University of Saskatchewan, Saskatoon, Sask.

Student

Babey, William Joseph, (Univ. of Sask.), 110, 4th Ave. N., Saskatoon, Sask.

Personals

News of the Personal Activities of members of the Institute

Relatives and friends of members in the active forces are invited to inform the Institute of news items, such as locations, promotions, transfers, etc., which would be of interest to other members of the Institute and which should be entered on the member's personal record kept at Headquarters. These would form a basis of personal items in the *Journal*.

Thomas H. Kirby, M.E.I.C., is the new chairman of the Winnipeg Branch of the Institute. Born at Ottawa he graduated from McGill University in 1913, and for a number of years was engaged in construction work with the Greater Winnipeg Water District. Later he was engineer with the Manitoba Power Commission and in 1930 he became sales manager of Filer-Smith Machinery Company, Limited, Winnipeg. He is now vice-president of the company.

T. H. Kirby, M.E.I.C.

H. J. G. Letson, M.E.I.C., Adjutant General of National Defence, Ottawa, has been awarded the United States Legion of Merit Medal in recognition of "exceptional meritorious conduct in connection with the organization and operation of the joint Canadian-American interview board which dealt with transfer of United States citizens from the Canadian to American forces in 1942." General Letson was designated as Commander of the Legion of Merit.

Lt.-Col. P. L. Debney, M.E.I.C., attached to the engineer's training centre at Petawawa Military Camp, Ont., was made a legionnaire of the United States Legion of Merit. The Legion of Merit is one of the highest honours awarded to persons who are not citizens of the United States.

A. L. C. Atkinson, M.E.I.C., has resumed his former position as assistant professor of mechanical and civil engineering, at the University of Saskatchewan, from which he had obtained leave of absence nearly three years ago to join the R.C.N.V.R. During his period of service as Construction Lieut. Commander at Naval Service Headquarters, Ottawa, he was in charge of all naval construction calculations, including experiments on all classes of vessels in the Canadian Navy. He was responsible for the design and the inspection of the first landing craft to be built in this country.

Edward P. Innes, M.E.I.C., has been promoted to the rank of major with the Canadian Army overseas. He is with a technical liaison group at the British Ministry of Supply, London, He was formerly in charge of the engineering department at Canadian Canners Limited, Hamilton.

W. B. Dunbar, M.E.I.C., formerly assistant professor of engineering drawing at the University of Toronto, has been appointed associate professor.

M. M. Price, M.E.I.C., has recently been transferred from Prince Rupert, B.C., to Edmonton, Alta., as division engineer with the Canadian National Railways. He was previously assistant division engineer.

W. R. McClelland, M.E.I.C., has recently been elected chairman of the Ottawa Branch, Canadian Institute of Mining and Metallurgy. Mr. McClelland is on the staff of the Metals Controller, and was formerly metallurgical engineer with the Bureau of Mines, from which his services have been loaned to the Department of Munitions and Supply.

Robert F. Ogilvy, M.E.I.C., formerly resident engineer for the Aluminum Company of Canada, Limited, at Passe Dangereuse has been at Kingston, Ont., since last October, completing the construction programme at the Kingston Works of the same company. He is at present on his way to India where he will be resident engineer on construction of a new plant near Calcutta for Aluminium Production Company of India, Limited.

R. E. McMillan, M.E.I.C., has been transferred from Arvida, Que., to the Toronto Works of the Aluminum Company of Canada, Limited.

J. L. McDougall, M.E.I.C., who until recently was on the staff of H. G. Acres and Company at Niagara Falls, is now located at Thorold, Ont., with the Ontario Paper Company.

Harold V. Serson, M.E.I.C., formerly at Shipshaw, has recently been transferred to the Montreal Office of The Foundation Company of Canada.

F. C. Dempsey, M.E.I.C., is now in charge of the asphalt division of the British American Oil Company Limited, Toronto. He was formerly with the same company in Regina, Sask.

C. G. Peters, M.E.I.C., has recently joined the engineering staff of the Canadian Pacific Railway at Brandon, Man.

W. F. Campbell, M.E.I.C., formerly connected with the Aluminum Company of Canada, Limited, Shipshaw, Que., has been transferred to the Roberval & Saguenay Railway, Arvida, Que.

W. E. Plummer, M.E.I.C., is now employed in the district engineer's office of the Department of Public Works, London, Ont. He was previously with the Canadian Synthetic Rubber Company, Limited, Sarnia, Ont.

C. O. P. Klotz, M.E.I.C., has been transferred from the Aluminum Company of Canada, Limited, Kingston, Ont., to Arvida, Que.

Paul Kellogg, M.E.I.C., head of the firm Stevenson & Kellogg, Limited, Montreal, management engineers, has recently been appointed general manager of the Newsprint Association of Canada.

Group Capt. J. A. Jones, M.E.I.C., has recently been made director of construction, engineering and maintenance in the division of works and buildings at R.C.A.F. Headquarters, Ottawa.

C. C. Lindsay, M.E.I.C., consulting engineer and land surveyor, Montreal, was elected president of the Corporation of Professional Engineers of Quebec, at the annual meeting held on March 25th. Mr. Lindsay is also chairman of the Montreal Branch of the Institute for the current year.

Wm. J. Ahearn, Jr.E.I.C., is now employed with the Northern Electric Company, Montreal. He was formerly with the Victory Aircraft Limited, Toronto.

J. W. Demcoe, Jr.E.I.C., has been transferred from Toronto to London, Ont., as assistant division engineer, with the Canadian National Railways.

Col. R. L. Franklin, Jr.E.I.C., has recently been promoted to this rank and appointed director of mechanical maintenance in the Department of National Defence, Ottawa.

W. F. Jarrett, S.E.I.C., recently with the Aluminum Company of Canada, Limited, Montreal, has been transferred to Saguenay Power Company, Limited, Isle Maligne, Que., as electrical engineer.

Geo. E. Backer, S.E.I.C., who graduated from McGill last year, is now on active service with the R.C.O.C., and is at present stationed at Barriefield, Ont.

Lionel Boulet, S.E.I.C., a fourth year student in electrical engineering at Laval University, Quebec, took the first prize for his paper presented at the Annual Student's Night of the Montreal section of the Institute of Radio Engineers last month. Mr. Boulet received the Engineering Institute prize at Laval last year.

Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

William Stephen Atwood, M.E.I.C., vice-president and director of Canadian Car and Foundry Company, Limited, Montreal, died suddenly on March 18, 1944.

Born in Conneaut, Ohio, on January 19th, 1876, he was educated in the local schools and in 1899 he joined the American Car and Foundry Company at Chicago as an estimating clerk. In 1901 he went with the Simplex Railway Appliance Company, Hammond, Indiana, as draughtsman and in 1903 he came to Canada as chief

W. S. Atwood, M.E.I.C.

draughtman for the same company. Later he occupied the position of mechanical engineer with the company, mechanical engineer with the Dominion Car and Foundry Company and chief engineer of the Canadian Steel Foundries Limited, Montreal. When these companies were merged into the Canadian Car and Foundry Company, Limited in 1912, Mr. Atwood was appointed chief engineer. In 1914 he was named operations manager and held this position during the Great War when the company built ships for the French Navy. In 1919 he was appointed assistant to the late president, W. W. Butler, and later was made a vice-president of the company.

He was a pioneer in the development of railroad cars and designed and developed the first steel frame box freight car in 1907 while with the Dominion Car and

Foundry Company and later on was prominent in the development of the all-steel box car. He was appointed a director of the Canadian Car and Foundry Company in October, 1941.

Mr. Atwood joined the Institute as a Member in 1914.

Aubrey B. Blanchard, M.E.I.C., died suddenly on February 24, 1944, at Truro, N.S. Born at Truro on October 24, 1876, he received his education at Dalhousie University, Halifax, where he was an honour graduate in philosophy. Later he taught for two years at St. Andrew's College, Toronto, before starting his engineering career.

Mr. Blanchard was resident engineer on construction of the following railway lines—Toronto-Sudbury line, Canadian Northern Ontario Railway at Bala, Muskoka, from 1904-1906; Toronto-Sudbury line, Canadian Pacific Railway at Parry Sound from 1906-1907; Transcontinental Railway from 1907-1908. He was designing engineer on construction of the Transcontinental Railway District "A", New Brunswick, from 1908-1909; Transcontinental Railway District "B", Quebec, from 1909-1911; Canadian Northern Railway, Sudbury-Port Arthur line from 1911-1913; Canadian Northern Railway, Hawkesbury-Montreal line at Montreal from 1913-1915. He enlisted with the Canadian Engineers in 1915 and was assistant camp engineer at Valcartier in 1916, camp engineer in 1917 and C.R.C.E. for New Brunswick, from 1917 until 1919. After the first Great War, Mr. Blanchard joined the Department of Highways of Nova Scotia, and was engaged in construction work for a number of years.

In 1928 he became an inspecting engineer for the department later being appointed division engineer at Sydney.

He joined the Institute in 1904, and was transferred to Associate Member in 1910. He transferred to Member in 1915.

Mr. Blanchard was also active in the Association of Professional Engineers of Nova Scotia, serving on the council for several years.

John Laurence Haslett Bogart, M.E.I.C., died at Pembroke, Ont., on March 18, 1944. Born at Whitby, Ont., on February 18, 1877, he was educated at Royal Military College, Kingston, where he graduated with honours in 1897.

For the next few years he worked on the R.M.C. topographical survey and lectured in engineering at Queen's University, while he served with the 14th Regiment, Kingston. He was granted the degree of B.Sc. by Queen's University.

In 1904 when the Royal Canadian Engineers were formed, he joined them and was posted to headquarters in Ottawa as assistant to the director general of engineer services. Two years later he was sent to Halifax as senior engineer officer, but in 1910 he returned to his old post in Ottawa and this marked the beginning of his connection with Petawawa. For three years he spent the summers there and the winters in Ottawa, and in 1913 he was made camp engineer.

He went overseas in 1914 as officer commanding the 2nd Division Signals and remained until 1919, latterly being in command of the Canadian Corps of Signals. He was awarded the D.S.O. and the 1914-15 Star.

During the latter part of the war he took a staff course in Britain and on returning to Canada was posted to M.D. 2, Toronto, as senior engineer officer. In 1923 he returned to Petawawa as camp engineer and remained in that capacity until 1930, when he was made director of engineering services at Defence Headquarters in Ottawa. Four years later he returned to Petawawa, where he had charge of the unemployment relief camps until 1937, when he was made District Officer Commanding M.D. 13, Calgary. He retired on pension the same year and returned to Pembroke to live.

Brigadier Bogart joined the Institute as an Associate Member in 1902 and he became a Member in 1940.

Charles Chapais, M.E.I.C., sales manager of Casavant Frères Limitée, organ manufacturers, St. Hyacinthe, Que., died in the hospital at Montreal on February 21st, 1944. He was born at St. Denis, Kamouraska County, Que., on May 12, 1879, and received his engineering education at Ecole Polytechnique, Montreal, where he graduated in 1904.

Upon graduation he joined the Department of Public Works of Canada, and for a number of years he was engaged as an assistant engineer on the improvement works carried out in the Quebec harbour.

Charles Chapais, M.E.I.C.

In 1914 he joined the staff of Casavant Frères at St. Hyacinthe and after having been employed through the several departments of the company, he became successively, sales engineer and later sales manager.

Mr. Chapais joined the Institute as an Associate Member in 1910, becoming a member in 1940.

Alvah Ernest Foreman, M.E.I.C., died in the hospital at Vancouver on February 19, 1944, after a year's illness. Born at Cheapside, Ont., on December 28, 1878, he graduated in engineering from McGill University in 1903. During his college course, he had worked with B.C. Electric Railway Company, Vancouver, and Canadian General Electric Company, Peterborough. After garduating from McGill, he spent a few years in Toronto, acquiring business experience.

Mr. Foreman became a member of the engineering firm, Dutcher and Foreman, in Victoria in 1909. From 1910-1912 he was engaged in construction work, and from 1912-1916 he was assistant city engineer of Victoria, B.C. He joined the Provincial Department of Public Works at Victoria in 1917, later becoming chief engineer of the department. He resigned this position in 1920, to engage in private practice at Vancouver, B.C. From 1920-1930 he was British Columbia manager for the Portland Cement Association of Chicago. During the last 10 years, he was connected with the construction of several large projects in British Columbia.

Mr. Foreman joined the Institute as a Student in 1903, transferring to Associate Member in 1909. He was transferred to Member in 1918, and in 1938 he was made a Life Member.

OLIVIER ODILON LEFEBVRE, D.Sc., B.A.Sc.

1879 - 1944

The utilization and control of the great sources of power in nature are among the major responsibilities of the engineer. This is especially the case with us in Canada, where the power available in our immense systems of lakes and waterways is being developed. Death has just taken from us an eminent engineer, whose life-work dealt with this development,—and whose reputation as a distinguished public servant extended far beyond the boundaries of his native province or of the Dominion.

Dr. O. O. Lefebvre, who was in his 65th year, died in Montreal on March 25th, 1944, after an illness of three weeks. He was born at St. Hugues, Bagot county, on November 14th, 1879, and had his early education at Mont St. Louis College, Montreal, which he left in 1898 to study at the Ecole Polytechnique, Montreal. He graduated there with honours in 1902, obtaining the degree of bachelor of applied science in civil engineering. In 1929, he received the honorary degree of doctor of science from the University of Montreal.

After over four years work in the laboratories of the Department of Public Works in Ottawa, from 1902 to 1907, he was appointed assistant to the Ottawa district engineer, and was then engaged in surveys and construction work carried out by the Department. He was sent to Vancouver in 1912 to make a survey of Burrard Inlet and False Creek. In February 1913, he resigned from the Dominion service and was made chief engineer of the Quebec Streams Commission. This position he held for over twenty years, then becoming vice-chairman of the Quebec Electricity Commission in 1935. When this body was superseded by the Provincial Electricity Board in 1937, he served as one of its members, but returned in 1940 to the Quebec Streams Commission as its vice-chairman. He held that position at the time of his death.

While with the Quebec Streams Commission, Dr. Lefebvre was responsible for all the important projects carried out by the Commission to regulate and improve the flow of the larger rivers of the province to provide for their more efficient use in the generation of hydro-electric power. Among these works may be mentioned the construction of the Gouin and other storage dams on the St. Maurice river, which increased its minimum flow from 6,000 to 16,000 cubic feet per second; dams to regulate the flow of the St. François, Chicoutimi and AuSable rivers; the Mercier dam and reservoir built in 1927 to regulate the flow of the Gatineau river to a minimum of 10,000 cubic feet per second; and the Cedars Rapids dam on the Lièvre river, completed in 1930, to regulate the discharge of that river. He had charge of the construction for the Province of Quebec of the Cadillac power development, on the Ottawa river, from 1939 to its completion in 1941. In addition to his work for the Commission, he found time for expert advisory and consulting practice and was frequently retained to give evidence in difficult law suits and arbitrations.

In 1924, Dr. Lefebvre was selected as one of the three Canadian members of the joint board of engineers appointed to investigate and report on the St. Lawrence deep waterway. The results of this enquiry were embodied in a full report, issued three years later, covering the engineering aspects of the St. Lawrence scheme. He was appointed to represent Canada at the World Power Conferences held in Berlin in 1930 and in Washington in 1936. At the time of his death, he was member of the Canadian Temporary Great Lakes St. Lawrence Basin Committee.

He was chief engineer of the Lake St. Louis Bridge Commission which supervised the construction, in 1933-1934, of the Honoré Mercier bridge over the St. Lawrence river, near Montreal.

Joining The Engineering Institute of Canada as a Student in 1903, he became an Associate Member in 1912, and a Member in 1920. Throughout his 41 years connection with the Institute, Dr. Lefebvre took an active part in its affairs. He served as councillor for five years, as vice-president for two years, and occupied the presidential chair in 1933. During his term of office as president, he visited the twenty-five branches of the Institute, thus developing a practice which has proved of great benefit to the Institute. At the time of his death, he was vice-chairman of the Committee on Professional Interests, and member of the Committee on International Relations, the Committee on Western Water Problems and the Committee on Deterioration of Concrete Structures. His interest in the activities of the Montreal Branch of the Institute was no less marked.

He was active in the formation and development of the Corporation of Professional Engineers of the Province of Quebec, having been a member of its council since 1923, and president in 1941.

Dr. Lefebvre was a member of the American Society of Civil Engineers. His interest in problems of professional education was shown by his membership of the administrative board of the Ecole Polytechnique and of the board of administration of the University of Montreal. In 1925, he was president of the Graduates

Society of the Ecole. At the time of his death, he was chairman of the Catholic School Board of Outremont, and chief warden of the church of St. Germain d'Outremont. From 1932 to 1936 he held the office of Grand Knight of the Lafontaine Council of the Knights of Columbus in Montreal.

He gave much of his time to charitable and welfare work, notably that of the Federation of French Charities; he had served as secretary of L'Assistance Publique since 1929. Just before his death he was cheered by hearing of the success of the Red Cross campaign in Montreal, of which he had been joint chairman. For many years he had been actively concerned in the work of the Province of Quebec Society for Crippled children, an organization of which he was president in 1938.

He had long been an active member of the Rotary Club, and was a life member of the Cercle Universitaire, of which he was president in 1934-35.

Born and brought up among rural surroundings, at a time when country life retained much of its primitive charm, Dr. Lefebvre liked to talk of the simplicity which characterized 'le bon vieux temps' on his father's farm near St. Hyacinthe, when the manifold industries of the members of a large family could supply practically all their needs. Later, as he pointed out, their broader contacts would open a wider, but not necessarily a happier, prospect. In fulfilment of a wish he had often expressed, he was buried at his native place, St. Hugues.

In his professional work, Dr. Lefebvre, gifted with sound judgment and well qualified by experience and training, brought to all his duties those powers of leadership which secured for him his enviable reputation as designer, constructor, adviser, and administrator. He was a staunch upholder of the status and privileges of the professional engineer, and always strove for the maintenance of the highest possible educational and professional standards. He leaves behind him many devoted friends and colleagues, who will sorely miss his congenial personality, his wise counsel, and the helpful guidance which he was so well able to give them.

News of the Branches

Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

CALGARY BRANCH

K. W. Mitchell, M.E.I.C. - *Secretary-Treasurer*
A. B. Giddes, M.E.I.C. - - *Branch News Editor*

At a general meeting held in the Palliser Hotel, Thursday, January 27th, Mr. C. K. Chisholm, sales engineer for R.C.A. Victor, spoke on the **Electron Microscope.**

Tracing the development of the microscope from the simplest form using a single glass lens Mr. Chisholm stated that the ultimate permissibility of use of this type is limited to the wave length of light. The electron type is many times more powerful, makes use of electron transmission and has a useful magnification of 100,000 or, graphically, enlargement of an object from the size of a dime to a diameter of one mile.

HALIFAX BRANCH

S. W. Gray, M.E.I.C. - - *Secretary-Treasurer*
C. D. Martin, M.E.I.C. - - *Branch News Editor*

The combined annual banquet of the Association of Professional Engineers of Nova Scotia and the Halifax Branch of the Institute was held on January 20th at the Nova Scotian Hotel. This was attended by a total of 232. The special guests were:- Dr. E. P. Linton, president of the Halifax Branch, Canadian Institute of Chemistry; Rev. Chaplain H. R. Pyke, *H.M.C.S. Stadacona*, guest speaker; C. C. Coffin, representing Nova Scotia Institute of Science; R. Morton, president of the Nova Scotia Architectural Society.

The speaker's topic was **The Good Earth**, and his address was greatly enjoyed.

G. J. Currie, chairman of the Branch, was in the chair for the first part of the evening, and J. H. M. Jones, new president of the Association, carried on in the capacity of chairman for the remainder of the evening.

The Master of Ceremonies was K. L. Dawson, who with the co-operation of Harry Cochrane, his orchestra and cast, supplied an excellent programme of entertainment, giving a variety of singing, dancing, and several very successful specialty features, all of which were enthusiastically received.

We are very grateful to the following firms who contributed to the success of this banquet:- Canadian Westinghouse Co. Ltd.; Foulis Engineering Sales Ltd.; Foulis & Bennett Electric Ltd.; Imperial Oil Limited; D. C. Keddy; Moloney Electric Co. of Canada Ltd.; Northern Electric Co. Ltd., and Wm. Stairs Son and Morrow Ltd.

The regular monthly joint dinner meeting of the Halifax Branch of the Institute and the Association of Professional Engineers of Nova Scotia was held February 24th at the Nova Scotian Hotel. Seventy-two attended this meeting at which G. J. Currie, chairman, presided.

W. S. Wilson, chief engineer, Dominion Steel and Coal Corporation, Ltd., Sydney, N.S., was the guest speaker. He spoke on the history, operation, development, and the post-war plans of the company and its various subsidiaries. All present listened with much interest to Mr. Wilson's very fine address.

Several of the students of the Nova Scotia Technical College were guests at this meeting.

HAMILTON BRANCH

W. E. Brown, M.E.I.C. - - *Secretary-Treasurer*
L. C. Sentance, M.E.I.C. - *Branch News Editor*

On Thursday, February 17th, the regular monthly meeting of the Hamilton Branch was held at McMaster University; eighty-five members and guests were in attendance.

H. A. Cooch, Branch chairman, introduced Mr. D. McLaren of the Barrett Company Ltd, of Montreal. Mr. McLaren, after a few introductory remarks, proceeded with the showing of two sound films kindly loaned by his company.

The first film, entitled **Stone Canyon,** dealt with the Los Angeles waterworks project of the same name, showing in detail the fabrication, protection and final laying of pipe.

The following film, **Oil for War,** covered in detail the construction of the Big Inch pipe line which in its 1400-mile length traverses every type of terrain. The pipe line was constructed in record time using the most modern methods and equipment; of particular interest were the machines used for automatically cleaning, priming and wrapping the pipe during the application of external protection. Included in the film were U.S. War Department pictures of the naval battle of Midway.

Upon adjournment members repaired to the anteroom for the customary refreshments.

KINGSTON BRANCH

R. A. Low, M.E.I.C. - - *Secretary-Treasurer*
C. E. Craig, S.E.I.C. - - *Branch News Editor*

The programme committee of the Kingston Branch under the chairmanship of R. J. Carter, continued, during February and March, its presentation of interesting meetings.

February 8th, C. J. Warrington, development manager of the Nylon Division of C.I.L. Kingston, delivered a most informative paper entitled **Nylon in War and Peace.** The speaker outlined in most interesting detail the properties of this new material and demonstrated by means of actual samples, the varied uses of nylon. It is hoped that the paper will appear in an early issue of the *Journal.*

February 22, in the New Art Building, Queen's University, the Kingston Branch further exemplified its efforts to assist the young engineer. Engineering students at the university were invited to present papers in open competition for student prizes and the results were so encouraging that meetings of this nature will most likely become an annual feature of the branch.

The board of judges composed of Prof. A. Jackson, Dr. S. D. Lash, and Lt. Col. L. F. Grant, chairman, chose A. R. Bader, S.E.I.C., Sc '45 as winner of the first prize of $15.00 in books. **Engineering Uses for Some Unknown Metals** presented the properties and possibilities of berylium, vanadium and tantalum. Second prize of $10.00 in books, was awarded jointly to C. E. Leon, Sc '45 and K. Rothchild, Sc '46 for their treatises **Fire Protection in a Small Factory** and **Industrial and Economic Aspects of the Plastics.** Honourable mention awards of membership fees in the E.I.C. went to W. P. Meredith, Sc. '45 and J. A. Brown,

March 7th the Kingston Branch sponsored a well-attended public meeting at Convocation Hall, Queen's University. The topic of the evening **Town Planning and the Future of Kingston** was discussed by three experts on the subject, following which, Dr. R. C. Wallace, chairman, invited questions from the audience.

A. S. Mathers, member of the Technical Advisory Committee, Town Planning Commission of the City of Toronto, outlined the many complex theories involved. W. Cecil Cole, chairman, Town Planning Commission of the City of Kingston, presented the development of this important phase of local civic endeavour. The more practical aspects of town planning were dealt with by R. A. Low, secretary of the Kingston Branch, who stressed the technical problems involved in town planning and further pointed out the many ways engineers will be called upon to solve these difficulties. Following the meeting the three speakers were bombarded with pointed queries from the audience which was composed largely of Kingston citizens who demonstrated a definite interest in this preliminary step to control the future development of their city.

MONTREAL BRANCH

L. A. Duchastel, M.E.I.C. - *Secretary-Treasurer*
H. H. Schwartz, Jr.E.I.C. - *Branch News Editor*

On Thursday, February 24th, the Montreal Branch held its annual social evening. Four films were shown.

The first dealt with the reaction of a Norwegian fishing village under the Nazi heel.

The next two films were technical, one dealing with the construction of "The Big Inch" oil pipe line from Texas to the East Coast, the other describing the construction of a water pipe line for the city of Los Angeles.

The fourth film gave a glimpse of the future, "A World of Plenty," in which food would no longer be wasted or burned, wheat would no longer be plowed under, coffee would no longer be dumped into the sea, while millions of people starved. But rather a rational system of distribution would be set up to feed the nations of the world.

On Thursday, March 2nd, Walter Griesbach spoke on **The Construction of Shipshaw Development.** His paper appears in this issue.

On Thursday, March 9th, R. A. H. Hayes spoke on **The Electrical Equipment at Shipshaw.** This paper appears in this issue.

On Thursday, March 16th, J. O. Martineau spoke on **Highway Expenditure vs. Highway Investment.** The speaker stressed the need of engineering skill and experience in highway planning and construction, if the funds available are to provide adequate transportation facilities, and, at the same time, are to be invested profitably for the economic and social welfare of the public.

Before considering the construction of a new highway, it is essential to have complete information on hand. This means a complete set of different maps of the various localities through which the road will pass. Road maps which show the existing road system; soil maps for construction purposes; accident maps; road sign maps; all types are needed. After the road is built, all maps must be brought up to date. New maps to show the density of traffic summer and winter maintenance schedule must be prepared.

The need, both present and future, both economical and social should determine the type and location of the road, not pressure groups.

Highway engineering means better and safer post-war roads. With the many new developments in ideas and materials, we may confidently look forward to a strong properly planned highway system that will knit the country together and materially speed our progress.

NIAGARA PENINSULA BRANCH

J. H. Ings, M.E.I.C. - - *Secretary-Treasurer*
J. W. Brooks, Jr.E.I.C. - *Branch News Editor*

Dr. H. G. Acres, renowned consulting engineer, presented a general description of the Shipshaw power development to the local Branch at its January dinner meeting, held in St. Catharines. A phenomenally large audience gave evidence of local engineers' interest in this magnificent project, and was also a tribute to the speaker of the evening. Dr. Acres, a graduate of the famous Varsity 1903 class, was introduced by his lifelong friend, Harold Bucke, Mr. C. G. Cline, immediate past chairman of the local Branch, moved the vote of thanks.

This issue of the Journal contains Dr. Acres' original paper, **The Design of the Shipshaw Power Development.**

On February 24, Mr. J. D. Willis, industrial control specialist of the Canadian General Electric Company, gave a most enjoyable lecture entitled **Electronics in Industry.** Mr. Willis outlined some of the innumerable uses of electronic control in radio, medicine, agriculture, war, and industry, illustrating his talk with motion pictures.

Through the courtesy of C.G.E., two technicolour sound films, "Sightseeing at Home" and "F.M.," were also presented. The former tempted its audience with the wonders of post-war television, and the latter explained the workings of frequency modulation, that amazing invention which eliminates static, station interference, and fading, and also improves tone control.

OTTAWA BRANCH

A. A. Swinnerton, m.e.i.c. - *Secretary-Treasurer*
R. C. Purser, m.e.i.c. - *Branch News Editor*

A sound-colour motion picture was the feature of a noon luncheon on March 9 at the Chateau Laurier. This picture **Oil for War** illustrated the construction of "Big Inch," one of the world's largest pipe lines for oil.

Helping to break the most serious oil transportation bottleneck in history, this pipe line extended for 1400 miles from Longview, Texas, to the Eastern Seaboard of United States. It has a capacity of 300,000 barrels of oil per day, the equivalent of 25,000 tank cars in shuttle service between Texas and the East. Flowing at the rate of 6.6 ft. per sec. the length of the line is emphasized by the fact that it requires fourteen days for the oil to move from one end of the pipe line to the other.

The motion picture illustrated methods of ditching in different kinds of soil, of the way rivers were crossed, of the care taken in coating the pipe with coal-tar enamel and asbestos felt to prevent corrosion of its surface, and special treatment required under certain conditions of topography. The pipe line crossed thirty rivers and almost two hundred smaller streams. The initial delivery of petroleum through the pipe line was made on the two-hundredth day after the commencement of construction.

The picture was shown through the courtesy of the Barrett Company, Limited, of Montreal. W. L. Saunders, chairman of the branch, presided at the luncheon.

PETERBOROUGH BRANCH

A. J. Girdwood, Jr.e.i.c. - *Secretary-Treasurer*
J. F. Osborn, Jr.e.i.c. - *Branch News Editor*

The Annual Party was held on Saturday, February 5th at the Kawartha Club and was attended by about 90 persons. Dinner was enlivened by songs and by a skit put on by Bud Hamilton and Bill Messervy. After dinner Jack Boothe, Globe and Mail cartoonist amused the audience with caricatures of some of those present and a humorous lecture on **Phrenology.** This was followed by several movie "shorts." Jack Marshall's orchestra played for dancing till midnight. The committee for arrangements consisted of—Messrs. D. C. McCrady, Clark Muir, W. Wright and J. F. Osborn.

Mr. C. G. Warrington, Development Manager of C.I.L., Nylon Division, addressed the February 17th meeting on "Nylon in War and Peace." It is expected that the paper will appear shortly in the *Journal.*

Some excellent slides illustrated the plant and processes involved in the manufacture of nylon.

SAGUENAY BRANCH

A. T. Cairncross, m.e.i.c. - *Secretary-Treasurer*

A meeting of the Saguenay Branch was held at Arvida on Feb. 23, 1944 when Mr. A. E. Bryne, B.A.Sc., Manager, Plastics Section Supply Department, Canadian General Electric Co., Toronto, spoke on **Plastics.**

Mr. Bryne explained that the term plastics covers an extensive range of materials which when processed can be squeezed into any shape and retain that shape after curing. There are 20 to 25 main types of plastics and within these types are many variations just as in steel there are many alloys.

Plastics may be classified physically as (1) Thermoplastic—flow with heat and harden on cooling—further application of heat will change the form. (2) Thermosetting—flow with heat—undergo chemical change—further application of heat will not change the form. (3) Elastomers—rubber like materials that are thermoplastic in nature some of which may be vulcanized to thermo-setting materials.

Plastics may be divided into two groups according to origin, synthetic and natural. The synthetics would be represented by the petroleum by-product materials and the naturals by the cellulose from cotton materials.

The materials from which plastics are made are plentiful and cheap to obtain. The five basic elements required are carbon, hydrogen, nitrogen, chlorine, and sulphur.

Summing up his topic the speaker said that the development of plastics had been rapid and it had passed the kitchen gadget stage. Plastics should now be considered engineering materials that can be designed to meet particular needs.

Illustrating slides were shown and numerous samples of engineered plastic products were displayed.

SASKATCHEWAN BRANCH

Stewart Young, m.e.i.c. - *Secretary-Treasurer*

The Annual Meeting of the Saskatchewan Branch was held jointly with the Association of Professional Engineers in the Hotel Saskatchewan, Regina, on Friday, February 18, 1944. A. M. Macgillivray occupied the chair for both meetings. The attendance at the business session in the afternoon was 32, and at the evening session 65.

The newly elected president of the Association and chairman of the Branch is J. McD. Patton, Bridge Engineer, Department of Highways and Transportation.

The guest speaker at the evening session was Rev. Harry Joyce who took as his subject, **People I Have Met.** F. B. Reilly introduced the speaker and at the conclusion of the address, which was well received, J. R. Young formally moved a vote of thanks.

During the business session a report from the Saskatoon section indicated 3 general meetings held during the year with an average attendance of 55.

The subjects presented at the respective meetings in Saskatoon were:

March 26, 1943—**The Historical Development and Present Day Practice in Firing Pulverized Coal** by A. L. Cole.

October 20, 1943—**Post War Reconstruction** by K. M. Cameron, President, E.I.C., January 25, 1944.

January 25, 1944—**Air Masses and Climate in Western Canada** by Dr. B. W. Currie.

TORONTO BRANCH

S. H. deJong, M.E.I.C. - - *Secretary-Treasurer*
G. L. White, Affil.E.I.C. - *Branch News Editor*

A joint meeting of the Toronto Branch and the Toronto Junior Section of the Institute held on January 26th took the form of an inspection of the exhibit of the City Planning Board at the Toronto Art Gallery. Four members of the Board, in turn, discussed the various engineering aspects of the plan. Mr. S. R. Frost outlined the general plan showing their proposals for transportation, housing and park improvements, to be carried out over the next thirty years. Mr. Norman Wilson spoke on the problems of rapid transit and mass transportation for the Toronto Transportation System. A series of separated right-of-ways, some underground, some depressed, and still other new routes devoted solely to street railway transportation are proposed. Mr. A. E. K. Bunnell, Chairman of the Advisory Technical Committee spoke on general traffic conditions. Highway transportation within the city will be provided by elevated and depressed roads and by entirely new high speed roads. Mr. A. S. Mathers explained the redevelopment and housing plan. He spoke of the proposed green belt around the city which will take in certain natural park lands. Inside the belt the city will own most, if not all, of the land. It can, however, by zoning ordinance, provide forever a "lung" of grass and trees in which real estate subdivision will be forbidden. The most important element in the master plan is the rehabilitation of the very old section bounded by College, Carlton, Queen, the Don, and Ossington.

The Student Night of the Toronto Branch drew an excellent attendance from the Senior Group, from the Junior Section, and from the Engineering Society, University of Toronto. The meeting was held in the Household Science Building on Thursday, February 17th, and was preceded by a dinner at which the Student speakers and the Executives of the Toronto Branch and of the Junior Section were present.

Following a few introductory words by S. M. Frost, J. M. Van Winckle, chairman of the Junior Section, occupied the chair.

The first item on the programme was the award of the certificate of the Engineering Institute prize to Robert H. Aspinall, Faculty of Applied Science and Engineering, University of Toronto.

There were three speakers in the Senior competition and two in the Junior competition. The first award in the Senior competition went to H. D. McNiven for his address on **Glass as a Structural Material.** This paper contained interesting references to the ability of glass to take high loads under certain conditions, its application in structures as a load bearing material, and some of its spectacular achievements in glass piping, centrifugal pumps, etc.

The second prize was awarded to J. Ward for his discussion of the timely subject **Air Jet Propulsion.** Mr. Ward's talk was illustrated with an interesting selection of slides showing the development of air jet propulsion from its inception to the present day. In spite of high fuel consumption and low efficiency, the speaker believed that this development merited the further attention of engineers.

The third award went to G. H. Perkins for his talk on **Flood Control.** Mr. Perkins outlined the increasingly disastrous effects of floods. His discussion of control dealt primarily with the need for further surveys of the Ganaraska type and the efficient use of contour ploughing, terracing, strip cropping, and reforestation to control the water on the upper water shed.

The first award in the Junior group went to J. H. Ward for his paper on **Magnesium as an Aircraft Component.** The speaker showed that the introduction of magnesium had not been rapid or easy and then proceeded to show that some of the greatest difficulties in the broader use of magnesium in aircraft had been overcome. Evidence of the present wide application of this material is its very large output as compared to pre-war years.

The second prize winner was E. M. Peacock who spoke on **Fluid Drives.** He outlined its history and development and discussed construction and mechanical features. Types, applications and future possibilities were also covered. With an efficiency of 98 per cent at normal operating speed, fluid drive may constitute the greatest advance in automotive manufacturing since the introduction of hydraulic brakes.

"The Design Features of the Shipshaw Development" was the subject of an address by Dr. H. G. Acres, H. G. Acres and Co., Niagara Falls, Ont., before a joint meeting of the Toronto Branch of the Engineering Institute of Canada and the Toronto Section of the American Institute of Electrical Engineers at the University of Toronto on Thursday, March 2, 1944. The paper appears in this issue.

VANCOUVER BRANCH

P. B. Stroyan, M.E.I.C. - *Secretary-Treasurer*
J. G. D'Aoust, M.E.I.C. - *Branch News Editor*

Wednesday night, February 23rd, marked the first "Student Night" of the Vancouver Branch. Members of the newly formed Student Chapter at the University of British Columbia, headed by Mr. V. L. Mosher, chairman, took charge of the meeting and presented a thoroughly enjoyable programme.

Mr. Allan Eyre, fourth year civil engineering student, gave a talk on **Aluminum,** tracing the history and development of the industry with particular reference to this country, and suggested some of the possible developments to be expected in the post-war period.

A description of the making of lofts and templates for the aircraft industry was given by Mr. Harold Graves who has been employed at the Boeing aircraft plant in this work.

The subject of **Soil Stabilization** was ably handled by Mr. Richard Scarisbrick in his interesting discussion of the principles and methods used in this relatively new branch of engineering.

A number of questions were answered by the speakers and the meeting concluded with a vote of thanks to the students, proposed by Mr. C. E. Webb, for a very successful evening.

Library Notes

Book notes, Additions to the Library of The Engineering Institute, Reviews of New Books and Publications

ADDITIONS TO THE LIBRARY

TECHNICAL BOOKS

Engineers' Dictionary:

Spanish-English and English-Sponish. Louis A. Robb. N.Y., John Wiley and Sons, Inc., 1944. 5½ x 8 in. $6.00.

Workshop Technology:

Part 1; An introductory course. W. A. J. Chapman. Toronto, Longmans Green and Co., 1943. 5½ x 8½ in. $2.50.

Communication Circuits:

Lawrence A. Ware and Henry R. Reed. N.Y., John Wiley and Sons, Inc., 1944. 5½ x 8¾ in. $3.50.

Chemical Industries:

18th edition. Edited by L. Ivanovszky. London, Leonard Hill Ltd., 1943. 8½ x 11 in. 15 sh.

TRANSACTIONS, PROCEEDINGS

Iron and Steel Institute:

Journal, Vol. 147, No. 1, 1943.

REPORTS

Canada—Department of Labour:

Report for the fiscal year ending March 31, 1943.

Canadian Broadcasting Corporation:

Annual report for the fiscal year ended March 31, 1943.

British Standard No. 1100—Part 10—1943:

Office organization and practice. British Standards Institution, 28 Victoria Street, London, S.W.1. 2s. 6d. Post free.

The purpose of this booklet, just issued by the British Standards Institution, is to give information regarding the practical technique of office and clerical organization. It offers suggestions of value to the needs of the smaller office as well as the principles which should be followed in the larger organizations.

U.S. Bureau of Mines—Technical Paper:

No. 660; Coke-oven accidents in the United States for the calendar year 1942.

BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet all of these books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

APPLIED SAFETY ENGINEERING

By H. H. Berman and H. W. McCrone. McGraw-Hill Book Co., New York and London, 1943. 189 pp., diagrs., tables, 8½ x 5½ in., cloth, $2.00.

This textbook places emphasis on the practical use of safety engineering rather than on methods and the reasons for them. After presenting the fundamental requirements for a safety programme, the book describes how investigations should be made, how to write safety rules, regulations and messages, how to hold safety conferences and how to make talks and inspections. Each topic is illustrated by cases and specimens.

AVIATION GASOLINE MANUFACTURE (Mineral Industries Series)

By M. Van Winkle. McGraw-Hill Book Co., New York and London, 1944. 275 pp., diagrs., charts, tables, 8½ x 5½ in., cloth, $3.00.

The manufacture of high-antiknock hydrocarbons is described in detail, with particular reference to their application as aviation fuel. Separate chapters deal with the manufacture of their components, the characteristics and performance of the fuels, specifications and test methods. Necessarily the very recent developments can not be included, owing to the war. The history and development of aviation fuel and its manufacturing processes are included.

CAR BUILDERS' CYCLOPEDIA of American Practice. 16th ed., 1943

Compiled and edited for the Association of American Railroads, Mechanical Division; edited by R. V. Wright, R. C. Augur and others; Simmons-Boardman Publishing Corp., New York, 1943. 1324 pp., illus., diagrs., charts, tables, 12 x 8½ in., fabrikoid, $5.00

The new edition of this well-known reference book follows the style of its predecessor, with some improvements in form and with better indexes. It again brings up to date the record of American car designs and car equipment.

CHEMICAL INDUSTRIES, edited by L. Ivanovszky. 18th ed., largely rewritten and revised

Leonard Hill Limited, 17 Stratford Place, London, W.1, 1943. 360 pp., illus., diagrs., charts, tables, 11 x 8½, cloth, 15s.

This annual is a combined trade directory and reference book for chemical engineers, industrial chemists and all engaged in chemical industries. The information is presented in admirable glossaries which describe the chemicals and materials used, and in tables that cover the information needed by the worker. The material seems excellently chosen, and the book is a very useful one for quick reference.

DIESEL LOCOMOTIVES—Electrical Equipment

By J. Draney. American Technical Society, Chicago, Ill., 1944. 388 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $3.75.

A simple, practical text on the operation and maintenance of the electrical equipment of Diesel locomotives. The equipment of the Baldwin-Westinghouse, Electro-Motive, and Alco-G.E. locomotives is described in detail.

ELEMENTARY STATISTICAL METHODS

By H. M. Walker. Henry Holt and Company, New York, 1943. 368 pp., diagrs., charts, tables, 9½ x 6 in., linen, $2.75.

This textbook is based on courses given in Teachers College, Columbia University. The author has aimed at a clear, simple exposition that will make the text practically self-teaching, with attention to the development of underlying concepts and to interpretation. Emphasis is placed upon statistical techniques, the limitations and advantages of each, the assumptions underlying it and the interpretations which can be made from it. Certain chapters have bibliographies.

(THE) LIFE OF SIR J. J. THOMSON

By Lord Rayleigh. University Press, Cambridge, England; Macmillan Co., New York, 1943. 299 pp., illus., tables, 9 x 5½ in., cloth, $6.00.

Lord Rayleigh has written an excellent account of the life of the great physicist, in which is reviewed the epoch-making scientific work done at the Cavendish Laboratory by Thomson and his pupils. The human side of the man is also covered. Laymen, as well as scientists, will find the book full of interest.

LUBRICATION OF INDUSTRIAL AND MARINE MACHINERY

By W. G. Forbes. John Wiley & Sons, New York; Chapman & Hall, London, 1943. 319 pp., diagrs., charts, tables, 8½ x 5½ in., cloth, $3.50.

This manual discusses the everyday problems that arise in lubricating engines and machines of various types, and offers practical solutions. Starting with a description of the fundamentals of distillation, cracking, refining, etc., the author proceeds to discuss the effects of heat, pressure and metals on lubricating oils and the methods of applying lubricants. Later chapters deal with the lubrication of steam engines, hydraulic turbines, pneumatic tools, internal-combustion engines, machine tools, steel and paper mills and wire ropes. Heat-treating oils and greases are discussed.

MATHEMATICS OF RADIO COMMUNICATIONS

By T. J. Wang. D. Van Nostrand Co., New York, 1943. 371 pp., diagrs., charts, tables, 9 x 5½ in., fabrikoid, $3.00.

This textbook was written to facilitate the study of radio, electronics, etc., by providing a course in mathematics integrated with that in communications, the subjects being interwoven so that each electrical topic is preceded by the requisite mathematics. The book is designed especially for use in accelerated programmes.

PATENTS AND INDUSTRIAL PROGRESS

By G. E. Folk, with a foreword by R. L. Lund. 2 ed. Harper & Brothers, New York and London, 1942. 393 pp., diagrs., charts, tables, 8 x 5½ in., cloth, $3.00.

One specific duty assigned to the Temporary National Economic Committee, when it was created in 1938, was that of investigating our patent system, with a view to improving the patent laws. At its hearings much testimony was presented by the Department of Justice, the Department of Commerce and the industries. In this volume this testimony is summarized, analyzed and evaluated by an experienced patent attorney.

PRINCIPLES AND APPLICATIONS OF ELECTROCHEMISTRY. Vol. 2. Applications

By W. A. Koehler. 2 ed. John Wiley & Sons, New York; Chapman & Hall, London, 1944. 573 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $5.00.

Intended both as a textbook for students and as a reference work for the man in electrochemical industry, this book covers primary and secondary cells, electroplating, electrometallurgy, electrolysis, electric furnaces, and various special applications. New topics added in this edition include continuous tin strip plating, magnesium from sea water, fluorescent lamps, induction heating and several new types of furnaces and storage batteries.

QUANTUM CHEMISTRY

By H. Eyring, J. Walter and G. E. Kimball. John Wiley & Sons, New York; Chapman & Hall, London, 1944. 394 pp., diagrs., charts, tables, 8½ in. x 5½ in., cloth, $5.00.

This book contains a systematic presentation of quantum mechanics from the viewpoint of its usefulness in developing the concepts of chemistry and physics. It provides an introductory treatment of reaction rates, optical activity, molecular structure, spectroscopy and group theory. It has been written at the level of the graduate student in chemistry, and assumes a knowledge of calculus on the part of the reader.

RADIO RECEIVER DESIGN. Part I, Radio Frequency Amplification and Detection

By K. R. Sturley. John Wiley & Sons, New York; Chapman & Hall, London, 1943. 435 pp., diagrs., charts, tables, 8½ x 5½ in., cloth, $4.50.

This book presents the fundamentals of receiver design by a detailed examination of the receiver, stage by stage, starting from the aerial. The present volume, the first of two, ends at the detector stage. Each chapter has a bibliography.

SPHEROGRAPHICAL NAVIGATION

By D. Brouwer, F. W. Keator and D. A. McMillen. Macmillan Co., New York, 1944. 200 pp., illus., diagrs., charts, tables, 7½ x 4½ in., cloth, $5.00.

In this new system of navigation, developed by D. A. McMillen and Dr. Anton Stuxberg, a sphere and auxiliary instruments are employed. The observer plots the observed altitudes on a sphere and obtains directly and visually his latitude and longitude. This Manual describes the method in detail, with examples.

The system has attracted considerable attention from aviators, who will welcome this authoritative explanation.

STATISTICAL ADJUSTMENT OF DATA

By W. E. Deming. John Wiley & Sons, New York; Chapman & Hall, London, 1943. 261 pp., diagrs., charts, tables, 8½ x 5½ in., cloth, $3.50.

This is a practical reference and text book on the adjustment of data, with emphasis on scattered portions of the subject that are difficult to find elsewhere and that, in the author's opinion, are becoming increasingly important. Different kinds of problems of adjustment are unified and brought under one general principle and solution. Statistical procedures for curve fitting and other adjustments by least squares are discussed.

(THE) TECHNIQUE OF RADIO DESIGN

By E. E. Zepler. John Wiley & Sons, New York; Chapman & Hall, London, 1943. 312 pp., diagrs., charts, tables, 8½ x 5½ in., cloth, $3.50.

This volume by an experienced radio designer deals with problems that are closely linked with the daily routine work of an engineer in the development and testing of radio receiving apparatus of all types. Questions such as the transfer of energy from the aerial, detection and frequency changing, selectivity, receiver noise, screening, undesired feedback, and distortion are treated rather comprehensively, with attention to intimate details.

TECHNOLOGY AND LIVELIHOOD, an Inquiry into the Changing Technological Basis for Production as Affecting Employment and Living Standards

By M. L. Fledderus and M. van Kleeck. Russell Sage Foundation, New York, 1944. 237 pp., charts, tables, 9 x 6 in., paper, $1.25.

This report, prepared for the Russell Sage Foundation, is a study of the effect of recent changes in the productive capacity of our basic industries upon opportunities for employment and upon living standards. The information accessible in government publications has been assembled and summarized so as to be understood by those without experience in production or training in technology.

TIME BASES (Scanning Generators), their Design and Development with Notes on the Cathode Ray Tube

By O. S. Puckle, with a foreword by E. B. Moullin. John Wiley & Sons, New York; Chapman & Hall, London, 1943. 204 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $2.75.

This book, based on a paper presented before the Institution of Electrical Engineers in 1942, is intended to cover the more important electronic devices available for producing the time axis in television receivers, cathode-ray oscillographs, engine indicators and similar apparatus involving precise timing or measurement of time intervals. It aims to provide an introduction to the principles, and to deal with the construction, testing and uses of these devices. Appendixes discuss the cathode-ray tube and the effects of time constants and other valve and circuit parameters.

TIME STUDY ENGINEERING

By W. H. Schutt. McGraw-Hill Book Co., New York and London, 1943. 426 pp., illus., diagrs., 9 x 6 in., cloth, $5.00.

Every detailed phase of time study is covered on the basis of specific machine studies and in a simplified form understandable by those unfamiliar with shop production methods. Shop production methods, machinery and tools are completely explained as well as the step-by-step study that should be made of particular operations. New, simplified explanations of speeds and feeds are given, and also detailed analysis for determining "line tasks" and controlling manpower.

PRELIMINARY NOTICE

of Applications for Admission and for Transfer

March 27th, 1944.

The By-laws provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described at the May meeting.

L. Austin Wright, General Secretary.

*The professional requirements are as follows:—

A Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science or engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainment or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

BASH—KENOWER WEIMER, of 15 Aylmer Ave., Toronto, Ont. Born at Huntington, Ind., June 21st, 1887. Educ.: B.Sc. (C.E.), Univ. of Michigan, 1909; R.P.E. Ont.; 1905-09 (summers) county & civil engr.'s office, Huntington; 1909-12, dftsman. & later i/c tower dept., Can. Bridge Co., Walkerville; 1912-14, engr. & mgr., Maritime Bridge Co. Ltd.; 1914-16, engr., Lewis-Hall Iron Wks., Detroit; 1916-19, sales & designing engr., Whitehead & Kales Iron Wks., Detroit; With Christmas-Burke Co. as follows: 1919-30, i/c constrn. dept., Detroit, 1930-32, mgr. & partner, Toronto; 1932-36, misc. engrg. work; With the Foundation Co. of Canada as follows: 1936-37, gen'l. supt., Baie Comeau (Que.) developm't., 1938-40, sec. & mgr., Ontario; With Loblaw Groceterias Ltd., as follows: 1940, supt. of bldg., equipm't & repair dept., 1942, loaned at govt.'s request to Wartime Housing Ltd., as asst. to managing director i/c constrn; At present, gen'l. mgr., Wartime Housing Ltd., Toronto, Ont.
References: C. M. Goodrich, W. Storrie, H. G. Acres, J. M. Oxley, G. L. Wallace.

BENDT—JOSEPH PHILIP, of 168 East St., Sault Ste. Marie, Ont. Born at Kenosha, Wisconsin, Sept. 27th, 1888. Educ.: B.S. (Civil Engr.) Univ. of Wisconsin, 1912; 1909 (summer), instru'man., C. & N.W.Ry.; 1912, U.S. Army Engrs., hydrographic survey; With the Semet-Solvay Co. as follows: 1912-15, field engr., 1916-22, constrn. engr., coke oven & other chem. & industrial constrn. at various steel mills; 1922-23, res. engr., Ironton-Russell Bridge Co.; 1923-33, constrn., highway & bridge, & erecting engrg. with various companies in Canada & U.S., also two years bldg. coke plants at Magnitogorsk, Russia; 1934-36, contract engr., estimator & supt., excavations, pipe lines, gas, oil, etc., R. L. Coolsaet Constrn. Co. & Gulf Refining Co.; 1936-38, constrn. engr., Semet-Solvay Co., 1939, engr., Mich. Consldt. Gas Corp'n.; 1940, engr., R. L. Coolsaet Co.; 1941, erecting engr., Koppers Co., coke ovens & sulphur removal plant; 1942 to date, engr., Algoma Steel Corp'n. Ltd., Sault Ste. Marie, Ont.
References: C. Stenbol, LeRoy Brown, A. M. Wilson, J. L. Lang, A. H. Russell.

BENNETT—ALBERT EDWARD, of 247 Simcoe St., Winnipeg, Man. Born at Rossburn, Man., July 11th, 1906; Educ.: Private tuition univ. maths; at present, studying civil engrg. (I.C.S. course); With Backus Brooks Co. as follows: 1924-27, timekeeper & material clerk, power house constrn., 1927-30, field clerk & engr's clerk, paper mill constrn.; 1930-31, asst. supt., bridge constrn., Foley Bros. Ltd.; 1932-33, asst. engr., Idaho Mineral & Smelting Co.; 1933-34, engr., City of St. Boniface; 1942 to date, asst. to engr., way & structures dept., Winnipeg Electric Co., Winnipeg.
References: G. McDermid, E. V. Caton, L. M. Hovey, C. P. Haltalin, A. W. Fosness.

BRAZIER—JACK HENRY, of London, Ont. Born at London, Ont., Dec. 21st, 1919; Educ.: B.Sc., Queen's Univ. 1943; R.P.E. Ont.; With J. E. Wainwright Constrn. Co., London, as follows: 1938 (summer), timekeeper, wharf constrn., 1939 (summer), breakwater constrn.; With Spramotor Ltd., London, as follows, 1940 (summer), sewage constrn., 1941 (summer), machinist, 1942 (summer), toolmaker; At present, navigation instructor, P/O. S. R., R.C.A.F., St. John's, Que.
References: F. C. Ball, R. W. Garrett, W. M. Veitch, H. A. Brazier, S. D. Lash, D. S. Ellis, A. Jackson.

CHARTERS—CHESTON MELVILLE, of Toronto, Ont. Born at Toronto, Ont., March 6th, 1907. Educ.: Private tuition (Struct'l. Design); 1926-31, dftsm'n., W. C. Charters, Architect, Toronto; 1931-33, junior partner, W. C. Charters & Son, Architects; 1934-41, pres., Charters Constrn. Co. Ltd.; 1941 to date, chief dftsm'n., British American Oil Co. Ltd., Toronto, Ont.
References: F. A. Gaby, F. W. Paulin, W. W. Fotheringham, R. S. Segsworth, R. F. Legget.

DONNELLY—JOHN, of Sault Ste. Marie, Ont. Born at Glenboig, Scotland, March 31st, 1881. Educ.: 1894-97, Glasgow Tech. School (evening classes); Home Study; R.P.E. Ont.; 1897-1903, dfting. & mach. shop practice; 1903-08 locomotive bldg.; 1908-10, crane bldg., 1910-11, steel mill (mech. & elec.); 1911-16, steel mill mtce. (elec.); 1916-17, constrn. foreman. Wm. Glen, C.E.; 1917 to date, professional engr. & elect'l. supt., Algoma Steel Corp'n., Sault Ste. Marie, Ont.
References: C. Stenbol, J. L. Lang, K. G. Ross, A. E. Pickering, R. S. McCormick, N. C. Cowie, A. H. Russell.

DUBRULE—JOSEPH ALPHONSE VICTOR, of Metabetchouan, Que. Born at Woburn, Que., March 1st, 1914; With the Dept. of Roads (Prov. of Que.) as follows: 1937-38, chainman, rodman, instru'man., 1939, transitman & instru'man., 1939-40, dftsm'n., res. engr., Rouyn-McWatters, asst. chief of survey party; 1940-41, dftsman., chief of party, res. engr., Rouyn-Arntfield, 1941-42, dftsman., asst. technician, res. engr., Dolbeau-Milot, on constrn. of concrete highway, Kenogami-Arvida-Chicoutimi, 1942-43, res. engr., Metabetchouan & 2nd asst. divisional engr., 1943 to date, asst. divisional engr., div'n. No. 1. (Asks for admission as an Affiliate.).
References: E. Gohier, J. Limoges, J. A. Frechette, R. A. Lemieux, L. Allaire.

HASKINS—REGINALD ERIC, of 55 Hargrave St., Winnipeg, Man. Born at Vancouver, B.C., Dec. 3rd, 1913; Educ.: B.A.Sc. (Mech.), Univ. of B.C., 1941; 1938-39-40 (summers), junior engr., thawing asst., Yukon Consldt. Gold Corp'n., surveying, hydraulic calculations, design, etc.; With D.I.L., Transcona, Man., as follows: 1941-42, supervisor, cordite ranges, responsible for one shift, 1942 (April to Aug.), senior supervisor, cordite ranges, responsible for three shifts (operations & personnel), 1942 to date, asst. supt., Dept. of Light Heat & Power.
References: N. M. Hall, E. W. Butler, J. N. Finlayson, H. J. MacLeod.

HOUSTON—GEORGE R., of 216 South Archibald St., Fort William, Ont. Born at Aberdeen, Scotland, July 5th, 1897; Educ.: 1911-15, Robert Gordon's College (night classes in arch. & bldg. constrn.); 2 years bldg. constrn., Central Tech., Toronto; 1915-17, Royal Engineers; 1925-29, gen'l. contracting; 1929-30, asst. supt., Robertson & Janin, Toronto; 1930-31, asst. supt. & 1931-36, constrn. supt., Gratton Ltd., Toronto; 1937-40, contractor, specializing in install'n. of X-ray equipm't. & lead-lined walls, floors & ceilings with specially designed ray-proof door at various hospitals. (Door & method of lead installing own design); 1941-43, asst. gen'l. supt. & later gen'l. supt., Angus Robertson Co. Ltd. at No. 3 Shell Filling Plant, Quebec; also 1942 (May to July), gen'l. supt., Aluminum Plant, Toronto; 1943 to date, plant engr., Canadian Car & Foundry Co. Ltd., Fort William, Ont.
References: A. B. McEwen, D. A. Killam, J. M. Fleming, M. McNeil, C. F. Davison.

LANGLOIS—CHARLES, of 3 Maguire Avenue, Quebec, Que. Born at Montreal, July 10th, 1904. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1931; R.P.E. Que.; 1928-29 (summers), Roland Paper Mills; 1931-33, engr. i/c hydro & steam power plant, mtce. of mach., Regent Knitting Mills; 1933-34, steel plates & boiler designing, elec. welding, Farand & Delorme, Ltd.; 1934-36, reinforced concrete designing, wash & diamond drill boring, Lalonde & Valois, consltg. engrs.; 1936-43, highway constrn. & mtce., tech. administration & superv'n., Dept. of Roads (Prov. of Que.), 1943 to date, engr., Corp'n. of Sillery, Que.
References: P. Vincent, Y. R. Tasse, J. St. Jacques, L. Duchastel, J. P. Lalonde, J. Benoit, A. Frigon, E. Gohier, A. Circe.

Employment Service Bureau

NOTICE

Technical personnel should not reply to any of the advertisements for situations vacant unless—

1. **They are registered with the Wartime Bureau of Technical Personnel.**
2. **Their services are available.**

A person's services are considered available only if he is—

(a) unemployed;
(b) engaged in work other than of an engineering or scientific nature;
(c) has given notice as of a definite date; or
(d) has permission from his present employer to negotiate for work elsewhere while still in the service of that employer.

Applicants will help to expedite negotiations by stating in their application whether or not they have complied with the above regulations.

SITUATIONS VACANT

SALESMEN, large life insurance company has opening for men, about 35 years of age. Married. Average salary of $2000 a year paid for servicing business plus commissions on all new business. Average yearly earnings $3200. Excellent prospects of advancement in sales executive work for capable men. Professional men have a high record of success in this business. Apply to Box 2715-V.

DRAUGHTSMAN required, with mechanical or structural experience. Some knowledge of material handling will be helpful. Position with established company. Not war work. Apply to Box No. 2732-V.

SITUATIONS WANTED

MECHANICAL ENGINEER, age 33, ten years' experience in construction and maintenance work in the pulp and paper industry. Open for engagement as plant engineer. Apply to Box No. 1396-W.

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.

STRUCTURAL ENGINEER, M.E.I.C., R.P.E. (Ont.). Designing engineer and estimator; all types fabricated steel and plate work. Experience covers positions as chief engineer, chief draughtsman, sales engineer and executive responsibilities. Apply to Box No. 2208-W.

CHEMICAL ENGINEER, B.A.Sc., M.E.I.C., Canadian graduate, ready for new appointment. Married, no children, Montreal home. Fifteen years' experience in most manufacturing departments of pulp and paper industry. This covers technical development, design and mill operation, particular emphasis being placed on plant supervision, operation of mill equipment, and handling of operating personnel. Extensively travelled on business in the British Isles, Europe and throughout eastern and southern U.S.A., hence foreign appointment or contacts may be attractive. Sales and servicing of equipment is of definite interest, and this need not be restricted to pulp industry. Apply to Box No. 2257-W.

CIVIL ENGINEER, 1933, age 32, married. One year railroad construction surveys, one year hydro construction, five years mining engineering, one year university instructor. Desire permanent position in industry, particularly interested in cost control, also interested in position with firm or consultant doing planning or construction. Initial salary secondary to opportunity and type of work. Available July 1st or earlier if necessary. Apply to Box No. 2460-W.

PRELIMINARY NOTICE *(Continued)*

LAZIER—MORLEY JOHN CAMPBELL, of 379 Glengrove Ave., Toronto, Ont. Born at Gonzales, Cal., July 25th, 1903. Educ.: B.A.Sc., Univ. of Toronto 1928; 1928-30, research, Cambridge Univ., England; 1925, dfting. & supervis'n. of constrn., Can. Nat. Exhibition; 1930, lecturer, & 1936, asst. prof. of applied mechanics, Univ. of Toronto; 1937, consltg. on industrial problems; 1940-43, wks. mgr., Massey-Harris, Weston; 1943 to date, tech. asst. to pres., Massey-Harris Co., Toronto, Ont.

References: T. R. Loudon, C. R. Young, W. S. Wilson, R. W. Angus, E. A. Allcut.

LEUTHOLD—ARMIN, of 4808 Lacombe Ave., Montreal. Born at Zurich, Switzerland, May 15th, 1903; Educ.: B.Sc., Swiss Federal Inst. of Technology (Zurich), 1927; M., A.I.E.E., M., Swiss Assoc. Elect. Engrs.; 1928-32, research on high voltage mercury arc rectifiers, Brown Boveri & Co. Ltd., Baden, Switzerland; 1932-33, erection, supervision & testing of mercury arc rectifier instal-l'n., Consolidated Mining & Smelting Co., Trail; 1933-36, testing & putting into operation mercury arc rectifier plants in England, South Africa & various countries in Europe; 1936-37, research work at Brown Boveri Works, Switzerland & putting into operation rectifier plant at St. Jean de Maurienne, France; 1938, erection, supervis'n., etc. of mercury arc rectifier install'n. at Aluminum Co. of Canada, Ltd., Arvida; 1939 to date, chief engineer, Swiss Electric Co. of Can. Ltd., Montreal.

References: A. C. Johnston, A. W. Whitaker, Jr., C. Miller, F. L. Lawton, A. D. Ross.

MEIER—CHARLES, of 533 Stanstead Ave., Mount Royal, Que. Born at Vevey, Switzerland, Feb. 8th, 1903. Educ.: Mech. Engr., Technical College, Burgdorf, Switzerland, 1925; 1925-26, Ateliers de Construction des Locomotives, Nevers, France; 1926-27, Societe Alsacienne de Construction Mecanique, Mulhouse, France; 1927-34, Brown Boveri & Co. Ltd., Switzerland, assembling & testing steam turbines, blowers, etc., erection & putting into operation steam turbine generator plants in various countries in Europe & U.S.; 1934 to date, sales & mech. engr., i/c erection & service, Swiss Electric Co. of Canada Ltd., Montreal.

References: W. S. Wilson, J. A. MacLeod, S. C. Mifflen, C. O. Maddock.

NAPIER—HEMY, HUBERT JOHN, of Victoria, B.C. Born at Falmouth, England, Sept. 27th, 1886. Educ.: 1904-08, Royal Naval Engineering College, Keyham, England; A.M., Institution of Mech. Engrs. (England); 1908-10, ap'ticeship, Cunard S.S.Co., Liverpool; 1910-23, Engr. Officer, R.C.N., war service, also Engr. of Patrols in H.M.C. Dockyard, Halifax, i/c mtce. & repairs, organization, etc., & 2 years as Instructional Officer in engrg., Royal Naval College of Canada, Esquimalt, and one year as Chief Engr., H.M.C.S. "Patrician"; 1923, retired as Engr. Lt. Cmdr.; 1923-32, with engrg. firms in U.S. including Pelton Water Wheel Co., as field engr., Great Western Power Co. as supervisor on constrn., Hunt, Mirk & Co. Inc., as designer on steam plant; 1936-42, engr. designer, marine engines, Sir John I. Thornycroft; 1942 to date, supervising dftsm'n., Yarrows Limited, shipbuilders, Esquimalt, B.C.

References. E. W. Izard, G. L. Stephens, A. D. M. Curry, N. A. Yarrow, R. Bowering.

PITCAIRN—JOHN, of 158—24th Avenue, Lachine, Que. Born at Kirkintilloch, Scotland, Aug. 5th, 1889. Educ.: 1904-10, Glasgow & West of Scotland Tech. (evening classes); 1905-10, struct'l. ap'tice., shop & drawing office, Sir Wm. Arrol & Co., Glasgow, Scotland; 1910-14, dftsman. & checker, Canada Foundry Co., Toronto; With Sr. Wm. Arrol & Co., Scotland, as follows: 1914-17, chief dftsman., 1917-24, shop supt. & asst. to mgr.; With Dominion Bridge Co. as follows: 1925-36, dftsman., checker, squad boss & designing engr., 1936-38, on loan to Aluminum Co. of Canada, Arvida, i/c all struct'l. designing; 1938, engr. of standards; 1939 to date, engr. i/c struct'l. design, Aluminum Co. of Canada (on loan from Dominion Bridge Co.)

References: F. P. Shearwood, R. S. Eadie, R. H. Findlay, D. B. Armstrong, A. W. Whitaker, Jr., M. E. Hornback, G. B. Moxon, G. J. Dodd, D. C. Tennant.

POIRIER—CUTHBERT, of 2027 St. Zotique St. East, Montreal. Born at Grand Junction, Colorado, U.S.A., Aug. 10th, 1912. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1935; R.P.E. Que.; With Dept. of Roads (Quebec) as follows: 1935-36. instru'man, 1936-37, junior res. engr., 1937-39, senior res. engr., 1939-43, div'n. engr. No. 7 (Ville-Marie); 1943 to date, div'n. engr., Drainage Bureau (Province of Quebec), Montreal.

References: E. Gohier, L. Trudel, M. Beaudouin, M. Pinet, J. P. Lecavalier, C. L. Dufort.

ROSS—CECIL MIDDLETON, of Montreal, Que. Born at Scotstown, Que., Jan. 13th, 1886. Educ. B.Sc., McGill Univ. 1908; R.P.E. Que.; 1904-08 (summers) surveys & underground mining work, Ont. & B.C.; 1908-10, assayer, engr., Crown Reserve Mining Co.; 1910-12, contracting, mining, road bldg., Ont. 1912-14, surveying, contracting, B.C.; 1914-19, overseas, capt., Can. Engrs.; 1919-20, mining dept., Man. Bridge & Iron Wks., Winnipeg.; 1920-22; engr. i/c "core wall" Twin Falls development, Abitibi Paper Co., for Morrow & Beatty, contractors; 1922 to date, rep. for prov. of Quebec of Mathews Conveyor Co. Ltd., designing, selling & install'n. of conveyer systems, Montreal, Que.

References: W. J. Hunt, A. E. Sargent, H. S. Petford, C. K. McLeod, G. McL. Pitts, R. A. Rankin.

WELLWOOD—ROBERT WILLIAM, of Ste. Therese, Que. Born at Victoria, B.C., Mar. 11th, 1912. Educ.: B.A.Sc. (Forest Eng.), Univ. of B.C.; Master of Forestry, 1939, Ph.D., 1943, Duke Univ., Durham, N.C.; 1929-32 (summers) B.C. Electric Rly Co. Ltd. & B.C. Forest Service, Victoria, B.C.; 1935 (summer) instru'mn., Victoria Lumber & Mfg. Co., Chemainus, B.C.; 1936-38 (April), office asst., B.C. Forest Service, Victoria, B.C.; 1938-39, research asst., Duke Univ., Durham, N.C.; 1939-40, research asst., B.C. Forest Service, Victoria, B.C.; 1941-43, research fellow, Duke Univ.; At present wood technologist & director of div'n. of research & development, Commonwealth Plywood Co. Ltd., Ste. Therese, Que.

References: E. S. Holloway, G. Lajoie, J. N. Finlayson, G. L. Wiggs, S. H. Clarke.

WILSON—VALENTINE WILLIAM GIBSON, of 141 Fentiman Ave., Ottawa, Ont. Born at Armagh, Ireland, July 3rd, 1899. Educ.: B.Sc. (Mech.) McGill Univ., 1926; M.Sc., Mass. Inst. of Tecy., 1928. 1924 (summer), plant engr.'s office, Abitibi Power & Paper Co., Iroquois Falls; 1925 (summer), Montreal Light Heat & Power Co. (Cedar Rapids, Que.); 1926-28, student engr., mech. dept., General Electric, Lynn, Mass.; 1928-29, asst. tech. supt., paper mill div'n., Spruce Falls Power & Paper Co., Kapuskasing, Ont.; With the Aluminum Co. of Canada, Ltd. as follows: 1929-37, engr. & estimator, Toronto Wks., 1937-41, divisional supt., sand foundry; At present, tech. asst. to Director-General, A.E.D.B., & staff engr., Directorate of Tank Design, A.E.D.B., Dept. of Munitions & Supply, Ottawa.

References: R. E. Jamieson, C. M. McKergow, E. Brown, A. M. Bain, C. Craig.

YOUMATOFF—SERGE, of 2050 Decarie Blvd., Montreal, Que. Born at Petrovsk, Russia, Oct. 31st, 1891. Educ.: Naval Academy, Petrograd, Russia, 1909-1913, commission in Imperial Russian Navy; 1913-19, with I.R.N., as Lieut., Lieut. Cmdr., Torpedo Elect'l. Lieut. Cmdr., Executive Officer and later Commanding Officer; 1920-24, i/c moving picture theatre in Antibes, France, projection, elect'l., install'ns., etc.; 1925-26, asst. to stationary engr., Central Y.W.C.A., Toronto, Ont.; 1926-28, electr'n., Vipond Mines, Timmins, Ont., repair, mtce., & new install'ns.; 1928-32, electr'n., with National Electric Co., T. Eaton Co., Can. Comstock Co., Montreal; 1932-35, mtce. repair work, wiring, etc. for Gault estate & Royal Trust Co.; 1935-43, shipper, agt., asst. mgr. & later mgr., J. Stevens & Sons Co., Montreal, (Dealers in surgical instruments & hospital supplies); 1943-44, Dept. of Munitions & Supply, Naval Shipbuilding Branch, i/c shipyard inspec'n. & produc'n. for D.M. & S. on naval craft under constrn. in Que. Prov.; At present, field rep. of Wartime Shipbuilding, Ltd.

References: R. C. Flitton, R. M. Doull, D. S. Scott, L. P. Cousineau, C. K. McDonald, R. C. Wiren.

THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 27 | MONTREAL, MAY 1944 | NUMBER 5

"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

★ ★ ★

PUBLISHED MONTHLY BY

THE ENGINEERING INSTITUTE OF CANADA

2050 MANSFIELD STREET - MONTREAL

Price 50 cents a copy, $3.00 a year: in Canada, British Possessions, United States and Mexico. $4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, $2.00 a year. —Entered at the Post Office, Montreal, as Second Class Matter.

CONTENTS

Rock cut being day-lighted so highway can be built between railway and river, on Prince Rupert Highway . . . . Cover

CANADA'S WARTIME ROAD—Prince Rupert-Hazelton Highway B.C. . . . 280
J. M. Wardle, M.E.I.C.

NYLON—A Chemical Research Product of Engineering Interest . 285
C. J. Warrington

RAILWAY SIGNALLING AND INTERLOCKING—Montreal Terminal—C.N.R. . . . 288
James J. Van Horn

EFFECTIVE FOREMANSHIP . . . 297
D. D. Panabaker

CEMENTED CARBIDE TOOLS AND CHIP CONTROL . . 301
Harry Crump

MACHINING OF ALUMINUM . . . 304
R. H. Ashcraft

MACHINING MAGNESIUM ALLOYS . . . 306
Carl J. Wiberg

FROM MONTH TO MONTH . . . 308

PERSONALS . . . 318
Obituaries . . . 320

NEWS OF THE BRANCHES . . . 324

LIBRARY NOTES . . . 328

PRELIMINARY NOTICE . . . 331

EMPLOYMENT SERVICE . . . 333

INDUSTRIAL NEWS . . . 334

THE ENGINEERING INSTITUTE OF CANADA

MEMBERS OF COUNCIL - 1944

PRESIDENT

deGASPÉ BEAUBIEN, Montreal, Que.

PAST-PRESIDENTS

*C. J. MACKENZIE, Ottawa, Ont.

‡K. M. CAMERON, Ottawa, Ont.

†C. R. YOUNG, Toronto, Ont.

VICE-PRESIDENTS

*W. P. BRERETON, Winnipeg, Man.
†G. L. DICKSON, Moncton, N.B.
†J. M. FLEMING, Port Arthur, Ont.
*L. F. GRANT, Kingston, Ont.
*C. K. McLEOD, Montreal, Que.
†E. B. WARDLE, Grand'Mère, Que.

COUNCILLORS

*J. E. ARMSTRONG, Montreal, Que.
*H. E. BRANDON, Toronto, Ont.
†H. L. BRIGGS, Winnipeg, Man.
*A. E. CAMERON, Halifax, N.S.
‡R. S. EADIE, Montreal, Que.
†G. H. FERGUSON, Ottawa, Ont.
†E. V. GAGE, Montreal, Que.
†P. E. GAGNON, Quebec, Que.
*R. E. HEARTZ, Montreal, Que.
*A. JACKSON, Kingston, Ont.
†J. A. LALONDE, Montreal, Que.
†ALEX. LOVE, Hamilton, Ont.
†P. A. LOVETT, Halifax, N.S.
*A. M. MacGILLIVRAY, Saskatoon, Sask.
*N. B. MacROSTIE, Ottawa, Ont.
†J. McMILLAN, Calgary, Alta.
*A. W. F. McQUEEN, Niagara Falls, Ont.
†E. B. MARTIN, Moncton, N.B.
*G. E. MEDLAR, Windsor, Ont.
†W. MELDRUM, Lethbridge, Alta.
*J. P. MOONEY, Saint John, N.B.
†A. S. G. MUSGRAVE, Oak Bay, B.C.
*E. NELSON, Edmonton, Alta.
*H. G. O'LEARY, Fort William, Ont.
‡P. E. POITRAS, Montreal, Que.
†J. A. RUSSELL, Sydney, N.S.
*C. SCRYMGEOUR, Dartmouth, N.S.
†H. R. SILLS, Peterborough, Ont.
†C. STENBOL, Sault Ste. Marie, Ont.
*J. A. VANCE, Woodstock, Ont.
*H. J. WARD, Shawinigan Falls, Que.
*J. W. WARD, Arvida, Que.
*C. E. WEBB, Vancouver, B.C.
†W. S. WILSON, Toronto, Ont.

*For 1944. †For 1944-45. ‡For 1944-45-46.

TREASURER

F. C. MECHIN, Montreal, Que.

GENERAL SECRETARY

L. AUSTIN WRIGHT, Montreal, Que.

SECRETARY-EMERITUS

R. J. DURLEY, Montreal, Que.

ASSISTANT GENERAL SECRETARY

LOUIS TRUDEL, Montreal, Que.

STANDING COMMITTEES

FINANCE
C. K. McLEOD, *Chairman*
J. E. ARMSTRONG
G. A. GAHERTY
F. C. MECHIN
R. M. CALVIN

LEGISLATION
P. E. POITRAS, *Chairman*
F. J. BLAIR
R. J. DURLEY

PAPERS
L. F. GRANT, *Chairman*

LIBRARY AND HOUSE
E. V. GAGE, *Chairman*
A. T. BONE
J. S. HEWSON
M. S. NELSON
G. V. RONEY

PUBLICATION
R. S. EADIE, *Chairman*
R. DeL. FRENCH, *Vice-Chairman*
R. C. FLITTON
J. A. OUIMET
C. A. PEACHEY

SPECIAL COMMITTEES

BOARD OF EXAMINERS
R. A. SPENCER, *Chairman*
I. M. FRASER
W. E. LOVELL
A. P. LINTON
H. R. MacKENZIE
E. K. PHILLIPS

GZOWSKI MEDAL
T. H. JENKINS, *Chairman*
E. G. M. CAPE
V. A. McKILLOP
W. H. POWELL
E. O. TURNER

DUGGAN MEDAL AND PRIZE
W. J. W. REID, *Chairman*
R. C. FLITTON
H. M. WHITE

PLUMMER MEDAL
P. E. GAGNON, *Chairman*

LEONARD MEDAL
F. V. SEIBERT, *Chairman*
A. E. MacRAE
D. H. McDOUGALL
G. W. WADDINGTON

JULIAN C. SMITH MEDAL
deGASPÉ BEAUBIEN, *Chairman*
C. J. MACKENZIE
C. R. YOUNG

MEMBERSHIP
J. G. HALL, *Chairman*
S. R. FROST
N. MacNICOL

PROFESSIONAL INTERESTS
J. B. CHALLIES, *Chairman*
J. E. ARMSTRONG, *Vice-Chairman*
G. A. GAHERTY,
A. SURVEYER
J. A. VANCE

STUDENTS' AND JUNIORS' PRIZES

H. N. Ruttan Prize—Western Provinces
W. P. BRERETON, *Chairman*
A. M. MacGILLIVRAY
C. E. WEBB

John Galbraith Prize—Province of Ontario
J. M. FLEMING, *Chairman*
H. E. BRANDON
A. W. F. McQUEEN

Phelps Johnson Prize—Province of Quebec (English)
C. K. McLEOD, *Chairman*
E. V. GAGE
R. E. HEARTZ

Ernest Marceau Prize—Province of Quebec (French)
E. B. WARDLE, *Chairman*
P. E. GAGNON
P. E. POITRAS

Martin Murphy Prize—Maritime Provinces
G. L. DICKSON, *Chairman*
J. P. MOONEY
C. SCRYMGEOUR

INTERNATIONAL RELATIONS
M. J. McHENRY, *Chairman*
E. A. ALLCUT
A. E. BERRY
C. P. EDWARDS
D. H. McDOUGALL
L. E. WESTMAN

WESTERN WATER PROBLEMS
G. A. GAHERTY, *Chairman*
C. H. ATTWOOD
L. C. CHARLESWORTH
A. GRIFFIN
D. W. HAYS
G. N. HOUSTON
T. H. HOGG
C. J. MACKENZIE
H. J. McLEAN
F. H. PETERS
S. G. PORTER
P. M. SAUDER
J. M. WARDLE

THE YOUNG ENGINEER
H. F. BENNETT, *Chairman*
C. G. R. ARMSTRONG
J. BENOIT
J. B. deHART
RENE DUPUIS
J. N. FINLAYSON
R. F. LEGGET
A. E. FLYNN
R. DeL. FRENCH
A. JACKSON
G. R. LANGLEY
A. E. MACDONALD
H. W. McKIEL
D. A. R. McCANNEL

ENGINEERING FEATURES OF CIVIL DEFENCE
J. E. ARMSTRONG, *Chairman*
P. E. ADAMS
J. N. ANDERSON
S. R. BANKS
H. F. BENNETT
W. D. BRACKEN
W. P. BRERETON
J. M. DAVIDSON
R. S. EADIE
E. V. GAGE
G. A. GAHERTY
R. J. GIBB
A. GRAY
J. GRIEVE
J. L. LANG
R. F. LEGGET
I. P. MACNAB
J. A. McCRORY
H. J. McEWEN
C. B. MUIR
W. H. MUNRO
J. A. A. PICHÉ
G. MacL. PITTS
C. J. PORTER
M. G. SAUNDERS
W. O. SCOTT
T. G. TYRER
H. K. WYMAN

INDUSTRIAL RELATIONS
WILLS MACLACHLAN, *Chairman*
E. A. ALLCUT
J. P. BRIERLEY
J. C. CAMERON
E. R. COMPLIN
J. A. COOTE
RENÉ DUPUIS
T. W. EADIE
S. M. GOSSAGE
F. W. GRAY
E. G. HEWSON
I. F. McRAE
W. H. MUNRO
W. J. W. REID

DETERIORATION OF CONCRETE STRUCTURES
R. B. YOUNG, *Chairman*
E. VIENS, *Vice-Chairman*
G. P. F. BOESE
A. G. FLEMING
W. G. C. GLIDDON
J. A. McCRORY
C. J. MACKENZIE
J. H. McKINNEY
R. M. SMITH

THE ENGINEERING INSTITUTE OF CANADA

OFFICERS OF BRANCHES

BORDER CITIES
Chairman, J. B. DOWLER
Vice-Chair., A. H. MacQUARRIE
Executive, G. W. LUSBY, J. M. WYLLIE, J. F. G. BLOWEY
(Ex-Officio), G. E. MEDLAR, G. G. HENDERSON
Sec.-Treas., W. R. STICKNEY, 1614 Ontario Street, Walkerville, Ont.

CALGARY
Chairman, H. B. LeBOURVEAU
Executive, J. V. ROGERS, P. F. PEELE, F. C. TEMPEST, J. LANGSTON
(Ex-Officio) J. McMILLAN, S. G. COULTIS, J. G. MacGREGOR, K. W. MITCHELL
Sec.-Treas., A. B. GEDDES, 4716 Elbow Drive, Calgary, Alta.

CAPE BRETON
Chairman, M. F. COSSITT
(Ex-Officio), J. A. MACLEOD, J. A. RUSSELL
Sec.-Treas., S. G. NAISH, Peacock Brothers Ltd., Post Bldg., Sydney, N.S.

EDMONTON
Chairman, C. W. CARRY
Vice-Chair., B. W. PITFIELD
Executive. J. A. ALLAN, J. W. JUDGE, E. D. ROBERTSON, J. D. A. MACDONALD, I. F. MORRISON, H. W. TYE
(Ex-Officio), D. HUTCHISON, E. NELSON
Sec.-Treas., F. R. BURFIELD, Water Resources Office, Provincial Government, Edmonton, Alta.

HALIFAX
Chairman, G. J. CURRIE
Executive, R. J. BETHUNE, J. W. MARCH, J. E. CLARKE, C. D. MARTIN, K. L. DAWSON, L. E. MITCHELL, D. C. V. DUFF, H. A. RIPLEY, J. H. M. JONES, R. B. STEWART
(Ex-Officio), A. E. FLYNN, A. E. CAMERON, C. SCRYMGEOUR, P. A. LOVETT
Sec.-Treas., S. W. GRAY, Wartime Bureau of Technical Personnel, 84 Hollis Street, Halifax, N.S.

HAMILTON
Chairman, H. A. COOCH
Vice-Chair., NORMAN EAGER
Executive, C. H. HUTTON, H. J. A. CHAMBERS, R. J. G. SCHOFIELD, A. R. HANNAFORD
(Ex-Officio), ALEX. LOVE, T. S. GLOVER
Sec.-Treas., W. E. BROWN, 91 Barnsdale Blvd., Hamilton, Ont.

KINGSTON
Chairman, S. D. LASH
Vice-Chair., J. R. CARTER
Executive, F. A. ATHEY, C. E. CRAIG, J. D. CALVIN, H. D. ROGERS
(Ex-Officio), L. F. GRANT, A. JACKSON, K. M. WINSLOW
Sec.-Treas., J. DOUGLAS LEE, Queen's University, Kingston, Ont.

LAKEHEAD
Chairman, R. B. CHANDLER
Vice-Chair., S. T. McCAVOUR
Executive, S. E. FLOOK, O. J. KOREEN, E. L. GOODALL, J. I. CARMICHAEL, W. H. SMALL, A. D. NORTON, E. A. KELLY, J. S. WILSON
(Ex-Officio), E. M. G. MacGILL (Mrs. E. J. Soulsby), J. M. FLEMING, E. J. DAVIES, H. G. O'LEARY
Sec.-Treas., W. C. BYERS, c/o C. D. Howe Co. Ltd., Port Arthur, Ont.

LETHBRIDGE
Chairman, A. L. H. SOMERVILLE
Executive, J. M. CAMPBELL, A. G. DONALDSON, P. E. KIRKPATRICK, R. S. LAWRENCE
(Ex-Officio), W. MELDRUM
Sec.-Treas., T. O. NEUMANN, Dept. of Transport, Post Office Building, Lethbridge, Alta.

LONDON
Chairman, R. S. CHARLES
Vice-Chair., H. G. STEAD
Executive, E. B. ALLEN, F. C. BALL, H. F. BENNETT, V. A. McKILLOP, G. N. SCROGGIE
(Ex-Officio), T. L. McMANAMNA, J. A. VANCE
Sec.-Treas, A. L. FURANNA, 732 Wellington Street, London, Ont.

MONCTON
Chairman, J. A. GODFREY
Vice-Chair., A. S. DONALD
Executive, E. R. EVANS, H. W. HOLE, A. GORDON, G. C. TORRENS, G. E. SMITH
(Ex-Officio), H. J. CRUDGE, G. L. DICKSON, E. B. MARTIN
Sec.-Treas., V. C. BLACKETT, Engrg. Dept., C.N.R. Moncton, N.B.

MONTREAL
Chairman, C. C. LINDSAY
Vice-Chair., J. B. STIRLING
Executive, C. E. GÉLINAS, J. BENOIT, K. G. CAMERON, L. H. BURPEE, G. H. MIDGLEY, M. S. MACGILLIVRAY
(Ex-Officio), deGASPÉ BEAUBIEN, C. K. McLEOD, J. E. ARMSTRONG, R. S. EADIE, J. A. LALONDE, E. V. GAGE, P. E. POITRAS, R. E. HEARTZ
Sec.-Treas., L. A. DUCHASTEL, 40 Kelvin Avenue, Outremont, Que.

NIAGARA PENINSULA
Chairman, G. E. GRIFFITHS
Vice-Chair., W. D. BRACKEN
Executive, A. G. HERR, C. G. MOON, G. F. VOLLMER, H. E. BARNETT, J. W. BROOKS, G. MORRISON, D. S. SCRYMGEOUR
(Ex-Officio), C. G. CLINE, A. W. F. McQUEEN
Sec.-Treas., J. H. INGS, 2135 Culp Street, Niagara Falls, Ont.

OTTAWA
Chairman, W. L. SAUNDERS
Executive, W. H. B. BEVAN, J. H. BYRNE, D. G. KILBURN, J. M. WARDLE, C. D. WIGHT
(Ex-Officio), K. M. CAMERON, G. H. FERGUSON, N. B. MacROSTIE
Sec.-Treas., A. A. SWINNERTON, Dept. of Mines & Resources, Ottawa, Ont.

PETERBOROUGH
Chairman, A. R. JONES
Executive, R. L. DOBBIN, A. L. MALBY, F. R. POPE, C. R. WHITTEMORE
(Ex-Officio), D. J. EMERY, H. R. SILLS
Sec.-Treas., A. J. GIRDWOOD, Can. Gen. Elec. Co. Ltd., Peterborough, Ont.

QUEBEC
Life Hon. Chair., A. R. DÉCARY
Chairman, E. D. GRAY-DONALD
Vice-Chair., J. O. MARTINEAU
Executive, A. E. PARÉ, Y. R. TASSÉ, W. J. MANNING, L. MARTIN, J. M. PAQUET
(Ex-Officio), P. E. GAGNON, RENÉ DUPUIS, P. MÉTHÉ, PAUL VINCENT
Sec.-Treas., GUSTAVE F. ST. JACQUES, Public Service Board of the Province of Quebec, Court House, Quebec, Que.

SAGUENAY
Chairman, CHAS. MILLER
Vice-Chair., G. B. MOXON
Executive, J. FRISCH, W. E. COOPER, F. T. BOUTILIER
(Ex-Officio), R. H. RIMMER, J. W. WARD, ALEX. T. CAIRNCROSS
Sec.-Treas., ALEX. T. CAIRNCROSS, 8-C Brittany Row, Arvida, Que.

SAINT JOHN
Chairman, A. O. WOLFF
Vice-Chair., C. D. McALLISTER
Executive, G. M. BROWN, C. C. KIRBY
(Ex-Officio), J. P. MOONEY, D. R. SMITH, G. W. GRIFFIN
Sec.-Treas., F. A. PATRIQUEN, P. O. Box 1417, Saint John, N.B.

ST. MAURICE VALLEY
Chairman, J. H. FREGEAU
Vice-Chair., R. DORION
Executive, G. B. BAXTER, E. BUTLER, A. G. JACQUES, R. D. PACKARD, M. EATON, E. T. BUCHANAN, J. JOYAL, W. E. A. McLEISH, H. G. TIMMIS
(Ex-Officio), VIGGO JEPSEN, H. J. WARD, E. B. WARDLE
Sec.-Treas., DAVID E. ELLIS, Shawinigan Water & Power Company, P.O. Box 190, Three Rivers, Que.

SASKATCHEWAN
Chairman, J. McD. PATTON
Vice-Chair., N. B. HUTCHEON
Executive, F. C. CHRISTIE, G. W. PARKINSON, W. B. RAMSAY, F. E. ESTLIN, E. K. PHILLIPS, J. I. STRONG
(Ex-Officio) A. M. MACGILLIVRARY
Sec.-Treas., STEWART YOUNG, P.O. Box 101, Regina, Sask.

SAULT STE. MARIE
Chairman, A. M. WILSON
Vice-Chair., G. W. McLEOD
Executive, G. W. HOLDER, C. O. MADDOCK, H. W. SUTCLIFFE
(Ex-Officio), N. C. COWIE, C. STENBOL
Sec.-Treas., T. F. RAHILLY, 174 Pim Street, Sault Ste. Marie, Ont.

TORONTO
Chairman, S. R. FROST
Vice-Chair., C. F. MORRISON
Executive, C. D. CARRUTHERS, E. A. CROSS, D. G. GEIGER, A. H. HULL, R. F. LEGGET, J. F. McLAREN
(Ex-Officio), H. E. BRANDON, W. S. WILSON, C. R. YOUNG, W. H. M. LAUGHLIN, F. A. DAVIS
Sec.-Treas., S. H. deJONG, Dept. of Civil Engineering, University of Toronto, Toronto, Ont.

VANCOUVER
Chairman, T V. BERRY
Vice-Chair., A. PEEBLES
Executive, J. P. FRASER, F. H. BALLOU, E. S. JONES, R. C. PYBUS, G. W. ALLAN, J. A. TAMES
(Ex-Officio), C. E. WEBB, W. N. KELLY
Sec Treas., P. B. STROYAN, 2099 Beach Avenue, Vancouver, B.C.

VICTORIA
Chairman, H L. SHERWOOD
Vice-Chair., A. L. FORD
Executive, P. B. HUGHES, C. M. TRIPP, S. R. WESTON, J. N. ANDERSON
(Ex-Officio), A. S. G. MUSGRAVE, KENNETH REID
Sec.-Treas., R. BOWERING, 41 Gorge Road West, Victoria, B.C.

WINNIPEG
Chairman, T. H KIRBY
Vice-Chair., C. P. HALTALIN
Executive, B. B. HOGARTH, N. M. HALL, R. A. SARA, W. F. RIDDELL, E. V. CATON
(Ex-Officio), W. P. BRERETON, H. L. BRIGGS, J. T. DYMENT,
Sec.-Treas., T. E. STOREY, 55 Princess Street, Winnipeg, Man.

CANADA'S WARTIME ROAD

Prince Rupert—Hazelton Highway, B.C.

J. M. WARDLE, M.E.I.C.

Director, Surveys and Engineering Branch, Department of Mines and Resources, Ottawa.

While the Alaska Military Highway was being built by the United States and receiving headline publicity on its attendant difficulties, the Dominion Government was quietly constructing a highway of its own for defence purposes in the North Pacific area. Now known as the Prince Rupert Highway, it extends easterly from that port along the Skeena River valley through Terrace, B.C., to the Hazelton district, where it connects with the existing provincial road from Prince George and Vancouver.

The main problems of the Alaska Highway arose from its isolation and the need of quick location and pioneer construction.

The difficulties of the Prince Rupert Highway were of an engineering and construction nature, and have been identified with the project since its construction was approved on March 16th, 1942, by Dominion order-in-council.

The distance by road from Prince Rupert to Hazelton is 172 miles. Prior to 1942 the Province of British Columbia had built sections of road of varying standards between these points, totalling 73.8 miles, so that 98.2 miles remained to be completed by the Dominion. Early in 1943, it was decided that a 13.4-mile section of existing road of poor type near the Hazelton end should be rebuilt and it was added to the project. The length of road to be constructed by the Dominion was thus increased to 111.6 miles.

The responsibility of constructing the road as quickly as possible was given to the Surveys and Engineering Branch, of the Department of Mines and Resources of Canada. Its Engineering and Construction Service, with many years experience on highway work, was placed in detailed charge of the project.

Location

Mines and Resources engineers started operations with practically no engineering information available. Not only were there no preliminary or location surveys of the route, but a major question of location had yet to be decided—viz. whether a large mileage of road west of Terrace should follow the south side or the north side of the Skeena river. (See Fig. 1.)

Prince Rupert had in a few weeks become a major port, its normal population of 6,650 had more than doubled, and the highway was being constructed as an alternative overland transportation route to it from the east and south. The Canadian National Railways line follows the north bank of the Skeena, and railway and highway would be adjacent for many miles if

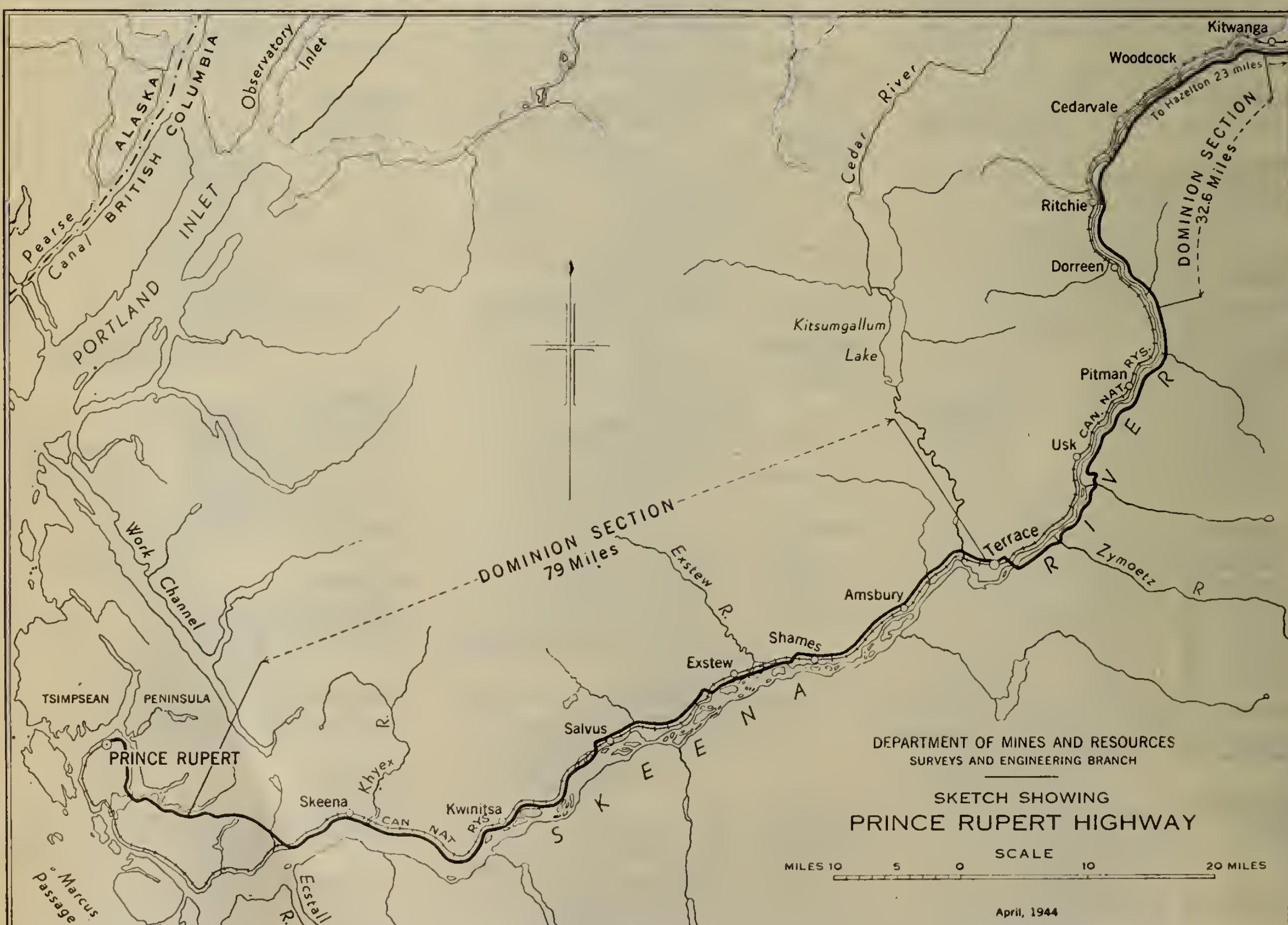


Fig. 1—Showing the route of the Prince Rupert-Hazelton Highway.

the latter were built on the same side of the river.

A road along the south bank, however, had one very serious disadvantage. Any worth while mileage of road west from Terrace would necessitate, to get to the Prince Rupert side, a long costly bridge over the Skeena river, which would be extremely vulnerable to air attack. After full consideration by military and engineering authorities, a location along the north and railway side of the river was decided upon.

As soon as the project was approved, location surveys were organized, and by early April 1942, with the fine co-operation of the Public Works Department of the Province of British Columbia, seven parties were in the field.

The proximity of highway and railway brought at once to the fore the question of railway crossings. Surveys generally showed that the more crossings, the lower initial construction costs would be. Preliminary location lines showed over twenty level crossings, revised location showed twelve and final location required only four.

Award of Contracts

Dominion Government engineers early decided that construction operations should begin in June 1942, and that the work should be undertaken by contract on a unit price basis—this despite the fact that location work would not be completed by that time, nor would estimates of quantities or cost be available. Great as these disadvantages were, they were outweighed by the need for prompt commencement of the work and the potential difficulties of cost plus contracts on a project of this nature. The fact that the location would be confined by the rugged topography to a comparatively narrow strip along the river, and that the character and extent of construction could be well visualized through careful ground inspection, made the letting of unit price contracts without advance plans or estimates a feasible procedure, and one that would save six months in beginning construction. In addition it was felt that if competitive tenders could be obtained that were at all reasonable, the existence and import of unit price contracts would, by requiring contractors to share financial responsibility with the Dominion, save the Canadian taxpayer thousands of dollars. Results have more than confirmed the wisdom of this course.

Difficulties of construction and the objectives desired were discussed at length with eastern and western contractors of proven ability in major highway construction work, and on April 25th, 1942 tenders were called for on eight sections, totalling 98.2 miles.

British Columbia contractors being familiar with mountain work, and being already established in that province, had no great difficulty in preparing their tenders. Eastern contractors interested arranged to inspect the work together, utilizing a special train. With a 16 mm. motion camera they took numerous shots along the site of the work, particularly at points where construction would be most difficult. On return to their eastern offices the contractors projected the film on the screen as required for their studies of construction methods, procedure, and cost of work operations, and then figured their unit price bids.

Tenders closed on May 14th, 1942, and on May 21st, contracts were awarded for sections 1 to 7, inclusive. The contract for Section 8 was awarded on June 10th.

The contract for the easterly 13.4 miles of road previously mentioned, designated as Section 9, was awarded after competitive bids on March 13th, 1943. In the case of this section, time had permitted the completion of final location surveys, so that plans, profiles and estimated quantities were available for the information of contractors submitting tenders.

Fig. 2—Boulder Creek trestle bridge, on curve, Section 9.

The basic factors affecting the cost of work operations were freely discussed with interested contractors before tenders closed in order that unit prices submitted would be well-balanced, well-informed, and reasonable. Among these factors were heavy construction, and the difficulties due to priority restrictions, shortage of labour, rising wage schedules, and heavy precipitation. Forced construction and the proximity of work operations to a busy railway line were other very important considerations.

Under current financial regulations, and particularly those applying to excess profits, contractors were undertaking on a unit price basis, work on which they could make at the best only a limited profit. The unselfish attitude of contractors in tendering as low as possible without inviting a financial loss that could not be recouped through contracts in the immediate years to follow, is worthy of mention.

Unit Prices

Construction difficulties varied on different sections and it might be of interest to give the price ranges on the more important work items as submitted by nine different contractors.

Clearing, limited in amount but very heavy, ranged from $360 to $850 per acre.

Solid rock excavation prices ranged from $1.95 to $2.75 per cu. yd. (Over 1,650,000 cu. yd. of solid rock were returned in progress estimates up to February 29th, 1944.)

"Other material" prices varied from 66 cents to 90 cents per cu. yd.

Surfacing with gravel of specified grade ranged from $1.20 to $2.10 per cu. yd. with prices for crushed rock (top course) averaging $3.90 per cu. yd.

Fig. 3—Kitsumgallum River bridge, Section 7.

Fig. 4—Widening rock cut on Section 5.

Overhaul prices were close, the average being 22 cents per cu. yd. for haul of one mile after a free haul of one-half mile.

The highway crosses numerous tributaries and backwaters of the Skeena river, and simple bridges, pile trestles, and truss bridges were required. Single truss spans ranged in length from 90 to 225 ft. The total length of truss spans erected is approximately 1,840 lin. ft.

Owing to steel shortage it was necessary to build timber structures, and this restriction required a great deal of study in fitting maximum allowable spans of timber trusses to bridge site conditions. All upper and lower chord members were given preservative treatment. Standard timber truss designs of the Province of British Columbia were used and plans of these were supplied by the Provincial Public Works Department. Centre piers were generally of heavy pile construction, with an average of 47 piles per pier driven to safe depth and well protected and reinforced to withstand flood and ice.

Trestles and simple bridges were constructed under the original contracts, while separate contracts were awarded in the case of truss bridges. The latter, pre-framed and treated, were supplied the bridge contractors ready for erection, by the Department of Mines and Resources. In trestle bridges, unit prices for piling in place after cut-off ranged from $1.45 to $1.70 per lin. ft., and timber in place from $75.00 to $80.00 per thousand f.b.m.

Trusses were erected on a lump sum basis. A typical bridge over the Kitsumgallum river consisting of two 140-ft. Howe truss spans with pier, abutments and approaches cost a total of $49,240. (Fig. 3.)

The 225-ft. truss span over the difficult Khyex river with abutments and long trestle approaches cost $104,745. This amount is made up as follows:

225-ft. Howe truss pre-framed and ready for erection	$ 28,018.00
Erection	10,200.00
Abutments, false work and 360 lin. ft. of trestle approaches	64,377.00
Miscellaneous and extras	2,150.00
Total	$104,745.00

Labour costs were high as bridge contractors were obliged to meet high wages authorized for bridgemen in the Prince Rupert area, and on the Alaska Military Highway. For example, the basic wage rate for bridgemen authorized by the Western Labour Board from June 15th, 1943, was $1.09 per hour, plus cost of living bonus of $4.25 per week. In regard to overtime rates, the established union agreement applicable in the area, and approved by the Regional War Labour Board, is quoted herewith:

> "Eight hours shall constitute a day's work, to be worked generally between the hours of 8 a.m. and 5 p.m., the working week to be from 8 a.m. Monday, until 5 p.m. Friday. Regular hours shall be worked between the hours of 6 a.m. and 6 p.m. and 8 hours shall be the regular shift. Any time worked over 8 hours, between 6 a.m. and 6 p.m., shall be paid at the rate of time and one-half for the first two hours and after that, double time. Any time worked before 6 a.m. or after 6 p.m. shall be considered overtime and shall be paid at the rate of double time. Work on statutory holidays shall be paid at the rate of double time. When three or more consecutive tide or traffic shifts are worked, all work outside the regular hours of 6 a.m. and 6 p.m. shall be paid at the rate of 6 hours work for 8 hours pay."

Construction Difficulties

Some of the particular difficulties encountered on this project might now be described.

With railway and highway on the same side of the Skeena river between Prince Rupert and Terrace, some 50 miles of the road parallel the Canadian National Railways, and of this, 35 miles are outside the railway grade and between it and the river. For many miles, the railway line had been blasted through solid rock bluffs along the river banks and the road could only be constructed through a combination of widening rock cuts and making river fills (Fig. 4). At some points, widening of cuts on the inner side of railway curves

Fig. 5—Completed road with rock cut widened and pole line re-located. Section 6.

permitted the shifting of track to the improved alignment, with the highway using part of the original railway grade. Proximity of railway and highway required adequate protection of telephone and telegraph lines and track during blasting operations. Utilization of railway right-of-way for the highway also involved the shifting of several miles of pole lines to new locations (Fig. 5).

Problems of drainage naturally arose and these required decisions as to the relative elevations of highway and railway grades and the clearance between them.

Where railway and highway are adjacent and at practically the same elevation, a joint grade has resulted. In such cases the minimum clearance between the outside edge of the road and the near rail is 6 ft. 6 in. As a temporary safety measure, a 6 by 6 in. timber guide rail supported on 6 by 10 in. sleepers at 12 ft. centres, is placed along the outside edge of the road on joint grade sections.

Where the highway grade is adjacent to, but higher than the railway, the toe of the fill slope is 9 ft. from the inner rail.

Culverts and bridges to carry drainage across the highway were at least equal in capacity to existing railway structures, and were placed at the same points.

The selection of bridge sites required study since the most favourable sites were already occupied by railway bridges.

The widening of rock cuts along the operating railway line was an operation attended by many troublesome factors. When work began, there was an average of three or four trains a day, while by midsummer of 1943 the average was twelve. Most of these trains carried freight of high priority and could not be seriously delayed. This involved the frequent setting up and dismantling of drilling equipment, and limited the amount of explosives that could be used for any one shot. As a safety measure, and to assist in planning each day's work, all contractors on sections adjacent to the railway employed dispatchers or telegraph operators who obtained the latest information on trains.

Fig. 6—Heavy rockfill along Skeena river. Section 4.

Highway grade along the river bank required special protection against erosion, particularly where much of the fill was in water (Fig. 6). Most of the river fill was solid rock, with all outer sections built of large selected pieces. Depth of fill in water varied from 5 to 30 ft. High flow velocities occurred during floods, and on lower reaches of the river during ebb tide. Owing to the scarcity of suitable material for ordinary construction it was often necessary to resort to rock borrow or river bed material with long haul. Loading of river gravel was necessarily synchronized with low tide.

Fig. 7—Railway has tunnelled through rock bluff, while highway is built around it. Section 3.

Physical obstacles to construction, being anticipated, were overcome as required, but difficulties from priority regulations and labour shortage were greater than expected.

Heavy construction equipment in use by the contractors, and repair parts for it, largely had its origin in the United States. From the beginning of construction, priority ratings given were lower than those for United States projects in the Prince Rupert area or for the Alaska Military Highway. In the case of materials originating in Canada, urgent demands and requirements of the United States were given preference to match the high priority rating held on United States products. These circumstances resulted in delays which at times upset construction schedules. While very good wages were offered and paid on the Prince Rupert Highway, they were considerably lower than those in effect on the Alaska Highway and allied projects, with the result that contractors on the former project found it practically impossible to keep their construction crews up to strength. This situation proved a particular drawback in a district where climatic conditions were generally not favourable for road construction.

The western section of the road lies in a heavy precipitation belt, with an annual rainfall ranging from 40 or 42 in. at Terrace, B.C., to 80 or 90 in. at Prince Rupert. In the winter months, heavy falls of wet snow are frequent, all of which result in most unpleasant working conditions. In the winter of 1942-43, the depth of snow on certain contracts was over 6 ft.

MISCELLANEOUS

Contractors did everything possible to counteract unfavourable conditions and make the project attractive, particularly in regard to camp establishment. Comfortable well-heated bunk houses of frame construction were provided, with drying rooms and shower baths. One contractor installed steam heat. Dining rooms were well laid out with ample space, and the best of food was served. Charges for meals were set at $1.25 per day per man, and most of the contractors operated their dining rooms at a loss.

It is believed the Prince Rupert Highway may have set a new mark for sustained heavy construction, and which is, of course, reflected in cost. The most expensive mile, which was on the west or Prince Rupert end, Section 2, cost $245,500. Two other miles cost well over $200,000 each. The average cost per mile of the road, including gravel surfacing, is approximately $88,000.

It might be interesting to note here that according to the Report of the Royal Commission on Railways

Fig. 8—Highway above railway. Skeena river on left. Section 7.

and Transportation, 1917, the cost of building the Grand Trunk Pacific railway grade between Prince Rupert and Terrace, B.C., in 1910-13, and including bridges and ballasting only, was approximately $78,386 per mile. Many factors would, of course, have to be considered in any actual comparison.

The standard of the new highway is good, being well adapted to the traffic it will carry, and the character of the country it will serve.

A clear roadway of 20 ft., exclusive of side ditches, has been provided, and surfacing with processed gravel or crushed rock is being undertaken to a width of 18 ft.

With the exception of one or two short sections of 8 per cent grade, the maximum is 6 per cent. Alignment throughout is excellent. Construction is well advanced, and it is estimated that the road should be finished by mid-summer of this year.

Contractors and Personnel

The contractors who are carrying this project to completion are as follows:

- Section 1—(Prince Rupert End)—Northern Construction Company & J. W. Stewart Limited, Vancouver, B.C.
- Section 2—Rayner Construction Limited, Leaside, Ontario.
- Section 3—Tomlinson Construction Company Limited, Toronto, Ontario.
- Section 4—Standard Paving Limited, Toronto, Ontario.
- Section 5—McNamara Construction Company Limited, Leaside, Ontario.
- Section 6—Dufferin Paving Company Limited, Toronto, Ont.
- Section 7—General Construction Company Limited, Vancouver, B.C.
- Section 8—Highway Construction Company Limited, Vancouver, B.C.
- Section 9—(Hazelton End)—R. Campbell Contracting Company Limited,Vancouver, B.C.

Contracts for the erection of truss spans of five bridges were awarded to the British Columbia Bridge and Dredging Company Limited of Vancouver, while the erection of the trusses of five bridges was undertaken by the main contractors. Timber Preservers Limited, of Burnaby, B.C., undertook preframing and preservative treatment of truss spans.

G. D. Archibald, M.E.I.C., is Construction Engineer in charge in the field for the Engineering and Construction Service, of which T. S. Mills, M.E.I.C., Ottawa, is Chief Engineer.

Fig. 9—Christmas Day 1942.

Conclusion

The Prince Rupert-Hazelton Highway is a link that has been wanted and visualized for many years, and its early completion because of the war, will be a great stimulus to the development of the whole Prince Rupert-Prince George area. It makes accessible a great new district to car and truck operators, and one that offers opportunities in both commercial and recreational fields.

The whole road between Hazelton and Prince Rupert is interesting, while the 111-mile new section with its fine scenic values, will undoubtably be a great attraction to motorists.

Initiated as a war project, the new highway has set the clock ahead from 10 to 15 years in the Skeena River valley, besides giving a much needed highway outlet to Canada's Northern Pacific port of Prince Rupert.

NYLON

A Chemical Research Product of Engineering Interest

C. J. WARRINGTON

Development Manager, Nylon Division, Canadian Industries Limited, Kingston, Ont.

Paper presented before the Kingston and Peterborough Branches of The Engineering Institute of Canada, on February 8 and 17, 1944.

Nylon is the generic name for a group of organic chemical compounds with plastic properties, which were discovered by Wallace H. Carothers in the United States in the early 1930's. This chemical research had as its object the building of large molecules, or 'high polymers,' in straight chains of controlled length rather than in cross-linked masses, such as are found in natural and some synthetic resins.

The type of chemical molecule which should produce a stable linear arrangement of molecules was reasoned first on theoretical grounds [(1)] and, by the application of the then recently developed laboratory technique of the molecular still, it was confirmed by several years of patient work under the auspices of the E. I. du Pont de Nemours & Co. Inc., in the United States.

Engineering Significance

An interesting outcome of the work was the ease with which materials of great strength could be obtained by the simple cold drawing of polymers of this type. While this has led first to the commercialization of the polyamides as filaments in a range of unit sizes between silk and catgut, this group of materials has other possibilities, some of which may have engineering applications. For example, their physical characteristics expressed in engineering units are mostly within the range normally attributed to metals; the processes which have been developed for nylon manufacture, in addition to the use of novel mechanical devices, are analogous to metal treating steps such as extrusion, drawing and annealing; and finally but possibly not least interesting, there is the contribution made by the nylon development to the theory of strength of materials in the fibrous state.

As was recently stated to the Faraday Society by a speaker on the subject, "much of our present knowledge and understanding of these fibrous states of matter is owed to the outstanding genius of the great American chemist, Wallace H. Carothers." [(2)]

On the assumption that these matters are of interest to engineers, the development will be discussed under these headings, followed by a general review of the actual and potential uses of the products called nylon.

Nylon might be defined as a thermoplastic solid having good moulding properties; capable of being shaped into sheets, rods, tubes, wire, filaments and other forms; but specially characterized by the greatly increased strength which results when it is cold drawn, rolled or otherwise worked. Extruded nylon polymer filaments can be permanently stretched under low tension to about four times their original length; there is no volume change in this process, the extension being accompanied by an equivalent decrease in cross section. During this drawing process, release of the stretching force does not result in appreciable recovery. Beyond the point of maximum drawing, the material develops fairly suddenly the properties of a truly elastic solid having the following physical characteristics, according to polymer chain length:—tensile strength 70,000 to 100,000 lb. per square inch; elongation at break 12 to 22 per cent; calculated elastic modulus 450,000 lb. per sq. in. The stress-strain curve is approximately linear up to 4 per cent. Recovery from elastic stretch is complete up to 8 per cent elongation.

Theory of Fibre Structure

According to the theory of internal structure developed from Carothers' research [(3)], the change is from a resinous solid, containing long-chain molecules which are largely in random or disorderly arrangement, to a tough elastic fibre showing a high degree of orientation of the chains parallel to the axis of drawing. A simple textile analogy to this molecular parallelization in nylon is the straightening of cotton by the processes of carding, gilling, etc., so that the fibrils have maximum area of frictional contact and resist rupture under stress. Similarly, the molecular forces are at a maximum in oriented or drawn nylon (Fig. 1). These molecular aggregates are shown by their X-ray diffraction pattern and bi-refringence to have assumed a crystallite structure during drawing (Fig. 2).

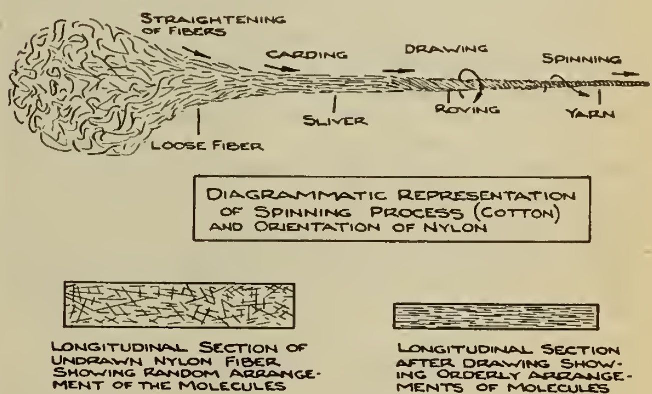


Fig. 1—Diagram showing rough analogy between the straightening and strengthening of cotton fibres with the orientation of nylon.

The current theory is that all natural and synthetic high polymers with a chain structure such as rubber, silk, cotton, rayon, nylon, etc., exhibit a mixture of crystallite (micelles, or bundles of long molecules) and amorphous areas and that the character of the material is determined by the degree of orientation or crystallization which is possible with a given chemical structure. Change from disorganized to organized areas is favoured by stretching at constant temperatures or cooling under constant stress; and the reverse process by allowing to relax; swelling with solvents or heating. The presence of side groups or groups having strong polarity may affect the cohesion which determines tensile strength. Thus, cellulose fibres such as rayon can be markedly strengthened by stretching while

Fig. 2—X-ray diffraction pattern of un-oriented (on top) and oriented nylon yarn.

plastic, but not to the same extent as with nylon, owing to the presence of side groups.

The crystallized areas are said to determine for the material its modulus of elasticity, its rigidity and its ultimate tensile strength, while the disordered or random areas impart flexibility, recovery from stretch, elongation and swelling characteristics. Metastable or near-crystalline portions are also shown to exist, which are responsible for shrinking during heating. Thus, heat treatment or annealing at constant stress will crystallize these portions and stabilize the fibres against further heat shrinkage and consequent distortion.

While reference is rarely made by high polymer research workers to related problems in the metallurgical field, it must be evident that there is a common interest here in the theory of material strength and those further interested may wish to consult the bibliography references (4), (5), (6). It will be seen from this brief review of the current theory of internal structure and fibre properties that large molecules which can be, so to speak, chemically tailored as to length and mutual chemical and physical attraction, should lend themselves to the production of a range of useful articles of controlled physical properties. In the following paragraphs we will discuss how this has been done in the case of nylon and with what results.

Chemical Derivation

The linear polyamides are usually derived from dibasic organic acids and diamines. These compounds are bifunctional, i.e. have reactive groups at each end of their molecules and if the right length of molecule is used, by chemical condensation reactions they can be formed head to tail in chains, the length of which can be controlled by the concentration of a monofunctional reagent which blocks off the chain from further reaction. These chains may be 100-150 times as long as the single molecule which forms the unit or molecular link in the chain. Increase in chain length raises the viscosity of the molten polymer and the tenacity of the drawn fibre, with a corresponding decrease in elongation at break. For a given chain length or viscosity, the tenacity (based on original cross section) increases, and elongation at break decreases with increase of ratio of drawn to undrawn length.

The commonly used nylon is polyhexamethylene adipamide which can be derived by a series of chemical reactions from the fairly common raw materials, coal tar benzene, atmosphere oxygen and nitrogen, and hydrogen from water. High pressure catalytic technique and the use of special stainless steels are essential to the synthesis, consequently capital and operating costs are relatively high compared with those for the common synthetic resins. The discovery that the molten polyamide could be spun into yarn, comparable with real silk worth several dollars per pound, initiated its first outlet as a textile yarn.

The production of nylon yarn may be briefly described as illustrating very clearly that large investments of patient research and money may be necessary to develop equipment and processes which will translate a test-tube phenomenon into a workable industrial process. The main problem which occupied several hundred du Pont research chemists and engineers, on and off, during the middle 30's was to develop methods, equipment and materials for the following process.

Yarn Spinning Process

It was necessary to melt, at nearly 300 deg. C. a solid, highly sensitive to atmospheric oxidation, in order to produce a viscous liquid which could be extruded uniformly through holes a few thousandths of an inch in diameter, at a pressure of 2,000 to 3,000 lb. per sq. in. The filaments had to be solidified immediately and wound up at a speed of several thousand feet per minute. Following this, it was necessary to develop equipment capable of uniformly drawing bundles of these filaments at high speed at a 4:1 draw ratio down to a diameter of less than one thousandth of an inch. The economical operation of the drawing process demanded not more than one complete thread breakage in 100,000 yards, and good yarn quality required not more than one filament breakage in several hundred thousand yards. It should be mentioned that there are over a million yards in a pound of standard individual (3 denier*) nylon filaments. The yarn consists of bundles of these filaments, 10 — 13 — 20 — 23 etc., according to the count required. This degree of fineness of the unit in textile structures is vital to the resiliency expected of woven and knitted fabrics.

The product from these operations was not adapted, at this stage of the development, for most textile converting processes such as weaving and knitting. The individual filaments, while as strong as steel in terms of pounds per square inch, would rupture under a tension of one-half an ounce and therefore had to be protected from the action of loom shuttles and knitting needles by means of a chemical sizing agent or gum which would coat and bind the filaments together until weaving or knitting was complete, when it would be removed by scouring. The severity of textile converting processes on fine yarns may be illustrated by reference to one of the most intricate and interesting of textile machines, the full-fashioned hosiery machine. In forming the 650,000 stitches contained in a woman's stocking, a standard 45-gauge hosiery machine uses 420 spring beard needles and a similar number of spring steel sinkers and dividers in a 14-in. needle bar, along which the knitting yarn is laid at the rate of one course every one-half second and crimped into loops and knitted by a cam-operated mechanism.

* The denier is the unit used to define the 'count' or size of silk, rayon or nylon. One denier yarn weighs one gram per 9,000 metres. Three-denier nylon is approximately seven ten-thousandths of an inch in diameter.

Auxiliary Research Problems

The development of the chemical sizing agent was a major research problem. Other problems were connected with dyeing and the thermal setting of the woven and knitted structures. It is illustrative of the confidence which can animate a research-minded industrial concern, having the necessary background of related experience (i.e. rayon manufacture), that several of these auxiliary conversion problems were solved during the period in which the plants for the production of polymer and yarn were under construction. The product was launched in the spring of 1940, twelve years after the beginning of the fundamental research programme. The public acceptance of nylon as a textile material prompted the immediate expansion of operations in the United States during 1940-1941. The decision to erect a nylon manufacturing plant in Canada during the war was based on the possible usefulness of strong synthetics to replace essential material fibres such as silk, linen and hemp, practically all the sources of supply of which were threatened by aggression. It was anticipated that there would be an expansion of war techniques demanding large quantities of parachutes, cords and ropes and that the textile sinews of war demanded by new conditions would have to measure up to a new tempo of speed and precision.

The forecast has been borne out by events and a few examples of interest will serve to illustrate the vital part which nylon has played in supplying our present war needs for strong textiles.

In general, it may be said that certain physical requirements in such articles of war as parachutes, glider tow ropes and heavy bomber tire cords cannot be met by rayon or cotton, owing to such critical limitations as bulk, impact loading, fatigue resistance, etc. For example, to reproduce a silk parachute from the strongest stretched viscose rayon would require nearly a doubling of weight to offset the lower wet strength. The higher strength rayons of the saponified stretched acetate type have low elongation and correspondingly lower impact strength. The loop or knot strength of these (probably related to the shear strength of engineering materials) is comparatively low (40 per cent of dry tensile compared with 85-95 per cent for nylon).

Wearing Properties

In addition to impact strength requirements, yarn for glider ropes must be resistant to chafing. A 11/16 in. rope of the type used in towing the glider which made the recent Atlantic crossing has a tensile strength of 11,000 lb., at an elongation of 30 per cent, and in addition, will survive at least ten times the abrasive wear of a manila rope on a rope abrasion machine. This remarkable abrasion resistance must have much to do with the long average wearing properties of nylon stockings, since this is greater than can be accounted for by the 50 per cent greater tensile strength of nylon compared with that of silk. Of the three causes of failure of sheer knitted fabrics such as hosiery—manufacturing defects, accidents and rubbing, the last is a function of abrasion. The average life of stockings—a factor even in the life of engineers, as it influences their budget and the morale of their ladies—, should be increased by the use of nylon after the war, providing the worsening of the first of these two factors does not offset the improvement in the third. Another interesting physical property of nylon which makes it valuable for hosiery fabrics is the ability to recover from distortion of the loop crimp, or it might be termed "bending elasticity." It is expected that the improved money value of nylon over silk hosiery will widen the use of the synthetic product and offset the effect on manufacturing volume of better wear, as it has in other technological improvements. Canada had a large hosiery industry and, before the war, exported more dozens of pairs of full-fashioned hosiery than any other country in the world.

Fig. 3—Wind-up section of one of the three storey spinning or extrusion machines used in the production of nylon yarn at Kingston, Ont., plant of Canadian Industries Limited.

An engineering application which may probably be related to abrasion resistance, or inherent surface smoothness of nylon is the use of moulded nylon for self-lubricating bearings in places where chemicals, etc. make the use of oil undesirable, for example in the bearings of viscose spinning buckets. Massive nylon has a Brinell hardness of 105 which is comparable with some types of steel and with certain aluminum alloys. Other specialized moulded products from nylon may be expected.

The case of bomber tire cords is interesting. The use of nylon fabric in the carcass of heavy bomber tires allows of greatly improved safety on short runways where heavy braking has been known to cause tires with cotton or rayon cords to buckle back on themselves and burst. The alternative to nylon would be to change to heavier tires and consequently to larger wing recesses and redesigned wing structure.

Physical Properties

Nylon is resistant to most chemicals (except strong acids) and to atmospheric corrosion. It is soluble in a few common liquids, such as cresylic acid and use is made of this property in applying coatings to wire by the usual enamelling procedure. A modified nylon coating is favourably reported on in the British *Electrical Review* of July 1943, in respect to its space factor and its breakdown voltage after immersion in salt, oil and gasoline. Abrasion and flex resistance tests compared favourably with commonly used oleo-resinous wire coatings, particularly for magnet wire.

Modified types of nylon may also be coated from solvent solutions onto fabrics to produce highly flex-resistant materials, since the effect of flexing is equivalent in some respects to drawing, which tends to strengthen rather than weaken the coating film.

Like other plastics, nylon can be cast into transparent films or sheets. The breakdown voltage of

(*Continued on page 307*)

RAILWAY SIGNALLING AND INTERLOCKING

MONTREAL TERMINAL — C.N.R.

JAMES J. VAN HORN

Engineer, Union Switch and Signal Company, Swissvale, Pa., U.S.A.

Paper presented before the Montreal Branch of the Engineering Institute of Canada, on October 21st, 1943.

The dedication and the opening of the new Central station of the Canadian National Railways at Montreal on July 14 and 15, 1943, climaxed the development of the Montreal Terminal, a project of which the city of Montreal, and the officials and employees of the railway who have had a part in its planning and execution, may well feel proud.

Layout of Trackage of Montreal Terminal

In addition to the Central station, this project has included the electrification of those tracks which serve the Central station, extending to the engine changing facilities at Victoria bridge on the east and Turcot on the west; this electrification is a continuation of that installed for operation through Mount Royal tunnel in 1918; the construction of new approaches from the main line northward to the new station; the construction of a new coach yard; the construction of two two-track lift spans over Lachine canal just east of Wellington street subway; the relocation of the double-track main line through Turcot; and extensive track changes to connect these facilities and make them an operative whole.

Figures in parentheses in the following paragraph identify the various zones or groups of interlocked switches and signals as shown in Fig. 1.

It will be seen that the main terminal trackage extends from St. Lambert on the east and includes the double track line across Victoria bridge extending westward through Point St. Charles (8) and St. Henri (9), where a swing bridge over the Lachine canal is crossed, to Turcot West (11), where tracks and switches have been installed so that electric locomotives may replace the steam locomotives on passenger trains inbound to the Central station. Facilities have also been provided for the substitution of steam power for the electric power used to pull the westward passenger trains from the Central station. In the vicinity of St. Marguerite street (10) there are connections to old Bonaventure station, which is being retained temporarily for some surburban train movements, and to the freight yard and round house for steam locomotives. From Point St. Charles, a new double track connection has been installed leading to the elevated line approaching the new station. Near Bridge street (6) this line merges with a new four-track line which connects to the main line at the west end of Victoria bridge (7). The layout of switches and crossovers at each end of this four-track extension has been designed to facilitate the interchange of steam and electric power. Parallel to this four-track extension there is a double-track line leading to the new coach yard. This connection includes a crossing at grade with the double-track main line. From Bridge street, four tracks extend northward to the two double-track lift spans over the Lachine canal (5) where they converge to two tracks on the south bank of the canal and diverge to six tracks on the north bank leading to the Central station (4) which now consists of eleven tracks, four of which are through tracks and seven are stub end tracks. Ultimately, when the projected west side of the station layout is completed, there will be twenty station tracks of which thirteen will be through tracks and seven will be stub end tracks. Between the north end of the station platforms, and the south portal of the tunnel under Mount Royal (2), the through tracks converge to two tracks. 1,500 ft. inside the south portal (Grotto) there is a pair of crossovers so that trains or locomotives may be crossed from one track to the other as required.

Passengers on trains approaching or leaving the Central station may at times wonder what agency directs the many trains and locomotives so unfailingly, each to its appointed track at the proper time, without interference from other trains or locomotives moving simultaneously in the same area. This agency is the railway signalling and interlocking system which has been installed so that a few men in one centre may efficiently, expeditiously, and safely direct all train movements within the area. Railway signalling and interlocking systems are an integral part of all major railroad terminals.

Montreal Terminal interlocking is larger than any other in America. The comparative size of interlockings is measured by the number of interlocked functions. An interlocked function is a switch, electric switch lock, bridge lock or operative signal unit which is controlled by a lever on the control machine. Montreal Terminal has 20 per cent more interlocked functions than the next largest interlocking in America. Bigness in itself is important but not necessarily interesting. The interesting and unique feature of this interlocking is that all of the switches and signals distributed throughout the 8.8 road-mile terminal area are controlled directly from one control machine.

We ordinarily think of an interlocking as the control of the switches and signals within the immediate area of the tower and possibly reaching out a half mile from the tower to the most remote switch or signal. In Montreal we reach out 1.3 miles to the north, 1 mile to the east and 3.5 miles to the west. Our study of this project led us away from the usual power interlocking practice and into the development of a system of control based in part upon our experience with centralized traffic control wherein upwards of 170 miles of single track are so controlled from one point that practically all train movements are made under signal indication and without train orders. If previous conceptions of interlocking practice had been followed, we might have had a separate interlocking machine for each of the numbered locations shown in Fig. 1. At the minimum, there might have been six separate interlockings.

This is the first terminal project of this scope where all the switches and signals in the terminal area are

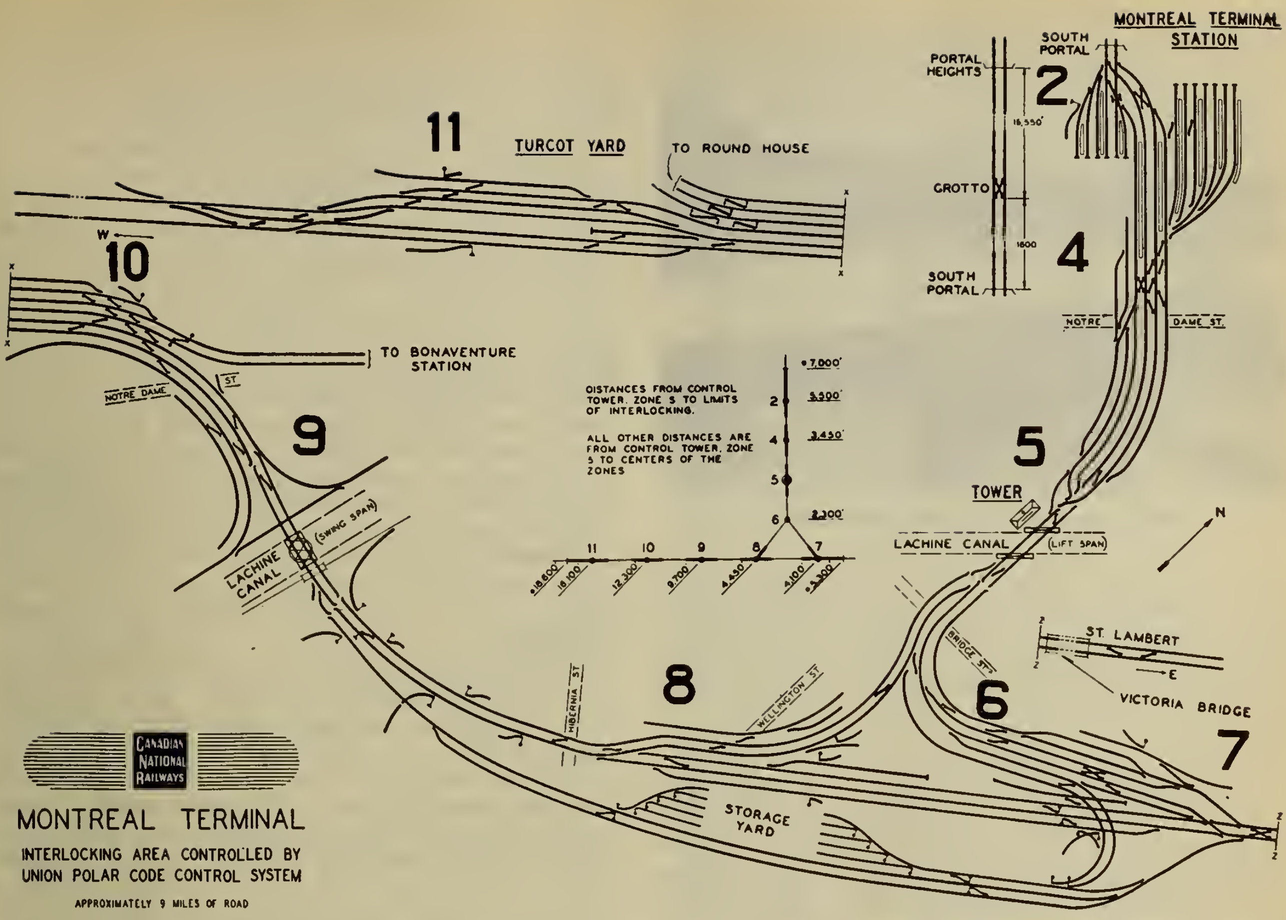


Fig. 1—Track layout, Montreal Terminal of Canadian National Railways.

controlled from one point (Fig. 2). This attainment has always been a desirable one, but of necessity had to await the development of systems of control which could compete economically with the older arrangement of establishing a number of separate points of control and coordinating them by telephoned instructions.

Early Methods of Train Operation

The discussion which follows will trace the development of the elements of railway signalling and interlocking and show how they are incorporated in this installation.

Steam railways date from 1825 in England and from 1830 in America. They are the outgrowth of systems of transportation using the horse to pull loaded wagons along a right of way consisting of two rails of timber which provided a smooth surface for the wagon wheels. These wagon ways were single-track for traffic in both directions. It is related that in the State of Pennsylvania, an attempt was made to settle priority by establishing centre posts midway between the turnout points. The first vehicle to pass the centre post was to have the right of way to the next turnout. This arrangement was not satisfactory for horse drawn vehicles, and obviously would not do for the heavier steam propelled units which were to follow.

The first record of signals being used for the direction of train movements describes an arrangement used on the Newcastle and Frenchtown Railway in 1832. The signals consisted of a post on which the operator raised and lowered a large globe to correspond with the position of adjacent signals as viewed through a telescope from a point of vantage.

But for the first twenty-one years of steam operation, practically all train movements were governed by time table. This was a satisfactory enough arrangement so long as the trains operated on schedule but you can readily appreciate what delays were introduced on single-track railways when one of the trains became delayed, as under that system a train could not advance beyond a station until it had met the train from the opposite direction scheduled to be passed at that station.

It was not until 1851 when a divisional superintendent on the Erie R.R., Charles Minot, made use of the telegraph to learn if an opposing train, running not, he issued the first train order to hold the opposing not, he issued the first train order to hold the opposing train at "A" and gave authority to the other train, on which he was a passenger, to proceed beyond its normal meeting point to "A". From that time, the telegraph and later the telephone have played an increasingly important part in directing train operation in America.

In 1864, the next development was initiated by the introduction of a manual block system on the P.R.R. near Trenton, N.J. In this system, block offices manned by operators and equipped with telegraph facilities were provided at intervals of 5 to 10 miles along the right of way. Passing tracks or turnouts were located at these block offices so that trains could clear the main track. As the operators could communicate with each other, it was a simple matter to determine if a train had entered the block from the adjacent

Fig. 2—Interlocking control machine

block office. If none had entered, the operator at that point could keep his signal at stop to hold all trains clear of the block; the first operator could then clear his signal to authorize a train movement into the block. (A block is the section of track between adjacent block offices.)

Track Circuits

In 1871, the first track circuit was installed. This simple circuit, designed to detect the presence of cars or locomotives in a section of track, has made possible the extensive use of automatic block signal systems, interlocking systems, automatic train control and cab signal systems and centralized traffic control systems, all of which contribute so importantly to make the great railway transportation systems in the United States and Canada the most efficient and the safest form of transport overland in the world.

It is well known that a railway track consists of two parallel rails of steel made up of rails usually 33 or 39 ft. in length spliced together with bolted rail joints, and attached to wood ties by spikes, the ties being supported by crushed stone, gravel or cinder ballast. The track circuit is formed by isolating a section of the track by the introduction of special insulated rail joints in each rail approximately opposite each other, and spaced the required distance apart; at one end a source of power, a primary cell or a storage cell, is connected across the rails, at the other end a tractive armature direct current relay is connected across the rails for a direct current track circuit, each rail thus serves as one side of the circuit between the battery and the relay. When the track circuit is unoccupied, the relay is energized. (Fig. 3A.)

When an engine or car enters the section, Fig. 3B, the steel wheels and axles form a low resistance path in parallel with the relay coil, so that the current through the relay is decreased below that value necessary to hold its front contacts closed whereupon the relay opens its front contacts and closes its back contacts.

There are several considerations which affect track circuit length:

(a) The relay should release and detect a broken rail.

(b) The relay should release when a shunt of 0.06 ohms is applied across the rails.

When the track ballast and ties are dry, very little power is required for the track circuit; however, when wet, each tie provides a path of conductance tending to drain current away from the relay. The track circuit must be so designed and adjusted that sufficient energy is supplied to energize the relay during wet weather, but this energy must not be so great as to keep the relay energized in dry weather if a rail should be broken nor should the energization of the relay be allowed to reach a level where it would not release upon the application of a shunt of 0.06 ohms across the rails. D-c. track circuits of the type illustrated may be up to 6,000 ft. in length. A track circuit of this length fed from one cell of primary battery will use 14 ampere-hours (A.H.) per day or approximately 12 A.H. per day per mile of track. The 4-ohm d-c. track relays are adjusted to pick up (close front contacts) with 0.074 amperes in the relay coil and to release (open front contacts and close back contacts) when the current in the coil is decreased to 0.037 amperes. If track circuits were designed to operate on the pick-up value of the relay instead of the release value, it is apparent that longer track circuits could be used or a higher resistance shunt could be tolerated.

A recent design of track circuit, in which the current fed to the track is periodically interrupted, operates a code-following track relay which successively opens and closes its front contacts, as current is removed and reapplied to the track circuit. By varying the rate of interruption and using tuned decoding circuits operated by the code-following track relay, we are able to detect at the relay end of the track circuit the presence of 75-120 or 180 code (75-120 or 180 interruptions of equal on and off periods per minute). This type of track circuit in which the code-following track relay is periodically energized and de-energized operates on the pick-up value of the relay and permits the use of d-c. track circuits up to 11,000 ft. long. (The a-c. coded track circuit is usually used only in electrified or cab signal territory where other considerations limit the length to 9,000 ft.) These d-c. track relays are adjusted to pick up on 0.250 amperes. A permanent magnet causes the relay to release promptly when the current is interrupted. An 11,000-ft. coded d-c. track circuit requires 10½ A.H. per day of 5.0 A.H. per day per mile of track.

When electric propulsion is encountered, the d-c. track circuits just described cannot be used; we must use a-c. track circuits in which a transformer is substituted for the battery and an a-c. relay for the d-c. relay. For a-c. propulsion, track circuit energy of a frequency different from that used for propulsion must be used with a relay designed to operate on the track circuit frequency only. As the rails usually form one part of the propulsion circuit, it is necessary that they be in effect continuous. This is accomplished by the use of impedance bonds connected around the insulated joints (Fig. 3C). These bonds are so designed that they offer a very low impedance to the propulsion current but a high impedance to the passage of the track circuit current.

For d-c. propulsion systems, such as used in this installation, double-rail a-c. track circuits complete with impedance bonds may be used. In this case, the impedance bond presents a path of low resistance to the d-c. propulsion current but a path of high impedance to the a-c. track circuit energy.

As Montreal Terminal is an interlocking installation, advantage is taken of the economy of single-rail

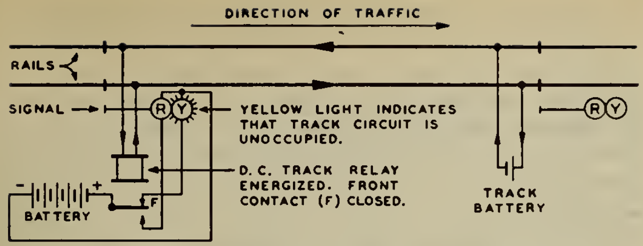


FIG. 3A - D.C. TRACK CIRCUIT - UNOCCUPIED

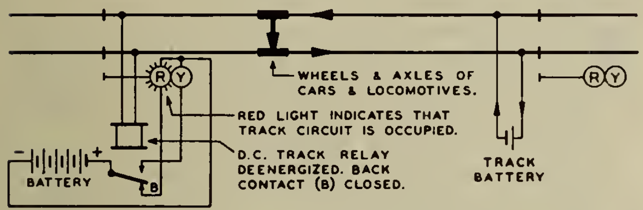


FIG. 3B - D.C. TRACK CIRCUIT - OCCUPIED

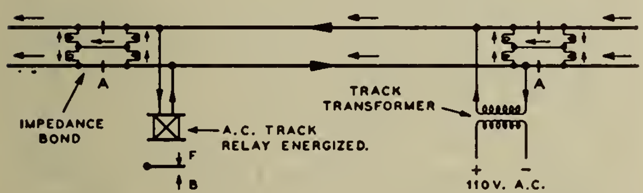


FIG. 3C - DOUBLE RAIL A.C. TRACK CIRCUIT

FOR SINGLE RAIL A.C. TRACK CIRCUIT REMOVE INSULATED JOINTS A AND IMPEDANCE BONDS. PROPULSION CURRENT WILL THEN FLOW IN LOWER RAIL ONLY.

SYMBOLS:-

Fig. 3.

track circuits in which one rail is continuous for the propulsion return while the other rail is divided by insulated joints to form track circuits. Impedance bonds are not required with this type of track circuit. The maximum length of track circuits on this installation is 1,800 ft. with an average a-c. power requirement of 75 volt-amperes.

Automatic Block Signalling

It will be readily understood how, with a succession of track circuits, automatic block signalling will provide protection in the rear of a train and how, by properly spaced blocks, the track capacity of a railroad may be increased considerably over that possible with manual block systems. This is illustrated in Fig. 4.

The arrangement of signals shown in Fig. 4 is for two-block (signal block) three-aspect signalling (using colour light signals) for one direction as is found on double track railroads. By placing a signal at the entrance to each track circuit or signal block, we are able to provide aspects on the signals which will indicate to the engineer in the locomotive the condition of the signal block or signal blocks ahead so that he may take action to properly control the speed of his train. The automatic signal 4 at the entrance to the track circuit which is occupied will display a "Stop and Proceed" aspect (red). The next signal in the rear, 6, will display an approach aspect (yellow) indicating: "Proceed Prepared to Stop at the Next Signal." The other signals, 8 and 10, in the rear, will display clear aspects (green) indicating "Proceed." With this arrangement, it is possible to have a number of trains proceeding at full speed separated by two signal blocks, each of which is equal to the distance required to stop a train. The term "signal block" is used here, and not track circuit, as the general rise in operating speeds of passenger and freight trains in recent years has greatly increased the distance required to stop them so that more than one track circuit of the type shown is frequently required between signals in high speed territory. With manual block systems, the trains would be spaced a full block apart which might be as much as five or ten miles.

In automatic block signal systems, the signals are controlled automatically through the track circuits. In manual block signal systems, the signals are controlled by levers manipulated by the block station operators. In addition, track circuit control may or may not be used.

The circuit arrangement shown in Fig. 4 is a simple one based on using the type of track circuit shown in Figs. 3A and 3B. Wires are required between signals for the control of the green indication. When coded track circuits are used, the track circuit between signals 4 and 6 would be coded at the rate of 75 interruptions per minute when a train is between signals 2 and 4, while the track circuits between signals 6 and 8, and signals 8 and 10, would be coded at the rate of 180 interruptions per minute. No wires are required between the signals for signal control in this system.

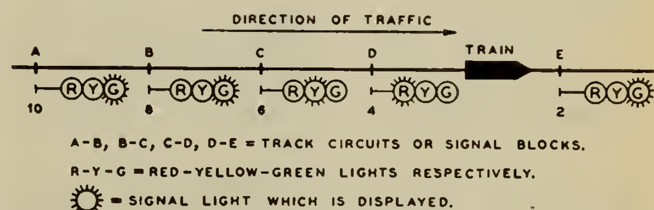


Fig. 4—Automatic block signals.

The signal controls which have just been discussed are for one direction operation. For two direction operation on a single track, the signals in the rear of the train will function as already described. In addition, the train will also set opposing signals to stop to provide opposing protection. The automatic permissive block signal system incorporating these principles is widely used on extensive mileages of single track.

Searchlight Signals

The searchlight signal consists of a movable vane holding three small coloured lenses (1 in. diameter), operated by a polarized d-c. relay mechanism. This vane has three positions, corresponding to no energy, energy of one polarity, and energy of the opposite polarity. It moves in front of a single lamp in a reflector assembly as shown in Fig. 5. The coloured lenses are so located that they are at the focal centre of the lamp system; thus a brilliant coloured indication is secured with a low wattage lamp, usually 11-volt, 11-watt, except for primary battery when an 11-volt, 5-watt lamp is used. Two of these mechanisms are mounted one above the other to provide

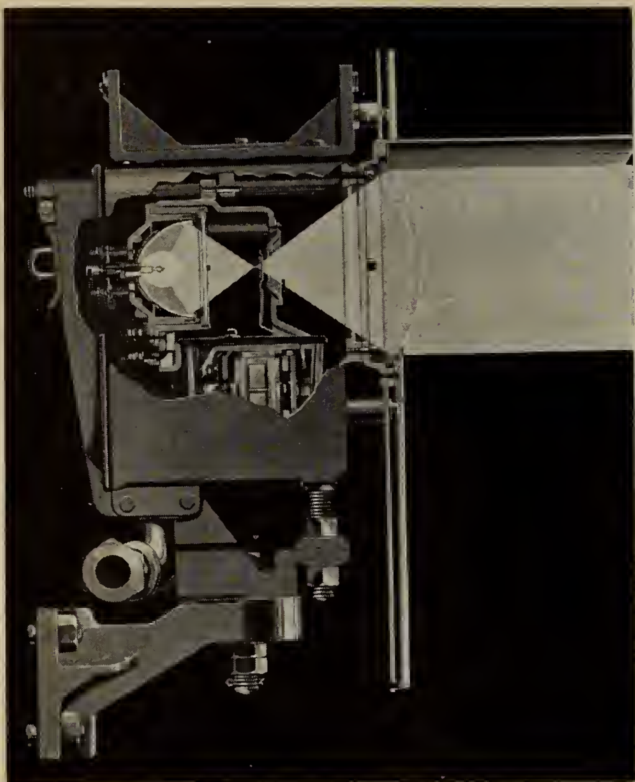


Fig. 5—Searchlight signal.

the following aspects and indications on this installation:

Aspect	*Indication* (Meaning)
Red over red........	Stop
Yellow over red.....	Proceed prepared to stop at the next signal
Green over red.......	Proceed
Red over yellow.....	Proceed at restricted speed.

The signal aspects previously discussed were for automatic signals; these are for semi-automatic signals, which, in addition to track circuit control, also include a check of the switches in the route and a lever control so that they may display proceed aspects only when required. Note that the red over red aspect indicates stop, not stop and proceed. A train may not pass this signal in the stop position without proper authorization, usually by clearance card. The yellow over red and green over red aspects convey the same direction as similar automatic signals without the bottom red light.

The fourth indication, red over yellow, is a restricted speed aspect, what we term a " call-on signal " as it is used for closing in movements into occupied track circuits. To display this signal, the operator must in addition to moving the signal lever, also operate the call-on push-button located below the lever.

Interlocking Machines

Track circuits and signals are only two components of the signal system which has been installed in Montreal Terminal. They, together with the switch operating mechanisms, control circuits and the control machine constitute the interlocking which is described by the Association of American Railroads as:

> "An arrangement of switch, lock and/or signal appliances so interconnected that their movements must succeed each other in a pre-determined order."

By locating the levers controlling a group of switches and associated signals at a central point and so intercontrolling the levers that they have to be moved in a predetermined sequence, we obtain an interlocking. This result was achieved as early as 1850 in England, and not until 1876 in America when the first interlocking machine was imported.

The levers of an interlocking machine may operate switches and signals directly through pipe connections between the levers and the switches or signals as in mechanical interlockings, or the levers may operate circuit controllers, opening and closing electrical circuits, which in turn control the application of electric or pneumatic power for the operation of the switches and signals as in power interlocking machines.

Strictly speaking, an interlocking machine is equipped with mechanical locking which requires the operator to move the levers in a predetermined order. Thus, the levers for switches and derails in the desired route must be operated before the signal lever may be oprated to clear the signal which authorizes the train to enter the route. Conversely, the signal lever must be returned to its normal (stop) position before the levers controlling switches and derails in the route may be operated. In addition to mechanical locking, the levers of an interlocking machine may also be equipped with electric locking: (a) to prevent a switch lever from being operated to move a switch while a train is approaching or moving over the switch — this is known as route and detector locking; (b) to prevent a switch lever from being operated to its full normal or full reverse positions until the switch corresponds with the position of the lever, this is known as switch indication locking; and (c) to prevent a signal lever from being returned to its full normal (stop) position until an electrical circuit checks that the signals controlled by the lever are actually displaying " stop " aspects, this is known as signal indication locking

The signal indication lock control also prevents the lever from being returned to its full stop position, if a train is within the first two signal blocks in approach to the controlled signal, until after a time delay to insure that the route may not be changed suddenly when it might be unsafe to do so.

The levers of the control machine installed in Montreal have neither mechanical nor electrical locking; they may thus be moved at any time. Electrical control circuits, however, provide the equivalent of the mechanical and electrical locking described in the previous paragraphs. Associated with each lever there is an indication lamp which is not normally lighted. When a switch lever is operated from normal to reverse positions, the lamp will be illuminated steadily if it is safe and proper for the switch to be moved, until the position of the switch points corresponds with the position of the controlling lever. However, if it is not safe for the switch to be moved the lamp will display a flashing light until the lever is restored to its former position. The indication lamp above each signal lever functions in a similar manner.

Electric Switch Movements

The control relays and the electric switch movements which operate the switch points are located as shown in Fig. 6. The unit away from the points is a junction box which houses the switch control and overload relays.

The unit connected to the points is the switch movement. It is divided into three sections; the rear section houses the 110-volt motor and clutch assembly, the middle section is the gear reduction box. The gears are driven from the motor through the clutch so that if the switch points cannot be closed for any reason the clutch will slip until the overload device operates to de-energize the control relay, thus removing power from the motor. The gears drive a slide bar in the base of the movement. This slide bar moves along the long axis of the movement and by means of an escapement crank applies the necessary force to the operating rod which causes the switch points to move into their normal or reverse positions. This operating rod is connected to the points through the tie rod in the first tie space back of the points. The forward section of the switch movement contains the circuit controller and lock rod. The lock rod is connected to the points in the first tie space ahead of the points, and extends through the movement across the path of the slide bar, so that the slide bar may only continue its motion to lock up the points when the proper point is fully closed. Only after the slide bar enters the proper notch in the lock rod does the circuit controller close its contacts to energize a relay which indicates the position of the switch.

Now if a trailing movement should be made improperly through the switch for example from the turnout when the points are set for the straight track, the switch points may be forced enough so that the car or locomotive will not be derailed. The closed point, however, will be forced open thus moving a point detector connection a sufficient distance to trip a toggle arrangement in the circuit controller compartment which will open the control circuit of the relay which repeats the position of the switch. These contacts will not be reclosed until the maintainer has inspected the switch and re-set the toggle.

Interlocked Signalling

In America two forms of interlocked signalling have developed:

(a) Route signalling usually characterized by three signal units on a semi-automatic high signal, the top unit for the main high speed route, the middle unit for the secondary or medium speed route and the bottom unit for closing in moves (call-on) to these two routes when occupied and for all other routes.

(b) Speed signalling which may have two or three signal units on one semi-automatic high signal. With this form the signal aspect indicates the speed of the movement past the signal, thus the top unit may lead to any number of routes. This is the form used at Montreal where the top unit may lead to any route which may be traversed safely at the maximum speed in effect at that location. The bottom unit leads to all other routes and to all occupied routes when the call-on pushbutton is operated.

Fig. 6—Switch layout.

Figure 7 represents in diagrammatic form the merger of the various elements, which we have reviewed, into an interlocked signal layout. At the top we have a single line diagram of the track showing the relative location of switches 1-3-5, signals 2RA-2RC-2L, etc. and track circuits AT-CT-1T-2RT, etc. Below the track we have a diagrammatic layout of the control machine with levers, push-buttons and indication lamps. Switch levers 1-3 and 5 are two-position and are shown in the normal (N) position which corresponds to the track route from A to B. Signal levers 2 and 4 are shown in their normal or stop position. When moved to the left (L) they will establish controls for proceed aspects in signal 2L and one of the 4L signals respectively; when lever 2 is moved to the right, signal 2RA will display a proceed aspect if switch 1 is normal; if switch 1 is reverse, signal 2RC will display the proceed aspect. It may be of interest to outline a typical train movement through on track layout.

Let us suppose that a train enters at C and occupies track section CT and that the train is to move to E and that no other trains are in the area.

1. The occupancy of the track section CT will be indicated by a light on the track diagram at the control tower.

2. The operator will then move lever 1 to the reverse (R) position, the lamp above the lever will be lighted steadily until the switch points in the track move into their reverse positions to set up the route from C to signal 4R, after which the light is extinguished.

3. Lever 2 may now be moved to right (R) position. A steady light will appear above the lever until signal 2RC clears to authorize the train on track section CT to proceed; the light above the lever is then extinguished and a lamp on the track diagram corresponding to the location of signal 2RC is illuminated, thus indicating to the operator that the route is setup and that the signal is cleared to authorize the train to proceed.

4. As signal lever 4 is in the stop position, signal 2RC will display a yellow light over a red light, indicating to the engineer that it is safe for him to proceed as far as signal 4R

5. At any prior or subsequent time the operator may position levers 3 and 5 in the reverse position and lever 4 in the R position after which signal 4R will display a proceed aspect for the route from signal 4R to E. If signal 4R is cleared before the train passes signal 2RC the aspect on the latter signal will change to a green light over a red light.

6. When the train passes signal 2RC and enters track circuit 1T, a lamp is lighted on the track diagram to indicate the occupancy of that circuit; the

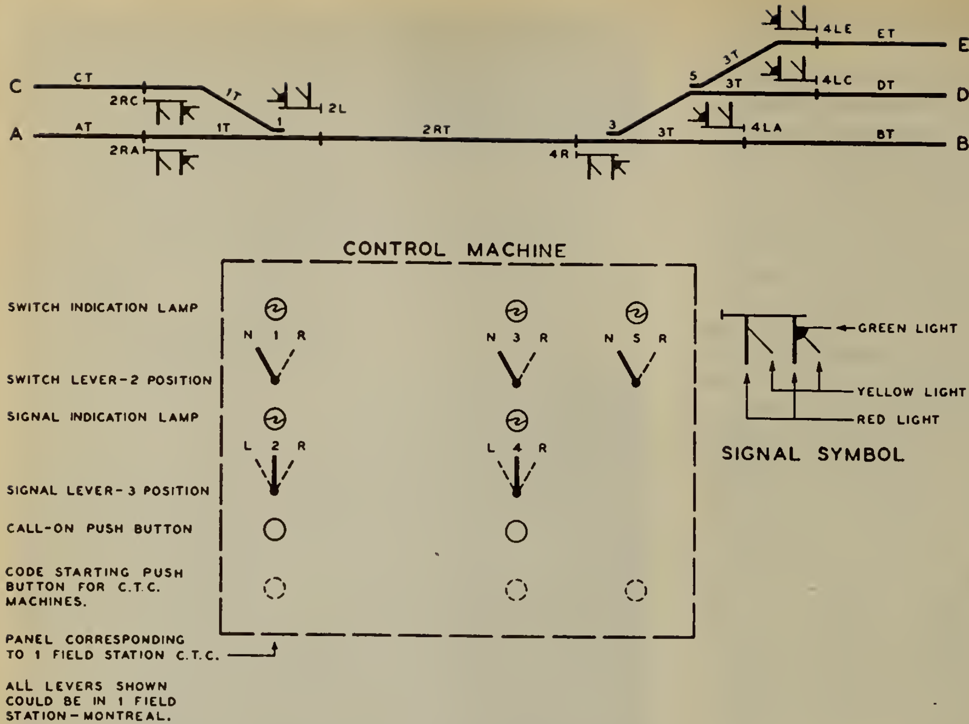


Fig. 7—Interlocked signal layout. (Single line diagram).

clear signal indication light for 2RC on the track diagram will be extinguished and a flashing light will appear above signal lever 2 until the lever is moved to its normal (stop) position.

7. When the train enters track circuit 2RT and proceeds past signal 4R, occupying track circuits 3T and ET in turn, its progress will be shown on the track diagram.

8. When signal lever 2 is moved to the right to clear signal 2RC, electrical circuits prevent the movement of lever 4 from clearing any of the 4L signals or interfering with the control of signal 2RC. At the same time switch 1 is locked so that the movement of its control lever will be ineffective until lever 2 is returned to its stop position and track circuit 1T is unoccupied.

In addition to the control machine in the tower, we also have an illuminated track diagram on which the tracks, switches, signals, and track circuits are shown with lamps lighted to indicate the occupancy of the various track circuits, and other lamps lighted to indicate the signals which have been cleared and display proceed aspects.

The Relay Code Control System

We now come to a consideration of the relay code control system which has been designed to serve as a communication system between the control machine and the remote groups (groups numbered 2-4-6-7-8-9-10 and 11, Fig. 1) of interlocked switches and signals. This relay code system consists of two circuits, one of which transmits controls from the control machine to align the switches and clear the signals at the remote interlocked groups in agreement with the positions of the levers on the control machine; the other circuit (of the same type) transmits controls from the remote interlocked groups to the control machine to control lamps which indicate the positions of switches and signals and the occupancy of track circuits, as previously described. The relay code system is analogous to a teletype or telegraph system where a particular code pattern is generated at one end of the circuit and is detected and identified, at the other end of the circuit. The relay code system used in Montreal has its counterpart on a smaller scale in supervisory power control systems with which some readers may be familiar. But first a review of the application of coded systems of control to railway signalling may be of interest.

Since 1851, when Minot first used the telegraph to authorize a change in scheduled meeting points, there has occurred a continuing development in the art of controlling train movements to the end that train operations may be carried on in the most expeditious manner and with the greatest possible safety. The development has resulted in " The Standard Code of Operating Rules " compiled by the Association of American Railroads, which serves as the basis of the rule book which each railroad compiles for the guidance of its operating and maintenance employees.

Train operation as in 1851 is still based on the time table which designates the superiority of trains by class and direction. Thus passenger trains are superior to freight trains by class (train of superior class) and eastward trains, for example, are superior to westward trains of the same class (train of superior direction). A train of superior right is one which has been given precedence by train order. The train orders are issued by the dispatcher and supersede the time table authority given to trains.

In single track operation where train orders are most used, it is necessary to impose certain delays on trains in order that the operation will be surrounded with the greatest possible safeguards. For this type of operation, we have the dispatcher usually at divisional headquarters and operators at the various passing sidings, who receive the train orders from the dispatcher and pass them on to the train crews. The operators also report the OS time, or time when a train passes their offices, to the dispatcher so that he may keep a record of the location of all trains in the territory.

Some of the delays incidental to this type of operation are:

1. Without automatic block signals only one passenger train may occupy a block at one time. One freight train may follow another freight train, however. Where automatic block signals are used, a train of any class may follow another train.
2. When a meeting point is established, the inferior train must clear the main line at least ten minutes ahead of the time the opposing superior train is due to leave the adjacent block office.

3. When a meeting point is to be changed the order authorizing the change must first be delivered to the train whose running rights are to be limited.
4. When an order is handed up to a moving train authorizing it to proceed, the train must first slow down to pick up the order.
5. The orders frequently include instructions for some actions to be taken miles away and hours later, which if overlooked may result in disaster.

Centralized Traffic Control

These and other limitations of the train order system have resulted in the development and installation of extensive mileages of centralized traffic control (C.T.C.) for the operation of trains by signal indication. C.T.C. is a system of train operation in which train orders are practically eliminated and all train movements are governed by the indications of signals which are controlled by the man who operates the C.T.C. machine.

Extensive installations of C.T.C. have been made economically possible because of the development of relay code systems of control which permit the operator of one control machine to line up routes and clear signals for the direction of all trains in territories as long as 200 miles. The relay code system also provides the operator of the control machine with indications of the positions of all controlled switches and signals and with indications of the occupancy of the various track circuits.

A corollary advantage of the C.T.C. system is that it so increases the track capacity that double tracking, possibly at prohibitive expense, is indefinitely deferred. It is gratifying to note that many installations of this system of control have enabled the railroads to continue to handle satisfactorily the tremendous increase in transportation volume incident to the war effort.

The Canadian National has a C.T.C. installation of 135 miles in service in the Eastern Region, which has alleviated a serious operating condition brought about by the heavy train movements to Halifax.

The principal elements of the C.T.C. system are:

(a) The automatic block signal system which, as we have already seen, provides automatic protection for following and opposing movements.

(b) Power operated switches at the ends of passing sidings with the usual complement of controlled signals so that the dispatcher or operator of the control machine has direct control of these functions, the same as at an interlocking.

(c) The Centralized Traffic Control Machine with its levers, indication lights and relay code circuit system.

The C.T.C. control machine is essentially the same as the control machine installed in Montreal with this particular difference. In the usual C.T.C. machine the non-interlocked levers are arranged in the manner shown in Fig. 7 with a push-button below the levers which is pushed to initiate the code action to transmit the desired control. In Montreal the code starting push-button is not used; instead, the movement of the lever initiates the code action automatically, transmitting controls for all switches or all signals. Indication codes are started automatically when a function at the field station changes.

Code relay systems consist of a control station or office where the control machine is located and field stations where groups of switches and signals to be controlled are located. Each of the groups numbered 2-4-6-7-8-10-11 on Fig. 1 are field stations. Group 5 is at the office.

Relay Coding Action

Relay code systems use a normally closed line circuit which is opened and closed successively the desired number of times. At the office and field stations relay counting chain actions generated by the transmitting station (office for control codes, field station for indication codes) operate in step. When the line circuit is opened, that is one step in the code; when it is reclosed, that is a second step, etc. for the desired number of steps until at the last step in the code the line circuit is reclosed until the next code action is started. On each step of the code some character may be transmitted. In the Union Time Code system the character of each step is determined by the length of time the line circuit is held open or closed on each step. When the step is short a control is not transmitted on that step; when the step is long a control is transmitted. For example, the code pattern may be designed to select one of thirty-five stations on the first eight steps of a 16-step code. The first step of the code starts the code action, the 2-3 and 4 steps when long, and the 5-6-7 and 8 steps when short will select station 234. Likewise the pattern for a second station might be 2-3-8 when steps 2-3 and 8 are long and 4-5-6 and 7 are short. When the field station corresponding to the switch and signal lever on the control machine above the starting push-button which was operated is selected, controls will be transmitted on succeeding steps 9 to 15 to energize relays which correspond to the positions of the levers; thus if the switch lever is normal step 9 will be long and a relay will be energized to cause the switch points to move to their normal position if they are not already in that position. If the switch lever is reverse, the 9th step will be short and 11th step will be long, thus registering at the field station a control to cause the switch points to move to their reverse position. The remaining steps in the code will be long or short depending on the controls to be transmitted.

Another form of character determination makes one line wire + and the other − to transmit a control corresponding to the long closed step above; the equivalent of the short closed step is obtained by reversing the polarity of the wires. The open period of the line circuit is used for code stepping action only as a distinctive character cannot be applied. This type of code is much faster than the time code as the time of each step need only be long enough to energize or de-energize a relay. This is the type of code action used at Montreal Terminal. Considerations which led to the use of the polar code system for this installation are reviewed in the following paragraphs.

The Polar Code System at Montreal Terminal

The Union Time Code system is designed to provide seven controls to and seven indications from each of 35 stations. Each control code requires approximately 4 seconds and each indication code approximately 4.6 seconds for transmittal. Now this system could have been adapted so that a separate two-wire line circuit could be installed between the tower and each zone or field station in which case the steps of the code required to identify the station could be used for functional control and the number of code steps could have been increased to handle all of the switch and signal controls in one code. This basic system has sixteen steps in the code and requires approximately ¼ second for each step.

For example, a zone such as 7 (Fig. 1) with:

17 switch levers
2 switch lock levers
4 2-position signal levers
8 3-position signal levers
10 call-on push-buttons
2 traffic levers
1 light dimming lever
1 maintainer's call lever

would require 72 steps and 18 seconds for transmitting controls. But if the control code were broken up into two station selections so that all switch controls were transmitted in one code and all signal and call-on controls were transmitted in a second code still using one two-wire line circuit, the coding time could be reduced to 9 seconds.

The indication code for zone 7 would require 110 steps in one code and 27.5 seconds for transmittal. If split into two station selections of 55 steps each, the transmittal time would be 14 seconds.

These time factors were considered as being unsatisfactory where it is necessary to change routes quickly so as not to delay train movements.

To handle an installation of this scope properly, we considered that no code should be longer than two seconds, and that control codes should not delay indication codes. These requirements ruled out the time code system, as twelve two-wire circuits would be required between the tower and zone 7 alone, and led to the adoption of two separate code line circuits of three wires each between the tower and each zone. One of these circuits is for control codes and the other is for indication codes. Approximately 66 steps or 33 controls may be transmitted in one second. As a consequence, the control code for zone 7 requires 1.1 seconds and the indication code requires 1.6 seconds for transmittal, values which are well within the 2-second limits established at the start of this project.

The design of the electrical intercontrol circuits is such that switch controls must be established and indicated before signal controls may be established. This enabled us to provide a two station selection on each code line, putting all of the switch controls and switch indications in one station and all signal controls and signal indications in the other station; the track indications were distributed between the two stations so as to make the two stations equal in the number of steps.

There is no safety vested in the relay code systems, they serve merely to transmit information between the office and field stations or vice versa. The electrical circuit equivalent of the mechanical and electrical locking applied to mechanically locked levers is located at the field stations where all of the safety features are incorporated as they would be for an interlocking at the site of an interlocking machine.

Montreal Terminal control machine (Fig. 2), contains 245 working levers for the control of 615 interlocking functions. The next largest interlocking, St. Louis Terminal, has 262 working levers in a 303-lever frame for the control of 517 interlocked functions. The St. Louis machine, which is of the mechanically and electrically locked lever type (power interlocking) is 64 ft. 7 in. long while the Montreal machine is 12 ft. 6 in. long. There are 19 additional levers on the Montreal machine for the control of non-interlocked functions—light dimming and maintainer's call.

Concrete bungalows, one for each zone, house the control relays associated with the zone. In addition to the relays, there are 6-cell, 12-cell and 55-cell lead storage batteries, each of which is trickle-charged by copper-oxide plate rectifiers which were developed by the Union Switch and Signal Company for the railroad signalling field and which have found wide commercial acceptance outside of that field. The 6-cell battery is for the switch and signal controls and general interlocking circuits, the 12-cell battery is for operation of the code equipment, the 55-cell battery is for operation of the switch movements.

In the photograph of the tower control room, Fig. 2, another control machine will be seen on the dispatcher's desk. This unit is used in the control of the station starting signal system so that the train conductor may signal the dispatcher when he is ready to load. The dispatcher then establishes an indication at the gateman's post instructing him to admit passengers to the platform. When all the passengers are through the gate, the gateman operates a push-button to establish indications to this effect on the platform and on the train starting machine. The dispatcher then instructs the leverman of the signal control machine to establish a particular route and clear the signal at the end of the platform. Then the engineer, who has previously received a clearance card from the station master authorizing the train to leave, releases the brakes and closes the controller notch by notch while passengers glance at their watches to note if they have left on time. (This system is likewise controlled by the code relay equipment.)

This signal and interlocking installation was designed by the Union Switch and Signal Company and installed by the Union Switch and Signal Construction Company under the direction of R. G. Gage, M.E.I.C. Chief Electrical Engineer, and J. J. Ginty, Superintendent of Signals, Montreal Terminal, both of the Canadian National Railways.

EFFECTIVE FOREMANSHIP

D. D. PANABAKER
University of Toronto, Toronto, Ont.

An article written at the request of the Institute Committee on Industrial Relations, being one of a series prepared for the *Journal*.

SUMMARY—The foreman has been described as a two-way transmitter between management and labour. In modern industry, the training of foremen is done systematically, in accordance with established principles. The author outlines the methods currently used in Canadian industry and indicates a selection of those procedures that are most likely to give satisfactory results.

The importance of the foreman and supervisor in the management structure is continually being emphasized by many writers. "Management neglects its most valuable human contact with the worker—the foreman. It takes great pains with its magazine, personnel counsellors, patriotic posters and entertainers. But one intelligent strawboss can do more to cut wastage, absenteeism and quittings, than can a boat-load of poster artists." Thus, the *Reader's Digest* of October 1943 quotes a worker, writing for its Symposium of Opinion from Workers—'What's Wrong with Management.' No doubt, the specific cases of inadequate foremanship, given in this article, could be duplicated in any part of Canada.

Perhaps all this may well be summarized by saying that the foreman is the personification, to the average worker, of the company and its top management. Reliable analyses indicate that fully 80 per cent of the attitude of the worker, to his work and to the company, is determined by his immediate supervisor, with all other management contributing only the relatively unimportant remainder. Small wonder that alert management is realizing that the foreman is its representative on the production front, and is striving to make this representation as effective as possible. In doing this, the foreman has a dual role. On the one hand he must transit to the worker the instructions and attitude of top-management; on the other, he must convey to the higher supervisory levels an accurate appraisal of the ideas and reactions of the worker. Someone has said that the foreman is a two-way transmitter, and fortunate is the organization that has complete two directional contact with its rank and file employees.

In covering this broad subject the writer plans to use the approach which seemed desirable several years ago when he was asked to organize foremanship training for one of our rapidly expanding war industries. He will indicate certain principles necessary for such a programme, will outline methods currently being used in Canadian industry for this purpose, and will attempt to make a selection of those procedures that are most likely to give satisfactory results. Moreover, the field has been broadened to show that the problem of developing adequate foremanship comprises much more than the narrow question of foremanship training.

The Attitude of Management

Although the foreman is nominally considered to belong to management, and therefore is expected to assume, within limits, part of the creative functions of this group, it is important to realize that he is primarily its representative. This is necessary in evaluating the effectiveness of existing foremanship for, to a considerable extent, this evaluation actually measures effectiveness in the whole field of management. If the efficiency of operators and equipment, the quality of the product, the adherence to schedules, the attitude of the workers, and the absentee and accident reports are all satisfactory, management may decide unanimously that the foremanship is of a high order. However, if conditions are unsatisfactory, it may condemn the foremen when the onus for the condition should be placed on the management itself.

This is no minor consideration, for many managerial groups are characterized by a careless attitude that expects a programme of foremanship training to eliminate the combined effect of poor foremanship and even worse top-management. Managers must realize that the foreman who is turned into a production chaser by the deficiencies of the Production Department, or who is continually harassed by the errors and oversights of the Tool Engineering Department, is unable to perform properly his supervisory function. Moreover, despite reasonable foremanship, a non-cooperative or bitter attitude on the part of the workers may result from their sensing nebulous or wavering company policies, an uncompromising managerial attitude toward labour, or inadequate techniques for controlling wage rates. Rare is the foreman (for he is human) who can lead and inspire when he is being bulldozed and driven; or who can win confidence in himself when his decisions are reversed constantly and his workers are receiving important company announcements through indirect channels before he is notified. Nor can he build up workers morale, when the treatment he is receiving has reduced his own morale to the vanishing point.*

Effective foremanship can be achieved only if top-management clearly defines the function of the foreman, and accepts its own responsibility for the remaining managerial duties. It must be based upon an administrative policy that treats the foreman as he is expected to treat his workers. Otherwise, a training programme will act as a boomerang, conveying to the foreman the deficiencies of the management, for the principles of good foremanship are, of necessity, the principles of good management.

The Objective

The management that is ready to make this approach may consider, profitably, other ways of raising the quality of its foremanship. The first step is to establish what is expected of supervision in the plant. In a broad sense this may define the aims of management itself, and it might well be patterned after the manner of the officer in a recent motion picture** who stated that his aim was to have a "happy and efficient ship." "For," he continued, "it can not be happy if it is not efficient, and it surely will not be efficient, if it is not happy." With the establishment of some such general policy, a specific outline of ideal foremanship, as applying to particular conditions, should be made. This must include a careful consideration of that criterion of supervision—the successful handling of men. Comparison with this standard will indicate the actual

*The manager who can 'take it' should read the article in *Industrial Engineer*, September 1943, by Dr. Albert Walton, entitled "The Forgotten Man," where this view is authoritatively expounded.

**"In Which We Serve," by Noel Coward.

deficiencies of existing foremanship. Since the whole policy in this matter will be based upon this ideal definition, it should be recognized as a major managerial decision, and should receive proper consideration.

In reaching this decision the considered opinion of every interested member of management, and, in many cases, those of senior foremen, should be obtained. Nor is this important only as a means of securing information, for it provides an excellent way to interest the whole organization, in the project. It is imperative to realize that a programme of foremanship training will not win and hold, automatically, the support of every executive. It makes a clear-cut issue between the short and long term views in management, and therefore must be sold, continually, to all levels of supervision. As suggested, an early step in this direction is to make sure that all those who are interested are consulted in the early stages, so that the final decision will reflect a corporate point of view.

To establish a definite line of responsibility someone should be delegated to head this programme even though, in smaller plants, his full time may not be required. His position in the organization will depend somewhat upon the urgency of the project; in critical cases he may report directly to the factory manager. In no case should his effort be limited by his being subordinate to a personnel executive, unless the latter is definitely familiar with and actively responsible for the training programme.

Having this clear definition of its objective, the management is now ready to consider the various methods that could be employed in this effort to improve the calibre of its foremen. The problem is not one of getting sufficient information, but rather that of determining those details that best apply to the particular local conditions. To illustrate this, it would seem advisable to outline, briefly, certain of the methods being used by Canadian industry at the present time.

Government Courses

Even the layman is becoming familiar with the Job Instructor Training, Job Relations Training and Job Methods Training, (J.I.T., J.R.T., and J.M.T., respectively) sponsored by the Departments of Labour of the United States and Canada.*

Each of these is covered in five two-hour meetings, using a round-table discussion technique, and is carefully outlined to assure standard presentation. Leadership is provided by personnel, usually plant employees, trained by the Department of Labour.

The first of these, Job Instructor Training, is an old story to many plants and has made a remarkable contribution toward assisting foremen and operators in the fundamental task of instructing employees in new work. It is based upon the principle that a good operator does not necessarily know how to impart his job-knowledge to others. The slogan used, 'If the learner hasn't learned, the teacher hasn't taught,' opens new horizons in educational work. Companies that have not used this course will find it worth investigating, and those who have might well make sure that the principles are actually being applied, and consider its extension to new personnel and changing conditions.

The Job Relations Training includes basic instruction in the problems met in handling people—the part of their work that confuses so many foremen. It is well to realize that the J.R.T. programmes offered by the American and Canadian Departments of Labour are not the same. The former, based to a large extent upon the 'Human Relations Series' prepared by the Verdun plant of Defence Industries Limited, has met with wide spread approval. However, for various reasons the course offered by the Canadian Government has not been entirely successful. This is a considered statement made by the writer after finding this reaction in each of four large war industries consulted in the Toronto district. In each of these cases, special arrangements have been made with Defence Industries Limited for use of their Human Relations Series after trying the other course. Since the Canadian J.R.T. programme deals with specific problems, it may prove more useful as a follow-up course, after the Human Relation Series, which deals with general fundamentals.

The third of the series, Job Method Training, is receiving wide approval on both sides of the border. It aims to make our supervisors 'method' conscious, and outlines a specific procedure for analysing existing methods for the purpose of producing 'greater quantities of quality products in less time.' Companies using this course are very enthusiastic and have in their files concrete evidence of effectiveness of improvements and ideas arising from its use. However, a word of warning should be given. This programme should not be introduced unless the management is definitely prepared to deal with the flood of suggestions it will produce, as there is no doubt that where enthusiasm of this nature is aroused and then is allowed to evaporate through managerial indifference, the final result will be most unfortunate.

A great deal of the success of these courses is due, no doubt, to their dramatic appeal in having each supervisor present a personal problem, with his own solution, applying the principles of the course under review. The result is that instruction becomes real and vital, with each participant actually applying the recommended procedure.

Lectures

There is an ever present temptation to have outside experts and departmental heads lecture to foremen. However, the concensus of opinion seems definitely to indicate that the actual results of this method of approach are disappointing. Two factors militate against it. In the first place, the average foreman usually resents being summoned to hear such an address, and the psychological effect should in no way be confused with the sense of importance and satisfaction experienced by the senior executive when he settles down to hear a similar address at the annual meeting of his favourite society. In the second place, a negligible amount of material is retained from a lecture even by the most alert and able listener. Thus, its field of usefulness is generally limited to training on pre-supervisory levels where a definite school-room attitude is often satisfactory.

Foremanship Conferences

Since the lecture method has generally proved unsatisfactory in developing foremen, the conference or discussion approach has gained wide acceptance. The men meet in groups of about fifteen and, under the direction of a leader, discuss subjects of current importance, as indicated by the original survey of foreman deficiencies. This method eliminates the lecture-schoolroom attitude, as the leader does not pose as a final authority, but merely directs the discussion so that the combined experience of the group can be used to reach a constructive conclusion. This approach covers the subject matter more slowly than lectures would, but requires that most members of the group consider care-

*See articles by Stuart Chase in *Reader's Digest* of September, October and November, 1943; also *Factory Management and Maintenance*, October 1943.

fully the matter under discussion, with the result that the findings, representing shop opinion (usually surprisingly sound) are acceptable to, and are used by, many foremen who would resent the opinion of an expert.

The keystone of such a programme is the conference leader. He should be carefully chosen, not only because of the leadership qualities required, but because he must be acquainted with the details of many unfamiliar managerial problems, so that he may lead discussion around difficult points. His function is to prevent a discussion from merely 'pooling the ignorance' of the group, but it is an established fact that a skilful leader can guide a meeting toward desired conclusions without himself introducing more than a nominal amount of the subject material. Standard books on the subject should be consulted regarding this technique. The leader is fundamentally the referee. He must be so well acquainted with the subject and with the objectives, of the discussion, that he will grasp each thread of an idea and pursue it until the desired conclusion has been reached. He must curb the natural tendency to talk too much himself, and must learn to refer to the group each contentious matter instead of ruling upon it himself.

Important as are each of these points, two principles are even more fundamental. The leader must know the group and its problems so well that the atmosphere of the meetings can be genuinely friendly and informal, with the leader talking the same language as the group. Nothing is more pitiful than the spectacle of an academically-minded leader—with a meager smattering of shop practice—trying to win leadership over a group of shop men. The second prerequisite is that the leader be entirely sincere in his approach to the programme, and that he have the ability to convince the group of this sincerity. All else is sounding brass. This has a specific importance, because successful conferences invariably are held upon the understanding that individual opinions and reactions are not reported beyond the conference, and that only the group conclusions are conveyed to management.

In meeting these essentials, day to day contacts are very important, and the 'imported' leader who appears only for conferences, is at a distinct disadvantage. Clever simulation of intimacy with the nauseating use of familiar names at first meeting may suggest superficiality, and even contempt, toward the group, on the part of the leader.

Many conference outlines to assist the leader are available in periodicals dealing with supervision and management, in conference leaders' manuals, and in books on foremanship. Moreover, certain companies specialize in such material, usually provided with supplementary literature for distribution to the foremen. A survey of this phase of training, made two years ago and corroborated recently, indicates that, apparently, most leaders find that foremen either resent or fail to use such literature. Moreover, rarely does a prepared series of conference outlines suit the need of any particular plant. Most leaders have available much of this material, selecting and modifying as required.

There is no doubt that most conference programmes could be greatly improved by the introduction of the dramatic, as exemplified by the 'J.T.' courses. Although this idea is not new, its widespread successful use in these courses gives an indication of its possibilities. The discussion of specific cases,* preferably problems from the particular plant, and their dramatization by members of the group, introduces an effective way to arouse and maintain group interest.

One problem frequently occurring in conferences is rarely discussed by writers on this subject, namely, the difficulty that arises in attempting to strike a balance between the basis training function of the conferences and the desire of the foremen to discuss current shop problems. To rigidly exclude the latter from the meetings, when they are applications of the principles under discussion, would seem to lose an opportunity to cinch the argument. Their exclusion will also produce an air of academic unreality. On the other hand, the unchecked discussion of these shop details can rapidly reduce the conferences to general shop meetings. The most effective compromise would appear to be one in which concrete shop problems are introduced as illustrations, under careful control, with other channels being made available for handling most of these problems. It is imperative that a policy be established to cover this point, and that it be clearly understood by all, for, if matters are allowed to drift, the situation will be found to contain all the components of an explosive mixture.

Another problem—often arising in meetings of senior foremen, where matters of current importance are very likely to be discussed—concerns the attendance of executives at these meetings. The deciding factor is, no doubt, the existing relationship between the manager or superintendent and the foremen. The author participated in one programme in which the presence of the manager added much to the meetings, without any evidence of limiting the foremen's participation. In another case, the presence of the manager completely destroyed the usefulness of the conference. If there is any doubt in the matter the best course is the safe one —let the executive stay out.

Films

Both motion and slide films, usually with sound, are available on a great variety of supervisory subjects. Their use in the Toronto district seems rather limited as far as foremanship training is concerned. The sponsors suggest their use to start a discussion on the subject in hand, but in many cases their effect is just the opposite. The film presents such a clear-cut, definite case that to all appearances the last word has been said, with the result that discussion is completely stopped. The author has never found it so difficult to lead constructive discussion as when such a film has been shown. In cases where the film is arranged for partial presentation, with a stop for discussion, the over-exaggeration, apparently necessary to present the case, caused most foremen to dismiss the whole matter with a shrug, and a request for the rest of the film. Individual films, carefully chosen, may have definite usefulness, but a complete series should be used very cautiously, and only after careful analysis of each film. The new film "It's Our Job," issued by Pratt and Whitney, is receiving favourable comment.

Management and Foremen Meetings

The need for a constant and direct flow of ideas, instructions and explanations down the organization, with a similar up-flow of ideas and reactions, is met by meetings of this type. They are arranged in several ways. The common staff meetings between supervisor and subordinates can be extended into a systematic series of meetings on several supervisory levels. Thus the works manager and his first line subordinates (including the manufacturing superintendent) may start a given series of meetings by discussing certain

*"Using the Case Method in Supervisory Training"—*Factory Management and Maintenance*, March 1943.

items of current importance to the whole organization. Subsequently, the superintendent will hold a similar meeting with his general foremen to cover the same subjects. These, in turn, will arrange a discussion with their respective foremen and assistant foremen. Matters brought up at any meeting on a lower supervisory level, which the group feels should be relayed upward, would be reported by the senior supervisor at the next meeting of the higher level. The plan has the advantage that meetings are small enough for active discussion, with the group spirit strong enough to allow the expression of opinions which might be repressed during individual conversation with the supervisor. Scheduled meetings will keep the foremen more conversant with company policy than would circular letters or spasmodic meetings, which are rarely called. This method has the disadvantage that the foreman has no direct contact with top-management.

One large war plant has overcome the latter difficulty by holding regularly scheduled meetings of all supervisory staff, from the foreman upwards. Large general meetings of about one hundred and fifty each are arranged to cover all shifts. At these meetings the top-management discusses current events and problems. The agenda is distributed well in advance, and an opportunity is given for anyone present to introduce written questions on the problem under discussion. These questions are covered very completely in an ample discussion period.

Foremen's Periodicals

In at least one Canadian company, a Supervisory Periodical is issued in which the foreman's point of view is aired. This presents new developments, details of policy, items from the suggestion system or job methods programme, explanation of new functions, such as job evaluation, and basic descriptions of many standard plant routines, all of which cannot be adequately covered in any other way.

Foremen's Manual

The foreman's manual, usually in loose-leaf form, places at his finger-tips a simple, detailed interpretation of company policy, standard procedure and established methods. Valuable as is this direct function, more valuable is the fact that before such a manual can be written, policies and standards must be established. It is not unusual for management to expect its foremen to interpret and uphold policies that have never been clearly defined. The writer is familiar with two cases in which the writing of such a manual had to be abandoned, temporarily, until policies could be established and clarified.

Liaison Duties

Management, by the widespread establishment of grievance committees, has generally accepted the principle that the worker should have some direct approach to itself other than through the line organization. That the same principle should apply to foremen seems to be less well recognized, and unless the foreman goes over the head of his superior, he often faces a blank wall. Certain of the procedures previously discussed open such channels to a limited degree. However, in plants where a conference programme is in operation, the conference leader can serve to relay to top-management group or individual opinions that are of sufficient value. This will require a great deal of judgment and tact, as well as courage, and it emphasizes the need for careful selection of such leaders. It might be well to add that, even though this function is not specifically given to the leader, he will shortly find that in the nature of things he will have to assume it, if his work is to be effective. However, it will give him an intimate contact with the group that will greatly increase his influence as a leader.

Pre-Supervisory Training

Since the logical time to inform supervisors regarding many principles of supervision is before they assume such duties, pre-supervisory courses are frequently provided for selected personnel. One company takes this carefully selected group from its routine work and provides a two-week intensive course covering safety, methods, shop records, and principles of supervision, with 50 per cent of the time devoted to detailed study of the product and to the analysis of those plant operations in which the individual will be employed. Direct teaching methods are used, with little use of discussion. After the completion of the course, members may act as provisional supervisors or may return to their former work, providing a reserve of supervisory material.

Another approach is to provide a series of training conferences or lectures covering basic principles of supervision and company policy, with the candidates continuing in their usual work. This opportunity for self-betterment is usually provided in the employees' own time. Direct instruction is generally used, although in certain cases the conference method has been quite satisfactory. Under present conditions, most candidates for such training should have previously attended the government courses in Instructor Training, Job Relations and Methods.

Two points must be watched very closely in this phase of training. In the first place, since many candidates may prove unsatisfactory for supervisory work, there must be a clear understanding that there is no actual or implied promise of promotion for those taking such training. As a corollary of this, the way should be left open for them to return to or continue their original work, for it would seem extremely foolish to lose a good operator or set-up man because he fails to qualify as a supervisor. One large manufacturer of aircraft engines has found the handling of this matter so delicate that it charges a nominal fee for its pre-supervisory courses, to indicate an impersonal relationship in the matter. The second consideration is that candidates for this training must be so selected that there is a minimum possibility for actual or apparent discrimination. So that the channels for advancement will be open to all without prejudice, this selection should not be left to the casual whims of various foremen, although it is beyond the scope of this article to discuss details of selection and ratings of employees.

Selection

The previous brief outline of possible methods of developing foremanship into a permanent effective function will serve to indicate that the final decision will not be simple or easy. Plant conditions and the existing efficiency of foremen will be the determining factors, but many of the following elements should be included in a complete programme:

The courses sponsored by the Department of Labour—with due consideration given to the situation regarding the Canadian Job Relations Training.

Foremen's conferences—to follow-up and supplement the above courses, (for it must be emphasized that they are not self-sufficient), as well as to cover other principles of supervision, with emphasis as required.

Management-Foremen meetings—as an intelligent and honest attempt to keep foremen properly informed.

Foremen's manual.

Foremen's periodical.

Liaison official.

Pre-supervisory training.

Foremen's club—this might be added as a desirable influence that should be supported but, perhaps, not sponsored by management. The move for such an organization should certainly come from the foremen themselves, and fortunate is the company that sees such a movement in capable hands as many clubs degenerate into social groups of questionable value.

It is interesting to note that, although no Canadian company with which the author is familiar has all these activities for its foremen, one firm uses all of them except the foremen's periodical.

It must be realized that these details constitute merely the machinery to handle the problem. The effectiveness of their use will be largely determined by the motive power behind them. If the management is thoroughly convinced of the need for such a programme, if it is ready to assume its responsibility in providing conditions under which good foremanship can flourish, and if it is sufficiently in earnest to sacrifice some of today's productivity towards building the personnel of the future, then, and only then, can this endeavour produce its intended yield of informed, efficient and satisfied foremen.

CEMENTED CARBIDE TOOLS AND CHIP CONTROL

HARRY CRUMP

Carboloy Company Inc., Detroit, Mich., U.S.A.

Paper presented at a joint meeting of The American Society of Mechanical Engineers and The Engineering Institute of Canada, at Toronto, Ont., on September 30th, 1943.

SUMMARY—The advent of cemented carbide tools has permitted the use of higher speeds in machining operations and has created the problem of chip control. Various means of breaking the chips are described, the most commonly used being a step ground-in on the tool.

History

Cemented tungsten carbide was first introduced in the United States in 1928 by the Carboloy Company, Inc.—a subsidiary of General Electric Company, following an extensive period of research and development.

From this start the use of carbide tools has developed throughout the United States, and in fact, the entire world, from the making of the original few small test ingots and tools to the present mass production manufacture of tips and tools, wire drawing dies, etc. The originally introduced material was tungsten carbide. Today there are available a whole series of "alloys" embodying not only tungsten carbide but also the so-called tantalum carbides, titanium carbides. However, tungsten carbide constitutes the basic ingredient in each case.

Manufacture

Tungsten carbide is made by mixing tungsten powder with lamp black and firing for a few hours at approximately 1450 deg. C. The "tantalum carbides" and "titanium carbides" are made in somewhat the same manner, but due to difficulty in producing the metal powders initially, they are more often made by heating the oxides with carbon at substantially higher temperatures. Binder or matrix metal is made in powder form by well-known mechanical or chemical methods. The control of particle size is of importance to both binder and hard constituents. Grain size measurements are systematically made, and they are used to regulate later operations in process, particularly milling and sintering. Carbide powder may be milled in ball mills or other types of crushing and grinding machines to bring the desired grain size for processing to a given structure. Carbide or carbides are mixed or milled with a softer binder metal, generally until each carbide particle has been coated with a more or less continuous layer. This may require from a few hours to a few days.

After the milling operation, a lubricant such as paraffin is usually added to powders which are to be pressed cold. In hot pressing, this lubricant is not needed. Cold pressing is done at pressures usually ranging from 5 to 30 tons per sq. in. Moulds of hardened steel or tungsten carbide are used for this process. In moulding tips, it is necessary to figure on shrinkage which is about 40 per cent by volume. This shrinkage takes place in the final sintering process which is done at about 1450 deg. C. in the hydrogen atmosphere. In the case of special form tips, ingots or bars are fired at temperatures within a range usually up to 800 deg. C. In this state, the carbide is hard enough to handle without breaking, and still soft enough to cut with rubber cutoff wheels, saws, etc. In this manner, various forms are produced by cutting or grinding in the carbide, always allowing, of course, for shrinkage. The tip is then given final sintering process and is then ready to be brazed on tool shank. Various methods are used for attaching tips to shanks. The method most generally used is to copper-braze in the hydrogen furnace. Other methods use silver solder. Easy Flo No. 3 being preferred among the various types of silver solder. The latest and a very satisfactory method is by induction brazing with induction heating furnaces.

Use of Carbide Tools

Carbide tools are used to manufacture everything from small pins for instruments, shells of all types including 20, 40, 75 and 105 mm.; planes, tanks. They are used for machining armor plate, for boring rifle barrels, for machining pieces as large as turbine rotors weighing as much as 12 tons. In this connection, it might be mentioned that as much as six tons of material has been removed on one single rotor, using carbide tools. The machining time in this operation has been reduced from 268 to 80 hours as compared with the previous record of using high speed steel.

Chip Control

The use of carbide tools has raised the problem of chip control. In the past, when machining with high

Fig. 1—The depth of the chip breaker provides the shoulder against which the chip starts to coil.

speed steel, the chips could be controlled by the operator without much trouble because they came off at a relatively slow speed; that is, he could grind a lip in the tool to curl the chip, or he could allow them to string out, breaking them up with a hook. When carbide tools were put into use for steel cutting, something had to be done to control the chips. At the high speeds used with carbide tools, the chips are dangerous and hard to handle, and unless properly controlled, cause a great deal of lost time.

The first means of controlling chips was by tool design; that is, a combination of rake angles, nose radii, etc. The chips were made to curl into the tool post or into the work, thereby being broken up. This method of chip control is quite satisfactory, except that considerable time is required to work out the proper tool design, and forgings or castings must be very consistent or chips will not break uniformly. In the average shop it is very difficult to meet the above conditions—either the jobs do not last long enough to work out the proper tool design, or the forgings come in from some outside vendor who does not keep them consistent.

Mechanical Chip Breaker

The next step in chip control development is the use of what is termed a mechanical chip breaker to curl or control the chip. An obstruction is placed at the top of the tool so that the chips moving across hit this obstruction and are deflected. This obstruction is usually a block attached to the top of the tool. This block is sometimes faced with carbide. The closer the block is placed to the cutting edge on the tool, the more the chips are obstructed and the tighter they curl, and where desired, they can be curled sufficiently tight to break.

This type of breaker is quite satisfactory for many jobs. It has its definite advantages, but also its disadvantages. At one time it was used in a great many cases. Today, however, its use is relatively limited.

Some of the disadvantages are as follows:

1. In order to have room to clamp a block on the top of the tool, the tool must be relatively large.

2. The top of the tool and the bottom of the block must both be precisely ground in order to give a good fit between them. Any small opening between the top of the tool and the block allows particles of metal to wedge in between the two. These particles of metal build up extreme pressure which may break the tool or the block.

3. The block must be held securely to the tool so it will not move while the tool is in use. This is rather difficult to accomplish because the holding mechanism heats up and tends to slip while the tool is on the job.

4. Any such arrangement is necessarily quite expensive, so tool failures are very costly.

Ground-in Step Breaker

The next type of chip breaker is what is commonly known as a ground-in breaker. This can be sub-divided into two types—the ground-in step and the ground-in groove. The ground-in step acts similarly to the mechanical breaker: instead of fastening a block on the top of the tool, a step is ground at the top of the tool to give a shoulder which obstructs the flow of the chip. The ground-in step is the most widely used breaker, the ground-in groove being more difficult to grind to proper dimensions.

Before going into a detailed study of the ground-in step breaker, it will probably be worthwhile to go back to chip breakers in general for a moment. To start with, chip breakers are necessarily a nuisance. They should never be used unless required. On many jobs the chips can be controlled quite successfully by increasing the feed, or by varying the rake angle of the tool. In many cases, this will be much more satisfactory than trying to control the chips by means of a chip breaker.

With the ground-in step type of chip breaker there are three dimensions that can be varied:

1. The angle between the shoulder and the cutting edge.
2. The width of the breaker.
3. The depth of the breaker.

The chip breaker is put in at an angle with the cutting edge, first, to facilitate grinding. It is much easier to grind straight through at an angle than it would be to grind back parallel to the edge stopping at the end of the tip then backing out.

The second reason for the angle is that it tends to control the flow of the chips. With the breaker in at an angle, it is narrower at the back than at the front, and the chip is bent tighter at the outside diameter than at the point of the tool. With the chip bent tight on the outside and loose on the inside, it tends to force

Fig. 2—The ground-in step is the most widely used type of chip breaker.

itself away from the work and around the shoulder of the cut. With the breakers ground parallel with the cutting edge, the chips curl up like a clock spring and often fly out just like a clock spring.

There is a time, however, when the parallel type of breaker is preferred; that is, where the depth of cut is quite irregular; for instance, on forgings or castings where ⅛ in. stock is to be removed on one side and ⅜ in. on the opposite side. If the breaker is put in at an angle, it is too wide to break the chips where only ⅛ stock is encountered and is so tight on the ⅜ stock side that the tool itself is apt to be broken. On this type of job the parallel type breaker can be used and adjusted to break the chips very satisfactorily for all depths of cuts.

The depth of the chip breaker is usually .015 to .020 in. It can be made shallower or deeper to increase or decrease the amount of obstruction and thus vary the chip control. However, the usual and more satisfactory method of varying the chip control is to vary the width of the chip breaker as will be shown later. Breakers deeper than .020 in. are seldom used because extra grinding is required and the carbide tip is wasted. Breakers less than .015 in. are seldom used because, when the breaker is very shallow it must be ground extremely accurately in order to work. For instance, if the breaker is only .010 in. deep, a variation of .003 in. on the depth would be 30 per cent. If the breaker is supposed to be .010 in. deep and it is made .003 in. too shallow, the .007 in. breaker resulting probably would not work. If the breaker is supposed to be .020 in. deep and is ground .003 in. too shallow, the .017 in. breaker resulting would probably work quite satisfactorily.

The shoulder of the breaker tends to wear somewhat as the tool is used. If this shoulder is only .010 in. high and wears, the breaker will soon stop functioning. With a .020 in. shoulder, considerable wear can take place before the breaker becomes unsatisfactory.

The third dimension of the chip breaker that is varied is the width. As a matter of fact, this is the one that is usually varied; the others are held constant —the angle at 8 deg., the depth at .015 to .020 in., the width being varied to take care of different type chips on different jobs.

The narrower the width of the chip breaker, the more obstruction it offers to the flow of the chip; therefore, the tighter it curls the chips. The wider the breaker the less obstruction it offers and the looser the chips are coiled. To break chips where the feed is light and the chips thin and springy, it is necessary to bend them over very quickly. This means that the chip must be obstructed greatly, so the chip breaker must be narrow. Where the feeds are heavy and the chips stiff, they need not be bent very much to break them, so the breaker is made wide. It is always important to have the breakers just as wide as possible, because, if the chip is obstructed more than is necessary, it takes away greatly from the tool life. There are charts available which show the approximate width of chip breaker required for various cuts; that is, feed and depth of cut. These charts are not 100 per cent complete, but they give sufficient information so that, with observation, very satisfactory results can be obtained. If the chip breaks too loose, the breaker must be narrowed. If the chip breaks too tight, it must be widened.

Fig. 3—Ground-in groove type of chip breaker.

To sum up the variations in the width of the chip breaker, the lighter the feed, the narrower the breaker. The heavier the feed, the wider the breaker. The softer the material, the narrower the breaker. The harder the material, the wider the breaker.

Coolant has an effect upon the way the chips break, particularly with relatively high carbon steels. A heavy flow of water quenches the chips, making them harder and stiffer, thereby making them break tighter.

Ground-in Groove Breaker

Another type of ground-in chip breaker is the grooved type or gullet type. This breaker consists of a shallow groove parallel with the cutting edge. This groove is usually .005 to .010 in. deep and 1/16 to 3/32 in. wide. The land between the groove and the cutting edge is usually from .010 to .015 in. wide, with a negative rake on the land of from 2 to 5 deg. This type of breaker has the advantage that it will work over a much wider range of cuts than the step type of breaker. However, it has the disadvantage of being difficult to grind in that it is very hard to check dimensions. A man who has had considerable experience with this type of breaker can do a very satisfactory job with it. However, it may be difficult to tell someone else just how to use it. For this reason the step type of breaker is recommended.

In conclusion it may be said that cemented carbide tools have played a major part in producing war materials, and they will again play a most important part in the production of peacetime necessities and luxuries, and in this way make available more goods for more people at less cost.

MACHINING OF ALUMINUM

Specially Designed Tool Permits Higher Milling Speeds

R. H. ASHCRAFT

Head Tool Designer, Curtiss-Wright Aeronautical Corporation, St. Louis, Missouri Plant.

Paper presented at a joint meeting of The American Society of Mechanical Engineers and The Engineering Institute of Canada, at Toronto, Ont., on September 30th, 1943.

SUMMARY—High cutting speeds and feeds may be used in machining aluminum. Through design of a new cutting tool, an improved method has been developed whereby aluminum can be milled faster and with a better finish.

By nature, aluminum has been endowed with good machining characteristics. In order to obtain the best results from these characteristics we should familiarize ourselves with the different types of aluminum and up to date machining practice.

Machining Properties

The word aluminum is commonly used to describe the pure metal and all its alloys, in either the cast or wrought condition. Some of the alloys have better machining properties than others, in that they can be cut fast, the chips are small, and smooth surfaces can be produced readily. Others are more difficult to machine—they produce cuttings that are long and stringy, while others are soft and gummy.

The casting alloys containing principally copper, magnesium, or zinc can generally be machined most rapidly and satisfactorily. The tools may have smaller rake angles than those required for most other alloys, the chips are smaller, and there is little or no tendency for the tools to leave a burr or for chips to build up on the cutting edge. On the other hand, the casting alloys in which silicon is the predominant alloy element, machine best if rake angles are increased. The alloys containing relatively large amounts of silicon are abrasive to carbon and hi-speed steel tools, and should be machined with carbide tipped tools.

Of the wrought alloys, those which depend on various amounts of work hardening to improve mechanical properties are easy to machine with tools having relatively large rake angles.

Even the softest aluminum, including high purity metal in the annealed temper, may be machined with excellent results when large rake angles are employed and tools are carefully finished with a fine abrasive stone.

Cutting Speeds and Feeds

Wide ranges for cutting speeds and feeds may be used in machining aluminum and its alloys. The particular values for speed and feed are dependent on the character of the work, the type of tool, the lubricant and the machine on which the work is done. Generally, aluminum can be machined to best advantage by using the highest speed at which the equipment is capable of operating, with moderate feeds and cuts.

So much has been written about speeds and feeds that one can find an authority for any feed or speed he wishes to use. I am not going to add any more figures on speeds, feeds, angles, or clearance rakes. I still believe the best way to determine these is by trial only. In the milling of aluminum much has been published about cutters, shape, contour, blading angles, speeds and feeds, but very little has been done about them. Most of us think of a milling cutter as something entirely apart from other cutting tools. We never doubt or question the design of various milling cutter manufacturers, we accept them as cutting tools of perfection.

The introduction of hi-speed and hi-cycle machines is rapidly changing this picture. To utilize the hi-production qualities of these new modern machines, we will have to disregard all common practice we have adhered to so rigidly heretofore. Speeds and feeds are changing, becoming much greater than we have experienced in the past, in production machinery. In the step forward, higher speeds, higher feeds, and higher production, the machine manufacturer has failed to keep step in developing cutting tools to be used in these modern machines.

This is the position we, at Curtiss Wright Missouri plant, found ourselves two years ago, in the purchase of several spar milling machines. We had in these machines hi-speeds and feeds, a means of high production, if cutting tools could be developed to utilize these speeds and feeds. In all machining operations the generated heat is a limiting factor on the speed of the operation. To increase the speed of production we must first decrease as much as possible the generation of heat in the part and in the tool, and second increase the dissipation of heat so generated as much as possible.

Observation of any machining operation will disclose the fact that a great percentage of the generated heat is in the chips, therefore the quicker we can get rid of these shavings, the faster we can remove them from the vicinity of the tool or the part being machined, the less heat will enter the tool or the part.

We are in the habit of thinking that the heat generated is in proportion to the speed. This is true, only if all other conditions remain proportional to the speed. But if we change other conditions, if we use a two bladed cutter instead of say a twelve bladed cutter we will reduce our heat factor. The inactive time, the time during which the tool and the part are cooling would be six times as long and the result would be an over all reduction of heat in the cutter and in the part, the generated heat would be concentrated more in the chips where we can readily dispose of it and where it does no harm. With two blades we can also increase the thickness of the individual chips by increasing the feed per unit of time at least 50 per cent, and in some cases the feed can be increased as much as two or three hundred per cent.

Too much emphasis cannot be put on the thickness of these individual chips. Theoretically we can cut a chip two ten-thousandths of an inch thick but that would require a cutting blade with an edge as sharp as a good razor blade, where as in reality a good sharp cutter has an edge with about five ten-thousandths radius.

In conventional milling, each blade will slide over the work until the feeding pressure sinks it deep enough into the material to start a chip, and often on our present multi-bladed cutter one or more blades fails to come up to the required pressure to "take a bite." A great deal of heat is generated by this sliding blade, transferring this heat to the part and to the succeeding blade where it can do the most damage.

Although we have never measured the amount of imparted heat caused by this sliding non-cutting blade we believe it is much more than that imparted by one blade cutting a normal chip. We also believe that the heat factor in cutting a thin chip, say about two thousandths of an inch, in comparison to cutting a chip of ten thousandths is very slight.

Milling with Specially Designed Cutter

We, at Curtiss Wright, in designing and developing milling cutters to utilize the high speeds and feeds we had available in our spar milling machines, choose a high grade malleable iron for our cutter bodies. This choice serves a two-fold purpose; in milling we have succeeding impacts which tend to set up vibrations in the blades, and at high speeds these vibrations can become destructive. Malleable iron, like lead, is almost

Fig. 3—Machining a spar cap with a 2¼-in. dia. cutter turning at 10,800 r.p.m. Depth of cut 2¾-in. Feed 20 ft. per min.

inert to vibration, and its damping qualities are very high.

Malleable iron having comparable coefficients of expansion and contraction, the carbide tip or blade is undistorted in the brazing to the body. To provide an adequate chip clearance we put two blades in our cutter, which also permits the use of thicker cutting blades which are quite desirable. These blades are set in at a 15 deg. spiral and ground to a 5 deg. negative rake. This negative rake in cutting aluminum is quite unusual and the advantages are manifold. The cutting edge is greatly strengthened as this negative rake results in approximately 90 deg. lip angle, and the centre of the cutting pressure is some distance behind the cutting edge. In using this negative rake we have found it will delay cratering, pitting, chipping and wear. Conventional cutters present the weakest cutting tooth to the work, while teeth with negative angles shear off the metal. Thrust is exerted against the bearing, instead of a pulling action against the end play adjustment collar, as with a positive angle cutter.

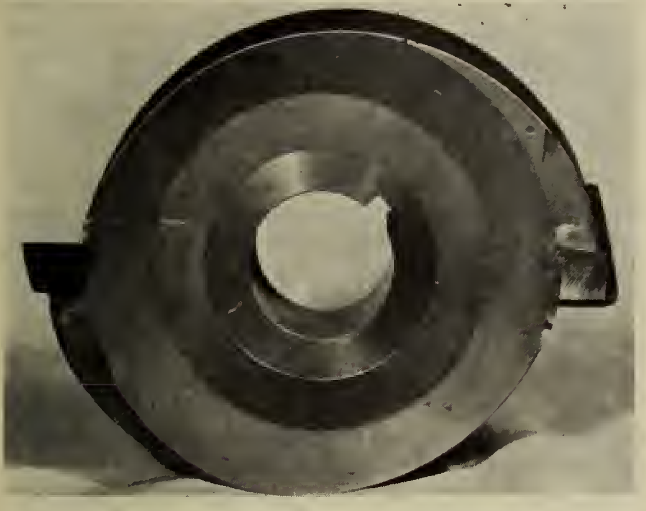
While negative rake theoretically traps the chips and obstructs their escape from the region of the cutting point, the extremely high speed causes rapid flow across the tooth face.

This 6-in. diameter cutter running at 5,400 r.p.m. gave us a milling rate of 8,482 surface feet per minute—a truly efficient high production cutter with a grinding life fifteen times longer than that of a standard solid tool steel cutter.

Considering all of these points I wish to recommend the use of simple milling cutters. These cutters can be made in your own shop, or made to order. Bodies should be made preferably of malleable iron or a mild steel, with one to eight cutting blades brazed on. Cutting material can be one of many choices, high speed steel, carbide, or anyone of the non-ferrous alloys now being offered by various manufacturers.

The cutting tip or blade should be fitted to the body by means of low temperature brazing.

This will result in a highly efficient tool which will not only increase production, but will conserve scarce material as it is used for only the cutting blade.



Figs. 1 and 2—Close view of special malleable iron cutters, showing carbide tips which are silver-soldered in place.

MACHINING MAGNESIUM ALLOYS

CARL J. WIBERG

Production Engineering Department, Wright Aeronautical Corporation, Paterson, N.J., U.S.A.

Paper presented at a joint meeting of The American Society of Mechanical Engineers and The Engineering Institute of Canada, at Toronto, Ont., on September 30th, 1943.

SUMMARY—The author outlines methods and describes tools which have been specifically developed for machining magnesium alloys, resulting in the use of high cutting speeds and feeds.

The heat treated alloys of magnesium have very good machining properties, and in many cases can be satisfactorily machined with tools used for cutting steel by increasing the clearance angles 3 to 4 deg. The materials used by the Wright Aeronautical Corporation conform to the Aeronautical Material Specifications and the heat treat cycle consists of solution and precipitation treatments as recommended for the respective alloys. Relatively high speeds and feeds are recommended, and where carbide tools are used the limiting factor for speed is the capacity of the machine.

Coolants

Our practice with magnesium alloys shows a much greater percentage of dry cutting as compared to aluminum alloys. When a coolant is used, it is generally recommended in order to reduce the fire hazard and improve the finish. For general machining, including reaming and tapping, the coolant specified consists of a light paraffin oil blended with 5 per cent of a sulphurized fatty oil. The use of the low viscosity oil coolant practically eliminates the fire hazard. Additional precautions as outlined by the alloy manufacturers will promote added safety.

Machining Practice

Our experience for the past several years has shown that better results can be obtained by the use of tools and methods which have been specifically developed for application to these alloys. The aim of this discussion is to describe several of the most interesting applications, as we feel that regular machining methods are usually known.

Turning

Because of the brittleness of these cast alloys, it is our practice to increase the lead angle to approximately 30 deg. This prevents chipping the part when the tool completes the through cut. On general turning operations, the side rake has been maintained as recommended by the magnesium manufacturers, but the back rake has been eliminated as experience in our shop has proved that this back rake has a tendency to cause the tool to dig in.

The general procedure in machining large magnesium alloy castings with thin sections is to rough, semi-finish, and finish machine in order to prevent distortion and maintain size. The casting is set on three rest spots for roughing on both sides and semi-finishing on one side only. On all following operations, the casting is completely supported on previously machined surfaces. In preparing the castings for machining, the parts are horizontally, vertically, and radially targeted 100 per cent in a qualifying fixture which divides casting errors. This replaces an initial inspection and tedious layout, making it possible to determine at a glance whether the casting is usable. The three rest spots, now located from a chosen centre line, are then machined to a given dimension. When using clamps for holding the parts in a fixture, the use of support pins is recommended. This will prevent chatter and distortion during machining.

To assist in maintaining size on large castings, a thermostatically controlled heating element is installed in the head stock reservoir of turret lathes to keep the oil warm, which in turn heats the spindle and other parts of the headstock, as any fluctuation in temperature causes a marked rise or lowering of the height of the spindle from the bed. In cases where no provision is made for heating the oil, the machine may be kept running to maintain its operating temperature, thus eliminating any changes in size due to the condition already mentioned. In conjunction with the precautions just described, it is also a question of shop experience to make the proper allowances for expansion or contraction resulting from internal strains and temperature changes which cannot be easily controlled.

Drilling

Drills for use on magnesium are ground with a slight flat on the cutting edges, as this not only provides a stronger cutting edge and prevents the edge from chipping, but also keeps the drill from digging into the work. On aluminum this is unnecessary. All drills have polished flutes to facilitate chip removal. On long cored holes which are usually irregular in shape and are not straight, a core drill followed by a fish tail drill has proved very successful. Usually, the conventional drill ground with the 118 deg. included angle acts as a cam when it enters the cored hole and causes the drill to go off on a tangent. The purpose of a core drill is to remove excess stock and present a clean circular hole for the fish tail drill which has been specifically designed to correct any misalignment. This fish tail grinding of drills also applies to three and four flute drills especially when drilling through a bushing as the more numerous flutes keep the drill centered better in the bushing.

Reaming

The width of the land on the flutes of the reamer for use on magnesium alloys should be kept between ten and fifteen thousandths of an inch. This has a two-fold advantage. Besides cutting cleaner and producing a finer finish it also reduces friction to a minimum, thereby reducing the fire hazard. On aluminum these conditions do not exist and the land on these reamers should be from the thirty to forty thousandths, which gives very satisfactory results for this material.

Tapping

On taps, a hook angle of 12 to 18 deg. formed by a ⅛ in. radius is ground on the cutting faces. This has made for a cleaner cutting tool and assists in maintaining size. Experience has shown that a more accurate thread can be obtained by using lead screw tapping machines to establish the lead of the threads. The use of ordinary tapping heads must be carefully controlled because any undue pressure will prevent the tap from cutting its own lead. On taps from 1¼ in. and larger, it is well to incorporate numerous flutes instead of three or four. This will produce a fine finish and hold size, particularly when tapping magnesium.

Milling

Most milling is done dry, but to obtain satisfactory results sharp tools with a high finish are essential. The machine and surrounding floor should be constantly cleaned to reduce the fire hazard from dry milling. Single blade carbide face cutters have gradually replaced hi-speed steel multiple blade face tools. The finish obtained with these fly cutters has been so satisfactory that we have been able to dispense with some lapping of magnesium parts. In addition to increasing production, the initial cost of the tool is lower and its grinding upkeep is reduced considerably.

Grinding

Grinding has been our practice on aluminum or magnesium alloy parts requiring exceptionally close tolerances with very fine finish, but recently some grinding has been replaced by the use of diamond and tungsten carbide tools and further research is being conducted along these lines. This is a more economical set-up, and it eliminates the use of a refrigerated coolant which was required in grinding due to the heat generated. In grinding, a 46-grain silicon carbide wheel of soft to medium hardness operating at 4,500 ft. per minute, is used with satisfactory results; but we feel that a treated wheel of more open structure to prevent loading will give a better finish.

Conclusion

The most satisfactory solution to various machining difficulties has been accomplished by careful attention to minor details similar to those described, and it is surprising to note the magnitude of the improvements that can be realized by applying these fundamentals to production.

NYLON — A Chemical Research Product of Engineering Interest

(*Continued from page 287*)

such sheets increases with rolling, e.g., a 9 mil. unrolled sheet has a breakdown strength of 1,300 volts per mm., while the value for a 2 mm. rolled sheet is 3,000 volts per mil. The above-mentioned study of nylon wire covering records an average breakdown voltage on a 3 mil. covering of unoriented modified nylon of 5,500 volts.

Other electrical characteristics which have been reported are as follows:—

(1) Volume resistivity 4 x 10^{14} ohm — cm. at 18% relative humidity (R.H.)
Volume resistivity 4 x 10^{9} ohm — cm. wet
(2) Dielectric constant 4 at 1,000 cycles at 18% R.H., 22°C.
(3) Power factor 5% at 1,000 cycles at 18% R.H., 22°C.

The specific gravity of nylon is 1.14, which is lower than that of natural fibres and synthetic resins. It melts at 253 deg. C., its specific heat being 0.555 cal. per gm. per deg C., and heat of fusion 22 calories per gram. It is practically non-flammable.

Miscellaneous Uses

Nylon can be extruded and drawn into heavy single filaments, commonly termed monofilaments, of diameters of the order of 0.005 to 0.025 in. In this form it has found uses in brush bristles, strands for fishing leaders, surgical sutures and racquet strings. The rigidity of brush bristles made from monofilament can be modified by use of other dibasic acids than adipic, and it is of interest to note that the difference between soft and hard brush bristles is a matter of a few thousandths of an inch. A method of reproducing the natural taper of hog's bristle has been worked out and paint brush bristles in use by the United States Navy are of tapered nylon.

Nylon monofilament surgical sutures of the dermal or nonabsorbable type are in wide use, nylon being physiologically inert. Heavy nylon monofilament can be woven into an insect screen material with remarkable ability to recover from distortion of the interstices.

A wide range of fabric possibilities can be suggested for nylon. Those of particular interest to engineers are light but strong fabrics which can be coated with rubber, neoprene, etc. for diaphragms; or with oleoresinous varnishes or synthetic resin coatings for sleevings, etc. Braided and twisted cords, ropes and threads, tapes, etc. may also be produced on standard textile equipment for industrial purposes.

The examples will suffice to illustrate the surprising versatility of this new material and to indicate that it has a place on the spear as well as the distaff side of the family.

The general description of the history of nylon development may also serve to emphasize the increasing amounts of time, effort and patient research money which appear to be necessary to pioneer new industrial fields as the frontiers of scientific knowledge recede.

References

(1) Carothers, W. H. "Studies on Polymerization and Ring Formation. I. An Introduction to the General Theory of Condensation Polymers." *Journal of the American Chemical Society*, 51, 2548, 1929.

(2) Whinfield, J. R. "Molecular Structure and Plastic Fibre Formation." Address to Plastics Group of the Society of Chemical Industry and the Faraday Society, February 9, 1943. *Journal of the Society of Dyers and Colourists*, 59, 12, 279-281, December, 1943.

(3) Carothers, W. H. "Fundamental Paper on the Structure of Natural and Synthetic High Polymers." *Chemical Review*, 8, 353, 1931.

(4) Astbury, W. T. "Fundamentals of Fibre Structure." Oxford University Press, London, 1933.

(5) Carothers, W. H. and Hill, J. W. "Structure and Mechanical Properties of Polyamides." *Journal of the American Chemical Society*, 54, 1599, 1932.

(6) Meyer, K. H. "The High Polymeric Substances." Vol. IV. of the series "High Polymers." New York, 1942.

From Month to Month

News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

COLLECTIVE BARGAINING

Engineers, chemists, architects, science workers and similar groups are now facing the necessity of making a decision which may well be the most important one they have been called on to make. There is before them a problem of great magnitude and significance, both social and economic—the determination of a policy to be followed with reference to trade unionism and collective bargaining.

Such matters have been in the background of society affairs for some time, but the recent promulgation of Wartime Labour Relations Regulations known as order-in-council 1003 has thrown them into the foreground, where for the moment at least they have pushed most other things to one side. Members of the Institute are urged to give this subject quick and intensive study.

What the Order Does

The order declares its purpose to be to establish procedures whereby employers and employees may negotiate to advance the enterprise in which they are engaged, to discuss matters of mutual interest and to settle differences by peaceful means. These are not new objectives of labour legislation, but the prescribed means of implementing them include some new features.

From the engineers' point-of-view, the most interesting consideration is that members of professions may be included in the scope of the order. The definition of employee reads "employee means a person employed by an employer to do skilled or unskilled manual, clerical or technical work." The last mentioned group surely includes the engineers, but exemptions are provided which eliminate a large percentage of the total.

The order goes on to say that "employee" does not include "a person engaged in a confidential capacity or having authority to employ or discharge employees". In this manner the professional groups are divided, which complicates the situation considerably.

The order also says that "if the majority of the employees affected are members of one trade union, that trade union may elect or appoint its officers or other persons as bargaining representatives on behalf of all the employees affected". A later clause says "a collective agreement negotiated by such representatives shall be binding on every employee in the specified unit of employees."

How it Works Out

In practice, this would mean that when a union is given bargaining rights for a whole plant, it controls the working conditions for the engineers as well as all others, whether they belong to the union or not. If eventually negotiations lead to a closed shop, the engineer not otherwise exempted would be forced to join the union or be dismissed.

Similarly in a smaller group such as an engineering department of an industry, if the number of persons working at sub-professional or non-professional level were in the majority, as might well be the case, they could form themselves into a section of union and under the terms of the order get the bargaining rights for the whole department, which might not be in the best interests of the professional employees or the department.

What to do? That is the Question

As reported elsewhere in this *Journal*, the Wartime Labour Relations Board has ruled that "persons employed in a professional capacity shall be deemed to be employed in a confidential capacity," but has reserved the right to reconsider the decision within six months. Although neither the Board nor the delegation said anything about it to the other, the implication is that within that time a decision should be reached by the group that will permit the Board to know what the professions actually want in relation to the order. That is the decision that must be made now.

As it appears to some only one of three things can be done by the engineers:

1. Throw in their lot with the trade unions.
2. Establish "employees' organizations" within the meaning of the order, which they would endeavour to operate and control themselves.
3. Have the Board exclude them permanently from the order, and then through their own existing organizations set up some form of procedure which will demonstrate to recalcitrant employers the advantages of paying living wages, and at the same time will establish a means by which pressure can be applied as it is required.

A Comparison of Procedures

It is not simple to select the correct one of these three moves. However, as a means of stimulating discussion within the Institute, let us look at them one at a time.

Number one would hand over to non-professional people the control of working conditions for the professions. It is true that the order does not require one to belong to a union, but it does give the controls to the union, and probably in its final workings would force the engineer to join the union or leave.

In considering number two it must be borne in mind that no existing organization such as the Institute or the professional associations can do this job for the engineers. They are not employees' organizations "formed to regulate relations between employers and employees." It must be something new. The existing societies can help in the organization work, but once it is completed all ties must be cut and it must go its own way on its own responsibility.

This might mean anything. If the group so desired it might take in sub or non-professionals. It might lose sight entirely of the professional aspect of its responsibilities. Another prospect is that it might, in time of trouble or duress, be taken over by a union as a ready-made unit.

Proposal number three does not go into detail at the moment. The principal thing is that by this means it may be possible to concentrate the weight and influence of the entire group on the problem of working conditions for the engineer; to bring a greater influence to bear when pressure is necessary; to conduct such matters at a professional level and to hold the profession together, rather than divide it as would be done in one and two.

The senior engineers must recognize the position of the younger men, and the temptation which faces them to join a union to get quick results. The economic welfare of the young man should have been worked out long ago by the Institute and/or the provincial professional organizations. The situation which has to be faced to-day would have been saved if such matters had been threshed out to a conclusion long ago. Sporadic attempts have been made over a great period of time, but so far as the record shows they have accomplished absolutely nothing. Something better was and is still required. If the professions don't do it now it looks as though somebody else would.

Institute Policy

As far as the Institute is concerned, at Council's request the president appointed a small committee to recommend the procedure which should be taken in order to inform all members of the situation so they may be able to judge for themselves, and to pass on to Council the benefit of that judgment. A great deal of preparatory work has been done already, so it is expected the committee will report shortly. In the meantime, members are asked to think on it. It is a very complicated problem that requires the best from those who are to deal with it.

All thinking should be based on the best interests of the profession. The interests of one organization in comparison with another should be disregarded. The problem is too serious from every point of view to be used as a means of jockeying for position in the organizational set-up in Canada.

The Experience in the United States

There is much to be learned from what has taken place in the United States. Similar legislation has been in force there for nine years, and some of the societies, notably to Amc.ican Society of Civil Engineers, have taken steps to meet it. They have not been cnt:rely successful, and the real decision is still ahead. It is hoped that Canadian conditions will permit of a more satisfactory solution than that being worked out in the States.

In the States the situation is more confused than it is in Canada, but we can get ourselves in precisely the same confusion if we do not think this out carefully, impersonally, and far into the future. The experience in the United States should be studied. It probably contains all the information and all the indications that are required to solve the Canadian problem.

Members of the Institute must study this subject. The profession needs the support of everyone. No one should remain indifferent. The special committee of the Institute will make every endeavour to see that members are properly informed, so they may have factual material upon which to base their thinking.

The Committee

The committee as selected by the President is as follows. In addition an advisory group of young engineers covering a wide area of interests is being formed.

R. E. Heartz, *Chairman*, Assistant Chief Engineer, Shawinigan Engineering Company, Montreal.

P. N. Gross, Vice-president and General Manager, Anglin-Norcross Corporation, Limited, Montreal.

G. N. Martin, Combustion Sales Engineer, Dominion Bridge Company, Limited, Montreal.

A. D. Ross, General Manager, Canadian Comstock Company Limited, Montreal; Secretary of the Corporation of Professional Engineers of Quebec.

I. R. Tait, Chief Engineer, Canadian Industries Limited, Montreal.

MEETING OF PROFESSIONAL SOCIETIES TO DISCUSS COLLECTIVE BARGAINING

A group representing fourteen engineering, chemical, architectural societies met in Ottawa on April 11th to discuss the method of approach to the Wartime Labour Relations Board, the following day, relative to the position of professional persons under order-in-council 1003, known as Wartime Labour Relations Regulations. The societies represented were:

The Engineering Institute of Canada
Canadian Institute of Mining and Metallurgy
Canadian Institute of Chemistry
Royal Architectural Institute of Canada
Canadian Society of Forest Engineers
Canadian Institute of Surveying
Dominion Council of Professional Engineers
Association of Professional Engineers of Ontario
Corporation of Professional Engineers of Quebec
Association of Professional Chemists of Quebec
Ontario Association of Architects
Province of Quebec Architects' Association
American Institute of Electrical Engineers (Canadian Section)
Institute of Radio Engineers (Canadian Section)

The meeting extended from 11.30 in the morning until 11.30 at night, with another session from 11.00 a.m. to 1.00 p.m. the following day. A. E. MacRae of Ottawa was selected as chairman and L. Austin Wright as secretary.

Every representative at the Meeting agreed that an effort should be made to improve the economic status of the engineer and the other professions, but a long discussion took place as to the best means by which this might be accomplished. Representatives of the Ontario Association were of the opinion that the group should remain within the purview of the order, and endeavour to establish units that could act as collective bargaining representatives for the engineers. Others were of the opinion that total exclusion from the order should be requested and other forms of collective bargaining units established.

This latter group based its argument on the fact that the order specifically stated that the bargaining representatives had to be employees, and no organization made up of employers and employees would be recognized by the Board. This group also felt that the professional status of the employees should be kept in mind, and that collective bargaining negotiations should be carried on at a professional level. The Ontario Association, however, felt that similar protection could be given to the profession within the terms of the order.

After many hours of discussion along this line, it was agreed finally, as a compromise, that representation to the Board should ask for a temporary exclusion for six months, during which time the groups could consult their memberships and arrive at a final decision as to what would be desired by the entire group. Accordingly, a brief was prepared along this line and the group appeared before the Board at 10.00 a.m., Wednesday, April 12th.

The Board's reception was very cordial. The brief was presented, but no questions were asked. The Board reserved judgment although an early decision was promised. W. P. Dobson read the brief for the delegation.

The group reassembled at 11.00 a.m. to discuss the next step. It was agreed that each society should bring the matter specifically to the attention of its membership, with the idea of obtaining a satisfactory cross-section of opinion from all members of the professions.

A sub-committee was appointed to select factual material which could be distributed to the societies, and by the societies to their members, so that persons would have sound facts upon which to base their reasoning. It was agreed that an endeavour would be made to collect the opinions within a period of three months, at which time further deliberations would take place as to the final policy.

Herewith is a copy of the brief and of the Board's decision.

April 12, 1944.

Wartime Labour Relations Board,
Ottawa, Canada.

Re: Wartime Labour Relations Regulations, P.C. 1003

Gentlemen:

The delegation which waits upon you to-day specifically represents fourteen professional organizations, which collectively thoroughly cover the field of engineers, chemists, architects and surveyors. It speaks on behalf of over 25,000 persons in all parts of Canada, and desires to place before you the possible implications of P.C. 1003 in relation to the practice of their professions.

Members of this group in the normal practice of their professions occupy a position between labour and management. In order to serve the best interests of both groups it is imperative that they constitute a separate group not identified with either labour or management.

There is widespread apprehension in our professions that the provisions of P.C. 1003 may, in practice, adversely affect their freedom and ability to continue to perform their special functions in the industrial and economic life of Canada. Although by no means unsympathetic to the principle of collective bargaining, those whom we represent feel that they may at times be made subject to agreements entered into by bodies not competent to represent their particular needs and interests.

We respectfully call the attention of the Board to the following facts:

1. The time available for consideration of the terms of P.C. 1003, as they may affect members of the associations we represent, has been very short.
2. Organizations representing professional men were not consulted when the order was being drafted, although trade unions and employers' organizations were given opportunity to express their views.
3. There are at present no professional bodies organized for the purposes of collective bargaining.

In view of the above we request that persons employed in a professional capacity should be specifically excluded from the provisions of P.C. 1003 for a period of six months; and that we be allowed to again appear before the Board, and to submit further proposals for its consideration, within that period.

Respectfully submitted by the following organizations:

(Signed) K. M. Cameron,
The Engineering Institute of Canada
" A. A. Mackay,
The Canadian Institute of Mining and Metallurgy
" Leon Lortie,
Canadian Institute of Chemistry
" A. J. Hazelgrove,
The Royal Architectural Institute of Canada
" J. D. B. Harrison,
Canadian Society of Forest Engineers
" W. L. MacIlquham,
The Canadian Institute of Surveying
(Signed) W. P. Dobson,
Dominion Council of Professional Engineers
" M. J. Aykroyd,
The Association of Professional Engineers of the Province of Ontario
" C. C. Lindsay,
Corporation of Professional Engineers of Quebec
" W. R. McGlaughlin,
Association of Professional Chemists of Quebec
" W. J. Abra,
Ontario Association of Architects
" Eugene Larose,
Province of Quebec Architects Association
" W. J. Gilson,
American Institute of Electrical Engineers (Canadian Section)
" R. A. Hackbusch,
The Institute of Radio Engineers (Canadian Section)

Secretary,
L. Austin Wright,
2050 Mansfield Street,
Montreal, Que.

Department of Labour
Canada

Ottawa, April 15, 1944.

Dr. L. Austin Wright, m.e.i.c.,
General Secretary,
The Engineering Institute of Canada,
2050 Mansfield Street, Montreal, Que.

Dear Sir:

The Wartime Labour Relations Board (National) on April 12, 1944, heard representations made on behalf of fourteen professional organizations against the application of the Wartime Labour Relations Regulations to employees in the professional classes.

The Board has considered the matter and has made the following decision: "For purposes of the regulations, persons employed in a professional capacity shall be deemed to be employed in a confidential capacity, with the Board reserving the right to review its decision in six months."

A copy of this communication is being sent to each organization represented at the Board hearing.

Yours very truly,
(Signed) M. M. Maclean,
Chief Executive Officer.

SUCCESSFUL BALLOT

The recent ballot on a new by-law and revision of three others passed with a substantial majority. This was reported at the April meeting of Council.

The most important amendment was that which provided for a representative on Council from every provincial professional organization with which the Institute has a cooperative agreement. The president has written the four associations with which agreements are already in force, asking them to make the appointment at their early convenience.

As the April meeting of the Institute Council was in Halifax, and as the Council meeting of the Association of Professional Engineers of Nova Scotia was held the day previous, it was easily possible for the association to have its representative present. Dr. Alan Cameron, the immediate past president of the Association was selected, and president Beaubien had the pleasure of welcoming him to the Institute meeting as the first representative to serve under the amended by-law.

This is an important and practical step in the development of cooperation between engineering organizations. With Dr. Cameron attending meetings, receiving all minutes of Council, participating in discussions and ballots on matters affecting the profession, it is reasonably certain that the policies of these two organizations will agree.

The presence of an Association councillor on the Council of the Institute should widen the vision and policy of both organizations. His appointment itself is a manifestation of a sincere desire for cooperation, which after all is the only basis for a genuine understanding. It is a hopeful sign and may be but the forerunner of a continuous series of such manifestations.

* * * *

Other changes are that the annual fee for Students becomes three dollars per year instead of four, which includes the *Journal*. There is the usual one dollar discount for prompt payment. This becomes effective in 1945. The treasurer of the Institute now is a member of Council with full voting power. Previously he attended Council meetings but had no vote.

The same privilege of representation on Council is also extended to sister societies with which the Institute may have an agreement. It is hoped the agreements can be worked out with several Canadian, American, and British societies that will do much to promote understanding and cooperation between all parties.

The small number of negative votes recorded is a great encouragement to the Institute's Committee on Professional Interests. It is a real indication of the engineers' desire for cooperation in a useful and practical form. The road is now clear for real progress.

THE PRESIDENT VISITS THE MARITIMES

Starting from Montreal on April 16th, President deGaspé Beaubien visited in succession Moncton, Saint John, Fredericton, Sackville, Halifax, Wolfville, Antigonish and Sydney.

This was a much more extensive itinerary than has been followed by any preceding president. It is the first time a president has spoken to the students at Mount Allison in Sackville, and at Acadia in Wolfville. Another "first" was the inclusion of the students at St. Mary's and Dalhousie in the meeting which was held at the Nova Scotia Tech, in Halifax.

Everywhere the president visited, there were definite evidences of the Institute's virility and usefulness. All meetings were attended by substantial numbers, and the warmth of the reception was a definite indication of the status of the Institute established by his predecessors and by himself.

The president was accompanied throughout the entire tour by R. E. Heartz, a councillor of the Montreal Branch, and the general secretary. Vice-President George Dickson joined him at Moncton, and visited Sackville, Halifax, Wolfville, Antigonish and Sydney.

At Moncton the meeting took the form of a dinner at the Y.M.C.A. under the chairmanship of J. A. Godfrey, chairman of the branch. At Saint John the meeting was also a dinner affair, under the chairmanship of Oscar Wolff, chairman of the branch. At head table there were also J. T. Turnbull, president of the provincial association, and Alderman J. K. Kennedy, who represented the mayor.

At Fredericton the president's party arrived in time for a luncheon which was attended by the members of the branch and by a large number of the students in the graduating class of the University of New Brunswick. At the conclusion of the luncheon there was a quick visit to the university buildings, and then the president addressed the students in Memorial Hall. The chairman for this meeting was T. H. McSorley, president of the undergraduates engineering society, and the speakers were introduced by N. A. M. MacKenzie, president of the university. A delightful feature of the visit to Fredericton was the tea which was given at the home of Dr. E. O. Turner at the conclusion of the meeting with the students.

Several members of the Saint John Branch accompanied the president's party to Fredericton, and the meeting there was something in the nature of a meeting of the Saint John Branch.

On Thursday afternoon, the party had lunch at Sackville, after which they spoke to the students. In the absence of Dean H. W. McKiel, Professor C. D. MacDonald, presided at this meeting. A visit around the engineering buildings followed the meeting and concluded with a tea in the women's residence, at which the president of the university, Dr. G. J. Trueman, was host.

That evening, the party entrained for Halifax, arriving there about eleven p.m., to be met by a delegation of the officers of the Halifax Branch.

The group made Halifax its headquarters for five days. On the first day, Friday, the students of Nova Scotia Tech, Dalhousie and St. Mary's met with the president and his party at Nova Scotia Technical College. This meeting was presided over by Dr. Sexton, the president of Tech, whose wit and wisdom specially qualify him for such positions. The party returned to the hotel to lunch with the officers of the Association of Professional Engineers of Nova Scotia, after which they attended a council meeting of the association. Both the luncheon and the council meeting had as their chairman J. H. Mowbray Jones, president of the association.

That evening a dinner meeting of the branch was held in the Nova Scotian hotel, at which 150 members were in attendance. In addition to the chairman of the branch and the president, the head table was graced by the presence of J. H. Mowbray Jones, president of the association, Rear-Admiral Murray and Commander Peers representing the Navy, Mr. J. E. Lloyd, the mayor of the city, the Hon. A. Stirling MacMillan, premier of the province, and Air Vice-Marshal G. O. Johnson representing the R.C.A.F.

The next day in the morning a regional meeting of the Council of the Institute was held followed by a joint luncheon with the professional association. In the afternoon the party was treated to a tour of the harbour.

On Sunday afternoon the officers of the branch with their wives assembled at the home of councillor Charles Scrymgeour at Imperoyal to receive the presidential party. This was a most happy occasion.

On Monday, Messrs. Currie and Gray provided cars to drive the party to Wolfville, where the students of Acadia met with the president immediately after lunch. A visit to the plants of the Avon River Power Company followed this meeting, and the party arrived back in time for a pleasant dinner at the hotel in Halifax. That evening, the president and his party were hosts to the officers of the branch and their wives.

On Tuesday morning the group went by motor to Antigonish, where they dined with the faculty of St. Francis-Xavier College after which they spoke to the undergraduates society.

Wednesday morning the party departed for Sydney, arriving there about noon in time to have lunch with the officers of the Sydney Branch and other prominent engineers at the Cove. In the afternoon a trip was made through the rolling mills, and that evening there was a dinner meeting which combined the annual meeting of the branch and the reception to the president. This dinner started under the chairmanship of J. A. MacLeod, the retiring chairman, who handed over during the course of the programme to M. F. Cossitt, the new chairman of the branch.

The following morning the party was taken to visit some of the power plants of the Dominion Steel & Coal Company, returning at noon to have luncheon with officers of the branch. In the afternoon the party divided, some visiting the naval base, and others taking in other points of interest that had to do with National Defence. The party left that evening by rail to return directly to Montreal.

The splendid hospitality which was extended to the group throughout the entire tour was a matter of considerable gratification. President Beaubien expressed himself enthusiastically over this hospitality and the many activities of the branches. The president's programme was a heavy one, but the cordiality of the officers and members as well as the staff and student bodies at the universities made the entire tour an exceptional pleasure and experience.

At each of the meetings, both before the branches and before the student bodies, the president was followed in his address by councillor Heartz and the general secretary. The president dealt very largely with post-war matters, and the need of engineering students acquiring something of the cultural subjects, or humanities to broaden his outlook. Mr. Heartz gave the students very sound advice as to what to expect after graduation to the engineering world, and on things which they could do that would be helpful to them in their search for success. The general secretary gave a brief account of the activities of the Institute, and dwelt at some length on the subject of collective bargaining.

GERMAN ATROCITIES IN RUSSIA

Recently the attention of the Council of the Institute was called to a report on the behaviour of Germans in Russia, as disclosed by investigations carried out after evacuation by commissions under the direction of Russian scientists. Through the National Council for Canadian-Soviet Friendship these awful and awesome reports have been reviewed by Council, and a message sent to the Soviet Academy of Science at Moscow.

The mind cannot grasp the enormity of these crimes. The studied cruelties, the planned mass murders that had as their objectives the elimination of competition in national attainment by the elimination of educated and cultured civilization, staggers the imagination. To think that such a people almost accomplished its objective, is a fearsome realization.

In Kharkov huge pits opened by a commission disclosed the murdered bodies of over 12,000 citizens. Gestapo prisons, designed to afford new horrors of torture and eventual death, were established everywhere the Germans went. At Smolensk a commission found bodies of 135,000 Soviet citizens who had been murdered during the two years occupancy by the Huns.

A studied plan of special torture for scientists, cultured people and intellectuals was in evidence everywhere. The destruction of institutions of learning, after looting, was a standard procedure. Libraries, universities, technical institutes, museums, were marked for preferred attention.

The mind revolts at the awful evidence and yet what has been revealed to the public in this country is but a portion of the horrible truth. There are no words to describe adequately the crimes that have been committed by this "superior race". Starvation, murder vans, blood pumping, deportation, mean little to those who have not experienced them, but they are words that should be kept in mind by those who will have the responsibility of determining the punishment of the guilty at the conclusion of the conflict.

In response to the appeal for protests of Hitler policy the Council of the Institute sent the following cable, through the office of the Council for Canadian-Soviet Friendship:

Soviet Academy of Science Moscow

The president and council of The Engineering Institute of Canada unanimously and vigorously condemn the crimes and atrocities perpetrated by the Nazi while occupying parts of Russia stop The cruel and fruitless destruction of civilians and institutions of learning constitutes the greatest crime of all time against civilization stop Such inhuman behavior such manifestations of mental and moral decay as disclosed in the reports of your scientists Tolstoy and Burdenko stagger the world stop We express to you our great sympathy in these trials and join with all decent people in utter condemnation of the criminals stop We salute your great nation particularly its soldiers and its scientists stop We will be glad to assist you in any way that we can.

deGaspé Beaubien, *President*
L. Austin Wright, *General Secretary.*

ROYAL CANADIAN ELECTRICAL AND MECHANICAL ENGINEERS

Herewith is an exchange of correspondence with the Minister of National Defence, Colonel J. L. Ralston, relative to engineers in the Army. This is a further step in the Institute's programme for securing equality of service and reward for engineers.

Colonel Ralston's letter overlooks the fact that professional pay of $1.00 per day was given to Ordnance Mechanical Engineers as far back as 1910. It was only cancelled after the last war in 1919. The reason or justification for the allowance was the same as for the doctors and dentists, namely that such persons had no prospect for promotion to senior command, or to other corps. They were limited definitely to command only in their own service.

The same restriction applies to engineers in the new R.C.E.M.E. Wartime Order No. 4230 declares "that all officers and other ranks of this Corps are combatant in the fullest sense, except that for the purpose of restricting the exercise of command, officers will be limited to military command over such officers and men as may be especially placed under their command or attached to their corps."

These officers cannot go beyond their own units. This results in them being denied staff course instruction. They are absolutely tied to a narrow range of promotions, and unlike officers in other units, including the Royal Canadian Engineers, must remain at almost a fixed level. No brigadiers or generals will ever come out of R.C.E.M.E. In the language of the day, they are controlled by a "ceiling," which slows up promotions for everybody in the corps, and makes it unattractive to prospective candidates.

The real difficulty seems to be that formerly so many non-technical persons were given commissions in the Ordnance that it would have been a farce to give professional pay to the whole group. Doubtless the department felt it could not distinguish between people of the same rank in the same corps, and therefore the non-professional man, who shouldn't be there at all, forced the department to deny the professional man his just dues. It is a difficult—an impossible—task for the department to justify this treatment. Colonel Ralston's letter does not help very much.

The reason the Ordnance Corps was "forced to accept students from universities .... prior to their having had any apprenticeship" was that engineers, both senior and junior, had learned that Ordnance was a poor field for them if they were ambitious to get any place. The Corps wasn't "forced" to give senior appointments to non-technical people to the exclusion of technical, yet that is what was done. If engineers had been given equality of opportunities with the stores side of Ordnance, there would have been no shortage of qualified candidates, even without a professional allowance.

It is to be hoped that the lesson has been learned, and that the new corps will not repeat the mistake of the old. Let us hope also that the stores officers do not get the pick of the appointments in the engineers' corps. Only engineers, professionally qualified and so recognized, should be given any commission from first lieutenant up. This is no place for accountants, lawyers, retail store managers, motor car salesmen, and so on. Let's take this electrical mechanical engineering business seriously at last.

March 27th, 1944.

The Hon. Colonel J. L. Ralston,
Minister of National Defence,
Ottawa, Canada.

Dear Colonel Ralston,

On behalf of the Institute's committee, representatives of which called on you on Monday, the 13th, I wish to thank you for your courtesy in seeing us and in listening to our case.

As you know, when we left you we called immediately on Major-General Young, the Master General of the Ordnance, and had a very cordial interview with him. He explained to us that the organization of a separate corps for electrical and mechanical engineers was well advanced and that something would be announced shortly. We understood from him that the corps would be organized very much on the same lines as the Royal Electrical and Mechanical Engineers in the Imperial Army.

This news gave us great satisfaction and will be well received by the thousands of engineers all over Canada and by those overseas as well. Knowing the engineers as we do, and after studying the history of a similar move in England we are confident that you and the officers in your department will be highly pleased with the results.

We regret that there will be no professional allowance for engineering officers in the new Canadian corps. Such an allowance is made in the British set-up. As long as this allowance is made to doctors and dentists in the Canadian services and not to engineers, the engineers are going to complain of the discrimination. No one has ever been able to explain why this discrimination has been established or why it continues. You will notice in the brief which we left with you that the committee believes that persons practising their professions should be treated alike and that they should all get the allowance or that none should get it. We still adhere firmly to this principle.

Recently I have been privileged to see a copy of the Canadian Army Routine Order No. 4230 which deals with the Canadian Electrical and Mechanical Engineers Corps. So far I have made only a quick examination of it but I am quite disturbed to see that no specification is included which limits the commissioned officers to persons with professional qualifications. Section 4 (b) states— "C.E.M.E. Officers will consist of electrical and mechanical engineers of appropriate ranks and of ungraded engineering officers." There is nothing to describe what the order considers as electrical and mechanical engineers. In the past many persons without engineering training or experience have been given engineering appointments.

The qualifications for commissioned rank in the R.E.M.E. are—"Candidates must have undergone an apprenticeship of at least three years' duration and, in addition, must (a) possess a degree in engineering of any recognized university, or (b) be a graduate member of the Institution of Mechanical Engineers or of the Institution of Electrical Engineers, or have qualifications exempting them from the examinations of these institutions."

If the senior appointments in the new C.E.M.E. are not going to be engineers the situation will not be much different from that which presently exists in the Ordnance Corps and about which so much adverse comment has been made. We had hoped that a policy of giving these technical positions to technical persons would be followed by the department as in the Imperial Army.

We do not want to ask the impossible and we realize that sufficient technical personnel may be difficult to get at this time, but we do feel the regulations should contain a specification similar to that for the R.E.M.E. so that the status will be established for the future. We believe satisfactory persons could be located through the Wartime Bureau of Technical Personnel or through the technical organizations such as The Engineering Institute of Canada. Certainly we would all be glad to help.

Once again we thank you for the courtesy of the appointment which you gave us. If we can be of assistance to your Department, we would be glad to have you call upon us at any time.

Yours sincerely,

L. Austin Wright, *General Secretary*

Note: See *Engineering Journal*, March 1943, page 147, for description of R.E.M.E. work and qualifications.

Minister of National Defence

L. Austin Wright, Esq., Ottawa, April 8, 1944.
General Secretary,
Engineering Institute of Canada,
2050 Mansfield Street,
Montreal, P.Q.

Dear Mr. Wright,

I appreciate your letter of March 27th. I was very glad indeed to meet the representatives of the Engineering Institute and was most interested to hear the opinion of the engineering profession in Canada in relation to the welfare of engineers in the Armed Forces.

The formation of the recently authorized Royal Canadian Electrical and Mechanical Engineers will, I trust, provide more satisfactory direction and co-ordination of repair services and we hope will result in more economical use of skilled manpower. I think I should say however that experience has shown that these benefits can only be achieved if there is the closest co-operation between the R.C.E.M.E. and the R.C.O.C. and I fully expect that that will be forthcoming.

With reference to your remarks concerning Canadian Army Routine Order No. 4230, I must point out that this order deals with the general formation of the

Corps and the transfer of personnel, their duties, etc., and therefore, does not handle in detail the matter of qualifications for R.C.E.M.E. officers. The academic and practical qualifications of R.C.E.M.E. officers will remain the same as they are at present for officers on the "E" side of Ordnance. These qualifications are and have always been equal to those demanded by R.E.M.E. with the exception that they do not require candidates for O.M.E. appointments to serve three years' apprenticeship in electrical and mechanical engineering. This is an additional qualification of R.E.M.E. which we believe is very valuable but our demands are such that the imposing of these requirements is not practical because in order to meet our demands for officer personnel we are forced to accept students from universities immediately upon graduation and prior to their having had any apprenticeship in the engineering world. The number of candidates accepted as E.M.E. officers with practical experience only is very small. Each case is treated on its merits and the selection is subject to the approval of the Master-General of the Ordnance.

The Wartime Bureau of Technical Personnel has, since its inception, been our major source for O.M.E. candidates. This body has been most co-operative in locating technical personnel for the Army.

The question of Professional Allowances for Engineers would have far reaching implications quite apart from the question of its justification on other grounds. As you know, there are many professions represented in the Canadian Army and whereas it is true that Doctors and Dentists are given special allowances I do not consider it advisable to open up the matter at present.

Thank you for your interest and your kind offer of assistance. I have been glad to now advise our officers that we can count on that whenever required.

Yours very truly,

(Signed) J. L. Ralston.

ENGINEERING EDUCATION AFTER THE WAR

An indication of the trends in engineering education is contained in the report of a special committee of the Society for the Promotion of Engineering Education. This Committee on Engineering Education After the War has reviewed the long range problems of educational principle and practice as well as the urgent problems of the immediate future. The report, which is full of substance for thought, is signed by 21 persons who have achieved eminence in the field of engineering education. Dr. C. R. Young, Dean of Applied Science of the University of Toronto and Past-President of the Institute is a member of the committee.

The report appears in full in the current issue of the *Journal of Engineering Education* and the conclusions are reproduced herewith. It is hoped that reprints of the complete report will be available shortly at Headquarters.

Purposes and Problems of Engineering Education

War experiences have altered temporarily the norms of engineering education but have not indicated the desirability of radical changes. With the cessation of hostilities war-time expedients should give place as rapidly as practicable to normal functions and the healthy processes of evolution should be resumed. The directives of the 1940 Report on Aims and Scope of Engineering Curricula remain essentially valid, within their limits. Events have shown one major extension to be needed, namely, a more positive indoctrination in civic and professional responsibilities. It has also become increasingly clear that secondary education needs to be strengthened, especially in mathematics and science, as a means of preparing for collegiate engineering education and means to this end must be sought vigorously.

The bounds of the undergraduate period are set at one limit by secondary education and at the other by certain goals of mastery distinctive to engineering and essential to its professional functions. These goals include mastery of fundamental scientific principles, engineering modes of thought, basic knowledge in some major branch of engineering, elementary competence in the art of engineering application, some understanding of cost relations, skill in the use of English, insights into social relations and processes, and concepts essential to worthy personal and professional life. The goals of advanced knowledge and specialized technique belong properly to graduate and post-college training. The major paths along which progress is to be sought in the undergraduate period include the choice of essential matters and the elimination of non-essential matters of instruction, the grouping of the chosen materials into coherent major sequences, the inculcation of effective habits and standards, skillful combination of teaching methods, the development of creative as well as analytical abilities, and the evaluation of the attainment of the larger goals as well as the details of learning.

Matters relating to administration and management which conform to engineering modes of analysis and procedure have a valid place in engineering education. Trends in industry also make opportune increased attention to the production of industrial materials and of consumer goods, and to the recruitment of the production personnel as distinct from research and planning personnel.

The restoration of graduate work and its extension in scope to include all areas of advanced specialization should be immediate post-war goals. Instruction and research should be developed as complementary and coordinate functions.

The Committee believes that both industry and the engineering profession would benefit from a clearer understanding of the relative functions of technical institutes of intermediate type and engineering colleges, and from the larger development and strengthening of the former. This can be aided by—in fact can scarcely be accomplished without—the establishment of appropriate measures for the recognition of technical institutes by the engineering profession and the acceptance of their graduates by industry and government for a wider range of sub-professional technical occupations.

It is the hope of this committee that one of the chief results of this report will be the stimulation of educational experimentation among engineering colleges and the presentation of papers before regional and national meetings of this Society on specific measures for accomplishing the purposes indicated herein. The immediate post-war period, when readjustments must be made in any case, would seem to be an opportune time for the trial of new methods and for the dissemination of information about them.

Matters of Immediate Concern

Among the problems which will have a bearing on the course that engineering education will follow for many years to come, two stand out as of great importance: (1) Devising more valid means than have been employed in the past for selecting and admitting students and insuring better preparation in secondary schools, and (2) building up faculties not only to the pre-war level of effectiveness but well above that level. Engineering education can never advance beyond the qualifications of its students and teachers. Hence, the engineering profession, industry, and the public who have a vital interest in its welfare, should vigorously support every possible means of improving the quality of its personnel.

Of more immediate concern is the planning of appropriate educational programmes for returning veterans in order to permit them to enter productive pursuits in the minimum time consistent with sound practice. This can and will be done. We would call attention especially in this connection to provision of postgraduate work, either full-time or part-time, for those who desire and can profit by it.

If, as present indications seem to suggest, there is to be a reaction away from the war-time accelerated academic calendar and if conditions of universal military service are such as to permit freedom of choice in relation to this matter, it may be necessary to meet the criticism of those who see serious waste in permitting valuable educational facilities to be operated for less than a full calendar year. We have referred previously to the values derived by students from the experience and the maturing influence of employment in industry. Engineering colleges might well establish systematic means of aiding students to secure employment that will afford the right sort of experience,* and of requiring such experience as a prerequisite to graduation. If educational programmes are to be in regular operation for less than the full calendar year, it is equally important that vacations be used profitably by teachers. It seems appropriate, and even necessary, that they be expected to spend vacations in industrial employment, research, writing, or other pursuits that will keep them abreast of current developments in science and engineering or otherwise promote their professional advancement.

Finally, and of the utmost importance during post-war years will be the inevitable problems of financing higher education during a period of world-wide economic rehabilitation. One not inconsiderable aspect of this matter will be the necessity of restoring to normal efficiency laboratory facilities worn out or damaged by war usage. The war has caused a suspension of replacement of items of equipment that have become obsolete; others have undergone abnormal wear and deterioration; provision must be made to make good these deficiencies. In sum, a period of serious financial difficulty lies ahead.

Wide fluctuations in enrollment of engineering students are being experienced. These fluctuations occur not only in total numbers but in distribution by years and curricula. It is to be anticipated that this condition will continue into the post-war period. It is possible also that in the immediate post-armistice years there will be a considerable influx of new students at the same time that veterans are returning to complete their curricula. How long this condition will continue is a matter of conjecture, but it seems plain that the resulting problems will be severe in the internal administration of engineering colleges.

If at the same time there is to be a permanent increase in enrollment in science and engineering, and if colleges of engineering are to occupy a larger place and exercise a more general function than they do at present in the scheme of collegiate education in this country, it is not only appropriate but necessary to plan in advance for the facilities and staffs which these changes will require. And it is especially important that the educational problems that will accompany such an expansion of scope and function should be considered on broad lines in the interest not only of industry and the engineering profession but of the nation as a whole.

*Certain colleges achieve this result through the co-operative plan.

MEETING OF COUNCIL

A regional meeting of the Council of the Institute was held at the Nova Scotian Hotel, Halifax, on Saturday, April 22nd, 1944, convening at ten o'clock a.m.

Present: President deGaspé Beaubien (Montreal) in the chair; Vice-President G. L. Dickson (Moncton); Councillors Alan E. Cameron (Halifax), R. E. Heartz (Montreal), P. A. Lovett (Halifax), E. B. Martin (Moncton), J. A. Russell (Sydney), C. Scrymgeour (Halifax), and General Secretary L. Austin Wright.

There were also present by invitation—Past Vice-President F. A. Bowman, Past-Councillors W. P. Copp, K. L. Dawson, H. W. L. Doane, J. R. Kaye, I. P. Macnab, Harvey Thorne, and C. H. Wright, of Halifax, and Fraser S. Keith, of Montreal; the following members of the Halifax Branch—G. J. Currie, chairman, L. E. Mitchell, vice-chairman, A. E. Flynn, immediate past-chairman, S. W. Gray, secretary-treasurer and past-councillor, C. D. Martin and H. A. Ripley, members of the executive; J. H. M. Jones, president of the Association of Professional Engineers of Nova Scotia; and G. A. Gaherty, chairman of the Committee on Western Water Problems and a member of the Committee on Professional Interests and the Finance Committee.

President Beaubien expressed his pleasure in attending a meeting in Halifax and extended a cordial welcome to all councillors and guests, many of whom had come from distant points to attend the meeting. It was most encouraging to know that Council had the support, co-operation and endorsement of the membership at large, as indicated by such regional meetings. He extended a special welcome to Mr. Jones, the president of the Association, and hoped that he, as well as the other guests, would take part in the discussions. He was particularly pleased to welcome to the meeting Dr. Alan E. Cameron, the newly appointed councillor representing the Association of Professional Engineers of Nova Scotia.

Technical Institutes—The general secretary reported that copies of Dean Young's memorandum entitled "The Desirability of Establishing Technical Institutes in Canada" had been sent to all Institute branches, to all the associations, and to the universities, with the suggestion that the various bodies in each province might get together and, after discussion, take the matter up with the Provincial Departments of Education. In each province the secretary of one of the Institute branches had been asked to act as convenor.

Dean Young and Mr. deJong have reported progress in Ontario, where it is expected that the Department of Education will establish such institutes immediately. Dean Young had suggested that it would be desirable if each province would report progress to the Institute headquarters so that through the *Journal* the other branches could be kept informed.

Reporting for Nova Scotia, Mr. Gray stated that he had had no word from the Cape Breton Branch, but he knew that Dr. Sexton had studied the matter and had made a report to the Nova Scotia government. As secretary of the Association he had brought the matter up at the Association Council meeting held the day previous.

The general secretary reported that copies of a pamphlet had been received from the National Council of Technical Schools at Washington, entitled "Proposed Code of Minimum Standards for Technical Schools", and, although applicable to conditions in the United States, he felt this pamphlet would be of assistance to any person studying the problem, and he undertook to secure a further supply for distribution in Canada.

During the discussion many questions were raised including the entrance requirements to such institutes, their relationship to existing technical schools and to night classes in specialized subjects, and the recognition which would be given to graduates of such institutes. Mr. Wright explained that it was planned that no degrees would be granted, and graduates would not be qualified for membership in the associations or in the Engineering Institute. Such persons, if they desired membership in those bodies, would be required to pass the examinations. The entrance requirement would probably be matriculation, and the standard would be about two years above the technical schools.

Professor Copp expressed a fear that the graduates of such schools might, in a very short time, be competing with young engineering graduates. Mr. Scrymgeour felt that there was a very definite place in industry for the graduates of such institutes, but they should not be permitted to get the idea that they are fully qualified engineers or professional men. Further discussion followed, in which Mr. Russell, Mr. Doane and Mr. Dickson took part. In the president's opinion, the discussion had been very helpful and indicated a definite need for this additional technical education. The matter would be followed up through the branches, and a further report presented at a later meeting of Council.

Employment Conditions (Collective Bargaining)—An important discussion took place on recent developments in labour legislation which might affect the professional status of the engineer employed in industry. These matters are discussed elsewhere in this issue.

Annual Meeting 1945—The general secretary reported that, following some correspondence regarding the location of the next annual meeting, a letter had been received from the secretary of the Winnipeg Branch indicating that the executive of that branch was definitely interested in the possibility of holding the 1945 annual meeting there. With the assistance which they would receive from Headquarters, particularly in regard to the attendance of members from eastern Canada, they felt that Winnipeg should prove an ideal location. If Council decided to hold the meeting in Winnipeg, the branch would make every effort to see that it was a success.

The suggestion was enthusiastically received by councillors and guests, and a resolution was passed approving of the proposal, with the understanding that the matter would be submitted again to the May meeting of Council in Montreal and the June meeting in Toronto before a final decision was reached. In this way the Winnipeg Branch would have assurance of support from eastern members.

Committee on Post-War Problems—The general secretary presented a letter from Mr. Warren C. Miller, chairman of the Committee on Post-War Problems in which Mr. Miller suggested that the committee should be discharged. His reasons for making this proposal were (1) that with its membership spread throughout so many branches it was almost impossible to get a collective opinion, and (2) post-war planning involved several controversial topics and he felt the Institute could not take part in matters of this kind which bordered on the political field. He thought that the elimination of the controversial items left the committee with little to do.

Mr. Miller went on to say that in his opinion the Institute "might well stand clear of any collective participation in public discussions of the problem except as they might affect the membership professionally, leaving to the individual members the matter of allying themselves with whatever economic group in which their interests appear to be."

Mr. Macnab explained that he had been a member of committees of this type and quite appreciated Mr. Miller's difficulties. He emphasized the difficulty in gathering information from any persons spread across the country. Mr. Miller was quite right in his proposals, and he thought that Council should accede to his suggestion of a discharge for the committee. Mr. Macnab went on to point out the importance of post-war planning and to suggest that better work might be done by the Institute if the individual branches took part in the post-war planning that was going on in their areas. He thought that in that way a great deal of good could be accomplished.

Mr. Gaherty referred to the duplication of planning which was now taking place and inquired as to whether or not the Institute branches might do something towards bringing order out of chaos.

Finally it was agreed that Mr. Macnab's suggestion should be brought to the attention of all branch executives, leaving it to the branches themselves to decide what they should do. This was agreed to unanimously.

The president and other members of Council referred favourably to the work which had been done by Mr. Miller and his committee. They appreciated the situation which faced him and in the light of his request agreed that the committee should be dissolved. It was moved by Mr. Heartz, and seconded by Mr. Dickson that a vote of thanks be tendered to Mr. Miller and his committee for the excellent work which they had done under difficult conditions. This was carried unanimously.

Town Planning—The general secretary reported on correspondence and conversations which he had had with members of the Institute relative to town planning. He pointed out that there were very few engineers in Canada who had specialized in this field. In view of the activity which appears to be developing for the post-war period he thought that more engineers should be encouraged to make a study of the subject.

The general secretary also expressed the desire to obtain from engineers, papers on this subject which might be printed in *The Engineering Journal*. In this way the interest might be increased and more men might be available to participate in this work as it develops.

Mr. Wright referred to an editorial which had appeared recently in the publication of the Royal Architectural Institute of Canada in which the suggestion was made that members of the two Institutes should get together to discuss this subject of common interest.

Mr. Macnab referred to the planning which was now being done in Halifax. He confirmed the general secretary's comment that few people were familiar with this field and he thought every endeavour should be made to expand the interest in and the knowledge of it. He thought it would be a splendid field for several young engineers who could become familiar with it now and grow up with it.

Finally it was agreed that the general secretary should communicate with the R.A.I.C. in order to expand the subject as mentioned in their editorial.

Death of Past-President O. O. Lefebvre—Reference was made to the death of Past-President O. O. Lefebvre which had taken place in Montreal on March 25th,

1944. Council expressed its deep sense of loss and, on the motion of Mr. Heartz, seconded by Mr. Dickson, the following resolution was passed unanimously. The general secretary was instructed to write to Madame Lefebvre on behalf of the Council:

"The Council of The Engineering Institute of Canada has learned with profound regret of the death of Past-President O. O. Lefebvre, a distinguished member of long standing, who rendered signal service to the Institute and to the profession.

"During his long service as councillor, vice-president and president of the Institute, he always had the interests of the Institute at heart. His ability, integrity and professional experience made him outstanding in his chosen profession.

"Few members of the Institute contributed more to the upbuilding of the profession of engineering. While Dr. Lefebvre's principal activities were in the province of Quebec, he was well known from coast to coast, both for his personality and for his professional attainments.

"Council desires to express to the members of his family its deep sympathy in their irreparable loss."

It was decided that the next meeting of Council would be held in Montreal on Saturday, May 20th, 1944, convening at nine thirty a.m. A regional meeting of Council would be held in Toronto on Saturday, June 17th, with a meeting of the Toronto Branch on the evening of June 16th, at which the president would be the guest of honour. Arrangements were also being made for the president to visit the Border Cities, London, Niagara Peninsula and Hamilton branches during the first four days of that week.

The president thanked the councillors and guests for their close attention to the various matters under consideration. On behalf of himself and the visiting councillors and guests he extended sincere thanks to the officers and members of the Halifax branch for their kindness and hospitality.

ELECTIONS AND TRANSFERS

A number of applications were considered, and the following elections and transfers were effected:

Members

Bickers, Cornelius Walter, Mech. Engr. ,(Delft Univ., Holland), mech. engr., Ford Motor Company, Windsor, Ont.

Bisson, Joseph Leonard, B.Sc., (McGill Univ.), district engr., Department of Public Works, Canada, Ottawa, Ont.

Bouchard, E. Andre, B.A.Sc., C.E., E.E., (Ecole Polytechnique), M.Sc., (M.I.T.), Professor of Elect'l. Engrg., Laval University, Quebec, Que.

Carswell, James Morrison, B.A.Sc., (Univ. of Toronto), chief engr., Central Inventory Records Divn., Dept. of Munitions and Supply, Ottawa.

Charles, Frderick Rolland, B.A.Sc., (Univ. of Toronto), F/Lt. Officer in charge engine section, R.C.A.F. School of Aeronautical Engineering, Montreal, Que.

Clifford, Harold Linscott, B.Sc., (Univ. of Maine), gen. mgr., Quebec Shipyards, Ltd., Quebec, Que.

Delisle, E. Alide, B.A.Sc., C.E., (Ecole Polytechnique), city engr., Shawinigan Falls, Que.

Deslauriers, Alfred J., B.A.Sc., C.E., (Ecole Polytechnique), engr., City of Lachine, Que.

Dumontier, Joseph Emile, B.A.Sc., C.E., (Ecole Polytechnique), divn. engr., Canadian National Railways, Quebec, Que.

Fenn, William Edward, B.A.Sc., (Univ. of Toronto), district radio engr., Radio Divn., Department of Transport, Winnipeg, Man.

Gaudette, Edgar, B.A.Sc., C.E., (Ecole Polytechnique), city engr., St. Jean, Que.

Gougeon, Elzear Napoleon, B.Sc., (M.I.T.), prodn. engr., Quebec Shipyards, Ltd., Quebec, Que.

Hebert, Camille Raymond, B.A.Sc., C.E., (Ecole Polytechnique), chief engr. and asst. mgr., Lord & Compagnie, Ltd., Montreal, Que.

Lake, Henry Morton, asst. to chief engr., Algoma Steel Corp., Sault Ste. Marie, Ont.

Lord, Joseph Henri, B.A.Sc., C.E., (Ecole Polytechnique), genl. mgr. and secy.-treas., Lord & Compagnie, Ltd., Montreal, Que.

Lupien, Leo, B.A.Sc., C.E., (Ecole Polytechnique), topographer engr., office of bridges, Dept. of Roads, Quebec, Que.

Phillips, W. Eric, B.A.Sc., (Univ. of Toronto), pres., Research Enterprises Ltd., Leaside, Ont., and pres. and gen. mgr. W. E. Phillips Co. Ltd., Oshawa, Duplate Canada, Ltd., and Fiberglas Canada, Ltd., and their subsidiaries.

Roxburgh, Gerald Steele, B.A.Sc., (Univ. of Toronto), regional representative, Wartime Bureau of Technical Personnel, Winnipeg, Man.

Stuppel, Isaac, (Polytechnisches Institut, Arnstadt, Germany), asst. supt., Hull Iron & Steel Foundries, Ltd., Ottawa, Ont.

Sutherland, John Gordon, B.A.Sc., (Univ. of Toronto), asst. engr. of track, Canadian Pacific Railway, Montreal, Que.

Swanson, Alfred Lawrence, asst. supt., Heaps Engineering, Ltd., New Westminster, B.C.

Thompson, George Alexander, B.A.Sc., (Univ. of Toronto), supt. of constrn., Aluminum Company of Canada, Ltd., Shipshaw, Que.

Wayland, Raymond Joseph, B.Sc., (Clarkson College of Technology), industrial engr., Stevenson & Kellogg, Management Engrs., Montreal, Que.

Whyte, James Smith, B.Sc., (Queen's Univ.), chief engr., Shawinigan Chemicals, Ltd., Shawinigan Falls, Que.

Juniors

Charnock, Edmund Thomas, B.A.Sc., (Univ. of Toronto), asst. sulphite supt., The Great Lakes Paper Co. Ltd., Fort William, Ont.

Finnie, Norman William, B.Sc., (Queen's Univ.), junior engr., Canadian General Electric Co., Peterborough, Ont.

Girard, Arnold Thomas, B.A.Sc., (Univ. of Toronto), engr. i/c compressors, John Inglis Co., Toronto, Ont.

Harakas, Peter, B.A.Sc., (Univ. of Toronto), res. engr., Anglo-Canadian Pulp & Paper Mills, Ltd., Quebec, Que.

Longworthy, William Harold, B.Sc., (Univ. of Sask.), Sub-Lieut. (E), R.C.N.V.R., Esquimalt, B.C.

Sharpe, Thomas Albert Alexander, B.A.Sc., (Univ. of Toronto), prodn. and mech. engrg., on loan from Vector Engrg. Co. Ltd., Toronto to General Motors of Canada, Oshawa, Ont.

Transferred from the class of Junior to that of Member

Benjafield, John Fordyce, B.Sc., (Queen's Univ.), travelling supt., Foundation Co. of Canada, Montreal, Que.

Cunningham, Donald David MacCoubrey, F/Lt., B.Sc., (Univ. of N.B.), chief engr. officer, No. 17 Aeronautical Inspection District, R.C.A.F., Moncton, N.B.

Elford, Wesley Fred, B.Se., (Univ. of Alta.), mtce. of diesel machinery, Demerara Bauxite Company, Mackenzie, British Guiana.

Godfrey, William R., B.Sc., (Univ. of N.B.), water supply engr., Department of Transport, Moncton, N.B.

Holt, William George Herbert, B.A.Sc., (Univ. of Toronto), mech. designer, Dominion Bridge Co. Ltd., Lachine, Que.

Lemieux, Gilbert, B.A.Sc., C.E., (Ecole Polytechnique), asst. chief engr., Department of Highways, Quebec, Que.

Miller, Lindsay, B.Eng., (McGill Univ.), engr., Defence Industries, Ltd., Montreal, Que.

Thom, James Edwin, B.A.Sc., (Univ. of Toronto), supt., Plant Engrg. Dept., Defence Industries, Ltd., Verdun, Que.

Transferred from the class of Student to that of Member

Athey, Frank Allan Powell, B.Sc., (Univ. of Man.), process dev. engr., Nylon Divn., Canadian Industries, Ltd., Kingston, Ont.

Cass, Lorne Osborne, B.Sc., (Univ. of N.B.), asst. engr., National Harbours Board, Saint John, N.B.

Warren, Pierre, B.A.Sc., C.E., (Ecole Polytechnique), asst. to manager, Dominion Arsenal, Valcartier, Que.

Transferred from the class of Student to that of Junior

Blackett, Robert Leslie, B.Sc., (Queen's Univ.), navigation officer, R.C.A.F., Chatham, N.B.

Dodd, Geoffrey Johnstone, Jr., B.Eng., (McGill Univ.), asst. inspr. of Naval Ordnance, British Admiralty Technical Mission, Chicago, Ill.

McLean, Alexander F., B.A.Sc., (Univ. of Toronto), elect'l engr., Canadian Vickers, Ltd., Montreal, Que.

Near, Frank Manning, B.A.Sc., (Univ. of Toronto), officer in R.C.E., 39 Alexandra Blvd., Toronto, Ont.

Students Admitted

Asselstine, Stanley Howard, (Univ. of Alta.), 11507-96th St., Edmonton, Alta.

Beauchemin, Roger Olivier (Ecole Polytechnique), 379 Elm Ave., Westmount, Que.

Bowden, Donald Arie, dftsmn., H. G. Acres & Co., Niagara Falls, Ont.
Griffiths, George Motley, Cadet, R.C.C.S., Brockville, Ont. (Home) Box 385, Thorold, Ont.
MacLean, Fraser Alan, (Univ. of B.C.), 327-9th St., New Westminster, B.C.

Students at Mount Allison University

Anderson, Harold Olba, Brunswick House, Sackville, N.B.
Cameron, John McLean, Mount Allison Univ., Sackville, N.B.
Campbell, Ronald Elliott, P.O. Box 162, Sackville, N.B.
Carson, George Fraser, Mount Allison Univ., Sackville, N.B.
Chalmers, Mount Allison Univ., Sackville, N.B.
Chisholm, Arthur Frederick, P.O. Box 471, Sackville, N.B.
Clawson, Robert Hall, Brunswick House, Sackville, N.B.
Cohen, Louis, c/o Brunswick House, Sackville, N.B.
Crozier, Glendon Lockhart, Mount Allison Univ., Sackville, N.B.
Cunningham, Milton William, Brunswick House, Sackville, N.B.
Dexter, Donald Merritt, Brunswick House, Sackville, N.B.
Dexter, Val. Farnham, Mount Allison Univ., Sackville, N.B.
Dodson, William Lloyd, 941 Victoria Rd., Sydney, N.S.
Durant, William Campbell, Brunswick House, Sackville, N.B.
Eldridge, Nowal Llewelyn, Brunswick House, Sackville, N.B.
Ferguson, Donald Stewart, Box 431, Sackville, N.B.
Flemming, John Albert, Box 119, Sackville, N.B.
Gregg, Donald Garrett, 67 Willow Street, Truro, N.S.
Hillier, Norman Charles, Box 484, Sackville, N.B.
Hollis, Edward Kimball, Mount Allison Univ., Sackville, N.B.
Kelly, Frank Leonard, Mount Allison Univ., Sackville, N.B.
Kirsh, Leonard Bernard, Mount Allison Univ., Sackville, N.B.
Lockhart, Charles Owen, Box 627, Sackville, N.B.
Macdonald, Donald Philips, Brunswick House, Sackville, N.B.
McLellan, Edgar King, River Philip Ctr., Cumb. Co., N.S.
McMulkin, George Jones, Sackville, N.B.
Mosher, Kenneth Roy, 116 Weldon St., Moncton, N.B.
Mouland, Gordon Cyril, Mount Allison Univ., Sackville, N.B.
Mulhall, William Frederick, Mount Allison Univ., Sackville, N.B.
Powers, John William, Brunswick House, Sackville, N.B.
Purdie, William McLeod, Brunswick House, Sackville, N.B.
Ross, George, Mount Allison Univ., Sackville, N.B.
Stonehouse, Donald Harry, Mount Allison Univ., Sackville, N.B.
Welch, John Kenneth, Mount Allison Univ., Sackville, N.B.
Williamson, John Richard, Mount Allison Univ., Sackville, N.B.
Yeomans, Lloyd Herbert, Mount Allison Univ., Sackville, N.B.

Students at the University of Toronto

Gladney, William Edward, 131 Stibbard Ave., Toronto, Ont.
Kent, Stanley Roland, 25 Humewood Drive, Toronto, Ont.
Martin, John Clayton, 639 Millwood Rd., Toronto, Ont.
Sanderson, David Reynolds, 266 Armadale Ave., Toronto, Ont.
Sommerville, Lorne Williams, 131 DeForest Rd., Swansea, Ont.
Travers, Frederick John, 58 Kingswood Rd., Toronto, Ont.
Ward, John William, 1 DeLisle Ave., Toronto, Ont.

Students at the University of Manitoba

Croome, Norman Carrol, 4A Fort Garry St., Winnipeg, Man.
Millar, Donald Mowbray, Ste. 6, Wauneta Apts., Winnipeg, Man.
Mudry, Nestor, 850 Selkirk Ave., Winnipeg, Man.
McCord, John Erskine Donald, 65 Scotia St., Winnipeg, Man.
Peebles, James Arthur, 428 Wardlaw Ave., Winnipeg, Man.
Tant, Verne Everet, 205 Aubrey St., Winnipeg, Man.
Tidholm, Charles Edward, 54 Noble Ave., Winnipeg, Man.

Students at McGill University

Boucher, Fernand R., 5538 St. Denis St., Montreal, Que.
Everett, Francis Edwin, 3425 St. Famille St., Montreal, Que.
Mendel, Arthur Hesse, 913 Rockland Ave., Outremont, Que.
Webster, David Richan, P.O. Box 600, Yarmouth, N.S.

Students at Nova Scotia Technical College

Merchant, John Anthony, 316 Tower Rd., Halifax, N.S.
Mitchell, Kenneth Roscoe, 106 Crichton Ave., Dartmouth, N.S.
Wilcox, Robert Bernard, N.S. Tech. Coll., Halifax, N.S.

Students at the University of New Brunswick

Bond, George Walter, Beaverbrook Residence, Fredericton, N.B.
Lewis, Aubrey Allison, Petitcodiac, N.B.
Mulherin, James Kenneth Conrad, 752 Union St., Fredericton, N.B.
Robinson, Paul Gordon, 752 Union St., Fredericton, N.B.
Wright, Howard R., 514 Regent St., Fredericton, N.B.

By virtue of the co-operative agreements between the Institute and the provincial associations of professional engineers, the following elections and transfers have become effective:

ALBERTA

Student

Martyn, Robert Edison, dftsmn., Gas and Oil Refineries, Ltd., Hartell, Alta.

NEW BRUNSWICK

Member

Turnbull, Wallace Rupert, M.E. (Cornell Univ.), Rothesay, N.B.
Ross, Gordon William, B.Sc. (Univ. of N.B.), No. 4 A.O.S., R.C.A.F. London.

SASKATCHEWAN

Transferred from the class of Student to that of Junior

Thomson, Walter Barron, B.Sc. (Univ. of Sask.), junior engr., P.F.R.A., Department of Agriculture, Regina, Sask.

Personals

Relatives and friends of members in the active forces are invited to inform the Institute of news items, such as locations, promotions, transfers, etc., which would be of interest to other members of the Institute and which should be entered on the member's personal record kept at Headquarters. These would form a basis of personal items in the *Journal*.

News of the Personal Activities of members of the Institute

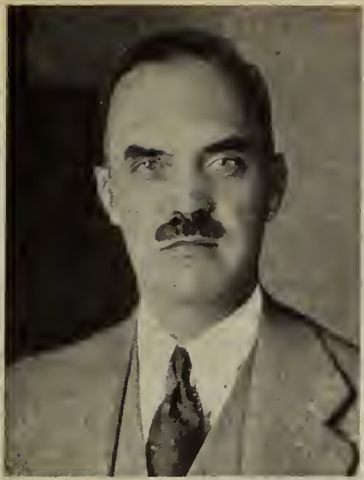
Professor R. W. Angus, HON.M.E.I.C., head of the department of mechanical engineering at the University of Toronto, retires at the end of the present session, after nearly 45 years' service. A graduate of the University of Toronto in the class of 1894, he acquired his early engineering experience with E. Leonard & Sons, London, Ont., and in Pittsburgh and Cleveland, U.S.A., where he was engaged in the design of automatic screw machines, steel plant equipment, and internal combustion engines.

He joined the teaching staff at the University of Toronto in 1900 as lecturer and became professor of mechanical engineering in 1906. He is responsible for the design and equipment of the mechanical laboratories of the university.

Through extensive travelling, Professor Angus has kept in touch with the most advanced engineering work in America and Europe. In addition to his teaching duties he has a large consulting practice, particularly along the lines of expert testing and reporting on hydraulic machinery. His published works include "Theory of Machines" (1915) and "Hydraulics for Engineers" (1931); in addition he has presented several papers before scientific and engineering societies.

Professor Angus is an Honorary Member of The Engineering Institute and holds the same distinction in The American Society of Mechanical Engineers. In 1942 he was awarded the George Warren Fuller Award of the American Water Works Association "for his noteworthy contributions to research in water hammers and other hydraulic subjects."

Gordon D. Hulme, M.E.I.C., assistant manager of the department of development of The Shawinigan Water and Power Company, was recently elected president of the Young Men's Section of the Montreal Board of Trade.



J. W. McCammon, M.E.I.C.

Raymond A. Latreille, M.E.I.C.

J. W. McCammon, M.E.I.C., is one of the members of the newly established Quebec Hydroelectric Commission which recently took over the plants of Montreal Light, Heat and Power Consolidated and the Beauharnois Light, Heat and Power Consolidated. At the first meeting of the Commission he was appointed general manager.

Since 1935 Mr. McCammon has been a member of the Quebec Electricity Commission which in 1938 became the Provincial Electricity Board and in 1940 the Public Service Board. A graduate of McGill University, Mr. McCammon has had extensive engineering and business experience, having been, in particular, assistant general manager of Beauharnois Power Company from 1929 to 1934.

H. B. LeBourveau, M.E.I.C., is the newly elected chairman of the Calgary Branch of the Institute. He was born at Cookshire, Que., and received his education at the University of Alberta, Edmonton, graduating in electrical engineering in 1924. Upon graduation he joined the staff of the Canadian Westinghouse Company, and a year later went with the Calgary Power Company. His present position is that of transmission and distribution engineer, involving the design, construction and maintenance of all transmission lines, distribution systems and small substations.

Mr. LeBourveau joined the Institute as an Associate Member in 1930 and has served on the Calgary Branch executive, as well as councillor of the Association of Professional Engineers of Alberta.

L. G. Trudeau, M.E.I.C., has been transferred to Ottawa, as district engineer with the Department of Public Works of Canada. He was previously district engineer at Quebec.

Lyle McCoy, M.E.I.C., has been appointed vice-president and assistant general manager of Canadian Car and Foundry Company, Limited, Montreal, succeeding the late W. S. Atwood, M.E.I.C. He has been associated with the company since 1916 and for the past two and a half years has managed the company's munitions plant at Cherrier, Que.

J. F. McGuire, M.E.I.C., formerly with the Lincoln Electric Company of Canada, Limited, Montreal, as sales and welding engineer, has recently joined Industrial Power Equipment Limited, Montreal, as engineer.

Wing-Commander D. B. Rees, M.E.I.C., has recently been posted at R.C.A.F. Headquarters, Works and Buildings Division, at Ottawa. He was previously stationed at Calgary, Alta.

Raymond A. Latreille, M.E.I.C., head of the hydraulic service in the Department of Lands and Forests at Quebec, was appointed one of the members of the newly established Quebec Hydroelectric Commission.

At the first meeting of the Commission he was appointed secretary.

Mr. Latreille is a graduate of the Ecole Polytechnique, Montreal, in the class of 1932. Upon graduation he was employed for a few years in construction work, successively with Arthur Surveyer & Company, and Beaubien, Busfield Company of Montreal. He entered the service of the government for the Province of Quebec in 1925 as a senior engineer in the hydraulic service. He successively roseto the positions of assistant chief engineer and chief engineer.

P. R. Sandwell, M.E.I.C., has recently returned from Australia, where he was resident engineer for the Australian Newsprint Mills Proprietary Limited, Boyer, Tasmania. He is now with Dominion Engineering Works, Montreal.

F. C. Stewart, M.E.I.C., who was formerly with the Greater Vancouver Water District, and the Vancouver and District Sewerage and Drainage Board, as assistant chief engineer, has gone into private practice as consulting engineer, in Vancouver.

Roger Trudeau, M.E.I.C., formerly with the Department of Roads of the Province of Quebec, is now employed as engineer with H. J. O'Connell, Limited, Montreal.

J. Alexander Walker, M.E.I.C., who has been in Ottawa for the past four years as mechanical engineer with the Department of National Defence, has recently returned to Vancouver, where he will resume his duties with the Vancouver Town Planning Commission.

K. G. Chisholm, M.E.I.C., has been transferred from Winnipeg to the Toronto office of the R.C.A. Victor Company.

James A. Ogilvy, M.E.I.C., has joined the R.C.N.V.R. as a Lieutenant (Special Branch). He was formerly with the Department of Munitions and Supply, Gun Division, Ottawa.

S. R. Frost, M.E.I.C., is the newly elected chairman of the Toronto Branch of the Institute. He is regional representative of the Wartime Bureau of Technical Personnel at Toronto, having been granted leave of absence from the North American Cynamide Company, Limited, in 1941.

G. R. Adams, M.E.I.C., of the Foundation Company of Canada, Limited, Montreal, is at present located at Peninsula, Ont., where he is engaged in construction work in connection with the establishment of the new paper mill of the Marathon Paper Mills Limited.

C. B. Britnell, M.E.I.C., temporary junior engineer in the Toronto district office of the Department of Public Works of Canada who was loaned to the Department of National Defence in December 1940, has enlisted as a Sub-Lieutenant (E) in the R.C.N.V.R.

J. L. Bisson, M.E.I.C., who became district engineer of the Department of Public Works of Canada at Ottawa in 1937, was recently promoted to the position of superintending engineer at headquarters, succeeding Robert Blais, M.E.I.C.

Oliver A. Barwick, M.E.I.C., formerly with the United Shipyards Limited, Montreal, is now with Robert A. Rankin & Company, Montreal.

James S. Campbell, M.E.I.C., formerly with the Massey Harris Company, Limited, Brantford, Ont., is now employed with Defence Industries Limited, Montreal.

R. E. Farmer, M.E.I.C., of the Canadian Pacific Railway was recently transferred from Sudbury, Ont., where he was employed as division engineer, to Montreal where he occupies the position of division engineer of the Laurentian Division.

F. C. Read, Jr.E.I.C., has recently been transferred to the Sydney plant of the Dominion Tar and Chemical Company, as assistant manager. He was previously with the same company in Toronto.

Squadron-Leader M. S. Layton, Jr.E.I.C., has been awarded the Distinguished Service Order, for outstanding devotion to duty and exceptional ability while a member of the crews of aircraft on convoy missions. He is at present attached to an operational training unit on the Pacific Coast.

Captain James Winn, S.E.I.C., a graduate of McGill University in 1935 and former mechanical engineer with the Anglo-Canadian Pulp and Paper Mills at Quebec, has been mentioned in dispatches for gallant and distinguished service in Sicily. Captain Winn enlisted as a 2nd lieutenant with the Royal Canadian Engineers in August 1940, obtaining his full rank the same year. In July 1943, he was promoted to acting captain and to the full rank in October, while on active service with the First Division in the Mediterranean area.

Anthony B. Rossetti, S.E.I.C., has recently been transferred from Defence Industries Limited, Montreal, to Canadian Industries Limited, as scheduling engineer, in the Cellophane and Organic Chemicals Division at Shawinigan Falls, Que.

Leon Wigdor, S.E.I.C., is now employed on the research staff of The Ault & Wiborg Company, Toronto. He was formerly with the engineering department of Distillers Corporation, Limited, Ville LaSalle, Que.

W. G. deHart, S.E.I.C., who is employed as an aeronautical engineer with Trans-Canada Air Lines, has been transferred from Calgary, Alta., to Winnipeg, Man.

Major Eric P. Stephenson, S.E.I.C., has been promoted from the rank of captain and is now in the Directorate of Mechanical Maintenance, Ottawa.

David E. Hibbard, S.E.I.C., of Toronto, is now with the International Petroleum Company, Guayaquil, Ecuador, S.A.

Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Henry Edward Ewart, M.E.I.C., Master of the Royal Canadian Mint, died in the hospital at Ottawa on April 28, 1944. He was born at Ottawa on March 11, 1878, and received his education in the local schools.

A son of the late David Ewart, a former chief architect of the Department of Public Works, Canada, he followed the family tradition, and in the nineties was associated with the late John Askwith of Ottawa in the contracting field. Mr. Ewart's architectural work took him to Halifax for some time, where he supervised the construction of the Halifax Armouries from 1896 to 1899.

Returning to Ottawa, he became assistant to T. W. Fuller, and was sent by the Department of Public Works to Dawson Territory in the Yukon, where construction of Government buildings had been necessitated by the Klondike gold rush. He remained in the Yukon as chief officer of the Public Works Department for some five years.

Shortly after his return to Ottawa, Mr. Ewart was appointed to assist in the purchase and installation of new equipment in the Royal Canadian Mint building on Sussex street, and in 1907 was named the first senior clerk of the permanent staff of the Mint. He was promoted to posts of increasing responsibility, and became the first Canadian to be Master of the Mint in 1938.

Mr. Ewart joined the Institute as a Member in 1935.

Benjamin Leonard Thorne, M.E.I.C., died at his home in Calgary on March 23, 1944. Born at Holland Landing, Ont., on Nov. 16, 1871, he received his education in Toronto.

Mr. Thorne entered the services of the Canadian Pacific Railway in the general freight department, in Toronto, in 1889 and remained there until 1893 when he left the company owing to ill health. From 1894 to 1896 he was employed as assistant to W. R. Burke, Ontario land surveyor, Ingersoll, Ont. In 1897 he left for Rat Portage, Man., where he was engaged in mining activities in the Lake of the Woods and Rainy River districts until 1900. In 1901 he went to the United States in connection with the mining operations of a New England syndicate and returned to Canada in 1902, when he was employed by the Algoma Commercial Company, prospecting for iron ore in Atikokan and Steep Rock Lake Districts, Ont.

In 1903 he entered the mining department of the Canadian Pacific Railway Company, and assumed charge of exploration operations in the Crows Nest Pass. Later he was engineer of development and construction at Bankhead mines, near Banff, and at Hosmer mines in British Columbia until 1914. He was then transferred to Calgary as mining engineer in the C.P.R. Department of Natural Resources, and occupied that position until his retirement in 1940.

After his retirement, Mr. Thorne became associated as mining engineer with the firm of Osler, Hammond and Nanton, Ltd., managers for the Calgary and Edmonton Corporation in Calgary. He was president of the Canadian Institute of Mining and Metallurgy in 1939, and also president of the Alberta Petroleum Association in 1942 and was re-elected again in 1943.

Mr. Thorne became a Member of the Institute in 1914. He was very active in the Calgary Branch of which he was chairman in 1921-22. He was a member of Council of the Institute in 1923-24-25.

GEORGES JOSEPH DESBARATS, C.M.G., Hon.M.E.I.C.

1861-1944

The Engineering Institute of Canada deplores the loss of one of its most distinguished past-presidents, a man whose career of fifty years in the service of the Dominion government began with active engineering work in the construction of the St. Lawrence canals, and closed while he was carrying out the responsible duties of deputy minister of National Defence. This eminent public servant—Dr. Desbarats, who died in Ottawa on April 28, 1944, was president of the Institute in 1937, the year of its semicentennial celebrations.

Georges Joseph Desbarats was born in Quebec on January 27, 1861, and at the age of eighteen graduated with honours from the Ecole Polytechnique, Montreal. Sixty-four years later, at the request of the faculty of the Ecole, the University of Montreal conferred upon him, one of their oldest alumni, the degree of Docteur ès-Sciences Appliquées '*ad honorem*'.

Entering the government service in 1879 as assistant engineer in the Department of Railways and Canals, he began his professional work at the time when important sections of our Canadian canal system were being built. He was engaged on the design and construction of the Carillon canal, the locks at Ste. Anne de Bellevue, the Canadian locks at Sault Ste. Marie, the Welland canal, and the Soulanges canal. In 1892 he was appointed inspector of railways in British Columbia for the Dominion government, a position which he resigned four years later to become engineer for the firm of contractors who were building the Galops canal. Returning to the government service in 1899 he was in charge of a hydrographic survey on the St. Lawrence, from Kingston to Quebec.

In 1901 he was made director of the Dominion government shipyard at Sorel, Que., being responsible for the reconstruction of the establishment and its subsequent operation under the then Department of Marine and Fisheries, the department of which he was promoted to be deputy minister in 1909.

In the following year the Department of Naval Service was organized; Mr. Desbarats was selected as its deputy minister. This department was called upon to carry a heavy responsibility during the war. In addition to its regular activities in connection with naval defence measures for Halifax, Sydney, and the St. Lawrence river and gulf, provision had to be made for the emergency construction of a fleet of one hundred and fifty mine-sweepers and a flotilla of torpedo motor boats, as well as the supply of their crews. These and other tasks were undertaken by the department which also acted generally as agent in Canada for the British Admiralty. In connection with air defence a large number of pilots were enrolled for the Royal Naval Air Service, and the department organized the Royal Canadian Naval Air Service, constructing air stations at Halifax and Sydney for that corps.

Mr. Desbarats' valuable services in dealing with these and other difficult questions during the early days of the war were recognized in 1915 when he was made a Companion of the Order of St. Michael and St. George.

In 1923 the Government decided to establish a Department of National Defence, merging in it the existing Departments of Militia and of Naval Service, together with the Air Board. The three military services were thus brought under one administration, and Mr. Desbarats became the deputy minister of the new department. He held that appointment with distinction until his retirement from the service in 1932.

His ability as an administrator found full scope in the strenuous days of 1914-1918, and in the succeeding years, during which there were many changes in organization, and many new technical branches of governmental work were developed. For example, these years saw the rise of air transportation in Canada. Mr. Desbarats early realised the commanding position which aerial transport must take in Canada, a country of such vast distances. Under his direction there grew up an important Civil Aviation Branch, together with the Royal Canadian Air Force.

Soon after the war, the department surveyed the Trans-Canada Airway, operating the links between Montreal and Windsor, and from Winnipeg to Calgary and Edmonton. These routes were provided with all the aids to navigation and operation then available. It was found necessary to discontinue their operation during the depression of the 'thirties', but they have since been revived and greatly extended by the present Department of Transport.

Under the Department of National Defence there were also constructed and operated a chain of radio stations extending from Edmonton north to Dawson and Herschel Island, a measure which proved of great value in aiding the mining and other developments which have since taken place in those northern regions.

In addition to these activities, the department of which Mr. Desbarats was the chief executive officer administered the armed forces of Canada, and dealt effectively with the new technical problems which arose in all arms of the services, for instance the mechanization of fighting and transport equipment for effective operation under Canadian conditions.

During his period of public service, Mr. Desbarats was entrusted with a number of technical missions, apart from his departmental work. In 1912 he served as plenipotentiary delegate from Canada to the International Wireless Conference in London, putting his signature to the first treaty made by Canada as an independent country. In Genoa, in 1920, he represented the Canadian government at the Seamen's Conference of the League of Nations; he was chief of the Canadian delegation to the International Conference on Civil Aviation at Washington in 1928, and at Antwerp in 1930 he was Canadian representative at the International Conference on Aerial Navigation.

Joining the Institute as a Member in 1897, Mr. Desbarats has been continuously active in its affairs. He served on Council in 1900, 1907, 1933 and 1934, was a vice-president in 1909, and was elected an Honorary Member in 1936. His election as president took place in the following year. The Ottawa Branch, of which he was chairman in 1931, owes much to his interest in its work and progress. He was awarded the Julian C. Smith Medal of the Institute for 1943.

He was an active and highly honoured member of the Canadian Red Cross Society, of which he was one of the national vice-presidents. He served also as president of the Canadian Club of Ottawa, and was treasurer of the Catholic Family Welfare. During the present war he worked unceasingly as national convener for prisoners of war parcels from next of kin. At the time of his death he was president of the Canadian Geographical Society.

The general esteem in which Dr. Desbarats was held was due to his genial personality as well as to his professional attainments. A devout churchman, his kindly concern for others was shown by his active support of so many charitable and community activities. He was an outstanding member of the Civil Service, possessing not only a wide knowledge of the technical details of his work, but also an enviable grasp of inter-departmental relations and of governmental administration in general. He will be greatly missed by all who were his colleagues, friends, or associates.

John Bonsall Porter, M.E.I.C.—A long and distinguished career as engineer, scientist, and educationalist ended with the death, on April 17th, 1944, of John B. Porter, emeritus professor of mining engineering at McGill University. During the thirty-one years of his active professorship he witnessed and took a leading part in the remarkable development of the engineering courses in that university.

Born in Glendale, Ohio, in 1861, he graduated at Columbia University in 1882, and two years later received the degree of Ph.D. for his work on the economic geology of coal and iron ores in Tennessee and Alabama. During the following twelve years he held a number of responsible positions in mining, metallurgical, and railway engineering work.

He came to McGill in 1896 as the first Macdonald Professor of mining and metallurgy. In 1904 he became professor of mining, and head of the department, which grew rapidly. At the time of his retirement in 1927 many of his former students occupied leading positions in the mining industry in widely separated parts of the world. In that year, through the efforts of a McGill graduate, Dr. W. W. Colpitts, Dr. Porter's work at McGill was commemorated by the establishment of the John Bonsall Porter Scholarship in the faculty of engineering.

In 1905 he received the honorary degree of D.Sc. from the University of the Cape of Good Hope, on the occasion of the South African visit of the British Association for the Advancement of Science. He had been a member of the Canadian Institute of Mining and Metallurgy since its foundation, having served on its council for many years, and as vice-president in 1907-8. His work as one of the founders of the Canadian Engineering Standards Association and on its executive was recognized in 1939 by the award of Honorary Life Membership in that body. In 1921 Dr. Porter was elected a member of the Council of the Institution of Civil Engineers (Great Britain) and became chairman of the Institution's Advisory Committee in Canada. He was also a corresponding member of the council of the Institution of Miningand Metallurgy (Great Britain).

He joined the Engineering Institute of Canada as a Member on his arrival at McGill in 1896, and served as a member of Council in 1904-1906. He was also an active member, a founder, and a past president of the Sigma Xi Society, McGill Chapter. His best known technical work was in connection with a six-volume report on an "Investigation of the Coals of Canada" which he carried out for the Department of Mines, Ottawa, in 1906-1910, at McGill University, with the collaboration of several of his colleagues and the necessary staff.

His interests and knowledge extended far beyond the limits of his own profession. Widely travelled, a man of varied experience, his kindly help and advice was always available for the students and young engineers attending the courses of his department. R.J.D.

Adrien Plamondon, M.E.I.C., consulting engineer, died in the hospital at Montreal on March 29, 1944, after a long illness. Born at St. Cesaire, Que., on December 8, 1885, he received his engineering education at the Ecole Polytechnique, Montreal, where he graduated in 1909.

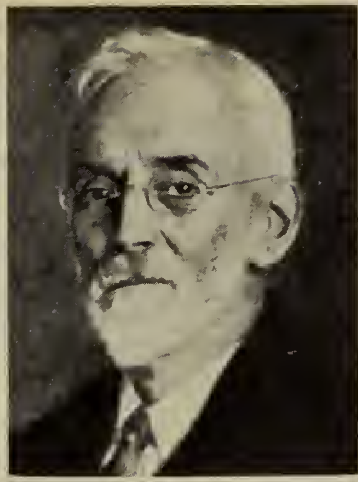
Following several years spent in hydrographic survey and construction work, he was in business as engineer and contractor in Montreal, from 1911 to 1920, since which time he has become widely known as a consulting engineer. In this capacity he designed and built a number of filtration plants in towns of the province of Quebec, besides designing complete water and sewer installations for the towns of Beauharnois, Nicolet, Farnham, Sorel, Drummondville, Shawinigan Falls, Longueuil and others. He was in charge of the installation of a 44-inch water line seven miles long for the Town of La Tuque.

An outstanding commission was his appointment as consulting engineer for the city of Warsaw, Poland, in connection with a fifty million gallon filtration plant.

He was a member of the consulting board for the City of Montreal on its water intake and had been honorary secretary of the Montreal Builders' Exchange of which he was a life member since 1939. He was appointed to the Montreal Electricity Commission in 1936, succeeding Dr. Augustin Frigon, M.E.I.C., and became president in 1939.

Mr. Plamondon joined the Institute as a Student in 1907, transferring to Junior in 1913. He was transferred to Associate Member in 1923 and became a Member in 1940.

Benjamin Leonard Thorne, M.E.I.C.



John Bonsall Porter, M.E.I.C.

Adrien Plamondon, M.E.I.C.

Leonard Martin Cox, M.E.I.C., died on December 12, 1943, at his home in St. Helena, California. Born at New Liberty, Kentucky, on March 21, 1870, he received his engineering education at Rensselaer Polytechnic Institute, Troy, N.Y., where he graduated as a civil engineer. From 1892 to 1899 he was employed in railroad construction work in Kentucky. He was commissioned as a lieutenant, junior grade, in the Corps of Civil Engineers in the United States Navy in 1907, rising to the rank of lieutenant in 1907 and to that of commander in 1909. In 1916 he was promoted to commodore and became a captain in 1921. He retired in 1923.

During his career with the U.S. Navy, Captain Cox had extensive engineering experience. From 1899 to 1901 he was assistant to the public works officer in the navy yard, New York, and from 1901 to 1903 he was public works officer on the island of Guam. In this capacity he carried out the first geographical survey of the island and supervised the construction of roads and the design of water works. From 1903 to 1906 he was in charge of the construction of a floating dock. He resigned from the navy in 1906 to accept the position of chief engineer of the Louisville, Henderson and St. Louis Railway, but the following year he was recommissioned in the navy and became assistant to the public works officer at Norfolk, Va. From 1909 to 1911 he was assistant chief of the Bureau of Yards and Docks, Washington. He returned to Norfolk, Va., as public works officer at the navy yard in 1911, and was transferred to the same position in New York, in 1915. In 1917 he became public works officer at San Diego, where he initiated the work on the Naval Air Station and Marine Expeditionary Depot. In 1918 and 1919 he was assistant manager of the division of shipyard plants for the Emergency Fleet Corporation at Philadelphia. He was appointed public works officer of the navy yard at Mare Island, Calif., in 1919 and occupied that position until his retirement in 1923. The following year he entered private practice as a consulting engineer in San Francisco and up until a few years ago, when he definitely retired from active work, he acted as consultant on several important projects, among which was the reconstruction of the Tampico Harbour.

Captain Cox also became interested in publishing after his retirement from the U.S. Navy and at one time he was co-publisher of a daily paper in Vallejo, California.

Captain Cox joined the Institute as a Member in 1926.

Air Vice-Marshal Walter Robert Kenny, D.F.C., M.E.I.C., Air Attaché for Canada at Washington, died in the hospital at Ottawa on April 11, 1944. He was born at Ottawa, September 18, 1885, and was educated in local schools and also at the Royal Naval Staff College, Greenwich, England.

He was commissioned in the Royal Naval Air Service in 1915 and, in 1917, was promoted to flight lieutenant and appointed second in command of H.M. Seaplane Base at Dundee, Scotland. In 1918 he became a captain in the R.A.F., and was in charge of squadron flying boats. Most of his time in the R.A.F. was spent in anti-submarine work for which he was awarded the D.F.C. In 1919 he returned to Canada and in the following year received an appointment with the Royal Air Board and later with the R.C.A.F. He rose steadily through the ranks to Air Commodore in 1939 and later he was made Air Vice-Marshal on his appointment as Air Attaché at Washington.

Among the many important posts held by Air Vice-Marshal Kenny in the Royal Canadian Air Force were those of: Staff Officer Operations and Staff Officer Personnel; Canadian Liasion Officer, Air Ministry, London; O.C. No. 1, Aircraft Depot, Ottawa; chairman, Air Station Development Committee; Directorate of Works and Buildings, head of Personnel and Training Division and member, Air Council for Personnel.

Air Vice-Marshal Kenny joined the Institute as an Associate Member in 1924, becoming Member in 1940.

Robert Edward Palmer, O.B.E., M.E.I.C., died in London, England, on April 6, 1944. Born at Charlottetown, P.E.I., on December 16, 1865, he received his engineering education at McGill University, Montreal, where he graduated in 1887 at which time he joined as a Student the Canadian Society of Civil Engineers, which had just been established. In the early days of his career, he did survey work in connection with railway construction and from 1888 to 1890 he was assistant city engineer at Vancouver, B.C. In 1890 he established a consulting practice at Vancouver and for the following ten years was engaged in survey and construction work as well as mining development. In 1900 he went to Spain as chief engineer of the Rio Tinto mines. Later he moved to London, where he established himself as a consulting and mining engineer. During his practice he was associated with several British firms engaged in mining development work.

Mr. Palmer joined the Institute as a Student in 1887, transferring to Associate Member in 1891 and to Member in 1907. He became a Life Member in 1932.

News of the Branches

Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

HALIFAX BRANCH

S. W. Gray, m.e.i.c. - - - *Secretary-Treasurer*
C. D. Martin, m.e.i.c. - .- *Branch News Editor*

The regular monthly dinner meeting of the Halifax Branch was held at the Nova Scotian Hotel on Thursday, March 23. G. J. Currie, chairman, presided.

The guest speaker was Dr. N. W. McLeod of Toronto, Ontario. Dr. McLeod gave an exceedingly interesting illustrated address on the subject of **The Place of Soil Engineering in Post-War Highway Construction.** Following this address he also had a film shown covering "Soil Technology as applied to Foundation Engineering." This was accompanied by Dr. McLeod's timely and instructive comments. The attention that Dr. McLeod received throughout gave evidence that his efforts were much apreciated by all present.

This meeting was attended by 82 members and guests, which latter included several students of the Nova Scotia Technical College.

HAMILTON BRANCH

W. E. Brown, m.e.i.c. - *Secretary-Treasurer*
L. C. Sentance, m.e.i.c. - *Branch News Editor*

On Thursday, March 23rd 1944, members of the Hamilton Branch of the Institute met at McMaster University on the occasion of the annual Student's Night meeting.

H. A. Cooch relinquished the chair in favour of R. J. Schofield who introduced the participants in the papers competition.

J. C. Buchanan, s.e.i.c., of the Canadian Westinghouse Company spoke on **The Economical Use of Power Hack Saw Blades.** Mr. Buchanan introduced his subject as a report on investigations carried out for the purpose of furthering the general programme for conservation of strategic materials and to establish definitely the economic desirability of reclaiming power hack saw blades in particular.

Factors affecting wear and breakage were discussed, and recommendations made with regard to hack saw selection, the use of cutting oils, and feeds and speeds necessary to achieve optimum blade performance.

Reclamation by sharpening was cited as the most obvious expedient and that most easily accomplished, either on an automatic saw grinder, or by the use of special fixtures for universal tool grinders. Economies of the order of 90 per cent were thus found possible.

By means of slides the speaker outlined methods used for repairing broken hack saw blades. A great deal of experimental work has shown that best results were to be obtained by the use of metallic arc welding and monel metal rod, in conjunction with specialized welding technique and subsequent stress relief treatment. By such means reclaimed blades have been put into service at 40 per cent of the cost of new blades.

In the case of hack saw blades worn or ground to the point where the set has been reduced beyond that necessary for satisfactory operation, reclamation is possible only through heat treatment. The cycle involves annealing, setting of individual teeth, hardening and tempering. In order to avoid surface decarburization, the use of a controlled atmosphere furnace is highly desirable.

The second speaker of the evening, K. R. Knights, s.e.i.c., also of the Canadian Westinghouse Company, chose as his topic: **Electronics as Applied to Spot Welding.** Electronics has been responsible for the development of spot welding from a crude forging operation into a highly specialized aid to industry. Credit goes chiefly to two types of tubes: the thyratron, and the ignitron.

The construction and operation of these tubes was carefully explained, the function of the thyratron being that of an automatic timer, and similarly the function of the ignitron being that of an electronic contractor. By varying the grid potential of the thyratron which controls the ignitor circuit, the ignitron may be made to fire as many as 600 times per minute.

A good spot weld will have sufficient heat generated at the contact surface in a short period of time for fusion of the inner core only, the outer surfaces will show no appreciable indentation. For every spot weld there exists an optimum contact pressure, current and time, and the success of a spot welding operation is contingent upon the production of uniform welds which in turn demands close control of the variables outlined above. Such close control can be achieved only by the use of electronic equipment.

Another important factor in obtaining desirable welds is the condition of the electrode tip. Cross sectional area and truth of surfaces must be maintained in order to eliminate heavy concentration of pressure and current.

In the welding of materials whose electrical conductivity approaches that of the electrode material, surface heating must be maintained at a minimum by the use of water cooled electrodes. Contact resistance should likewise be as low as possible, and therefore in the spot welding of such substances as aluminum and zinc, clean contact surfaces are essential. In the welding of brass, excessive heat results in volatilization of zinc, and thus a porous weld is produced.

A high degree of perfection has now been reached in the spot welding art, and much credit is due to the electronic control. This type of control has made possible the production of a high activity part at the plant of the Canadian Westinghouse Company, with a spot failure incidence of one in five hundred thousand.

The extension of this same electronic control promises for the future faster and even better spot welds, and the expansion of the spot weld to cover heavy materials which can now be joined by arc or gas welding only.

Dr. A. H. Wingfield, E. G. Wyckoff, and A. R. Hannaford formed the judges' committee; their decision will be announced at the regular May meeting.

At the conclusion of the presentation of papers, the meeting viewed a motion picture entitled "Vision Fulfilled", which illustrated manufacturing procedures at the plant of Atlas Steels Limited.

The attendance was 48.

* * *

On Friday, April 14th 1944, members of the Toronto Section of the American Institute of Electrical Engineers and of the Hamilton Branch of the Institute were guests of the Canadian Westinghouse Company at the annual joint meeting, held in the Westinghouse Auditorium.

H. A. Cooch, branch chairman, opened the meeting and then turned it over to F. C. Barnes, chairman of the Toronto Section of the American Institute of Electrical Engineers. E. M. Coles introduced the speaker of the evening, A. C. Monteith, manager of industry engineering, Westinghouse Electric and Manufacturing Company, who addressed the gathering on **Engineering Opportunities in the Electrical Industry.**

Mr. Monteith predicted an ever expanding post-war market for numerous types of domestic, commercial, and industrial goods. The domestic field was, he felt, particularly fertile, and in demonstrating this fact it was shown that the potential post-war domestic consumption in the United States, 10,000 kwh. per year, contrasted strongly with the present average of 1,100 kwh. Such load increases are expected from the use of improved lighting, air conditioning, heating, refrigeration, radio and television units.

Commercial and industrial illumination of to-day, though much improved over pre-war standards provides a vast field for continued expansion of fluorescent lighting. Better street and highway lighting alone is expected to save thousands of lives each year, in addition to having vast load-building possibilities.

Power loads will be stepped up by the increased use of arc furnaces in steel production, the use of induction and dielectric heating in industry, the adoption of precipitron air cleaning in home and factory, and by the use of newly developed electrical apparatus and processes presently on the secret list.

Mr. Monteith answered numerous questions, at the conclusion of his talk.

J. Henry tendered a vote of thanks to the speaker.

Upon adjournment, lunch was served to the 190 members and guests present.

LAKEHEAD BRANCH

W. C. Byers, Jr.E.I.C. - - *Secretary-Treasurer*
R. B. Chandler, M.E.I.C. - - *Branch News Editor*

Members of the Lakehead Branch of the Institute received first hand knowledge of construction of Curtiss Helldiver bombers in a visit to the Fort William aircraft plant, Canadian Car and Foundry Co. Ltd., on Wednesday evening, March 22nd.

They made a three-hour tour of the plant, visiting every department and watching the progress of construction from the unfinished to the finished product —a sleek, fast plane. The visit to the plant followed a dinner meeting at which J. Carmichael, A. D. Norton and P. H. Spence, three company officials, explained workings of the plant.

Mr. Carmichael dealt with the operations of the engineering department, Mr. Norton covered tooling problems and Mr. Spence, production manager, stressed the co-ordination necessary between various departments in assembling a highly intricate machine of war.

Forty-eight members and guests attended. Joseph Russell, company works manager, had been scheduled to address the meeting, but due to his being detained in the east was unable to be present.

R. B. Chandler, chairman of the branch, complimented the speakers for their addresses and thanked those who had handled the tour of the plant for their courtesy to the branch.

* * *

Members and guests of the Lakehead Branch of the Institute listened to an address on powdered metallurgy at their regular dinner meeting held in Port Arthur on the evening of April 12th.

J. Murie, branch manager, Canadian General Electric Company, Fort William, was the speaker. Mr. Murie described the manufacture of cemented carbide tools, magnet materials and machine parts.

Following the address, a technicolour sound film entitled "Manufacture of Alloy Steel", prepared by the Atlas Steel Company, Welland, Ont., was shown. A. D. Norton, chief tool designer of the Canadian Car and Foundry Company, Fort William, had charge of the film, assisted by A. Myer, foreman of the die department, Canadian Car and Foundry Co. Ltd.

R. B. Chandler, chairman of the branch, presided and extended thanks to those taking part. Twenty-two members were in attendance.

LETHBRIDGE BRANCH

T. O. Neuman, Jr.E.I.C. - - *Secretary-Treasurer*
A. G. Donaldson, M.E.I.C. - *Branch News Editor*

After being dormant for a considerable time, the Lethbridge Branch has once again become active.

An initial get-together meeting was held on March 3rd, in the local Y.M.C.A. Mr. L. A. Jacobson of the Entomological Department gave a short paper on **Sawfly Control.** This was eagerly received as it has become a paramount problem in Western Canada today. Following the address, films on water supply problems were shown.

On March 25th a joint meeting of the Lethbridge Branch of the Institute and the Association of Professional Engineers of Alberta was held in the Marquis Hotel. Between 60 and 70 sat down to dinner, during which very enjoyable entertainment was furnished by an orchestra and talented entertainers. Vernon Pearson of Edmonton presided.

The feature of the evening was an address on the **Alaska Highway.** This was given by Lt. Leckie, official historian for the U.S. Army on Alaskan projects.

With the bombing of Dutch Harbor and the occupation of Attu and Kiska of the Aleutian Chain, America suddenly realized that Alaska was the first line of defence for North America. The cost of making these defences effective was incidental.

Canada and the U.S. are working together on the Alaskan and Northwestern defence projects. These projects consist of the Alaska Highway, the Canol pipe line from the Mackenzie Valley oilfields, and the North West Staging routes. The Alaska Highway project started in the spring of 1942. By July, 54 contractors employing 40,000 men and 20,000 U.S. soldiers were feverishly engaged in pushing it through. The cost was great but so was the need.

The highway was finally completed October 13th, 1943. Today we have a highway suitable for its purpose, which has already moved 200,000 tons of freight. The airline is a good one. The oilfield and pipe lines and the 3,000 miles of telephone lines will all serve a great purpose.

Supplementary to Lt. Leckie's address, coloured films were shown.

PETERBOROUGH BRANCH

A. J. Girdwood, Jr.E.I.C. - - *Secretary-Treasurer*
J. F. Osborn, Jr.E.I.C. - - *Branch News Editor*

The March 2nd meeting was addressed by G. W. N. Fitzgerald, assistant test engineer of the H.E.P.C. on the subject **Testing of High Voltage Bushings.**

The occasional failure of high voltage bushings in transformers, circuit breakers and other apparatus causes financial loss and hazard to personnel out of all proportion to the value of the bushings. The H.E.P.C.

have greatly reduced the number of failures by regular testing of bushings which reveals incipient defects.

The commission employs the potential grandient method, a rather simpler technique than the power factor tests in common use. A long insulated stick carries a test prong connected to ground through a very high resistance, an insulated lead, and microammeter. Current readings are taken with the test prong at various points on the bushings and compared to those taken on bushings of known soundness.

A study of voltage gradient curves enables the test engineer to anticipate breakdown from cracks, moisture, low oil, contaminated compound and other sources of trouble. Bushings are taken out of service and reconditioned when abnormal results are recorded, and irregularities are almost invariably found.

Mr. Fitzgerald exhibited slides illustrating the technique of testing and types of defects encountered.

SAGUENAY BRANCH

A. T. Cairncross, m.e.i.c. - *Secretary-Treasurer*
J. T. Madill, Jr.e.i.c. - *Branch News Editor*

The first meeting of the Saguenay Branch of the Institute during the 1943-1944 season was held in the Grill Room of the Saguenay Inn on the evening of October 25th, 1943. The first speaker, Mr. J. F. Roberts, manager, hydraulic dept., Allis Chalmers, Milwaukee, spoke on the subject **Some Recent Hydroelectric Developments in the United States,** while the second speaker, Mr. F. Nagler, chief mechanical engineer, Allis-Chalmers, Milwaukee, discussed **Some Recent Engineering Developments.**

Mr. Roberts first outlined general comparative figures such as head, firm river flow, installed capacity, ultimate capacity, cubic yards of concrete, and construction period, for several of the recent large government hydroelectric projects in the United States, including Boulder Dam, Bonneville Dam, Grand Coulee Dam, Shasta Dam and concluded with the Shipshaw project.

Then, with the aid of lantern slides the speaker illustrated the unusual or newer features of the hydraulic designs or station arrangement in the projects mentioned previously.

Next Mr. Roberts drew the attention of the audience to the TVA project on the Tennessee river. It was pointed out that this was a government corporation with three objects: the generation of power, the improvement of navigation, and the control of flood water. The total head available for power on the river proper was 500 ft. Navigation had been extended 465 miles and 20 plants having a total of 70 generating units had been installed. An excellent series of slides was shown to illustrate the general engineering and architectural features of the plants and to show some of the interesting details of the turbine installations in several of the stations.

The second speaker, Mr. Nagler, first discussed engineering materials, pointing out that one obstacle to be overcome in the gas driven turbine was the finding of a material which would stand the high temperatures involved, as he illustrated that only at the very high temperatures and pressures does the efficiency of this prime mover become acceptable.

As a criteria of a material it was suggested that an interesting figure was obtained if the ultimate unit strength of the material is divided by the specific gravity of the material. Thus, for ordinary steel the figure is approximately 8,000, for high grade steel 20,000, for aluminum 20,000, for wood 50,000, for plastics 50,000, for hair 75,000 and for glass 500,000. The speaker suggested that engineers were gradually moving up the scale in the materials which would be satisfactorily used; obviously no application of glass using the properties suggested here has yet been made.

The speaker next showed some slides illustrating the damage that could be done by means of modern high explosive bombs to large solid steel shafts such as used for hydroelectric generators.

Mr. Nagler concluded his discussion with a short outline on the hobby of bow and arrow hunting of big game. He illustrated the high stresses in the material used and gave a very interesting description of the English long bow and its probable effect on history and compared it to modern hunting equipment. While refreshments were being served, Mr. Nagler gave a demonstration which satisfied all present of his skill and accuracy with the bow and arrow.

After a very hearty vote of thanks the meeting was adjourned.

* * *

At a meeting of the Saguenay Branch of the Institute held on the evening of December 9th, S. R. Banks of the Aluminum Company of Canada, Limited, Montreal, presented a very interesting paper on **The Bridges of the Newfoundland Railway.**

While Mr. Banks was associated with the firm of *Monsarrat* and *Pratley* he spent the greater part of one summer making a survey of the bridges of the Newfoundland Railway, so that complete and accurate data would be available to serve as the basis of an improvement programme to be drawn up by the consulting firm.

As a very interesting introduction to his paper Mr. Banks outlined very briefly the industrial history and the general geography of Newfoundland. It was obvious that the railroad had never been designed for the heavy traffic caused by the war and an improvement programme was highly essential at this time.

Mr. Banks then explained that for the purpose of bridge analysis the rolling stock was examined to determine what equipment placed the most severe load on the structures. It was found that the 1,000-ton Mikado type locomotives weighing about 130 tons with a length of 66 ft. had the heaviest wheel loading at any appreciable speed and were therefore the limiting equipment.

To illustrate the problem of the bridge designer, the speaker, with the help of several excellent slides, gave a very clear qualitative explanation of the effect of locomotive impact on bridges and the resulting forces and vibrations. The speaker discussed the different methods which have been used by designers in different parts of the world to make allowance for locomotive impact and concluded by illustrating the more modern curves used.

By means of a very excellent series of lantern slides the many different conditions encountered during the survey and the recommended changes were discussed and in one or two cases new bridges were illustrated. One very interesting reference was to a wrought iron bridge built in 1880 and though the material was found to be in excellent condition, modern loadings showed the bridge to be rather overstressed. In several sections of the railroad the corrosion problems due to the very close proximity of the open sea were shown to be very severe indeed.

After questions by the members had been answered a hearty vote of thanks was extended to Mr. Banks for his interesting paper.

* * *

A meeting of the Saguenay Branch of the Institute was held on January 19th at which Mr. F. H. Moody, manager of the industrial sales dept., Imperial Oil

Limited, Montreal, presented two sound films and an interesting talk on the subject of **Lubrication.**

Mr. Moody first presented a sound film entitled "The Inside Story." This illustrated in a very clear and interesting manner the modern theories of lubrication and from these theories developed the required characteristics of the proper lubricants for the different types of bearings.

Following this film a very interesting talk dealing with the history of lubrication and with newer products in the field of lubricants was presented. Mr. Moody outlined the development of oils from the first use of vegetable oil and sperm oil about 1840 up to the present time, illustrating that to-day machinery manufacturers are likely to specify the exact lubricant for their particular equipment.

The speaker then suggested some of the developments which should be forthcoming after the war requirements are reduced and outlined what might be accomplished by, and expected from, some of the newer lubricants.

The second sound film entitled "Pipeline Builders" showed the construction of the Portland, Maine to Montreal pipeline. All stages of construction were illustrated, from the initial aerial survey to the first pumping operations. The film was in technicolour and not only were all construction features shown, but also excellent scenes of the country through which the pipeline passes were included.

After a question period the meeting was brought to a close with a very hearty vote of thanks.

* * *

At a meeting of the Saguenay Branch of the Institute held on the evening of 3rd February, Mr. F. L. Lawton, assistant chief engineer, Aluminum Company of Canada, Limited, Montreal, presented a paper entitled **The Lake Manouan and Passe Dangereuse Water Storage Developments.**

The paper appeared in the April issue of the *Journal.*

After a vote of thanks moved by Mr. G. Lamothe the meeting was adjourned.

SASKATCHEWAN BRANCH

Stewart Young, m.e.i.c. - - *Secretary-Treasurer*

The Saskatchewan Branch met jointly with the Association of Professional Engineers in the Kitchener Hotel, Regina, on the evening of March 24 to hear an address by Robson Black, president, Canadian Forestry Association on **Forest Conservation in Canada.**

The meeting was preceded by dinner at which the attendance was 39. The branch chairman, J. McD. Patton, who is also president of the Association of Professional Engineers, presided.

E. H. Roberts, director of forests, Department of Natural Resources, Saskatchewan, introduced the speaker and stated that the Canadian Forestry Association, with a membership of over 10,000 was organized as an educational institution to foster the protection of forests and to promote tree planting.

Tracing the development of public opinion towards forest conservation Mr. Black stated that 50 years ago there was no thought of preserving our forest areas. At that time the forest was a natural resource for exploitation only, or for removal for agricultural purposes regardless of the suitability of the soil.

In most parts of Canada the forests are under the ownership of the Crown and are held as a public trust. Their greatest value lies in the fact that they are in a position to be continuously productive through scientific control of natural replenishment. Stating that modern human activities are greatly dependent on forest life, Mr. Black pointed out that in those countries depleted of forests the agricultural industry has practically disappeared, including the dependent communities. The present day outlook is towards the preservation of permanent forest areas and to add to them submarginal agricultural lands.

After a period of discussion a hearty vote of thanks was tendered the speaker on motion of H. S. Carpenter. The meeting concluded with an explanation and discussion of engineering organizations in Saskatchewan.

SAULT STE-MARIE BRANCH

T. F. Rahilly, Jr.e.i.c. - - *Secretary-Treasurer*

A general meeting of the Sault Ste. Marie Branch was held in the Windsor Hotel on March 31, 1944, when twenty-four members and guests sat down to dinner.

Mr. Becker of the General Electric Company gave an informative talk supplemented by lantern slides on **Electronics in Industry.** The paper had been prepared by Mr. Turnbull.

Electronics was defined and some applications given.

Electronics are controlled by means of electron tubes. Electronic control is used where it will do a better job than conventional methods and where there are no conventional methods of doing certain jobs.

Electronic photoelectric control depends upon the action of an interrupted beam of direct or reflected light upon a photoelectric cell. This application is used for limit switching, sorting, inspecting, guiding, etc.

Electronic welding control is used chiefly in resistance welding to apply a high current for periods as short as one half cycle.

Electronic motor control consists of rectifying A.C. power and controlling the application of power to motors to give a range from zero to full load.

Electronic heating control is applied to the heating elements in electric furnaces and to produce induction or dielectric heating by means of higher than normal frequencies.

Electronic power is used to replace M.G. sets for exciting currents and battery chargers.

Special electronic products are the recording spectrophotometer which analyzes and gives permanent records of two million different shades and colours; the electron microscope; the industrial X-ray and temperature recorders.

A. M. Wilson, branch chairman, presided at the meeting and N. C. Cowie conveyed the thanks of the meeting to the speaker.

TORONTO BRANCH

S. H. de Jong, m.e.i.c. - - *Secretary-Treasurer*
G. L. White, affi.e.i.c. - - *Branch News Editor*

The construction and operation of the B.A. Oil Company Refinery at Clarkson, Ontario was discussed by R. L. Rude at the meeting of the Toronto Branch of the Institute at Hart House on March 16th. One of the largest groups to attend a meeting of the branch during the year thoroughly enjoyed his illustrated address and the film "Oil for War" shown through the courtesy of the Barrett Company Ltd. The film depicted the construction of the "Big Inch" pipe line showing various phases of its laying including the application of coal tar for protective coatings.

In his address, Mr. Rude gave an interesting outline of the factors involved in the choice of the Clarkson site for the new British American refinery. The three greatest considerations are freight rates, cooling water, and site and facilities. The first of these needs no elaboration. Cooling water is often one of the most difficult problems faced in refinery operation. Products enter and leave the refinery at normal temperature and practically all the heat absorbed by the products in the course of processing must be removed by water. Lake Ontario, with a maximum temperature of 65 deg. F., and no debris, provides the most perfect cooling facilities that a refinery could hope to have.

The site chosen had excellent contours to provide draining. There is no water shed through the property and it was easy to provide adequate docking facilities since the depth of water increases quite rapidly from the shore line.

The clay top soil is helpful in refinery construction, any oil leaks from underground pipes coming to the surface immediately. There is a blue shale at a depth of 4 to 8 ft. which provides a solid foundation for the heavy towers and the stack. The importance of a solid foundation may be judged from the fact that the erection of stacks at some gulf coast refineries has involved an expenditure on supporting piling, exceeding the total cost of the construction of the stack at this new B.A. refinery.

It is not possible in this brief review to go into details in regard to the pumping of cooling water. However, one point is of particular interest. It was found in the operation of refineries that as much water was used in cold weather as in warm for cooling purposes, because with water coming from the intake at around 34 deg. F., it was impossible to cut down the flow without danger of the lines freezing up. In the design of this new refinery, provision was made for the return of warm discharge water to temper the water being taken in from the lake. By supplying temper cooling water at a temperature of approximately 50 deg. F., it is possible to use less water than when the supply is at a temperature of about 34 deg. F.

The electrical services for the plant are carefully designed to provide maximum reliability and to make it unlikely that fire in any section could knock out the electrical supply and cut off the pumps.

An interesting erection problem was involved in setting up three towers weighing up to 120 tons. This was accomplished by unique methods which have aroused considerable interest among engineers concerned with this type of work.

Mr. Rude gave a brief outline of the operation of the polyform cracking process employed at this plant showing the various fractions produced, their general treatment and use.

The speaker was introduced by Stanley Frost and the thanks of the meeting were expressed by Dr. Norman Grace, Dunlop Tire and Rubber Company Ltd.

VANCOUVER BRANCH

P. B. Stroyan, m.e.i.c. - - *Secretary-Treasurer*
J. G. D'Aoust, m.e.i.c. - - *Branch News Editor*

On March 24th at the Stanley Park Pavilion, a "Ladies Night" was held by the Vancouver Branch, the first in a number of years. A good turnout of members and their wives together with a number of students of the newly formed Student Chapter made this the outstanding meeting of the season to date.

The speaker of the evening, C. E. Webb, gave an interesting address on the northern country, illustrated by a film. Mr. Webb, who is district chief engineer for the Dominion Water & Power Bureau, Dept. of Mines and Resources, recently completed an aerial reconnaisance trip through the northern part of British Columbia and the Yukon which took his party over four thousand miles of our north lands in twelve days. Much of the trip was through territory traversed by the Alaska Highway and some interesting shots of the work on the highway were seen in the film.

Interesting views were shown also of various mining and industrial activities in this little known part of our country, and Mr. Webb's address was full of colourful details of the life and activities of this latest frontier of Canada.

Following Mr. Webb's talk, a brief sketch of the highlights of the Institute Annual Meeting at Quebec was given by H. N. MacPherson after which refreshments were served to conclude a very pleasant evening.

Library Notes

Book notes, Additions to the Library of The Engineering Institute, Reviews of New Books and Publications

AN ENGINEER WRITES ABOUT THE WAR

Pipeline to Battle—by Major Peter W. Ranier, Random House, New York. ($3.25 in Canada)

This book is a thrilling experience, full of keen and critical observation of personnel from sappers to generals, of action and of humour. The author's style is so simple and direct that you feel he is actually talking to you. Engineers who have time to read a non-technical book, who want a clear picture of what happened in North Africa, should not overlook this one.

Perhaps the quickest way to present a good review would be to quote the one published in *Engineering News-Record* of April 6th. No review can do justice to the work, but this one goes a long way.

"Here is the best book of the war to date, and one to delight an engineer's heart. Not only does the author describe battlefront construction operations with uncommon facility, he lets you "see" topography, understand troop and armor deployment and sense strategy and follow tactics as though you were on the scene.

It is the story of Britain's great Eighth Army from the dark days of 1940, when it undertook the seemingly hopeless task of saving the Suez Canal, to the victorious entry into Tunis by the side of French and American troops in the summer of 1943. It is the chronicle of three years of dirt, disease and death spread over 2,000 miles of North African desert where 12 big battles and countless skirmishes exacted a quarter of a million casualties. And it is all interwoven with the experiences of a 50-year old Royal Engineer officer whose main job during those three years was to assure every fighting man a minimum of half a gallon of water a day. Between battles, he built camps and roads and kept a frontline railway in operation, but principally he was "just a water bloke" to use his own words.

Major Rainier's desert pipeline brought Alexandria's filtered water to the men at El Alamein, and his drilled wells kept up with General Montgomery on his three month, 1,400-mile chase of Rommel to Tripoli and beyond.

There have been other fine books about the war. Robert St. John's "Land of Silent People" and Russel Hill's "Desert Warfare" are of the best, but these men were correspondents, perforce only hitch-hikers on the chariot of war. Major Rainier was of the war. He lived it, and by many miracles lived to write about it, which he does superbly. Moreover, he draws freehand sketch maps of battle situations, which will earn him applause from every reader.

It is not possible to "brief" this book, which is compounded of such a wealth of information and entertainment on military movements, Middle East history and the plain dirty work of war, but it is possible to suggest its essential character by a few excerpts. There is for example the description of the use of old Roman BIRS or reservoirs for underground water storage right at the front lines; their plastered surfaces were found to be watertight after 1,500 years. There is the account of the construction of 0.6 m.g.d. slow-sand filter plants within the fortified zones at El Alamein. And there is the tale concerning the Germans who surrendered after drinking from the pipeline when it was being tested with salt water, which had increased their thirst to the point of delirium.

The author helped Montgomery deceive the Germans by building dummy tanks and airplanes and parking them around the desert, and he constructed roads of saltmarsh mud, which the Germans thought were dummies, but which were used to get vehicles up to the front line on the day of the battle. The practice of ingenuity also had its amusing aspects, as when the author, tired of constructing different type toilets for the Christians and the Moslems, developed a combination "sit and squat" design; or when he was confronted with the problem of convincing the troops that the water in the wells near the Mareth Line in Tunisia would not render them impotent. The solution of the latter problem was to connive with the Medical Corps officers to issue a statement to the effect that the lime that was put in the water was a special powder that destroyed the "dangerous bacteria".

Perhaps the outstanding engineering achievement of Major Rainier's little band of "sappers" was chalked up after the Germans were defeated at El Alemein. Then, in 20 days, they repaired 200 miles of the pipeline which the Germans had sought to destroy. They welded 459 breaks and installed 21 pumping sets, and as a sideline lifted nearly 400 mines that had been concealed under and along the pipeline. It is a thrilling and satisfying book."

ADDITIONS TO THE LIBRARY

TECHNICAL BOOKS

Spherographical Navigation:
Dirk Brouwer, Frederic W. Keator and D. A. McMillen. N.Y., MacMillan, 1944. 4½ x 7¾ in. $5.50 (Canadian price).

Handbook of Chemistry:
5th ed. rev. and enl. Compiled and edited by Norbert Adolph Lange. Ohio, Handbook Publishers, Inc., 1944. 5½ x 8 in. $6.00.

Modern Turbines:
Louis E. Newman, Allen Keller, John M. Lyons, Lawrence B. Wales. Edited by Louis E. Newman. N.Y., John Wiley and Sons, Inc., 1944. 5½ x 8½ in. $2.50.

Illustrated Technical Dictionary:
Ed. by Maxim Newmark. N.Y., The Philosophical Library, 1944. 6 x 9¼ in. $5.00.

Engineering Drafting Problems:
Kenneth E. Quier. N.Y., Harper and Bros., 1944. 8¼ x 10¾ in. $2.50.

Materials and Processes:
Ed. by James F. Young. N.Y., John Wiley and Sons, Inc., 1944. (General Electric Series). 5½ x 8¾ in. $5.00.

Modern Drafting:
William H. Johnson and Louis V. Newkirk. N.Y., MacMillan Company, 1944. 8¼ x 11¼ in. $2.75 (Canadian price).

TRANSACTIONS, PROCEEDINGS

American Society of Civil Engineers:
Transactions No. 108, 1943. N.Y., The Society, 1943.

Institution of Naval Architects:
Transactions Vol. 85, 1943. London, The Institution, 1943.

REPORTS

Institute of Radio Engineers:
Standards on facsimile—temporary test standards, 1943.

Prairie Farm Rehabilitation Act:
Report on activities for the eight-year period ended March 31, 1943. Ottawa, Department of Agriculture, 1943. 78 p.

Canada—Dept. of Mines and Resources:
Report of Lands, Parks and Forests Branch for the year ended March 31, 1943.

Ontario—Dept. of Mines:
Fiftieth annual report, Vol. L., Part IV., 1941—Geology of the Bryce-Robillard area.

Lethbridge Northern Irrigation District:
Twenty-third annual report and financial statement, 1943.

Nova Scotia Power Commission:
Twenty-fourth annual report for the twelve months' period ended November 30, 1943.

Institute of Radio Engineers:
Radio markets after the war.

U.S.—Bureau of Mines—Bulletin:
No. 456; Coal-mine accidents in the United States, 1941.

University of Illinois—Engineering Experiment Station:
Bulletin No. 348; Fuel savings resulting from closing of rooms and from use of a fireplace—Bulletin No. 349; Performance of a hot-water heating system in the I-B-R research home at the University of Illinois—Circular No. 48: Magnetron oscillator for instruction and research in microwave techniques.

Electrochemical Society—Preprint:
85-3; Pure columbium—85-4; Copper in powder metallurgy. 85-5; Electrodeposition of copper powder.

BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet the books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

AIRCRAFT SHEET METAL WORK
By C. A. LeMaster. American Technical Society, Chicago, 1944. 387 pp., illus., diagrs., charts, tables, 9½ x 6 in., fabrikoid, $3.75.

This practical book provides a basic course of instruction for apprentices and other students of aircraft sheet metal work. The first chapters deal with safety rules, personal and shop-furnished tools and blueprint reading. The other chapters progress from simple to more complicated processes and operations. Practical projects accompany the chapters dealing with processes in accordance with the emphasis on "how to do it." Two chapters are devoted to the properties of the important metals for this type of work.

AIRPLANE PROPELLER PRINCIPLES
By W. C. Nelson. John Wiley & Sons, New York; Chapman & Hall, London, 1944. 129 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $2.50.

The aerodynamic, mechanical and structural principles that must receive consideration in the design of propellers are presented in an elementary course, which is believed sufficient to prepare the student for specialization when need arises.

BASIC MATHEMATICS FOR WAR AND INDUSTRY
By P. H. Daus, J. M. Gleason and W. M. Whyburn. Macmillan Co., New York, 1944. 277 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $2.00.

A single text which presents selected principles of elementary mathematics in a carefully organized manner is here offered. The text covers the elements of arithmetic, algebra, geometry and plane and spherical trigonometry.

BASIC RADIO
By C. L. Boltz. Ronald Press Co., New York, 1944. 272 pp., diagrs., charts, tables, 8 x 5 in., cloth, $2.25.

Basic Radio is based on the syllabus for British Air Training Cadets, and forms an interesting contrast to the similar books published for use in the U.S. Army. It presents an elementary course in fundamentals and is exceptionally clear and simple.

(The) CHEMISTRY OF SYNTHETIC SUBSTANCES
By E. Dreher. Philosophical Library, 15 East 40th St., New York, 1943. 103 pp., diagrs., tables, 8½ x 5½ in., cloth, $3.00.

The series of essays presents a summary of recent research work on the chemistry of the macromolecular substances that have such important technical uses, such as rubber, cellulose and paint media. The determination of the molecular weight of such compounds, their relations to drying oils, the principles of processes of polymerization and polycondensation and the solubility of high-molecular, film-forming substances are discussed.

COMMUNICATION CIRCUITS
By L. A. Ware and H. R. Reed. 2 ed. John Wiley & Sons, New York; Chapman & Hall, London, 1944. 330 pp., diagrs., charts, tables, 8½ x 5½ in., cloth, $3.50.

This up-to-date introductory text affords a concise, clearly written course for serious students of college grade. The basic principles of communication transmission lines and their associated networks are presented, covering the frequency range from voice frequencies through the ultra-high frequencies. Ultra-high-frequency transmission by means of wave guides and coaxial cables is treated rather extensively. This edition has been thoroughly revised and extended.

ENGINEERS' DICTIONARY, SPANISH-ENGLISH and ENGLISH-SPANISH
By L. A. Robb. John Wiley & Sons, New; York; Chapman & Hall, London, 1944. 423 pp., 8 x 5½ in., fabrikoid, $6.00.

This dictionary contains about ten thousand terms used in civil engineering, including many mechanical and electrical words, as well as geological, chemical and other scientific terms. A special advantage of the book is that the Spanish vocabulary is South American Spanish, and the English is American.

ESSENTIALS OF PRECISION INSPECTION

By W. Mollard. McGraw-Hill Book Co., New York and London, 1944. 207 pp., illus., diagrs., tables, 11 x 8½ in., cloth, $3.00.

This manual offers a systematic course of instruction in the use of the instruments used in interchangeable manufacturing. The instruments used are described, methods of checking their accuracy given, and their uses for various purposes explained and illustrated by problems.

FUNDAMENTALS OF RADIO COMMUNICATIONS

By A. R. Frey. Longmans, Green & Co., New York, London, Toronto, 1944. 393 pp., diagrs., charts, tables, 8½ x 6 in., cloth, $4.00.

In this book an effort has been made to present the fundamentals of the subject as concisely as possible. In accordance with this desire, the aim has been to familiarize the student with the terminology of radio, with the more important types of circuits and with the ways in which vacuum tubes can be used to generate, control and detect the high-frequency currents that are used. References are supplied for further study of various subjects.

FUNDAMENTALS OF VIBRATION STUDY

By R. G. Manley with a foreword by W. K. Wilson. John Wiley & Sons, New York; Chapman & Hall, London, 1942. 124 pp., diagrs., charts, tables, 9 x 5½ in., cloth, $2.75.

Fundamental principles underlying present-day vibration study are presented in such a way as to be readily assimilated by the busy engineer. Major topics considered are the physics of the simple vibrating system, damping and forced vibration, systems with two or more degrees of freedom, and the application of Fourier's analysis to complex vibrations.

GAS TURBINES AND JET PROPULSION FOR AIRCRAFT

By G. G. Smith, published in U.S.A. by Aerosphere, Inc., 370 Lexington Ave., New York 17; in England by Flight Publishing Co., London, 1944. 80 pp., illus., diagrs., 8½ x 5½ in., paper, $1.50.

This little book discusses the various proposals that have been advanced for propelling aircraft by jets or by steam or gas turbines. The survey is as comprehensive as is possible at this time and is illustrated by drawings. The material originally appeared in "Flight."

INDUSTRIAL MANAGEMENT

By A. S. Knowles and R. D. Thomson. Macmillan Co., New York, 1944. 791 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $4.50.

The subject matter of this book is confined to topics of immediate concern to persons who must direct the work of others in manufacturing enterprises. The six main divisions are: introduction; management of physical property; organization of the physical plant; management of manpower; production control; and cost control. Such topics as time and motion study may appear under two or more headings if pertinent. Practical problems are included representing actual situations.

MARINE COPPERSMITHING

By F. J. Carr. McGraw-Hill Book Co., New York and London, 1944. 195 pp., diagrs., charts, tables, 9 x 5¾ in., cloth, $2.00.

This practical manual on coppersmithing is a welcome addition to the scanty literature upon an important craft. The author describes tools and processes for all kinds of work, showing the ways of working that he believes the best and simplest. The illustrations add greatly to the text.

MATERIALS HANDBOOK, an Encyclopedia for Purchasing Agents, Engineers, Executives and Foremen

By G. S. Brady. 5th ed. McGraw-Hill Book Co., New York and London, 1944. 765 pp., charts, tables, maps, 9 x 5¾ in., cloth, $5.00.

This handbook is intended as a quick source of information on the characteristics of materials of industrial importance. It will be useful to purchasing agents, des'gners, executives and others. The arrangement is alphabetical, with a good index to trade names, synonyms, etc. The new edition has been carefully revised and is larger than preceding ones.

METEOROLOGY, THEORETICAL AND APPLIED

By E. W. Hewson and R. W. Longley. John Wiley & Sons, New York; Chapman & Hall, London, 1944. 8½ x 5½ in., cloth, $4.75.

The object of this book is to give a well-rounded view of the essentials of meteorology. Part I deals with theoretical meteorology: the physical and thermodynamical characteristics of air; the movements of air masses; and the statistical analysis of meteorological data. Part II covers applied meteorology: instruments and observational procedures; climatology; map analysis and precasting procedure; and the applications of meteorology to other specialized fields.

MODERN DRAFTING

By W. H. Johnson and L. V. Newkirk. The Macmillan Company, New York, 1944. 197 pp., illus., diagrs., charts, tables, 11 x 8 in., cloth, $2.50.

This textbook is intended for use by students at the high-school level, and is intended to provide a course in the fundamentals of drafting and its industrial applications which will enable the student to go to work. Chapters are devoted to pictorial drawing, sheet-metal, machine and aircraft drafting, to architectural drafting, graphs and maps, etc.

OCCUPATIONAL INDEX, Vol. 8, Nos. 1-5, January, April, July, October and Index, 1943. References 1-375

Publ. by Occupational Index, Inc., New York University, Washington Square East, New York. 10 x 7 in., paper, $5.00, annual subscription.

This bibliography, issued quarterly, contains annotated references to current pamphlets, books and magazine articles containing information about opportunities in various occupations. Over three hundred publications are listed in 1943. The annotations are clear and informative. Indexes by author, title and subject are provided. Both military and civilian occupations are covered.

POWER AND FLIGHT

By A. Jordanoff. Harper & Brothers, New York and London, 1944. 314 pp., illus., diagrs., charts, tables, 10 x 7 in., cloth, $3.50.

A readable, elementary text on the aircraft power plant and its maintenance, intended for students and mechanics. It will also be useful to others who wish to know something about aircraft engines. The book is distinguished by over four hundred illustrations which clarify the text.

(The) PRACTICAL DESIGN OF WELDED STEEL STRUCTURES

By H. M. Priest. American Welding Society, 33 West 39th St., New York 18, 1943. 153 pp., illus., diagrs., charts, tables, 8 x 5 in., cloth, $1.00.

The essentials of welding and welded construction are presented in concise form as a working manual for the practical welder and designer. The various welding processes, forms of joints and weld testing are discussed. The general and detail design considerations for simple welded joints and connections precede their application to typical structural members. A separate chapter is devoted to the problem of fatigue.

PRECISION MEASUREMENT IN THE METAL WORKING INDUSTRY, Vol. I

Prepared by the Department of Education of International Business Machines Corporation; publ. by Syracuse University Press, Syracuse, N.Y., 1942. 263 pp., illus., diagrs., charts, tables, 11 x 8 in., cloth, $2.75.

This is a revised edition of the manual on precision measurement and inspection methods in metal working originally prepared for use in training International Business Machines Corporation workers. Volume I contains the first seven chapters, dealing with measurement in general, non-precision line-graduated instruments, micrometer and vernier types, precision gage blocks, fixed gages, thread gages, dial gages and test indicators. Volume II, now in process, will treat the more advanced types.

RUBBER RED BOOK, Directory of the Rubber Industry, 1943 Edition, 4th Issue

Published biennially by The Rubber Age, 250 West 57th St., New York 19, N.Y. 579 pp., illus., 9½ x 6 in., cloth, $5.00.

This directory of the rubber industry lists the rubber manufacturers of this country and Canada, the manufacturers of rubber machinery and accessories, the suppliers of chemicals, fabrics and crude rubber. The varieties of synthetic rubber and their makers are listed. Other listings include rubber reclaimers and scrap dealers, rubber derivatives and rubber latex, consultants, sales agents, technical journals, organizations and a directory of men prominent in the industry.

STRENGTH OF MATERIALS

By H. F. Girvin. International Textbook Co., Scranton, Pa., 1944. 357 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $3.00.

After a survey of the first sources in strength of materials given at our larger colleges, Professor Girvin has prepared this textbook. It aims to give the student thorough training in basic principles and to avoid attention to specialized topics which are better treated in later courses in design. The area-moment method of determining deflections is emphasized. A large number of problems are included.

PRELIMINARY NOTICE

of Applications for Admission and for Transfer

April 27th, 1944.

The By-laws provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described at the June meeting.

L. Austin Wright, General Secretary.

*The professional requirements are as follows:—

A Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science or engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainment or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

ANDERSON—ALEXANDER GORDON, of Westmount, Que. Born at Buckingham, Que., April 20th, 1897. Educ.: B.Sc., McGill Univ., 1921; R.P.E. Que.; with the Bell Telephone Co. of Canada as follows: 1921-24, traffic engrg. dept., 1925-27, gen. traffic engr., 1927-34, plant extension engr., 1935-40, operating results supervisor, 1941 to date, chief engr., Eastern Area.

References: R. V. Macaulay, J. L. Clarke, J. S. Cameron, C. V. Christie, J. A. McCrory.

ALDER—WILLIAM ROBERT, of 963 Maitland St., London, Ont. Born at Prescott, Ont., Aug. 14th, 1886. Educ.: B.Sc., Queen's Univ., 1907; R.P.E. Ont.; 1911-15, instru'man. and field engr., mtce. of way dept., C.P.R.; with the Dept. of Highways (Ontario) as follows: 1919-24, assist. res. engr., 1924-44, div'n. engr., London, Ont.

References: J. A. Vance, W. R. Smith, H. F. Bennett, R. W. Garrett, E. V. Buchanan.

BARBOUR—ROBERT, of 2076 Gerrard St. East, Toronto, Ont. Born at Winnipeg, Man., March 21st, 1910. Educ.: B.Sc. (C.E.), Univ. of Manitoba, 1934; with the Dept. of Highways (Saskatchewan) as follows: 1933 (summer), highway constrn., 1934 (summer), land surveys and diversions, etc.; with the Hydro-Electric Power Comm'n. of Ont. as follows: 1941-42, junior engr., plotting topographic maps, etc., 1942 to date, asst. engr., investigation into various types of hydraulic structures, such as, weirs, dams and cofferdams, railway economics, preliminary estimates for proposed powerhouses, etc.

References: O. Holden, J. R. Montague, G. R. Lord, T. J. Pounder, S. H. deJong.

BAILEY—EDWARD THOMAS WALTER, of 176 Sterling St., Hamilton, Ont. Born at Hawkesbury, Ont., May 5th, 1901. Educ.: B.A.Sc., Univ. of Toronto, 1926; R.P.E. Ont.; 1926-28, asst. chief chemist, Aluminum Co. of Canada, Ltd., Arvida, Que. With the Steel Co. of Canada as follows: 1928-36, engrg. dept., 1936 to date, combustion engr., specifying the purchase of most equipment used for steam generation, compressed air, acid and water pumping, systems for blast furnace, coke oven and oxygen gases, all types of automatic controls and instruments, etc.

References: H. A. Cooch, A. Love, W. A. T. Gilmour, G. R. Connor, R. E. Butt.

BLAND—PERCY NEWCOME, of 3528 Point Grey Road, Vancouver, B.C. Born at Vancouver, B.C., July 23rd, 1903; R.P.E. B.C. (By exam.) 1933; with Can. Sumner Iron Works as follows: 1920-22, ap'tice, drawing office, Vancouver, 1922-25, junior dftsman., Everett, Washington, 1933-38, senior designer mach., Vancouver; 1936, designer, Vancouver Kraft Co., Port Mellon, B.C.; 1938-41, eng., i/c of drawing office and 1941 to date, chief engr., i/c design and specifications of machinery, Canadian Sumner Iron Works, Ltd., Vancouver, B.C.

References: A. C. R. Yuill, W. O. C. Scott, R. Rennie, W. N. Kelly, G. W. Allan.

BORDELEAU—JOSEPH LIONEL, of 260½ Dalhousie St., Ottawa, Ont. Born at Ottawa, Ont., Feb. 6th, 1914; 1930-33, Hull Tech. School; 1936-37, engrg. maths. (corres. course) British Inst. of Technology; with the National Research Council as follows: 1933-34, lab. asst., physics and elect'l. engrg. lab., 1934-35, standards and meters, 1935 (Jan.-May), radio commission, 1935-36, committee on aeronautical research, 1936 to date, with the mech. engrg. divn., gas and oil lab., from 1942-43 as senior lab. asst. and 1943 to date, lab. steward.

References: J. H. Parkin, C. J. Mackenzie, R. W. Boyle, D. S. Smith, A. Haltrecht, B. G. Ballard.

BRIGHT—WILLIAM JAMES, Major, of London, Ont. Born at Portadown, Ireland, Jan. 16th, 1907. Educ.: B.Sc. (Mech.), Queen's Univ., 1934; 1928-30, dftsman., David M. Bright & Co., Engrs.; 1930-32 (summers), electr'n., P.U.C., London; 1932-34 (summers), junior engr., David M. Bright & Co.; 1934-35, junior engr., Dominion Natural Gas Co., Brantford; 1935-39, eng., Cdn. Johns-Manville Co. Ltd., Leaside; 1939 to date, with the Cdn. Army overseas as follows: 1939-42, with 7th Fd. Coy., R.C.E. as Lieut. and later as Capt., 1942-43, H.Q., R.C.E., 1st Cdn. Army Tps., as Staff Capt. and later as Major (supt. of works), 1943 (May to Aug.) attached as Major to 1st British Army, 1943 to date, O.C., 1st Cdn. Fd Coy., R.C.E., 1st Cdn. Div'n., Cdn. Army Overseas.

References: H. A. McKay, H. G. Stead, J. L. Melville, I. Leonard, D. S Scrymgeour.

CARMICHAEL—JOHN WILLIAM, of 37 Gloucester St., Ottawa, Ont. Born at Trenton, Ont., Aug. 10th, 1916. Educ.: B.Sc. (Chem.), Queen's Univ., 1938; 1938, vegetable oil refinery, Canada Packers, Toronto; with the Dept. of Public Works, Ottawa, as follows: 1939-42, junior chemist, testing bldg. materials, such as, creosote, cement, steel, etc., 1942 to date, asst. chemist, i/c men engaged in testing of materials, etc.

References: K. M. Cameron, E. Viens, F. E. Sterns, D. W. McLachlan, G. E. Martin.

CHARRON—ROLAND, of 48, 2nd Ave., Limoilou, Que. Born at Ste Edwidge, Que., March 15th, 1911. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1938; R.P.E. Que.; 1937 (3 mos)., res. engr., Highway No. 2, Dept. of Roads (Prov. of Que.); 1938-44, engr., Union Quarries & Paving Ltd., Quebec, estimates, tenders and supervis'n. on road constrn.

References: Arthur Laplante, Lucien Martin.

COCKBURN—KENNETH OSCAR, Sgt., R.C.A.F., of 550 Birch Ave., St. Lambert, Que. Born at Crysler, Ont., March 8th, 1919. Educ.: B.Sc. (Metallurgical Engrg.), Queen's Univ., 1942; 1939-40, asst. assayer and research asst., Hard Rock Gold Mines, Ltd., Geraldton, Ont.; 1942 (April-Dec.), asst. metallurgist, Pedlar People Ltd., Oshawa, Ont.; 1944 (Jan. to date), metallurgical inspr., No. 11 Aeronautical Inspection Dist., R.C.A.F., Montreal.

References: L. M. Arkley, L. T. Rutledge, R. A. Low, J. R. Cockburn, A. Jackson, J. W. Harkness, H. J. Roast.

DE LEUW—CHARLES EDMUND, of 259 Woodland Road, Highland Park, Ill. Born at Jacksonville, Ill., July 3rd, 1891. Educ.: B.S. (C.E.), Univ. of Illinois, 1912; 1912-17, junior engr., design and supervis'n. of constrn. on various railroad and municipal improvements; 1917-19, 1st Lieut. and Capt. 4th U.S. Engineers; 1919-29, partner, Kelker, De Leuw & Co.; 1929-42, pres., Charles De Leuw & Co.; 1942 to date, pres., De Leuw, Cather & Co., consltg. engrs. of Chicago. Practice has included investigations, surveys, plans, estimates, specifications and supervis'n. of constrn. of railroads, subways, tunnels, water supply, water purification, sewerage works, industrial plants, pavements, highways and elect'l. works, etc.

References: D. E. Blair, A. E. K. Bunnell, A. Duperron, H. V. Serson, H. W. Tate, N. D. Wilson.

DONNELLY—JAMES PLAYFAIR, of 12118 Ranger St., Cartierville, Que. Born at Kingston, Ont., Oct. 10th, 1904. Educ.: Diploma, (Civil Eng.) R.M.C., 1925; two years private study aerodynamics, aircraft design; 1919-24 (summers), Donnelly Salvage & Wrecking Co. Ltd.; 1925-29, R.C.A.F.; 1932-36, Canada Steamship Lines; with Noorduyn Aviation Ltd., as follows: 1937-39, stress analyst, 1939-40, production mgr., 1940 to date, executive engr., i/c aeronautical engrg. div'n.

References: G. L. Wiggs, H. Scheunert, W. E. Seely.

ERNST—CARROLL A., of 233 Victoria Ave. North, Hamilton, Ont. Born at St. Joseph, Mo., Feb. 19th, 1914. Educ.: B.A.Sc. (Mech.), Univ. of Toronto, 1938; 1939 to date, asst. to chief engr., Smart-Turner Machine Co. Ltd., designing and testing centrifugal power and steam pumps.

References: W. A. T. Gilmour, W. E. Brown, R. W. Angus, A. R. Hannaford, H. S. Philips.

GENDRON—HENRI, of Montreal and Sorel. Born at Montreal, Que., May 28th, 1904. Educ.: B.A.Sc., Ch.E., Ecole Polytechnique, 1924; R.P.E. Que.; 1919-24, hydraulic surveys, Quebec Streams Comm'n.; 1924-25, engrg., training course, S.W.P.Co.; 1925-26, illuminating engr., and 1926-27, commercial mgr., Quebec Power Co.; with the Frigidaire Corp. (G.M.C.) as follows: 1927-28, sales engr., 1928-30, dist. supervisor, 1930-31, provincial mgr., 1931-33, gen'l. mgr. (Que.); with the Can. General Elec. (Quebec) as follows: 1933-34, commercial ref. mgr., 1934-36, air cond'g. supervisor, 1936-42, dist. sales specialist; also 1936-42, prof., Air Conditioning Tech. School, Montreal; 1942 (6 mos.), mgr., Leaf Line Ltd., 1942-43, personnel mgr., and 1943-44, labour controller, Marine Industries, Ltd.; 1944 to date, industrial research engr., Sorel Industries Ltd., (on loan from Marine Industries Ltd.).

References: J. A. Lalonde, L. Duchastel, A. Frigon, G. H. Gillett, P. S. Gregory, R. H. Mather, I. S. Patterson, P. E. Poitras.

HOGG—WILLIAM MacDOUGALL, of Toronto, Ont. Born at Chippawa, Ont., Jan. 10th, 1910. Educ.: B.A.Sc., Univ. of Toronto, 1939; with the Hydro-Electric Power Comm'n. of Ont. as follows: 1925-35 (summers), rodman and junior instru'man., Queenston-Chippawa Canal, Ontario P.H., Trethewey Falls development, 1936, asst. res. engr., Chats Falls Development, 1937, asst. res. engr. and constrn. supt., Rat Rapids Development, and instru'man i/c field party, Madawaska River Survey, 1937-38, instru'man. and asst. divisional engr., Long Lac Diversion; at present, designing engr., hydraulic dept.

References: O. Holden, J. R. Montague, T. H. Hogg, A. E. Nourse, W. Jackson.

JOHNSTON—JAMES STUART, of 216 Willard Ave., Toronto, Ont. Born at Montreal, Sept. 22nd, 1915. Educ.: B.Eng. (Mech.), McGill Univ., 1940; R.P.E. Que.; 1936 and 1937 (summers), gen'l. mining, McIntyre Porcupine Gold Mines & Johnson's Asbestos Mines, Thetford Mines; 1938 (summer), surveying, St. Regis Pulp & Paper Co., Godbout, Que.; with the Dominion Oxygen Co. Ltd., Montreal, as follows: 1939-40, engrg. sales, 1940-42, sales engr., 1942-44, field engr. (transferred to Toronto Office April 1st, 1944).

References: D. S. Lloyd, W. A. Duncan, C. M. McKergow, J. G. Dodd.

KIRBY—WILLIAM EDWARD GORDON, of Montreal, Que. Born at Ottawa, Ont., June 13th, 1909. Educ.: B.Eng. (Chem.), McGill Univ., 1933; 1930 (summer), lab. asst., Forest Products Lab., Ottawa; 1931 and 1932 (summers), asst. constrn. foreman, Federal Tile & Mosaic Co., Ottawa; with the Spruce Falls Power & Paper Co., Kapuskasing, Ont., as follows: 1935, tester, sulphite mill, 1935-36, junior asst. chemist, 1936-37, senior asst. chemist, lab. investigations, water treating and filtration; 1937-41, sulphite control engr., Ontario Paper Co., Thorold, Ont.; 1941, received C.P.P.A. Tech. Section Weldon Medal for paper, "Slime Control at Ontario Paper Co."; 1941 to date, asst. office mgr., Price & Pierce Ltd., Montreal, supervising shipments for Ministry of Supply and assisting Dr. J. S. Bates in tech. service to suppliers of woodpulp.

References: J. S. Bates, J. L. McDougall, M. H. Jones, J. V. Fahey.

LEE—ROY EUGENE, of 64 Laird Drive S., Leaside, Ont. Born at St. Paul Minn., April 1, 1913; Educ.: B.Eng., Univ. of Sask., 1934; 1931 (summer), elevator and powerhouse constrn., at Ft. Churchill, Man., Carter-Halls-Aldinger Co. Ltd.; 1936-39, dist. supervisor, London, Ont. Dist., Imperial Oil Ltd. (included lubrication engrg. work at factories located in the area); 1939-42, dist. mgr., Stratford, Ont. Dist., J. I. Case Co., supervising and training dealers in marketing and servicing line of farm and industrial mach.; 1942 to date, area engr., Defence Industries Ltd., Ajax, Ont., i/c mtce., constrn. and mach. install'ns.

References: C. F. Morrison, E. K. Phillips, I. M. Fraser, C. W. Bell.

LEONARD—HUGH ANTHONY, Lieut. (E) R.C.N.V.R., of Ottawa, Ont. Born at Ilford, England, Oct. 3rd, 1920. Educ.: B.Eng., (Mech.), McGill Univ., 1942; 1938-41 (summers), dftsman., mech. detailing office, Dominion Bridge Co., Lachine; 1942 to date, on active service, 1942 (May to Aug.) preliminary course at H.M.C.S. Royal Roads, later proceeded overseas to join H.M.S. Garter, obtained Engine Room Watchkeeping Certificate, service at Scapa Flow and Mediterranean, 1943 (May to Sept.), special course in Gun Mountings in England and Scotland. At present on staff of the Director of Naval Ordnance, Naval Service Headquarters, Ottawa.

References: R. S. Eadie, E. Brown, C. M. McKergow, R. DeL. French, G. J. Dodd, I. N. MacKay, C. Bedford-Jones, D. B. Armstrong.

McLEAN—LOYOLA JOHN, of 43 Coulson Ave., Sault Ste. Marie, Ont. Born at Sault Ste. Marie, Ont., May 25th, 1909. Educ.: 1928-30, elec. engrg., Findlay Engineering College, Kansas City, Mo.; with the Algoma Steel Corp'n. Ltd. as follows: 1930-40, elect'l. dftsman. on constrn. and mtce.; 1940 to date, elect'l. engr., i/c engrg., design and dfting. of elect'l. equipm't., indoor and outdoor substations, overhead and underground transmission lines, industrial controls, metering, relaying, etc., also engrg. and dfting. relating to plant mtce.

References: Carl Stenbol, F. J. McDiarmid, A. H. Russell, A. E. Pickering, R. A. Campbell, N. C. Cowie.

MORRIS—CARL REYNOLDS, of 7 Champlain St., Shawinigan Falls, Que. Born at Preston, Ont., April 21st, 1902. Educ.: I.C.S. courses in mech. and struct'l. engrg. (diplomas); 1918-20, tracing and detailing, Can. Electro Products; 1920-22, dfting. and survey work, Spanish River Pulp & Paper Co.; 1922-28, dfting. and plant layouts, Can. Electro Products; with Shawinigan Chemicals Ltd. as follows: 1929-40, section head, i/c dfting., mech. design of chem. equipm't. and bldg. constrn., 1940 to date, chief dftsman., i/c plant layouts, material handling, and constrn. details and design.

References: H. K. Wyman, A. F. G. Cadenhead, P. W. Blaylock.

OTTER—GEORGE EDWARD, of Fort Erie, Ont. Born at Toronto, Ont., Nov. 30th, 1915. Educ.: B.A.Sc., Univ. of Toronto, 1938; with the deHavilland Aircraft as follows: 1934-37, 16 mos. shop work in Canada and England prior to graduation, 1938-39, dftsman., England, 1939-40, stressman, England; 1941 (5 mos.), stressman, Airspeeds (1934) Ltd., 1941 to date, chief aeronautical engr., Fleet Aircraft Ltd., Fort Erie, Ont., i/c engrg. dept., and all aeronautical engrg. work, stress approval, testing, etc.

References: W. R. Manock, L. C. McMurtry, W. U. Shaw.

PEART—JOHN WALTON, of 474 Talbot St., St. Thomas, Ont. Born at Brantford, Ont., Aug. 31st, 1891. Educ.: B.A.Sc., Univ. of Toronto, 1913; R.P.E. Ont. 1912-13, apprenticeship course, Can. Westinghouse Co. Ltd.; 1913-26, Public Utilities Comm'n., London, 1913-16, dftsman. and 1919-26, engr.; 1926-44, gen'l. mgr. and engr., Public Utilities Comm'n., St. Thomas, Ont.

References: E. V. Buchanan, V. A. McKillop, R. L. Dobbin, J. C. Keith, W. C. Miller, F. A. Bell.

PROCUNIER—GORDON WILLIAM, Capt., of Ingersoll, Ont. Born at Bayham, Ont., Nov. 2nd, 1917. Educ.: B.A.Sc. (Elec.), Univ. of Toronto, 1941; 1940, elect'l. switch gear, Crouse-Hinds Co. of Canada; 1941 (Mar.)-1942 (Aug.), Junior Officer, Armd. Bde. Wksp; 1942 (Sept.)-1943 (Aug.), Officer i/c L.A.D. (Armd. Regt.); at present, EME i/c Armd. Vehs., DDME Branch H.Q., First Cdn. Army (OS).

References: H. G. Thompson, J. D. Relyea.

WHITE—JOHN ROBERTSON, of Montreal, Que. Born at Parkside, Sask., Sept., 2, 1916. Educ.: B. Eng. (Mech.), Univ. of Sask., 1938; 1937 (summer), rodman, Dept. of Highways Ontario (Bancroft Div'n.); 1938-39, switchbd. operator and elec. mtce., Saskatoon Plant, Sask. Power Comm'n; 1939 (June to Dec.), instru'man., P.F.R.A. (Alberta), topographic surveys; 1940, engr., design, dfting., surveying, etc., Consolidated Paper Corp'n., Three Rivers, Que.; 1940-41, dftsman., (squad boss), engrg. dept., D.I.L., Montreal; 1941 (6 mos.), material engr., Fraser-Brace Engrg. Co. on constrn. D.I.L. Winnipeg plant (on loan from D.I.L.), 1941-42, quantity surveyor, engrg. dept., C.I.L.; 1942 to date, asst. project engr., engrg. dept., D.I.L.

References: I. R. Tait, C. H. Jackson, B. A. Evans, G. R. Stephen, E. K. Phillips, I. M. Fraser, D. A. Killam.

FOR TRANSFER FROM THE CLASS OF JUNIOR

COSSER—WALTER GEOFFREY, of Bourlamaque, Que. Born at Boksburg, Transvaal, Union of S. Africa, April 17, 1908. Educ.: B.Sc., McGill Univ., 1930; 1930, dftsmn., McIntyre-Porcupine Mines Ltd.; 1931, sales engr., McCarthy & Robinson Ltd.; 1932-35, dftsmn., Hollinger Consolidated Gold Mines; 1935-36, mech. engr., Preston East Dome Mines Ltd.; 1936-42, mech. supt., Sigma Mines (Quebec) Ltd.; at present, Lieut., R.C.E. Halifax Fortress Detachment, No. 6 E.S. & W.Coy., Halifax, N.S. (St. 1930: Jr. 1936.)

References: H. Idsardi, A. Campbell, C. Steubol, D. H. Sutherland, D. Giles, H. S. Dunn.

FRANKLIN—ROBERT LAWRENCE, Colonel, R.C.O.C., of Ottawa, Ont. Born at Riceville, Ont., Aug. 2, 1908. Educ.: B.Sc., Queen's Univ., 1930; 1928-30 (summers) Massey Harris Co., Toronto, shop work; 1930-31, research staff engr., Abitibi Power & Paper Co., Iroquois Falls; 1934-36, gun and carriage branch, Royal Arsenal, Woolwich, England; 1936-38, Ordnance Mech. Engr., Kingston; 1939-41, staff engr., Dir. of Mechanization and Army, N.D.H.Q., Ottawa; 1941-42, section engr., bodies and equipment, 1942-43, asst. director of automotive design, army engrg. design branch, Dept. of Munitions and Supply, Ottawa; 1943-44, 2 i/c Director, Acting Director, and at present Director Mech. Mtce., N.D.H.Q., Ottawa. (St. 1928: Jr. 1934.)

References: N. C. Sherman, D. S. Ellis, L. M. Arkley, N. Eager, W. D. Bracken, L. T. Rutledge.

TURNBULL—JOHN G., of Amherstburg, Ont. Born at Durham, Ont., June 23, 1905; Educ.: B.Sc., Queen's Univ., 1937; Summers, 1934, General Motors, 1935, Ford Motor Co.; 1937, field engr., and 1938 to date, i/c all expansion and cnstrn. work, Brunner Mond, Canada, Amherstburg, Ont. (Jr. 1938.)

References: D. S. Ellis, L. M. Arkley, A. Jackson, L. T. Rutledge, R. A. Low.

FOR TRANSFER FROM THE CLASS OF STUDENT

BECKER—SIDNEY, of Montreal, Que. Born at Montreal, May 26, 1916, Educ.: B.Eng., McGill Univ., 1938; R.P.E. Quebec; Summers: 1933, foundry, Crane Ltd., 1934, dftng. room, Darling Bros., 1935, foundry, Warden King. 1936-37, British American Oil Co.; 1941-43, British Air Commission, inspn. and supervision Air Ministry contracts and contractors' facilities; 1943-44, general engrg. dept., Aluminum Co. of Canada, Montreal; 1938-40, and at present, engr. at J. Becker, Inc., plumbing, heating, ventilation and powerhouse work, Montreal, Que. (St. 1937.)

References: G. J. Dodd, S. R. Banks, L. Shector, R. deL. French.

CAMERON—ADAM KIRKLAND, of Montreal, Que. Born at Quesnel, B.C., Apr. 27, 1916. Educ.: B.Eng., McGill, 1938. Summers: 1934, engine room work, Swift Canadian Co., 1936, gen'l. plant work, Hi-Way Oil Co., 1937, shop work, Canada Car & Foundry; July 1938-Jan. 1941, shop, estimating and service, sales engr., and from Jan. 1940 to Jan. 1941, district sales mgr., F. S. B. Heward & Co., Toronto; Jan. 1941 to Aug. 1941, foreman, gen'l. foreman, Jan. 1942 to Aug. 1943, shift supervisor, Defence Industries Ltd., Brownsburg, Que. At present, field investigator, Employee Relations Dept., D.I.L., Montreal. (St. 1938)

References: C. M. McKergow, R. deL. French, F. S. B. Heward, C. Bedford-Jones, E. L. Johnson.

CRAIG—CLARENCE EDWARD, of Kingston, Ont. Born at Cobalt, Ont., June 28, 1914; Educ.: B.Sc., Queen's, 1938. 1938-43, dftsmn., and layout of design, Horton Steel Works, Ltd., Fort Erie, Ont.; Feb. 1943 to date, prodn. development engr., Aluminum Co. of Canada, Forge Divn., Kingston, Ont. (St. 1938.)

References: C. S. Boyd, W. R. Manock, S. D. Lash, A. Jackson, R. A. Low.

D'AMOURS—ALBERT, of Sorel, Que. Born at Montreal, Que., Feb. 20, 1916. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1942. R.P.E. Quebec. Summers, 1938-41, Road Department, Prov. of Quebec; 1942 to date, fitting supervisor and dftsmn., Marine Iudustries, Ltd., Sorel, Que. (St. 1939.)

References: J. A. Lalonde, A. Circe, L. Trudel, A. Duperron, H. Gaudefroy, P. P. Vinet.

DAVIS—BRUCE LUMBERS, of Arvida, Que. Born at Toronto, Ont., Oct. 7, 1915. Educ.: B.A.Sc., Univ. of Toronto, 1941; Summers, 1938, Siscoe Gold Mines Ltd., 1939, International Nickel Co. Ltd., 1940, Sylvanite Gold Mines, Ltd.; with Aluminum Co. of Canada as follows: 1939, mtce. engr., supervising mtce. and constrn. work, 1942, supervisor of operation and control of Calcination and Grinding Depts., Ore Plant No. 1, and 1943 to date, mech. supervisor of Ore Plant No. 1, Arvida, Que. (St. 1941.)

References: C. R. Young, G. B. Moxon, B. E. Bauman, P. E. Radley, M. G. Saunders.

DeBLOIS—JULES-NOEL, of Quebec, Que. Born at Parish of St-Roch, Que., Dec. 24, 1917. Educ.: Tech. School and Michaud Institute, Quebec City. 1938-39 (summers), dftsmn. with Tremblay & Drouyn; with Dept. of Highways, Quebec, as follows: 1940, technical service of expropriations, 1941, instr'mn. on road cnstrn., May, 1942, to date, res. engr., roads constrn., including eight months as asst. divnl. engr. (St. 1943.)

References: A. Gratton, A.-V. Dumas, A. Morissette, P. Methe, J. Limoges, E. Gohier.

Employment Service Bureau

NOTICE

Technical personnel should not reply to any of the advertisements for situations vacant unless—

1. They are registered with the Wartime Bureau of Technical Personnel.
2. Their services are available.

A person's services are considered available only if he is—
(a) unemployed;
(b) engaged in work other than of an engineering or scientific nature;
(c) has given notice as of a definite date; or
(d) has permission from his present employer to negotiate for work elsewhere while still in the service of that employer.

Applicants will help to expedite negotiations by stating in their application whether or not they have complied with the above regulations.

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.

SITUATIONS VACANT

DRAUGHTSMAN required, with mechanical or structural experience. Some knowledge of material handling will be helpful. Position with established company. Not war work. Apply to Box No. 2732-V.

CIVIL ENGINEER for service work in Newfoundland. Some knowledge of road building and road building materials essential. Not over 45 years of age. Must be available under regulations Part III, Technical Personnel, Order in Council P.C. 246. Apply to Box No. 2758-V.

PARTNER WANTED—Small manufacturing plant and machine shop on attractive peacetime programme requires the services of a mechanical engineer with practical machine shop experience to step up production and expansion. Investment required, $7,000. Salary, stock and share of profits. A splendid opportunity to invest in a profitable, ready-made peacetime operation. Apply to Box No. 2759-V.

TIME STUDY engineer required by large textile mill (wool) situated in the Province of Quebec. Person conversant with French language preferably, familiar with Bedaux system, to organize job methods, job evaluation, piece rates and efficiency control. Apply to Box 2761-V.

SITUATIONS WANTED

STRUCTURAL ENGINEER, M.E.I.C., R.P.E. (Ont.). Designing engineer and estimator; all types fabricated steel and plate work. Experience covers positions as chief engineer, chief draughtsman, sales engineer and executive responsibilities. Apply to Box No. 2208-W.

CHEMICAL ENGINEER, B.A.Sc., M.E.I.C., Canadian graduate, ready for new appointment. Married, no children, Montreal home. Fifteen years' experience in most manufacturing departments of pulp and paper industry. This covers technical development, design and mill operation, particular emphasis being placed on plant supervision, operation of mill equipment, and handling of operating personnel. Extensively travelled on business in the British Isles, Europe and throughout eastern and southern U.S.A., hence foreign appointment or contacts may be attractive. Sales and servicing of equipment is of definite interest, and this need not be restricted to pulp industry. Apply to Box No. 2257-W.

CIVIL ENGINEER, 1933, age 32, married. One year railroad construction surveys, one year hydro construction, five years mining engineering, one year university instructor. Desire permanent position in industry, particularly interested in cost control, also interested in position with firm or consultant doing planning or construction. Initial salary secondary to opportunity and type of work. Available July 1st or earlier if necessary. Apply to Box No. 2460-W.

GRADUATE ELECTRICAL ENGINEER, age 30, married, with seven years' experience in electrical engineering including maintenance, operation and engineering office experience. Available shortly. Apply to Box No. 2462-W.

INSTRUMENTS
FOR SALE

Thatcher's calculating machine, K & E No. 5005 Engineer "Y" level, railroad transit, 36 railroad curves, polar planimeter, survey compass, 2 brass 24" parallel rules, tapes and drawing instruments. Excellent condition. Apply to Box No. 54-S.

WANTED

Askania magnetometers, preferably new, compensated models. Apply to Box No. 55-S.

PRELIMINARY NOTICE *(Continued)*

MERRITT—ROBERT J., of 495 Prince Arthur W., Montreal. Born at Calgary, Alta., April 29, 1915. Educ.: B.A.Sc., Univ. of Toronto, 1941. 1935-36, 1937-38 (summers), laborer and operator, various mines; 1940 (summer), technician, Algoma Steel, Ltd.; with Defence Industries, Ltd., as follows: 1941, acting supt., Met. and Chem. labs., 1942, metallurgist of shops divn. and supervisor of metallurgical control, Verdun, late 1942 supervisor in Process Engrg. Dept., Westmount Tool Works, April 1943, i/c as supervisor of methods and time study groups, Process Engrg. Divn., Westmount, involving supervision of shops methods and dev. test work, and time study of all operations. (St. 1940.)

References: F. H. Barnes, A. C. Rayment, H. B. Hanna, C. R. Young, E. A. Allcut.

McELROY—GEORGE ROBSON, of Mackenzie, British Guiana. Born at Regina, Sask., Apr. 30, 1916. Educ.: B.Sc., (Mech.), Univ. of Sask., 1942. 1934-36, driver, electrician's helper, mtce., Horseshoe Lake Mining Co., Ormiston, Sask.; 1937-38, storekeeper; 1940-41 (summers), driver, Diesel Locomotive; 1942-43, repairs and mtce. to mining equipment, and at present, mines mech. engr., i/c mtce. of mining equipment and power house, Demerara Bauxite Co. Mine, Mackenzie, British Guiana. (St. 1942.)

References: W. G. Stuart, I. M. Fraser, N. B. Hutcheon, R. A. Spencer.

McGEACHY—DUNCAN DONALD C., of 114 Balmoral Ave. S., Hamilton, Ont. Born at Hazelton, B.C., Dec. 12, 1918. Educ.: B.Sc., Queen's, 1940. Summers, 1938, machine operator, Chatham Malleable Iron Co., 1939, operator steam concrete mixer, Anglin Norcross Cnstrn. Co., 1940, foreman-in-training, Proctor & Gamble Co., Hamilton; 1940-41, foreman of cartridge drawing dept., and shift supervisor of metallic factory, Canadian Industries, Ltd., Brownsburg, Que.; 1941-44, inspecting officer, i/c various plants in U.S.A. and Canada for British Admiralty Technical Mission. (St. 1938.)

References: L. A. Wright, G. J. Dodd, E. L. Johnson, L. T. Rutledge, A. Jackson, D. S. Ellis.

NORTON—HOWARD WILLIAM, of 4165 Marcil Ave., Montreal. Born at Montreal, Jan. 9, 1919. Educ.: B.Eng., McGill, 1942. 1939-40, and 1941-42 (summers), machinist apprentice, Canadian National Motive Power Shops; 1942 to date, aeronautical engr., R.C.A.F., St. Johns, Que. (St. 1942.)

References: E. Brown, J. J. O'Neill, R. deL. French, C. M. McKergow, D. Hillman.

JOURNALS REQUIRED

There has been an unusual demand for extra copies of the January, February and March, 1944, issues of *The Engineering Journal* and it would be appreciated if members who do not retain their copies would return them to Headquarters at 2050 Mansfield Street, Montreal, Que.

Industrial News

Industrial development — new products — changes in personnel — special events — trade literature

AWARDED MEDAL

Dr. John F. Thompson, executive vice-president, International Nickel Co. of Canada Ltd., has been awarded the 1944 Egleston medal for distinguished engineering achievement, according to an announcement by Dr. Nicholas Murray Butler, president of Columbia University.

MERGER ANNOUNCED

Merger of Monsanto Chemical Co. of St. Louis, Mo., and I. F. Laucks Ltd. of Vancouver, B.C., has been announced jointly by Charles Belknap, Monsanto president, and Irving C. Smith, managing director of I. F. Laucks. The transaction brings Monsanto to the Pacific coast at three different points, the same arrangement having been made with I. F. Laucks Inc. at Seattle and Los Angeles.

MANUFACTURING RIGHTS

United Steel Corp. Ltd., with head office in Toronto and branches in Montreal and Welland, for many years has been closely associated with the Chain Belt Company of Milwaukee in the application and distribution of the latter company's products in Canada.

Under a new arrangement, many Chain Belt products bearing the trade mark "Rex" will now be manufactured in Canada by United Steel Corp. These will include Rex uni-flow elevator-conveyors for grain and bulk material handling, also a comprehensive line of sanitation equipment for sewage and water treatment plants. The sales and engineering service of United Steel Corporation will now be available to the Canadian territory east of Port Arthur, Ont.

CANADIAN CAR APPOINTMENT

At a meeting of the board of directors of the Canadian Car & Foundry Co. Ltd., Lyle McCoy was appointed vice-president and assistant general manager succeeding the late W. S. Atwood.

Mr. McCoy has been associated with the company since 1916 and his experience, covering all phases of its operations, has taken him to all plants in a wide range of capacities. For the past two and a half years he has managed the plant at Cherrier, Que.

Mr. McCoy's new duties will include the assistant general managership of subsidiary companies, among them Canadian Car Munitions Ltd.

Lyle McCoy

Ellis H. Jones

FIFTY YEARS SERVICE

Ellis H. Jones, general manager, The Yale & Towne Manufacturing Company, (Canadian Division), St. Catharines, Ont., completed fifty years service with the Yale organization on April 6th, 1944.

Mr. Jones joined the staff of the company at Stamford, Conn., as a boy, where he served his apprenticeship in toolmaking and draughting, later becoming manager of the draughting department.

In 1912 he was transferred to Canada as assistant superintendent of the Canadian division. In 1930 he was appointed general manager of the Canadian divison, in charge of all of the company's Canadian business.

ELECTRONICS

Canadian Westinghouse Co. Ltd., Hamilton, Ont., have issued a 40-page booklet entitled "ABC of Electronics," which was prepared with a view to helping those whose duties, either in the services or industry, include the operation of electronic devices. It gives by word and diagram a clear explanation of the six basic ways in which electronic tubes function.

N.I.A.A. OFFICERS

H. A. Standing, Gypsum, Lime & Alabastine Canada Ltd. was elected president of the Ontario chapter of the National Industrial Advertisers Association for 1944, at the recent annual dinner held in Toronto.

Other newly elected officers are Vincent R. Young of Canadian General Electric Co. Ltd. as vice-president; Sid Ives of the Glidden Co. Ltd. as secretary; J. G. Beare of Link-Belt Ltd. as treasurer.

Immediate past-president, Ted Dowsett of the Trane Co. of Canada Ltd. will act as a director along with Geo. Clark of Canadian Line Materials Ltd., G. A. Elliott, James R. Kearny Corp., I. M. Gringorten, Canada Motor Products Ltd., R. J. Avery, Ronalds Advertising Agency Ltd. and J. L. Craig, MacLean Publishing Company.

CHIMNEY CONSTRUCTION

National Sewer Pipe Co. Ltd., Toronto, Ont., have recently published a 24-page booklet, with a view to stimulating an interest in the adoption, by Canadian municipalities, of uniform chimney construction by-laws for the prevention of fires from defective flues, sparks on roofs and gas asphyxiation. The booklet contains a model chimney construction by-law covering chimneys, fireplaces, flues and pipes. The balance of the booklet contains drawings of standard chimney constructions and illustrates the method of incorporating flue linings to meet the requirements of the by-law. It also contains illustrations and specifications of a variety of flue components available to meet the most residential construction needs.

NEW SUBSIDIARY

Purchase of Canadian Jefferson Electric Co. Ltd. by Amalgamated Electric Corp. Ltd. has just been announced. Identity of the Jefferson company is being retained as a subsidiary in the Amalgamated Electric group. Management and manufacture has been moved to the Toronto plant of Amalgamated Electric.

TECHNICAL DICTIONARY

The Philosophical Library Inc., 15 East 40th St., New York City, have published a 352-page illustrated technical dictionary. This book contains the standard technical definitions of current terms in the applied sciences, graphic and industrial arts and mechanical trades; including air navigation, meterology, shipbuilding, synthetics and plastics; with illustrations, technical data, and interconversion tables. It is priced at five dollars per copy and is available direct from the publisher.

RESUMES POSITION

Frank T. Armour has recently returned to his position on the technical staff of Taylor Instrument Companies of Canada Ltd., after serving for three and a half years on loan to the instrument division of the Department of Munitions & Supply. Mr. Armour has had many years experience in the temperature, pressure and flow control fields and is well-known to processing industries throughout Canada.

Frank T. Armour

THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 27 — MONTREAL, JUNE 1944 — NUMBER 6

"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

★ ★ ★

PUBLISHED MONTHLY BY

THE ENGINEERING INSTITUTE OF CANADA

2050 MANSFIELD STREET - MONTREAL

Price 50 cents a copy, $3.00 a year: in Canada, British Possessions, United States and Mexico. $4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, $2.00 a year. —Entered at the Post Office, Montreal, as Second Class Matter.

CONTENTS

BOFORS ANTI-AIRCRAFT GUNS ROLLING OUT OF A CANADIAN ORDNANCE PLANT . . . . Cover
(Photo *Globe and Mail*, Toronto)

THE DEVELOPMENT OF STEAM PRODUCTION AT ARVIDA . 338
M. G. Saunders, M.E.I.C.
Discussion 343

OGOKI DIVERSION 347
O. Holden, M.E.I.C.

PROBLEMS IN DESIGN OF ALASKA HIGHWAY BRIDGES . 353
Raymond Archibald, William K. Greene and John W. Guppy

A SUBWAY PLAN FOR MONTREAL 357

POST-WAR PLANNING (Discussion) 364

MONTH TO MONTH 368

PERSONALS 373
Obituaries 375

NEWS OF THE BRANCHES 377

LIBRARY NOTES 383

PRELIMINARY NOTICE 388

EMPLOYMENT SERVICE 389

INDUSTRIAL NEWS 390

THE ENGINEERING INSTITUTE OF CANADA

MEMBERS OF COUNCIL - 1944

PRESIDENT

deGASPÉ BEAUBIEN, Montreal, Que.

PAST-PRESIDENTS

*C. J. MACKENZIE, Ottawa, Ont.
‡K. M. CAMERON, Ottawa, Ont.
†C. R. YOUNG, Toronto, Ont.

VICE-PRESIDENTS

*W. P. BRERETON, Winnipeg, Man.
†G. L. DICKSON, Moncton, N.B.
†J. M. FLEMING, Port Arthur, Ont.
*L. F. GRANT, Kingston, Ont.
*C. K. McLEOD, Montreal, Que.
†E. B. WARDLE, Grand'Mère, Que.

COUNCILLORS

*J. E. ARMSTRONG, Montreal, Que.
*H. E. BRANDON, Toronto, Ont.
†H. L. BRIGGS, Winnipeg, Man.
*A. E. CAMERON, Halifax, N.S.
‡R. S. EADIE, Montreal, Que.
*J. W. D. FARRELL, Regina, Sask.
†G. H. FERGUSON, Ottawa, Ont.
†E. V. GAGE, Montreal, Que.
†P. E. GAGNON, Quebec, Que.
*R. E. HEARTZ, Montreal, Que.
*A. JACKSON, Kingston, Ont.
†J. A. LALONDE, Montreal, Que.
†ALEX. LOVE, Hamilton, Ont.
†P. A. LOVETT, Halifax, N.S.
*N. B. MacROSTIE, Ottawa, Ont.
†J. McMILLAN, Calgary, Alta.
*A. W. F. McQUEEN, Niagara Falls, Ont.
†E. B. MARTIN, Moncton, N.B.
*G. E. MEDLAR, Windsor, Ont.
†W. MELDRUM, Lethbridge, Alta.
*J. P. MOONEY, Saint John, N.B.
†A. S. G. MUSGRAVE, Oak Bay, B.C.
*E. NELSON, Edmonton, Alta.
*H. G. O'LEARY, Fort William, Ont.
*J. McD. PATTON, Regina, Sask.
‡P. E. POITRAS, Montreal, Que.
†J. A. RUSSELL, Sydney, N.S.
*C. SCRYMGEOUR, Dartmouth, N.S.
†H. R. SILLS, Peterborough, Ont.
†C. STENBOL, Sault Ste. Marie, Ont.
*E. O. TURNER, Fredericton, N.B.
*J. A. VANCE, Woodstock, Ont.
*H. J. WARD, Shawinigan Falls, Que.
*J. W. WARD, Arvida, Que.
*C. E. WEBB, Vancouver, B.C.
†W. S. WILSON, Toronto, Ont.

*For 1944. †For 1944-45. ‡For 1944-45-46.

TREASURER

F. C. MECHIN, Montreal, Que.

GENERAL SECRETARY

L. AUSTIN WRIGHT, Montreal, Que.

SECRETARY-EMERITUS

R. J. DURLEY, Montreal, Que.

ASSISTANT GENERAL SECRETARY

LOUIS TRUDEL, Montreal, Que.

STANDING COMMITTEES

FINANCE
C. K. McLEOD, *Chairman*
J. E. ARMSTRONG
G. A. GAHERTY
F. C. MECHIN
R. M. CALVIN

LEGISLATION
P. E. POITRAS, *Chairman*
F. J. BLAIR
R. J. DURLEY

PAPERS
L. F. GRANT, *Chairman*

LIBRARY AND HOUSE
E. V. GAGE, *Chairman*
A. T. BONE
J. S. HEWSON
M. S. NELSON
G. V. RONEY

PUBLICATION
R. S. EADIE, *Chairman*
R. DeL. FRENCH, *Vice-Chairman*
R. C. FLITTON
J. A. OUIMET
C. A. PEACHEY

SPECIAL COMMITTEES

BOARD OF EXAMINERS
R. A. SPENCER, *Chairman*
I. M. FRASER
W. E. LOVELL
A. P. LINTON
H. R. MacKENZIE
E. K. PHILLIPS

GZOWSKI MEDAL
T. H. JENKINS, *Chairman*
E. G. M. CAPE
V. A. McKILLOP
W. H. POWELL
E. O. TURNER

DUGGAN MEDAL AND PRIZE
W. J. W. REID, *Chairman*
R. C. FLITTON
H. M. WHITE

PLUMMER MEDAL
P. E. GAGNON, *Chairman*

LEONARD MEDAL
F. V. SEIBERT, *Chairman*
A. E. MacRAE
D. H. McDOUGALL
G. W. WADDINGTON

JULIAN C. SMITH MEDAL
deGASPÉ BEAUBIEN, *Chairman*
C. J. MACKENZIE
C. R. YOUNG

MEMBERSHIP
J. G. HALL, *Chairman*
S. R. FROST
N. MacNICOL

PROFESSIONAL INTERESTS
J. B. CHALLIES, *Chairman*
J. E. ARMSTRONG, *Vice-Chairman*
G. A. GAHERTY,
A. SURVEYER
J. A. VANCE

STUDENTS' AND JUNIORS' PRIZES

H. N. Ruttan Prize—Western Provinces
W. P. BRERETON, *Chairman*
A. M. MACGILLIVRAY
C. E. WEBB

John Galbraith Prize—Province of Ontario
J. M. FLEMING, *Chairman*
H. E. BRANDON
A. W. F. McQUEEN

Phelps Johnson Prize—Province of Quebec (English)
C. K. McLEOD, *Chairman*
E. V. GAGE
R. E. HEARTZ

Ernest Marceau Prize—Province of Quebec (French)
E. B. WARDLE, *Chairman*
P. E. GAGNON
P. E. POITRAS

Martin Murphy Prize—Maritime Provinces
G. L. DICKSON, *Chairman*
J. P. MOONEY
C. SCRYMGEOUR

INTERNATIONAL RELATIONS
M. J. McHENRY, *Chairman*
E. A. ALLCUT
A. E. BERRY
C. P. EDWARDS
D. H. McDOUGALL
C. SCRYMGEOUR
L. E. WESTMAN

WESTERN WATER PROBLEMS
G. A. GAHERTY, *Chairman*
C. H. ATTWOOD
L. C. CHARLESWORTH
A. GRIFFIN
D. W. HAYS
G. N. HOUSTON
T. H. HOGG
C. J. MACKENZIE
H. J. McLEAN
F. H. PETERS
S. G. PORTER
P. M. SAUDER
J. M. WARDLE

THE YOUNG ENGINEER
H. F. BENNETT, *Chairman*
C. G. R. ARMSTRONG
J. BENOIT
J. B. deHART
RENE DUPUIS
J. N. FINLAYSON
R. F. LEGGET
A. E. FLYNN
R. DeL. FRENCH
A. JACKSON
G. R. LANGLEY
A. E. MACDONALD
H. W. McKIEL
D. A. R. McCANNEL

ENGINEERING FEATURES OF CIVIL DEFENCE
J. E. ARMSTRONG, *Chairman*
P. E. ADAMS
J. N. ANDERSON
S. R. BANKS
H. F. BENNETT
W. D. BRACKEN
W. P. BRERETON
J. M. DAVIDSON
R. S. EADIE
E. V. GAGE
G. A. GAHERTY
R. J. GIBB
A. GRAY
J. GRIEVE
J. L. LANG
R. F. LEGGET
I. P. MACNAB
J. A. McCRORY
H. J. McEWEN
C. B. MUIR
W. H. MUNRO
J. A. A PICHÉ
G. MacL. PITTS
C. J. PORTER
M. G. SAUNDERS
W. O. SCOTT
T. G. TYRER
H. K. WYMAN

INDUSTRIAL RELATIONS
WILLS MACLACHLAN, *Chairman*
E. A. ALLCUT
J. P. BRIERLEY
J. C. CAMERON
E. R. COMPLIN
J. A. COOTE
RENÉ DUPUIS
T. W. EADIE
S. M. GOSSAGE
F. W. GRAY
E. G. HEWSON
I. F. McRAE
W. H. MUNRO
W. J. W. REID

DETERIORATION OF CONCRETE STRUCTURES
R. B. YOUNG, *Chairman*
E. VIENS, *Vice-Chairman*
G. P. F. BOESE
A. G. FLEMING
W. G. C. GLIDDON
J. A. McCRORY
C. J MACKENZIE
J. H. McKINNEY
R. M. SMITH

THE ENGINEERING INSTITUTE OF CANADA

OFFICERS OF BRANCHES

BORDER CITIES
Chairman, J. B. DOWLER
Vice-Chair., A. H. MacQUARRIE
Executive, G. W. LUSBY J. M. WYLLIE
J. F. G. BLOWEY
(Ex-Officio), G. E. MEDLAR
G. G. HENDERSON
Sec.-Treas., W. R. STICKNEY,
1614 Ontario Street,
Walkerville, Ont.

CALGARY
Chairman, H. B. LeBOURVEAU
Executive, J. V. ROGERS F. C. TEMPEST
P. F. PEELE J. LANGSTON
(Ex-Officio) J. McMILLAN
S. G. COULTIS
J. G. MacGREGOR
K. W. MITCHELL
Sec.-Treas., A. B. GEDDES,
4716 Elbow Drive,
Calgary, Alta.

CAPE BRETON
Chairman, M. F. COSSITT
Executive, M. R. CHAPPELL
J. R. MORRISON
(Ex-Officio), J. A. MACLEOD
J. A. RUSSELL
Sec.-Treas., S. G. NAISH
Peacock Brothers Ltd.,
Post Bldg., Sydney, N.S

EDMONTON
Chairman, B. W. PITFIELD
Vice-Chair., J. W. JUDGE
Executive, H. W. TYE
I. F. MORRISON
J. D. A. MACDONALD
J. E. B. CRANSWICK
R. SCOTT
R. H. LINKE
(Ex-Officio), E. NELSON
C. W. CARRY
F. R. BURFIELD
Sec.-Treas., G. H. MILLIGAN
Calgary Power Company,
214 McLeod Bldg.,
Edmonton, Alta.

HALIFAX
Chairman, G. J. CURRIE
Executive, R. J. BETHUNE J. W. MARCH
J. E. CLARKE C. D. MARTIN
K. L. DAWSON L. E. MITCHELL
D. C. V. DUFF H. A. RIPLEY
J. H. M. JONES R. B. STEWART
(Ex-Officio), A. E. FLYNN A. E. CAMERON
C. SCRYMGEOUR
P. A. LOVETT
Sec.-Treas., S. W. GRAY,
Wartime Bureau of Technical
Personnel, 84 Hollis Street,
Halifax, N.S.

HAMILTON
Chairman, H. A. COOCH
Vice-Chair., NORMAN EAGER
Executive, C. H. HUTTON
H. J. A. CHAMBERS
R. J. G. SCHOFIELD
A. R. HANNAFORD
(Ex-Officio), ALEX. LOVE T. S. GLOVER
Sec.-Treas., W. E. BROWN,
91 Barnsdale Blvd.,
Hamilton, Ont.

KINGSTON
Chairman, S. D. LASH
Vice-Chair., J. R. CARTER
Executive, F. A. ATHEY C. E. CRAIG
J. D. CALVIN H. D. ROGERS
(Ex-Officio), L. F. GRANT
A. JACKSON
K. M. WINSLOW
Sec.-Treas., J. DOUGLAS LEE,
Queen's University,
Kingston, Ont.

LAKEHEAD
Chairman, R. B. CHANDLER
Vice-Chair., S. T. McCAVOUR
Executive, S. E. FLOOK
O. J. KOREEN
E. L. GOODALL
J. I. CARMICHAEL
W. H. SMALL
A. D. NORTON
E. A. KELLY
J. S. WILSON
(Ex-Officio), E. M. G. MacGILL J. M. FLEMING
(Mrs. E. J. Soulsby)
E. J. DAVIES H. G. O'LEARY
Sec.-Treas., W. C. BYERS,
c/o C. D. Howe Co. Ltd.,
Port Arthur, Ont.

LETHBRIDGE
Chairman, A. L. H. SOMERVILLE
Executive, J. M. CAMPBELL
A. G. DONALDSON
P. E. KIRKPATRICK
R. S. LAWRENCE
(Ex-Officio), W. MELDRUM
Sec.-Treas., T. O. NEUMANN
Dept. of Transport,
Post Office Building,
Lethbridge, Alta.

LONDON
Chairman, R. S. CHARLES
Vice-Chair., H. G. STEAD
Executive, E. B. ALLEN
F. C. BALL
H. F. BENNETT
V. A. McKILLOP
G. N. SCROGGIE
(Ex-Officio), T. L. McMANAMNA
J. A. VANCE
Sec.-Treas, A. L. FURANNA,
732 Wellington Street,
London, Ont.

MONCTON
Chairman, A. S. DONALD
Vice-Chair., H. W. HOLE
Executive, H. J. CRUDGE A. GORDON
T. H. DICKSON E. C. PERCY
E. R. EVANS G. E. SMITH
(Ex-Officio), G. L. DICKSON
J. A. GODFREY
E. B. MARTIN
Sec.-Treas., V. C. BLACKETT,
Engrg. Dept., C.N.R.,
Moncton, N.B.

MONTREAL
Chairman, C. C. LINDSAY
Vice-Chair., J. B. STIRLING
Executive, C. E. GÉLINAS J. BENOIT
K. G. CAMERON L. H. BURPEE
G. H. MIDGLEY
M. S. MACGILLIVRAY
(Ex-Officio), deGASPÉ BEAUBIEN
C. K. McLEOD
J. E. ARMSTRONG
R. S. EADIE J. A. LALONDE
E. V. GAGE P. E. POITRAS
R. E. HEARTZ
Sec.-Treas., L. A. DUCHASTEL,
40 Kelvin Avenue,
Outremont, Que.

NIAGARA PENINSULA
Chairman, W. D. BRACKEN
Vice-Chair., A. G. HERR
Executive, M. H. JONES
A. D. SMITH
H. E. BARNETT
J. W. BROOKS
W. D. BROWNLEE
P. E. BUSS L. J. RUSSELL
(Ex-Officio), A. W. F. McQUEEN
G. E. GRIFFITHS
J. H. INGS
2135 Culp Street,
Niagara Falls, Ont.

OTTAWA
Chairman, W. L. SAUNDERS
Executive, W. H. B. BEVAN
J. H. BYRNE
D. G. KILBURN
J. M. WARDLE
C. D. WIGHT
(Ex-Officio), K. M. CAMERON
G. H. FERGUSON
N. B. MacROSTIE
Sec.-Treas., A. A. SWINNERTON,
Dept. of Mines & Resources,
Ottawa, Ont.

PETERBOROUGH
Chairman, C. R. WHITTEMORE
Executive, R. L. DOBBIN
A. L. MALBY
F. R. POPE
A. J. GIRDWOOD
W. T. FANJOY
(Ex-Officio), A. R. JONES
H. R. SILLS
Sec.-Treas., E. WHITELEY,
611 Weller Street,
Peterborough, Ont.

QUEBEC
Life Hon. Chair., A. R. DÉCARY
Chairman, E. D. GRAY-DONALD
Vice-Chair., J. O. MARTINEAU
Executive, A. E. PARÉ
CHARLES LEMIEUX
Y. R. TASSÉ W. J. MANNING
L. MARTIN J. M. PAQUET
(Ex-Officio), P. E. GAGNON
RENÉ DUPUIS
P. MÉTHÉ
PAUL VINCENT
Sec.-Treas., GUSTAVE F. ST-JACQUES
Public Service Board of
the Province of Quebec,
Court House,
Quebec, Que.

SAGUENAY
Chairman, CHAS. MILLER
Vice-Chair., G. B. MOXON
Executive, J. FRISCH W. E. COOPER
F. T. BOUTILIER
(Ex-Officio), R. H. RIMMER J. W. WARD
ALEX. T. CAIRNCROSS
Sec.-Treas., ALEX. T. CAIRNCROSS,
8-C Brittany Row,
Arvida, Que.

SAINT JOHN
Chairman, C. D. McALLISTER
Vice-Chair., J. M. LAMB
Executive, G. M. BROWN
W. J. LAWSON
H. A. STEPHENSON
R. M. RICHARDSON
(Ex-Officio), J. P. MOONEY
A. O. WOLFF
F. A. PATRIQUEN
E. O. TURNER
Sec.-Treas., L. O. CASS,
National Harbour Board,
P.O. Box 1393,
Saint John, N.B.

ST. MAURICE VALLEY
Chairman, J. H. FREGEAU
Vice-Chair., R. DORION
Executive, G. B. BAXTER
E. BUTLER
A. G. JACQUES
R. D. PACKARD M. EATON
E. T. BUCHANAN J. JOYAL
W. E. A. McLEISH H. G. TIMMIS
(Ex-Officio), VIGGO JEPSEN
H. J. WARD
E. B. WARDLE
Sec.-Treas., DAVID E. ELLIS,
Shawinigan Water & Power
Company,
P.O. Box 190,
Three Rivers, Que.

SASKATCHEWAN
Chairman, J. McD. PATTON
Vice-Chair., N. B. HUTCHEON
Executive, F. C. CHRISTIE
G. W. PARKINSON
W. B. RAMSAY
F. E. ESTLIN
E. K. PHILLIPS
J. I. STRONG
(Ex-Officio), J. W. D. FARRELL
Sec.-Treas., STEWART YOUNG,
P.O. Box 101,
Regina, Sask.

SAULT STE. MARIE
Chairman, A. M. WILSON
Vice-Chair., G. W. McLEOD
Executive, G. W. HOLDER
C. O. MADDOCK
H. W. SUTCLIFFE
(Ex-Officio), N. C. COWIE
C. STENBOL
Sec.-Treas., T. F. RAHILLY,
174 Pim Street,
Sault Ste. Marie, Ont.

TORONTO
Chairman, S. R. FROST
Vice-Chair., C. F. MORRISON
Executive, C. D. CARRUTHERS
E. A. CROSS
D. G. GEIGER
A. H. HULL
R. F. LEGGET
J. F. McLAREN
(Ex-Officio), H. E. BRANDON
W. S. WILSON
C. R. YOUNG
W. H. M. LAUGHLIN
F. A. DAVIS
Sec.-Treas., S. H. deJONG,
Dept. of Civil Engineering,
University of Toronto,
Toronto, Ont.

VANCOUVER
Chairman, T. V. BERRY
Vice-Chair., A. PEEBLES
Executive, J. P. FRASER F. H. BALLOU
E. S. JONES R. C. PYBUS
G. W. ALLAN J. A. TAMES
(Ex-Officio), C. E. WEBB
W. N. KELLY
Sec. Treas., P. B. STROYAN,
2099 Beach Avenue,
Vancouver, B.C.

VICTORIA
Chairman, H. L. SHERWOOD
Vice-Chair., A. L. FORD
Executive, P. B. HUGHES
C. M. TRIPP
S. R. WESTON
J. N. ANDERSON
(Ex-Officio), A. S. G. MUSGRAVE
KENNETH REID
Sec.-Treas., R. BOWERING,
41 Gorge Road West,
Victoria, B.C.

WINNIPEG
Chairman, T. H. KIRBY
Vice-Chair., C. P. HALTALIN
Executive, B. B. HOGARTH N. M. HALL
R. A. SARA W. F. RIDDELL
E. V. CATON
(Ex-Officio), W. P. BRERETON
H. L. BRIGGS
J. T. DYMENT
Sec.-Treas., T. E. STOREY,
55 Princess Street,
Winnipeg, Man.

THE DEVELOPMENT OF STEAM PRODUCTION AT ARVIDA

M. G. SAUNDERS, M.E.I.C.
Mechanical Superintendent, Aluminum Company of Canada, Arvida, Que.

Paper delivered at the Fifty-Eighth Annual Professional Meeting of The Engineering Institute of Canada, at Quebec, on February 11th, 1944

The history of the development of steam production at Arvida illustrates the changes which have to be made from time to time in plant equipment and location due to variations in the requirements of production and in the fuels available.

In the original plant set up for aluminum production at Arvida, steam was required mostly for heating, the main process applications being its use in the preparation of mix for carbon electrodes and lining of electric reduction furnaces. To meet these conditions, two boiler houses were constructed, one of which contained three hand-fired low pressure heating boilers for office and wash and locker room heating and a second boiler house which contained one 485-hp. Babcock and Wilcox boiler fed by Taylor stokers and designed for 250 lb. pressure. This boiler supplied the necessary process steam and heat for several plant buildings in its immediate neighbourhood.

Early in the operation of the plant at Arvida, it was found that surplus electric energy was available and an 8,000 kw. electric steam generator at 200 lb. per sq. in. was installed in a building attached to the second boiler house mentioned above. This unit was run in parallel with the steam unit and used such power as was available up to the limit of the steam demand. It was soon found that there was sufficient excess capacity in the second plant to supply its requirements as well as those of the low pressure heating plant first mentioned, so these two plants were connected by a main steam line and the load handled in one place. This resulted in a great saving in labour and although the low pressure boilers were left in position for several years to be available in case of emergency, they were never used again and were finally removed to use the space for other purposes.

Further plant expansion for the preliminary treatment of ore was made two years later and a third boiler house was built containing two Babcock and Wilcox boilers, similar in size and characteristics to the one mentioned above and which supplied steam for the heating of the new plant as well as process requirements consisting of fairly large demands for about five to ten minutes every four hours.

The success of tying together the first two plants caused an investigation to be made into the economy which might be effected in connecting the second and third plants and it was decided, after study, to do so. A steam line was therefore installed, suspended from towers as the ground over which this line had to be run had several roads and railway tracks, making a single pole suspension impractical and a tunnel very costly.

The investment made in tying these boiler plants together was returned in approximately one year by savings in operation and maintenance and the generally lesser losses caused by the operation of one plant instead of two.

One very interesting problem was caused by a process requirement at the rate of 30,000 to 40,000 lb. of steam per hour from five to ten minute periods at four hour intervals. The length of the steam line was such that the pressure drop at this flow was excessive. In order to remedy this condition, the boiler drums of the plant which was shut down, located about halfway between the plant supplying the load and its point of use, were connected into the steam line and used as accumulators. Water level in these drums was drawn down approximately 2 in. at each period of demand and the whole system functioned quite satisfactorily.

Somewhat later, electric energy being plentiful, the whole load was handled with the electric boiler and a special type of control was used to pick up the additional load and drop it again which, at that time, amounted to about double the normal load the boiler was carrying. This apparatus consisted of a surge tank in which water was kept at boiler pressure and at the same temperature and concentration as that being used in the electric boiler. This surge tank was set at an elevation above that of the boiler drum and when the period of demand came, by putting boiler pressure on top of the water and opening the bottom valve in the surge tank, this water entered the electric boiler drum thus increasing the electrode immersion and raising the rate of steam production very rapidly.

As soon as the demand was over, the process was reversed and the water was returned into the surge tank. This system operated very satisfactorily until the discontinuance of the process which had made this arrangement necessary.

In 1935, a different ore treatment process was introduced at Arvida which required larger quantities of steam for process work than had hitherto been used and it became necessary to reopen the last built boiler house. At this time, however, surplus electric energy was plentiful and one 15,000 kw. electric steam generator was installed. This carried the whole load for the plant.

Later, expansion of process made it necessary to install a second electric steam generator of the same size in the same location, and at the same time the Babcock and Wilcox boilers were reconditioned, new tuyeres being installed, and in one of the units partial water walls were added to act as clinker chills.

This was the situation up until definite expansion for war purposes was made. At this time, it was obvious that surplus electric energy could no longer be obtained and it became necessary to produce much larger quan-

Fig. 1—Feed water pumps—boiler house No. 2

Fig. 2—Feed water control laboratory.

tities of process steam than previously as plant expansion was being made on an increasingly large scale.

It was therefore necessary to go to combustion boilers but the problem remained as to what fuel could be used. The company had a large fuel oil handling system which was used in connection with calcining kilns. At first it was thought that this would be the more economical type of fuel to be used, but before studies had progressed very far, it was seen that a sufficient supply of fuel oil might be difficult to obtain and that there was very little, if any economy, to be gained from its use at the time.

Consequently, it was decided that such boilers as were installed would be suitable for pulverized coal and at the same time have such features in their design as would make their conversion to fuel oil possible with the minimum of trouble and expense.

Other considerations in the selection of the first unit were its ability to fit into the space available and the fact that it was very necessary to have a unit which could be kept on the line for comparatively long periods without coming down for cleaning or repair as the process supplied was a continuous one and any lack of steam supply meant a shutting down of process work with consequent loss of production which, at that time, was a vital necessity.

The unit finally selected was a Combustion Engineering Corporation's VU type steam generator with a capacity of 131,000 lb. per hour at 250 lb. per sq. in. pressure.

The pulverizers were finally selected to use eastern Canadian coals but were ordered somewhat oversize. The reason for this was that it might be necessary to use types of coal with less grindability than that originally selected and furthermore, if one mill were down for repair, boiler load could be maintained at approximately 65 per cent rating with the other mill.

These precautions have proved to be wise, as during the war years it has become increasingly difficult to obtain the necessary coal from any one source of supply and with the equipment provided, there has never been any difficulty in meeting the required demand.

In the case of the driving equipment for boiler auxiliaries, it was decided to use electric motors throughout and to provide an auxiliary steam turbine drive on the induced draft fans. As the continued operation of the aluminum reduction process depends on an uninterrupted supply of power and as the boilers originally installed were provided with steam driven auxiliaries and could supply sufficient steam for plant heating purposes, it was felt that it was not necessary to provide steam driven auxiliaries for the new installations which were primarily to produce process steam.

Operating experience over the past three years has demonstrated the correctness of this view and the last two units to be installed did not have any steam driven auxiliaries while the ones which have been installed were never used beyond giving them a trial run and all of the four turbines supplied have since been sold to other users.

As a protection against improper combustion conditions in the furnaces, all drives were electrically interlocked so that they must be started up in proper sequence and, should any one drive fail, those preceding it were immediately shut off.

As plant expansion was made by successive steps and as it was impossible to predict what the next steps might be, if any, or for how long a period the equipment might be in service, it was logical to make use of as many existing facilities as possible; hence the first unit was installed in an addition to the largest existing boiler house and as many of the existing auxiliaries as possible were continued in service. This had particular reference to the coal handling system, the feedwater pumps, feedwater heaters and stack, all of which were, with slight modifications, able to care for the new demand until it became necessary to go beyond a second unit.

At this time, a considerable enlargement was made on account of the war programme, which required the installation of a third and fourth unit. It had been decided, at the time of the installation of the second unit, to have all units of the same design and capacity, which would avoid the necessity of preparing drawings and specifications and would thus permit quicker delivery, as well as lessen the number of replacement parts to be kept in stock.

When the third and fourth units were considered, it became necessary to re-open the whole matter of feedwater supply and treatment, the arrangement of steam distribution headers and the provision of satisfactory stacks. Figure 1 shows the feedwater pumps as finally installed.

In the case of the feedwater treatment, it was decided to install a laboratory in which samples of boiler blowdown water could be continually checked with an electrical apparatus which indicated the amount of impurities present and allowed close control of the amount of feedwater treatment supplied to the boilers.

Figure 2 shows the feedwater treatment laboratory, and how the connections from all boiler blowdown lines are brought to a common point for testing.

Feedwater and Treatment

The feedwater is treated with chlorine to kill any disease-carrying bacteria as this water is also used for drinking purposes in part of the plant. This water has a light brown colour, due to dissolved vegetable and organic matter such as leaf-mould and also has some suspended solids such as very fine sand and clay.

The chemical analysis is as follows:

	Per U.S. Gal.	
Silica (sand or clay)	0.58	grains
Calcium Carbonate (limestone)	0.80	"
Magnesium Carbonate	0.25	"
Sodium Carbonate (soda-ash)	0.11	"
Sodium Chloride (salt)	0.10	"
Sodium Sulphate	0.30	"
Total dissolved solids	2.7	"
Soap hardness	1.1	"
pH	6.7	

In addition to the above, there are dissolved gases such as oxygen and carbon dioxide from the atmosphere. The solids which precipitate out in the boilers are, for the most part, vegetable matter, silica, calcium carbonate, calcium sulphate and magnesium hydroxide. This water with 1.1 grain per U.S. gal. soap hardness is considered a medium soft water.

Internal treatment combined with deaeration of the feedwater is the method of control used, i.e., dissolved gases are removed in a deaerating feedwater heater and the mineral impurities are precipitated as sludge internally in the boiler drums by the injection of chemicals.

The chemicals used and the method employed are supplied by Aluminate Chemicals Limited. These chemicals are made up in the form of ball briquettes of which there are three types, one consisting mainly of di-sodium phosphate with small percentages of glucogum used as a coagulant for sludge and sodium carbonate. The second briquette consists mostly of soda ash and a small percentage of tannin. The third briquette consists chiefly of Quebracho tannin.

In general, the phosphate briquette prevents scale by the formation of insoluble calcium phosphate sludge. The soda-ash prevents corrosion by increasing the alkalinity and also helps decrease the phosphate sludge, and the Quebracho tannin compound which is fed into the feedwater heater prevents deposits in the feedlines, absorbs residual oxygen in the boiler feedwater and acts as a general stabilizer.

The maximum amount of dissolved solids which may be carried in the boilers without causing scale or corrosion has been set at 100 grains per U.S. gal. with a minimum of 80 grains. The phosphate excess has been set at 70 parts per million (ppm), and the alkalinity range is 20-22 grains per U.S. gal.

In the control of feedwater treatment, hourly tests are taken for dissolved solids and phenolphthalein alkalinity and the phosphate excess is tested every two hours. A soap hardness test is made on raw water once per shift; condensate returns are tested hourly from dissolved solids and tests are taken for hardness, phenolphthalein alkalinity and methyl alkalinity twice per shift.

The above tests are recorded on daily logs which are forwarded to Aluminate Chemicals Limited who recommend changes or improvements in treatment, when necessary.

A completely new system of feedwater pumps and piping was installed with a feedwater heater and deaerating unit which had sufficient capacity to supply the whole station. A regrouping of steam headers was also made at this time. Separate stacks were provided for the first group of two boilers, and individual ones for units three and four.

When further plant expansion became necessary, it became a question as to whether it would be more economical to try to place two more boilers as an addition to the existing station or to build a new plant nearer the point where the bulk of the steam would have to be used. Although it was physically possible to place the required number of boilers at the first plant, yet at the time this decision had to be made, it was by no means certain whether more units might not have to be installed at a later date for which there would definitely be no room available in this location. Further, the size of the steam line supplying the new plant would have to be increased at a very considerable cost and the line was so long that a comparatively large pressure drop would be experienced at the required flow. It was therefore decided to build a completely new plant which would have two more boiler units of the same size and design as those previously purchased. The general arrangement of this plant was such as to incorporate any lessons learned over the previous two years and, to date, its operation has been quite successful.

Fig. 3—Main coal storage.

Due to the shortage of structural steel, this building was constructed of reinforced concrete which introduced a number of problems new to Arvida, principally in the supporting of pipe lines and equipment. Previously it had been possible to attach them to steel building members with very little difficulty but now it required considerable work and planning to support them from concrete members.

Special consideration was given to the design of the coal bunkers as difficulty had been experienced with wet coal sticking in the ones at the first plants. The new ones were made with steeply sloping sides which have improved matters considerably although they are not entirely trouble free.

Feedwater treatment and control and other auxiliaries with the exception of coal handling are essentially duplicates of those previously purchased.

One other reason for the establishment of a boiler plant in a new location was the possibility of damage from direct enemy action and it was felt that it would be unwise to have all boilers under one roof. Fortunately, we have never been called on to experience such action but, at the time the decision was made, there was sufficient possibility that such an event could happen to give this point very definite weight.

The establishment of two large boiler plants located at some distance from one another and supplying steam to a common distribution header raised the question of load control. After considerable thought had been given to this question, it was decided to establish a central load dispatching station, at which there would always be an operator on duty who would have information as to the demands from each section of the plant, the amount of steam being supplied by each boiler and such other pertinent information as might be required to decide where any additional load would be taken from or, if it was necessary to cut back, which boiler would be reduced in load or cut out.

This station was set up on the operating platform of the main boiler room and connected by a direct telephone line to the other two boiler plants. A master selector switch was installed on the operating table so that the total load at the large plant could be controlled from this point if desired.

Operation of Despatcher's Panel

In practice, the despatcher observes the trend of the load on the system and, if fluctuations are

Fig. 4—Auxiliary hot air duct to pulverizer.

not excessive, regulates them through means of a station master selector valve located on his desk. Should the fluctuations become excessive, he immediately contacts the head operator at whichever of the plants he believes should absorb the fluctuation and issues instructions accordingly. The method of control used to date has been to carry base load at the smaller plant and absorb fluctuations at the larger.

The operation of this control has proved entirely satisfactory and has enabled us to pick up load very quickly, when required, or to cut back just as efficiently; fluctuations of 100,000 lb. per hour having been handled without difficulty.

In the operation of these boiler plants, certain difficulties have been encountered which have been practically overcome and it is possible that a brief discussion of these various points would be of interest.

The first difficulty which developed from the operation of these units arose from the fact that the feedwater treatment apparatus had not been received when it was desired to put the first unit on the line. Operating experience from nearby plants and our own experience pointed to the conclusion that it should be possible to operate for at least a limited time without feedwater treatment. However, within the first twenty days, at approximately 75 per cent rating, a tube failure was experienced due to scale deposits.

By this time, feedwater treatment was available and an attempt was made to remove deposits by treatment. This however proved unsatisfactory and it was necessary to turbine all the tubes of this unit.

Further difficulties were met with in an attempt to control the quality of feedwater due to the varying temperature of the water used in dissolving the compound and in the supply, control and quality of condensate return water.

As has been mentioned previously, the first two units were installed using a number of existing boiler auxilliaries, among them the feedwater heaters, but with the installation of the third and fourth units, it became necessary to obtain additional feedwater heater capacity. Consequently a complete change was made in the system, a feedwater heater was purchased with additional capacity to supply the whole station, and a completely equipped feedwater control laboratory was installed. This laboratory was equipped with a blinker system with electrodes permanently connected into the continuous blowdown lines from each unit from which the concentration maintained in the water of any boiler could be immediately determined.

A further connection was installed in the condensate return line which indicated any contamination of these returns. This was necessary because at times the condensate return water was contaminated by caustic soda due to break-downs in heat exchangers. Whenever this occurred, it was necessary to turn the condensate water to sewer while repairs were being made. This was done by an automatic dumping valve, included as a part of the system.

The final installation has worked quite satisfactorily and after one tube turbining in the first unit, no further work of this kind has been necessary. One unit in fact has remained on the line for 9½ months at 80 to 110 per cent of rating, which could not have been done without fairly efficient water control.

Some trouble has been experienced due to precipitation of the compound in feed lines. This was remedied by the addition of a stabilizing compound to the feedwater treatment and recent inspections have shown lines and pump housings to be free from deposits.

A second difficulty came from the fact that much of the coal was at times mixed with snow which melted in the pulverizers and made it impossible to keep the boiler properly supplied with fuel. This problem was attacked from two angles, one being to supply coal as free from moisture as possible and the other to supply sufficient heat to the pulverizers to take care of any moisture which might be admitted. The combination of these attempts has proved quite successful. In the first case, the bulk of coal required for boiler operation is stored at a point some miles away from the plant where it is unloaded and placed in a large pile and compacted by a caterpillar bulldozer.

Coal Handling

The coal pile is located near terminals where it can be unloaded direct from ships by dock equipment and handled by conveyors to a central point in the storage area from which it is moved and compacted by bulldozers.

During the winter season, this coal is loaded by steam cranes into railway cars and hauled to the plant where it is emptied into track hoppers and conveyed by machinery to bunkers over the pulverizers. Crushing equipment and magnetic separator form a part of the circuit. A reserve storage of coal is also kept in the plant yard in case of any failure of delivery.

At the close of the storing season, the outside edges of the pile are cut off and the coal thrown into the centre of the pile and compacted again. This leaves a pile comparatively free from air pockets and eliminates much of the hazard of loss through heating. When this coal in being loaded, care is taken to keep a nearly vertical face so that snow will not accumulate over the top of the coal being moved. This, together with care

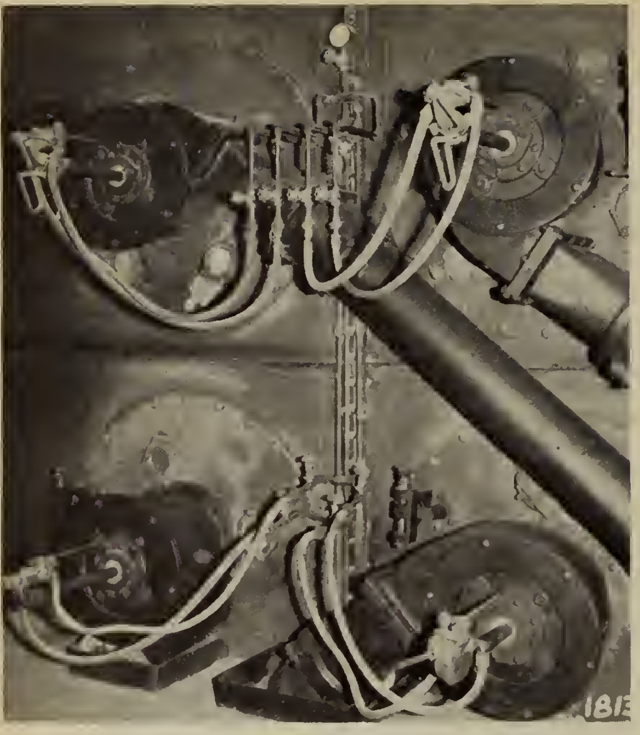


Fig. 5—Lighting off torches in position.

being taken to clean the cars into which the coal is loaded of all snow before loading is commenced, has enabled the amount of moisture coming into the boiler plant with the coal to be cut down to a considerable degree.

The second method of dealing with this problem consisted in taking auxiliary air ducts from the superheater area of the boiler (which in these boilers is free due to the fact that no superheaters are installed) and by using this hot air to temper the primary air delivered to the pulverizers. One of these ducts is shown in Fig. 4.

This allows the air temperature in the pulverizers to be raised as high as 700 deg. F., if necessary, which results in the evaporation of any moisture remaining and makes the pulverized coal sufficiently dry to be blown to the furnace without trouble.

Some minor difficulties with dampers were experienced when this expedient was first tried but by slight changes in design and construction, these difficulties were overcome and everything now works in a satisfactory manner.

There have also been several slight furnace explosions for one reason or another which have removed part of the furnace roof but never so much as to seriously interfere with operation. One of these instances permitted the examination of a section of the boiler tubes not ordinarily visible and it was discovered that by using another soot blower element, these tubes could be kept very much cleaner than had been possible previously. Further, it was found that by counterweighting the explosion doors, they could be made to operate more easily and that after this had been done, these minor explosions were taken care of by the explosion doors rather than by having a section of the furnace roof lifted off.

Among the major replacement problems were those of blades on exhauster fans, parts for pulverizers and soot blowers. Considerable experimental work has been done with hard surfacing fan blades. This has in the main been quite successful. The life of the liners of the grinding chambers of pulverizers has been found to be shorter than that of the moving parts. By building up liners by electric arc welding, their life has been greatly lengthened.

In the case of soot blowers, the chief difficulty has been with their length, as the elements tend to warp. Experiments are now being conducted with a view to using shorter elements from both sides of the boiler rather than a single long element from one side only.

The lighting off of the boilers is done by air atomizing, oil burning torches which are permanently connected to each burner. These are directly connected to a central oil supply system which is fed by a pipe line from a large outside storage tank. It is possible to place a boiler on the line from a cold start with these torches; this has now been made a standard practice as the temperature can be brought up more evenly by this method. Figure 5 shows a unit with torches in position and Fig. 6 shows the oil reservoirs and pumps in one boiler house.

The boiler control panels and instruments were furnished by Bailey Meter Company. The control for each two boilers is placed midway between the boilers. A master panel is placed between the two boiler panels to provide for joint operation of the two units if desired.

Ashes are handled by a Nuveyor system and deposited in a large tank which empties into railway dump cars through a feeder in which the ashes can be wet down to prevent dispersion by the wind. The base of the stack is also connected to this tank. A further use of this system is made by using it as a part of a vacuum cleaning system for the boiler house by installing connections at various points and using an ordinary vaccuum cleaner brush.

The first of the six VU units has now been in service for 3¼ years and has been on the line for 87.5 per cent of the time. The average for the six units to date has been 85.2 per cent with a high of 89.8 and a low of 82 per cent for individual units. These figures do not represent the availability of the units, which has been from 96 to 98 per cent, the difference being accounted for by the fact that at least one unit is off the line during the summer months owing to decrease in heating load. A test efficiency of 85.89 per cent has been realized and average daily efficiencies are close to this figure.

The foregoing is a brief summary of the history of boiler plant development and operation at Arvida. In general, the apparatus installed has performed satisfactorily and such difficulties as have been encountered have been successfully overcome. The system has proved to be sufficiently flexible to absorb any load fluctuation met with in practice and no loss of aluminum production has ever resulted from lack of steam.

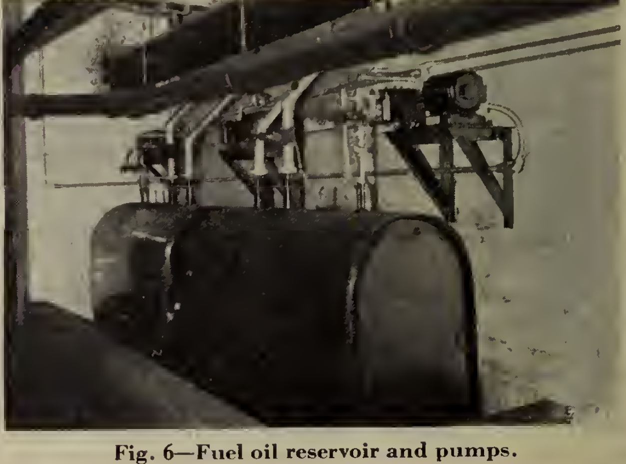


Fig. 6—Fuel oil reservoir and pumps.

DISCUSSION

John T. Farmer, m.e.i.c.[1]

Boiler plants are often called upon to operate under rather abnormal conditions. The boiler system at Arvida appears to have been no exception to this, when we learn that, at one stage, the normal steam output was increased 100 per cent for a few minutes out of every four hours. Such a condition calls for excess capacity not only in the boiler itself, but in all accessory plant and in the piping to the point of utilization. Such a situation offers an ideal opportunity for a steam accumulator where such equipment is applicable. It is interesting to note how in this case such an application was carried out by utilizing the steam drums of otherwise idle boilers. Presumably a certain drop of pressure was incurred during the period of high steam demand, but apparently this was not greater than was admissible without inconvenience.

The device of the hot water surge tank later used with the electric boiler constituted an ingenious method of providing for sudden changes in load. It would be interesting to know to what extent the accumulation principle came into play in this case to speed up the release of steam. To analyze this it would be necessary to know in more detail the relative dimensions of the electric boiler and the surge tank, and the pressure range during the period of increased output. In any case, it appears that the device of the surge tank should be very generally applicable in connection with electric boilers subject to varying loads.

In view of the rapid increase of steam demand recorded, from a few thousand pounds to some 750,000 lb. per hour, it was not surprising that it became necessary to resort to fuel boilers, as this steam output would have required an input of some 250,000 kw. This is merely in line with the recognized fact that the employment of electric power for the production of heat is in general an extravagant misuse of this form of energy. The type of equipment selected for this service is in line with modern practice. We note with interest some details which prudent foresight has dictated in other cases. An example is the provision of over-size pulverizers, more ample in capacity than close calculation would call for, to take care of the contingency of low-grade fuels. The use of electric power for auxiliary equipment is generally preferable in view of the ruggedness and reliability of electric motors, provided the source of power is dependable as in this instance. Steam driven auxiliaries are sometimes desirable where isolation of plant limits and leaves subject to interruption the power supply necessary to maintain production; and sometimes for reasons of overall economy: but these conditions do not appear to have been present at Arvida.

As in most modern plants, the importance of proper boiler water conditions has been realized and provided for. No mention is made of any pre-treatment of the water. Presumably this was not considered necessary in view of the relatively low solid content of the water available. As the steam produced is apparently mainly used for process, presumably the proportion of condensate in the water as fed to the boiler is inconsiderable. With this in mind, it would appear that the quantity of blowdown necessary to maintain suitable boiler concentration must be rather high. This would appear to be a case justifying pretty complete recovery of heat from the blowdown by means of heat exchangers. To those interested in this vital phase of boiler operation some further particulars would doubtless prove interesting and of value.

The construction of the latest boiler house in reinforced concrete was interesting to the writer, who has recently been connected with a construction of a similar nature resorted to for similar reasons. As the author remarks, this type of construction does introduce a number of problems, principally in the matter of providing in advance for the accommodation and supporting of equipment, as concrete is by no means as adaptable as structural steel. The question of pipe supports did not occasion much difficulty. In general it was solved by attaching the pipe hangers to roof or convenient beams by means of cinch anchors. In some cases, difficulty has arisen in finding suitable points in concrete buildings from which to suspend slings for hoisting heavy pieces during erection. Attention was given to this feature by providing during construction for suitable hooks or eye-bolts embedded in the concrete at points where it was foreseen that they would be required. In the case referred to, concrete coal bunkers formed a part of the building construction, and the difficulties mentioned by the author were envisioned. The bunker sides were given a slope of about 50 deg. to the horizontal and, in addition, short lengths of 3-in. pipe were embedded in the sloping walls at intervals, so that a rod could be inserted and the coal agitated if it appeared to have a tendency to bridge over and stick. This seemed a reasonable precaution although in the case in question there is no reason to anticipate much trouble from excessive moisture in the coal. An attempt was also made to provide drainage channels by which any accumulation of moisture from melting snow or ice might be drained off without having to pass through the pulverizer. It remains to be seen how effective this may prove.

The necessary coal handling at Arvida, from ship to open storage, and thence by rail to the boiler house undoubtedly increases greatly the likelihood of collection of moisture. It is interesting and instructive to note the precautions devised to mitigate this difficulty.

The reference to slight furnace explosions serves to emphasize the desirability of providing ample explosion doors or loose roof sections in furnaces burning fuel in suspension. While it may not be possible entirely to eliminate damage from this cause, such provision will probably serve to minimize its effects.

The brief record of performance given for these units certainly shows most satisfactory efficiency and what is probably even more important, a most gratifying record of availability. The author is to be congratulated most heartily on this showing.

F. L. Lawton, m.e.i.c.[2]

Ordinarily large steam plants are thought of in connection with central stations, but Mr. Saunders in his comprehensive paper has presented a case where an industrial process-steam station or group of stations is outstanding. Built up from essentially standard units, the overall result is very gratifying. One of the major features is the distribution of steam over such an extensive area and the methods of control adopted.

Exhauster fans used in connection with large boiler plants seem to present somewhat the same difficulties as waterwheels, as they frequently lose weight in operation due to erosion or cavitation. Could Mr. Saunders advise which phenomenon is responsible for the difficulties with the fan blades?

[1] Mechanical Engineer, Montreal Engineering Company, Limited, Montreal.

[2] Assistant Chief Engineer, Aluminum Company of Canada, Limited, Montreal.

L. A. McKeown, Jr.E.I.C.[3]

The source of raw water used at the Arvida steam plants is generally referred to as Chicoutimi River water. This water is classified as a soft organic water, the impurities consisting mainly of calcium and magnesium bicarbonates and soluble organic material. The silica content is high in relation to the other scale-forming impurities and requires adequate consideration in the overall chemical treatment.

The City of Arvida filtration plant changes the composition of the natural raw Chicoutimi River water considerably. It has been necessary, under certain circumstances, to use mixtures of filtered and raw water.

The raw water with no chemical treatment would form scale deposits consisting of a mixture of calcium carbonate, calcium and magnesium silicates with varying percentages of organic material. Of these various types of scale the calcium silicate would be the most dangerous as formation would occur in the sections of the boiler where the temperature is highest. Due to the hard dense structure of this type of scale, only a thin deposit would be required to cause a tube failure from overheated metal.

The chemical feedwater treating system was set up so that the required chemicals can be fed continuously into the feedwater system and all scale-forming impurities are precipitated as an insoluble sludge in the boilers. This sludge is further conditioned by the organic materials incorporated with the softening chemicals so the sludge or, more correctly, the suspended solids flow freely with the natural circulation of the boiler water and are proportionately removed by boiler blowdown. A continuous feed of chemicals is very desirable, in fact almost essential, in high capacity steam generators where the actual volume of water in the boiler is small in comparison with the steam output. The whole system is designed to maintain a uniform chemical balance in the boiler water in conjunction with the continuous blowdowns installed on the steam generating units.

The chemicals used are compressed dry into non-porous ball briquettes. With the chemicals in this form no mixing, weighing or chemical pumping apparatus is required. The chemical feeders are steel cylinders with inlet and outlet pipe connections and a special type of control valve to regulate the volume of water flowing over the ball briquettes thus controlling the amount of chemicals dissolved in a specified time. The system provides flexibility for rapid compensation to meet changes in raw water composition.

The condensate contamination condition which was troublesome in the initial stages has been overcome by the installation of the Nalco blinker system operating the automatic dumping valve which delivers only uncontaminated condensate to the boiler house. Prior to the installation of this equipment, severe carryover was experienced whenever contaminated condensate reached the boilers but subsequently a very good quality steam has been produced. The steam quality is checked by means of steam samples drawn from the outlet of each boiler and connected to the blinker systems installed in the power plant laboratory. The total dissolved solids in the condensed steam from the boiler outlets averages about 3 ppm.

This routine steam sampling showed that considerable carryover was taking place on a small waste heat unit, although the concentration of total solids in the boiler water was not excessive. Investigation revealed that the steam baffles had not been installed properly, and since correction of this condition steam of satisfactory quality has been produced by this boiler.

Proper control of chemical application and of boiler blowdown are of vital importance in the success of any feedwater treating system and the operating staff at the Arvida plants have at all times shown a keen interest in maintaining the required uniform chemical balance in the boiler water. The good results obtained are in no small measure due to their untiring efforts.

W. H. D. Clark[4]

The boiler units installed at Arvida are the standard design of Combustion Engineering steam generator, Type VU. The furnace volume of each unit is 7,346 cu. ft., the heating surface of each boiler is 11,632 sq. ft. and of each water cooled furnace is 2,297 sq. ft.

The furnaces are almost cubical in shape, being 19 ft. 10 in. long by 20 ft. 10 in. high, and 17 ft. 10 in. wide. They are fully water cooled on all surfaces, the side walls being of the fin type, and the bottom of the furnace being formed by a standard floor screen.

Each furnace is fired by two No. 412 bowl mills, which deliver the fuel to four Type R burners symmetrically arranged in the front wall. The air for these burners passes through an air heater behind the boiler, which raises its temperature to around 400 deg. F.

The most unusual feature of operation reported by Mr. Saunders is the continuous uninterrupted service at full load required of these boilers. As far as the design of the unit is concerned, it is believed that the main factor in the performance reported is the furnace arrangement. The combustion rate is moderate, being only some 21,000 B.t.u. per cu. ft. per hr. at an evaporation of 131,000 lb. per hr., and furthermore the burner arrangement and the use of four burners fills the furnace with flame and makes use of the volume provided. Also, the amount of water cooled surface exposed to radiation from the flames is relatively large, and with all coals burned to date the temperature of the gases leaving the furnaces has been below the fusion temperature of the ash. There has been no accumulation of slag in the boilers, and only light deposits on the furnace walls, which fall off of their own accord.

As far as operation is concerned, the main factor has unquestionably been control of the feedwater treatment. Mr. Saunders' description of the unusual means adopted at Arvida to ensure this control is extremely interesting, for it has been our definite experience that while the treatment of feedwater in the average plant may be a very simple matter for a trained chemist, it is by no means easy to maintain the close control required in every day service. Starting up troubles, such as those reported by Mr. Saunders, are the rule rather than the exception.

A modern boiler requires very close control; an Arvida boiler, for example, contains only some 65,000 lb. of water at operating level and temperature, so that the boiler water changes every half hour, and it is very easy for the concentration of chemicals and sludge in the boiler to get out of hand. At the same time, the temperature of the flames may easily reach 2,800 deg. F. in parts of the furnace, and large areas of the water cooled walls are washed by these flames; any scale deposit is a serious matter and may shut down the boiler.

The importance of this feature of operation was recognized at an early stage in the Arvida development, and a logical and comprehensive solution was worked out in the feedwater laboratory described. This arrangement is believed to be unique, and consideration and

[3] Service Representative, Aluminate Chemicals Limited, Montreal.

[4] Chief Engineer, Combustion Engineering Corporation Limited, Montreal.

study of it is urged on all those who are interested in the operation of large boilers.

It is believed that a secondary factor in design, apart from the characteristic design of the VU unit, is the arrangement for disposing of the ashes. The ash hoppers are deep, with large storage capacity, and the floor screen above shades the hopper from radiation, so that the ashes do not fuse or sinter. The slope of the hopper walls is steep, so that the hopper is self emptying, and ash removal is accomplished quickly and without interruption of boiler operation.

Another secondary factor is the ability of the induced draft fans to withstand erosion; this is severe, for in a nine month period one of the these fans at Arvida has to handle some 3,000 to 4,000 tons of solid material. Further information on the life of the fan wheels and casings would be interesting.

Mr. Saunders' point about the desirability of ample pulverizer capacity is well taken. The irregularity of coal quality during the war has emphasized this feature, but even in ordinary times the changes in coal that may occur during the twenty to forty year life of a large boiler plant make it no more than a reasonable precaution. It is open to the objection that it limits the range of load over which the unit can be operated, but if two mills per boiler are used, operation down to 15 or 20 per cent of full load can always be relied on, which should cover nearly all requirements.

Mr. Saunders' description of experiences with wet coal should interest every one concerned in the operation of large and small boiler plants, for wet coal is the most distinctive feature of our Canadian steam plants. It is interesting that the first large Canadian pulverized fuel installation, the three 120,000 lb. boilers built for the Ford Motor Company, at Windsor, Ont., about 1923, did not have this trouble, and operated for a number of years with no provision for drying coal either ahead of or in the mills. This was made possible by an unusual coal storage arrangement, which permitted the selection of dry coal from the pile very easily. Subsequent plants, such as Winnipeg Hydro and Canadian International Paper, built in 1924 and 1925, included coal dryers ahead of the mills, but these were complicated and expensive devices. The introduction of direct firing permitted drying in the mills with preheated air, and our first direct fired installations, made at St. Lawrence Paper Mills and at Laurentide Paper about 1925 and '26, incorporated this. It has been the usual arrangement since then, and with air at say 400 deg. F., dry coal is delivered with raw coal moisture up to about eight per cent and operation can be maintained at higher moisture content with more or less difficulty from imperfect drying in the mills.

In some plants a sort of super air heater, which passes the air for the mills through tubes in the superheater zone, and thus raises its temperature to 600 or 700 deg. F. has been used, but the present standard is the arrangement described by Mr. Saunders for bleeding hot gas into the primary air ducts. There is a limit to the amount of dilution of the primary air by inert gas beyond which trouble develops in the flames, but it is apparent from Mr. Saunders' paper that with 400 deg. F. air to start with this limit is beyond the capacity of the coal handling system to handle moisture.

This part of the system, particularly the coal bunkers and coal spouts, now seems to be the limiting factor. In the last boiler room at Arvida, particular thought was given to the bunkers, and instead of the catenary type previously used they were made as symmetrical hoppers, square in plan, and with 60 deg. slopes. Vibrators were installed, and two 20 in. round spouts run to each feeder. It is indicated that the trouble has been only partially overcome, and Mr. Saunders' comments as to the magnitude of the remaining difficulty, and the extent to which more expensive arrangements can be justified, would be of great interest.

The other difficulties that are reported from the Arvida plants are of a less fundamental nature. Occasional furnace puffs or slight explosions are difficult to avoid entirely in any unit burning pulverized fuel or liquid or gaseous fuel, and the design of the VU unit provides for them in a form of roof construction that will yield if the explosion doors fail to deal with the situation adequately, and thus prevent damage to the walls.

The trouble with soot blowers has also occurred in other plants. At the time of installation, long elements, running from one side of the boiler, were the manufacturer's standard, but there is no doubt that they were too long, and all new installations for this furnace width are being made with shorter elements, supplied from both sides.

Mr. Saunders' comment about replacement of pulverizer parts other than the grinding parts is very interesting. The bowl mills installed at Arvida are a relatively new development; the basis of the design is a grinding element in which the grinding parts do not come into contact at all, and when the machine was first introduced it was, of course, hoped that in this way the life of the grinding parts would be greatly increased. Actually, it has been so greatly increased that other parts, whose life had previously seemed adequate, now wear out first, and development is still proceeding to improve them. To appreciate the problem it should be noted that the grinding parts of the Arvida mills have an average life in excess of 30,000 tons of coal per mill, and have reached 40,000 tons; another plant which grinds a 20 per cent ash coal to 85 per cent through 200 mesh reports a life of 60,000 tons on a larger mill.

The description of the load despatching panel is most interesting. The situation at Arvida, where two large boiler rooms operate in parallel on a common pipe line, is somewhat unusual; in most such cases the steam is used in turbines, and governing of the system and distribution of the load, are obtained in the usual way on the electrical side. The only similar case with which the writer is familiar, solved the problem by connecting the second boiler room to the line through a reducing valve arranged to hold a constant pressure in the main header of this boiler room, which thus operates at a fixed load. Very little load despatching is required, for the second plant is small in relation to the rest of the system, so usually it simply operates at full load and lets the line pressure vary.

As indicated by Mr. Saunders, this load despatching panel was built in most complete form, so as to provide a clear picture of all important plant conditions. This serves other purposes besides load despatching, for it is believed that the operating problem at Arvida has always been more or less difficult, and centralization of control to as great an extent as possible is a sound means of easing this difficulty.

As mentioned by Mr. Saunders, the plant had run on electric boilers for years before the war, and had no recent background of coal burning experience. It developed slowly, as the load required, and by the time it had become a very large plant experienced operators were very scarce; as a result the plant largely had to train its own, and to select them from an already depleted labour market.

As a matter of fact, the writer has always considered that the success of the Arvida supervisory staff in this respect is a remarkable feat, for the plants are well operated, their reliability meets any standard, and their average performance over a period is about as close to manufacturer's predictions as one can get. Regardless of the care and thought put into the design of a steam plant, and the selection of equipment for it, the results obtained ultimately depend on the operators.

A. L. Stewart[5]

The metering and automatic control equipment at the Arvida steam plant has certain unique features and plays a somewhat more difficult role than in the average plant.

Until the point was reached in the rapid extension of this project, where the decision was made to build the second boiler plant at some considerable distance from the first, the application of meters and automatic control equipment presented no special problems or complications. Consequently, it was designed and applied along the same general lines as in many other plants having substantially the same type of air supply and fuel-burning equipment.

The metering equipment included the widely-accepted quota of recording and indicating instruments, recording the factors of primary importance useful both as an operating guide and for subsequent reference, and indicating those factors which are commonly considered only necessary as an operating guide. The former included records of steam pressure, feedwater pressure, feedwater flow, steam flow, air flow, boiler water level, flue gas temperatures entering and leaving air heaters, and air temperatures entering and leaving air heaters. The latter included the indication of drafts and pressures in connection with the pulverizers, boilers, and air heaters; also indications of the temperature of the coal and air going from the individual pulverizers to the burners, and of the electrical load on the pulverizer and fan motors.

The automatic combustion control was arranged to control fuel supply to the burners and induced draft air in accordance with steam pressure changes in the main steam header, with induced draft air automatically re-adjusted to maintain the desired excess air condition for optimum combustion efficiency; also to control forced draft air to maintain constant pre-determined furnace draft. It also included provision for remote manual control from the individual boiler panels, when desired, of each of the factors mentioned above and of the load to be carried by each boiler. As Mr. Saunders has pointed out, a boiler panel was provided to serve each boiler, and also a master panel for mounting the equipment common to the complete group of boilers in the plant.

The decision to build the second boiler plant with the two final boilers, at some considerable distance from the first which had a much greater capacity, with the two plants connected by a steam main and feeding into the same steam distribution system, posed a problem in automatic control. Would it be feasible to operate both plants as one, from a single steam pressure controller ? If so, what location in the long inter-connecting steam main could be considered a representative point to which to connect this master steam pressure controller to insure satisfactory automatic control of both plants, and reasonably constant steam pressure throughout the system ?

It should be realized that this inter-connecting steam main was relatively large, and with the entire steam distribution system, provided sizeable receiver capacity; also that large and sudden demands for steam could be expected to occur in the sections of plant to which steam would be delivered from either end of this main. If both plants were operated automatically from steam pressure, with the pressure controller connected to either end of this main, sudden large demands for steam at the other end of the system could drop the steam pressure in that area to an undesirable extent before the inertia of the system permitted the pressure controller to "feel" the reduction and increase the rate of combustion to meet it. The seriousness of this situation would be aggravated by the fact that the steam generating capacity of the original plant was so much larger than that of the new one. (Approximately 3 to 1.)

After due consideration, the system of load dispatching described by Mr. Saunders was decided upon, the larger of the two plants being selected as the logical one to operate automatically from steam pressure, leaving the smaller one to operate as a base load plant under the direction of the load dispatcher located in the former. It was realized that the success of this system would largely depend on the decisions and actions of the load dispatcher, so to provide him with all pertinent information to enable him to discharge his duties intelligently, a very complete load dispatching panel was provided.

On it was mounted remotely-operated indicators showing the rate of steam output of each of the boilers in each plant, and recorders showing the total feedwater to the boilers in each plant; also the master steam pressure recorder-controller for the larger plant and indicators showing the steam pressure in the steam header leaving each plant; also recorders and indicators showing the rate of flow of steam, water, and compressed air to the principal plant departments and processes. The various records and indications on his panel assist at the load dispatcher in deciding to what extent load should be picked up or dropped in either plant, and by any one or combination of boilers in either plant. His instructions are then transmitted over the intercommunicating telephone system.

It is possible for the boiler operators to promptly carry out these instructions, since the combustion control system includes on each boiler panel a master selector valve or load adjustor, by means of which, by merely rotating a knob, the boiler can be readily transferred from automatic to manual control. Then by turning another knob, the output can be increased or decreased to the desired extent. The boiler can then be put back on automatic control. In the interval while changing boiler output, all other factors such as fuel supply, induced draft, and forced draft, remain on automatic control.

It is gratifying to learn from the author's paper that this system has functioned as it was designed to do, and the results have been satisfactory.

The Author

Mr. Farmer asks if there was any appreciable accumulator effect when steam production was doubled for a few minutes every four hours. I would say that such was not the case, particularly where the surge tank was used, as water level in the boiler was maintained and steam pressure was maintained. There was however a considerable pressure drop in the line but not to such a point as interfered with the process involved. We would not recommend this device for rapidly fluctuating loads or those which are subject to constant variation as this is more of a field for automatic control.

(*Continued on page 356*)

[5] Vice-President and General Manager, Bailey Meter Company, Limited, Montreal.

OGOKI DIVERSION

O. HOLDEN, M.E.I.C.
Chief Hydraulic Engineer, The Hydro-Electric Power Commission of Ontario, Toronto, Ont.

A paper presented before the Lakehead, Hamilton, Toronto and Border Cities Branches of The Engineering Institute of Canada on October 6, October 14, 1943, February 3, and April 14, 1944, respectively.

As announced in the press, the Ogoki Diversion project was placed in operation in July 1943. Diversion projects for various purposes are by no means new. History records that Cyrus, in capturing the city of Babylon, gained entry to the city by diverting the river which flowed under its walls. In our own times and in our country, diversions have been made in connection with both water supply and power works. However, undertakings of this type of the relative magnitude and with such far reaching effects as the one under discussion are uncommon. The project itself comprises the works necessary to change the course of the run-off from some 5,500 sq. mi. of drainage area. Whereas the original course of this water was through unsettled territory along the Albany river to James bay, its new route leads through the most densely populated and most highly industrialized section of Canada, viz., the Great Lakes—St. Lawrence basin. It is in fact a reversal of the order followed in the settlement of this country where population followed the lakes and rivers, in that the river is now being brought to the centres of population.

The benefits along the new route are of major importance. The engineering features of the project present some unusual problems. It is the intention of this discussion to present these benefits and problems.

History

The early surveys for the Trans-Continental Railway, through the country north of lake Nipigon, encountered the interlacing of streams flowing in a northerly direction with those flowing in a southerly direction. Mr. Ralph Keemle, who was engaged in this early railway work, observed that hydrographic surveys might disclose possibilities of diverting portions of the Albany river drainage area into lake Superior and, in particular, part of its tributary—the Ogoki river, into lake Nipigon. In 1923, Mr. Keemle brought this possibility to the attention of The Hydro-Electric Power Commission of Ontario, and a reconnaissance party travelled over the territory between lake Nipigon and the Albany river and reported on the feasibility of the project. The Commission subsequently thoroughly explored these possibilities during 1924 and 1925, and then developed the proportions of the scheme as now constructed. Further survey work was carried out during 1936. Finally, in the fall of 1940, through an agreement with the United States, approval was given for the utilization of additional flow at Niagara on the understanding that provision be made immediately for diversions into the Great Lakes system of waters from the Albany river basin.

General Description

The Albany river runs in a general easterly direction into James bay at Fort Albany (Fig. 1). Its principal tributaries drain from the south. Of these tributaries, two are the Kenogami river (a portion of the drainage area of which is embraced in the Long Lac Diversion scheme) and the Ogoki river. The Ogoki river flows into the Albany river about 250 miles west of Fort Albany. Some 120 miles up the Ogoki river is located Waboose rapids and the site of the main diversion dam. Mojikit creek, with its North Summit lake and Mojikit lake, flows into the Ogoki river about ten miles west of Waboose rapids (Fig. 2). The watershed area, above Waboose rapids, is 5,545 sq. mi. North Summit lake on the Ogoki river drainage area is separated from South Summit lake on the Great Lakes drainage area by a comparatively short and low gravel ridge, which at this point forms the height of land. This South Summit lake forms the headwaters of the Jackfish river, the route of diversion into lake Nipigon.

The diversion project consists essentially of a concrete diversion dam at Waboose rapids on the Ogoki river, almost due north of the east shore of lake Nipigon. This dam raises the water level in the Ogoki river some forty feet and floods back to the height of land. Through the ridge forming this height of land a channel has been excavated to enable the water to flow south. Across this channel is placed a concrete dam to control the rate of the diverted flow. The diverted water, after passing the Summit control dam, finds its way through a series of lakes into the Jackfish river and thence to lake Nipigon, a distance of approximately thirty miles, and descends some 220 ft. in this length. The Canadian National Railway, which skirts the north shore of lake Nipigon, crosses the Jackfish river about two miles north of lake Nipigon. As the Jackfish river was only a minor stream, it was necessary to construct a channel suitable for the very much greater flows which will result from the operation of the diversion works. This involved the excavation of a channel through solid rock and the construction of a new bridge approximately 300 ft. south of the now replaced structure.

Geology and Topography

A brief review of the principal geological and topographical features is here presented, in view of the important part these played in the planning of the project. The district embraced in this project lies within the pre-Cambrian area, and consequently has the basic characteristics common to this formation. The country is generally flat, with hills at most a few hundred feet in height, with numerous deposits of till, sand and gravel left by the movement of the ice cap during glacial times.

Fig. 1—Map showing location of the Ogoki diversion.

Geological references indicate that as the glaciers retreated, the released water formed large lakes, one of which, known to scientists as lake Algonquin, covered the upper portion of the present Great Lakes basin and extended north to the present height of land. During the subsequent draining of this lake, a portion of it was retained for a time north of the height of land, and to this the name of lake Ojibway has been given.

The Ogoki river, which for the most part runs through the bed of this latter lake, has cut its channel through the sands and clays deposited on this old lake bottom, encountering occasional rock ridges such as at Waboose rapids. This ridge provides an excellent foundation for the main dam that, like the glacier, again blocks the north flowing water. It is of interest to note that the new shore line above the main dam approximates closely the old shore line of lake Ojibway, as indicated by geological investigation, and which would lead to the surmise that the present diversion is a replica, in a feeble way perhaps, of conditions in that far off time.

While there are local irregularities that make the country, when seen from the ground, appear quite irregular and picturesque, when viewed from the air, it appears much like a level plain covered by innumerable lakes and rivers. Many of these lakes are interlaced, some draining north and being separated from those flowing south by relatively low and narrow ridges. In the case of the Ogoki diversion, North Summit lake flowing north to the Ogoki and South Summit lake at the headwaters of the Jackfish river, draining south, were at approximately the same water level and were separated by a divide just a few feet above the water level and some 1,200 ft. in width. This divide was composed mainly of gravel and boulders, permitting of easy excavation for the diversion channel, yet the underlying rock was high enough to provide a suitable base for the control dam located in this channel.

Immediately below South Summit, a series of lakes at successively lower levels (formed by rock ridges and boulder moraines) extend to the head of the Jackfish river. This river runs to lake Nipigon through a deep valley which it has cut through the stratified overburden laid down in the bottom of the former lake Algonquin. At the Canadian National Railway crossing of the river, rock was at or near the surface on the east bank, but dipped sharply to the west under a clay and gravel overburden. This condition permitted the excavation of a channel, to accommodate the increased flow, through the rock of the east bank and provided the foundations for the new railway bridge in the area adjacent to this waterway. From the above will be seen the coincidence of natural conditions which facilitated the undertaking. Particularly fortunate were the circumstances that in a country composed in such large part by deep overburden, yet at suitable locations, solid rock was at or near the surface to provide excellent foundations for the Waboose and control dams and for a portion of the new Canadian National Railway bridge. The readily excavated material at the height of land was a most favourable circumstance, as were also the deposits of sand and gravel from which excellent concrete materials were secured within reasonable distance of the various structures.

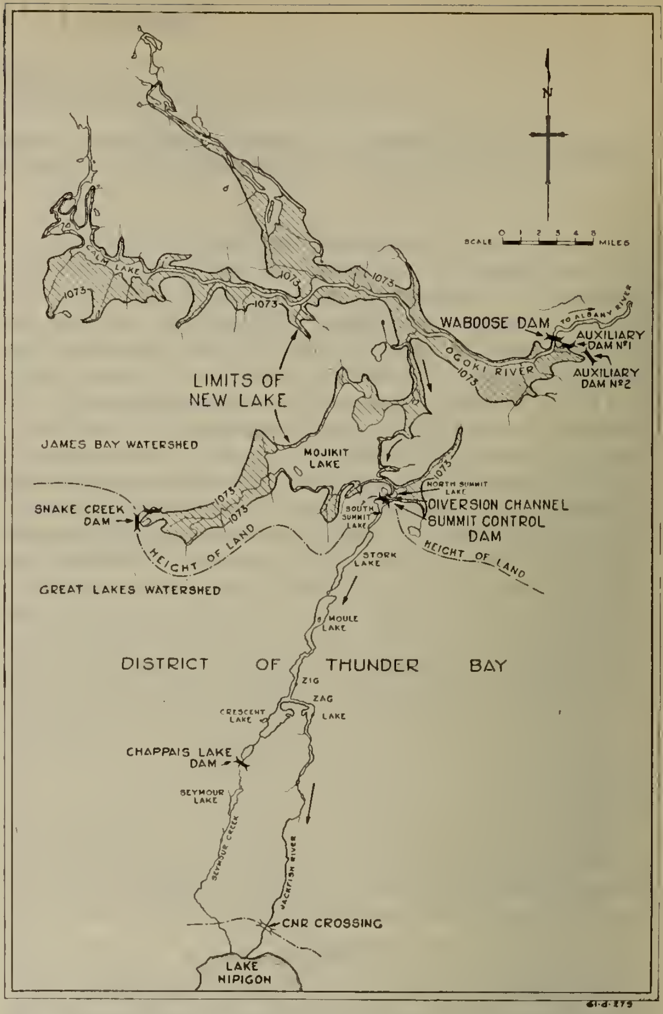


Fig. 2—Plan of project showing location of principal structures.

Flow Estimates

In order to determine the potential benefits to be derived from the diversion, it was necessary to first calculate the amount and variation in flow of the Ogoki river.

Due to the isolated nature of the district, no records of flow, other than a few stream flow ratings made during the surveys, were available. However, there were reliable records of the flow of the English and Nipigon rivers, and as these two watersheds practically bracket the Ogoki watershed to the west and south, respectively, it was considered that their run-off records could be used to derive a reasonable estimate of the average Ogoki flow.

From a study of the precipitation records and topography of these two drainage areas, it was apparent that the English river watershed resembled more closely that of the Ogoki, and it was decided to give twice the weight to the English river flow records in deriving the estimated flow of the Ogoki. Further, due to the similarity of these two watersheds, that is the English and the Ogoki, it was judged that the variation in flow of the latter might be assumed to follow closely that of the English river.

Taking into consideration the difference in drainage areas, a factor was obtained which, when applied to the English river records, gave the estimated mean monthly flows of the Ogoki river. On this basis it was estimated that the flow available for diversion from the Ogoki river would, over a period of years, average about 4,000 cu. ft. per sec.

The actual flow of the Ogoki river has been observed since April 1941 and, while the period is too short for the results to be considered conclusive, the records indicate a satisfactory agreement with the estimated flows.

Economic Studies

As in most engineering projects, the diversion of water is subject to economic limitations, in that the expenditure involved must be warranted by the economic and social benefits to be gained. While the diverted water will be of benefit to both power development and navigation, only the results affecting the former were considered. Some of the earliest investigations were therefore directed to ascertain if the gain in power to be expected from the availability of this additional water justified the expenditure required.

Since most hydroelectric developments incorporate extensive works and structures and the costs of which are affected to only a minor degree by the amount of water available for the generation of power, it follows that within reasonable limits the addition of flow will enable the production of an increased amount of electricity at a price considerably below the average of that which was formerly possible. A careful review was conducted to ascertain the economic benefits at each power site to be affected by the diversion.

In selecting the most economical plan of diversion, a thorough study was made of the costs for various arrangements. Diversion of the Ogoki waters across the height of land into the Nipigon basin was susceptible of accomplishment by the construction of a dam at the Waboose site sufficiently high to achieve the desired results without the excavation of channels. On the other hand, by the excavation of very deep channels up to and across the divide, only a comparatively small dam at Waboose rapids would have been required. Preliminary studies showed that neither of these extremes, if feasible, was economical. It remained, therefore, to select that combination of diversion dam and channel excavation which gave a minimum of cost commensurate with sound engineering practice and economical operation. (This in turn determines the maximum and minimum water levels to be maintained.) Since the discharge of the Ogoki river at the point of diversion varies between a minimum of 1,200 cu. ft. per sec. and a maximum of some 21,000 cu. ft. per sec., it was apparent that the expenditures necessary to provide sufficient channel capacity to divert the full flood flow on the infrequent occasions on which they occur would be out of proportion to the value of the water involved in these crests. In such cases it would be advisable to waste some of the maximum flow through the dam at Waboose rapids. With these as guiding limitations,

Fig. 3—Aerial view of Waboose dam before closure. Ogoki river flow passing through two openings in spillwall and down channel beyond island. Note cofferdam extending upstream from island.

Fig. 4—Waboose dam sluiceways discharging about 6,000 cu. ft. per sec.

economic studies were conducted to establish finally the maximum discharge capacities and the dimensions of the channels and the elevation of the dam.

Principal Elements of Project

The principal features and the main structures of the project will now be described in somewhat greater detail following, as far as possible, the course of the diverted water. (See Fig. 2.)

Waboose dam is located on the Ogoki river at the head of Waboose rapids on a line practically due north from the easterly shore of lake Nipigon. Over 1,700 ft. long, it is founded on solid rock throughout, with a maximum height of about 50 ft. above the original river bed (Fig. 3). It contains approximately 40,000 cu. yd. of concrete and is designed to withstand water, ice and uplift pressures. Twelve sluices, 16 ft. wide, controlled by stop logs, are provided and when fully open, with normal high water level, will discharge about 50,000 cu. ft. per sec., or more than twice the estimated maximum flood flow. In the event of delay, for any cause, in removing the stop logs from the main sluiceways, emergency discharge capacity is also provided by making the crest of 765 ft. of the dam just at normal high water level, i.e., elevation 1,073. Should the reservoir rise above this normal level, water will be spilled automatically. When the level reaches a stage three feet higher than normal, the discharge over the spillway and the top of the stop logs will be about 15,000 cu. ft. per sec. This amount is equal to the normal flood flow and in the event of extreme flows, this spilling will materially reduce or arrest the increase in the reservoir water level and provide additional time to enable the removal of stop logs from the main sluiceways. The stop logs are handled into or out of the sluiceways by means of a spud type winch which travels on rails along the working deck above the sluiceways.

To close off low spots in the upper contours of the reservoir, auxiliary dams of the earthfill type, known as Nos. 1 and 2, are located one-half mile and one and one-half miles east of the main dam, respectively (Fig 2). At both these dams the areas were stripped of forest litter down to firm ground to provide a proper foundation for the fills. The fills were compacted of a sandy material obtained from borrow pits nearby and covered with gravel or riprap to prevent erosion. Auxiliary dam No. 1, the more important of the two, is about 2,600 ft. long and is provided with a diaphragm of creosoted 3-ply timber sheet piling to provide a positive seal.

By means of these three structures, the Ogoki river is blocked and the water raised about 40 ft. above the original water level. The new lake or reservoir so created will extend up the Ogoki river for thirty miles from Waboose dam and will also flood the shores of Mojikit and North Summit lakes down to the control dam at the height of land. The levels of the reservoir thus formed will be varied over a range of seven feet, thereby providing about 400,000 acre-ft. of storage capacity, of which approximately one-third is located in the Mojikit lake area and the other two-thirds in the Ogoki river valley itself.

This storage provides for partial regulation of the outflow by making possible the impounding of a portion of the higher inflows until such time as the diversion channels can dispose of them down the Jackfish river into lake Nipigon. In this latter lake the variations in diverted flow are reduced further before passing down the Nipigon river.

In passing from the Ogoki river to Mojikit lake, the diversion flows will occupy the whole of the Mojikit creek valley and, although the original stream was but a tortuous creek in the valley bottom; the valley itself is of sufficient proportions to pass the flow. No work was required in this flow channel other than the removal of some boulders and the clearing of trees and brush.

From Mojikit lake, the water passes south through Summit creek to the North Summit lake. Improvements were made in this channel by the excavation of part of an island which otherwise would have restricted the flow.

From North Summit lake, the main diversion channel through the height of land to South Summit lake is 80 ft. wide, about 15 ft. deep and required about 50,000 cu. yd. of excavation almost entirely through muskeg and gravel.

About 200 ft. south of the end of the diversion channel is located Summit control dam which is founded throughout on a ridge of rock across the upper end of South Summit lake. As its name implies, this structure is designed to control the amount of water diverted through the height of land into the Great Lakes system. For this purpose, eight sluiceways, 16 ft. wide, are provided to pass as much as 10,000 cu. ft. per sec., which is the maximum amount for which the channels have been designed. This dam is comparatively small, containing some 3,500 cu. yd. of concrete. It is about 530 ft. long and has a maximum height of only 25 ft. Stop logs are employed to completely block off the sluiceways or to control the discharge at any desired amount and, as at Waboose, these stop logs are handled by means of an electrically driven winch (Fig. 5.)

Fig. 5—Summit control dam.

After passing through the control dam, the diverted waters enter South Summit lake, the first body of water on the Great Lakes watershed. To increase the discharge capacity of the outlet and to accelerate the erosion of the channel controlling the level of the lake and thereby permit of the use of the control dam as a measuring device, a pilot cut was excavated at the outlet of South Summit lake.

Fig. 6—View showing Jackfish river new channel and bridge. Flow about 2,500 cu. ft. per sec. Note rock covering on right bank.

Once past this lake, the water flows freely through a series of lakes and intervening channels to the valley of the Jackfish river, which carries it over a series of rapids to lake Nipigon. The banks of the Jackfish valley were cleared over a width sufficient to include the new slopes resulting from the anticipated increased erosion of the valley by the greater flows.

As it was not feasible to adapt the existing railway bridge to suit the expected enlargement of the valley, it was necessary to construct a new bridge and to excavate under it a channel which would not be affected by erosion (Fig. 6).

The new railway bridge, located about 300 ft. south of the old structure, is of trestle construction about 800 ft. long and necessitated the relocation of 1-1/10 mi. of approach track. It required 735 tons of steel, approximately 95 per cent of which was obtained from the Canadian National Railways' stock, so that only a very minor tonnage of new steel was required; a very desirable circumstance in view of the necessity of conserving this critical material. The steel recovered when the old bridge was dismantled was returned to the Railway to replenish their stock. The easterly footings of the bridge in the vicinity of the new channel are founded on solid rock, but in the valley bottom and up the west bank it was necessary to support the bridge piers on concrete piles constructed in place in the deep overburden.

The channel which was designed for high velocity flows was excavated 50 ft. wide and about 1,000 ft. long in the sloping rock of the east bank. The channel extended about 600 ft. above and 400 ft. below the bridge location while a concrete wall was built along the west side of the channel to encompass the flow where the sloping rock was not of sufficient height (Fig. 7). Approximately 515,000 cu. yd. of overburden was removed to expose the rock in the channel area. Much of this earth was later used to backfill behind the training wall and over the valley bottom. The channel, including the entrance and outlet portions, was designed to meet the anticipated deepening and widening of the original river bed and to provide discharge capacity for the maximum flow. The rock excavation in places attained a depth of 50 ft. The broken rock resulting from the 105,000 cu. yd. of excavation was subsequently placed as riprap over the adjacent earth slopes and in extensive rockfills which were located so as to control erosion at the entrance and outlet of the channel.

Construction

A measure of the size of the undertaking may be gained from the overall quantities of work, which are as follows: 800,000 cu. yd. of earth and muskeg material and 140,000 cu. yd. of rock were excavated. Earth and gravel-fills amounted to 310,000 cu. yd., while 160,000 cu. yd. of broken rock was used for riprap and in rock-fills. Approximately 49,000 cu. yd. of concrete was placed.

At times about 820 men were actively engaged on the work, and were housed at the various camps in large bunkhouses of wood frame construction sheeted with fibre board. These dwellings made comfortable living quarters throughout the coldest weather. The field headquarters for the project were located at Ferland on the Canadian National Railway, about three miles west of the Jackfish river.

About 18,000 tons of materials, fuels and supplies were freighted in to the various dam sites over the winter roads; 13,000 tons of freight, including 175,000 gal. of fuel oil, were taken into Waboose alone. These winter roads, the routes for which were previously determined by aerial surveys, are roads only in the sense that during colder weather hard-packed snow and ice provided smooth-surfaced paths capable of bearing tractor-drawn sleigh trains, trucks and other heavy construction equipment. In warm weather they become merely clearings through the bush.

A chartered aeroplane using skis in winter and pontoons in summer operated from a base on lake Nipigon, two miles south of Ferland, made over 1,000 passenger trips in moving personnel between the various sites and carried about 1,550 tons of freight, such as perishable foods, repair parts, etc., requiring delivery to the construction camps. Short wave radio communication from the Toronto Head Office to Ferland and thence to the various work centres permitted close supervision of the construction operations and enabled prompt ordering of needed materials and checking of shipments.

The dewatering procedure followed in the construction of the dam at Waboose rapids was arranged to

Fig. 7—View of rock cut under new C.N.R. bridge and showing concrete training wall.

Fig. 8—Aerial view of a portion of the Jackfish river valley showing the C.N.R. bridge, the new channel and the relatively small stream bed of the original Jackfish river.

suit the topography of the site and the seasonal variations in the flow of the river. The dam is 200 ft. upstream from the head of the rapids which are divided into two channels by a rocky island. Crib-work cofferdams, extending from the island upstream past the location of the dam and then over to the east bank, forced the Ogoki flow through the west channel while the easterly half of the dam was being constructed. Four 16-ft. wide openings, the full height of the dam, were left in this section of the structure through which the river flow was by-passed when the west part of the stream bed was subsequently blocked off by other cofferdams to permit the construction of this end of the dam. The four openings were then closed progressively. The first two openings were closed by stop logs placed in checks in the adjacent sections, to a predetermined height sufficient to allow for the rise in river resulting from the restriction in discharge area. Finally, the remaining two openings were closed by steel gates and stop logs to a height sufficient to force the river flow over the main sluiceways. The logs and gates used for this purpose were later recovered.

The dewatering of the Summit control dam site was accomplished by building a cofferdam across the upper arm of South Summit lake, in which the dam is located, and pumping out the enclosed area.

In the construction of the enlarged channel for the Jackfish river under the Canadian National Railways, careful planning of the sequence of construction operations was necessary to avoid interruption of railway traffic, and to ensure against any hazard to the original bridge, while this structure was still in place. As this line forms part of the transcontinental mail line, the necessity for such precautions is apparent. By locating the new bridge structure a sufficient distance from the old bridge, it was possible to excavate the southerly portion of the channel to a point north of the new bridge location, but still sufficiently south of the old structure to prevent any disturbance or damage to the latter. During this period, foundations for the new bridge were constructed and, following completion of these, the new steel structure erected. Traffic was then diverted over the new bridge and the old bridge dismantled, thus permitting completion of the excavation of the northerly half of the channel.

The writer wishes to acknowledge the helpful cooperation of the engineering staff of the Central Region of the Canadian National Railways, whose assistance greatly facilitated the furthering of this portion of the work.

Fig. 9—Aerial view of height of land showing control dam and diversion channel with uncompleted portion at upper end. North Summit lake in background.

The first work on the project, consisting of the clearing for camps at Ferland and for the winter road to Waboose rapids, commenced in December 1940, and the first water was diverted through the height of land in July 1943. The total expenditure for the project will be slightly less than $5,000,000.

Operation

The necessary operation of the works is carried on by resident operators located at the main dam at Waboose rapids and at the control dam in the channel at the height of land. Comfortable houses, well insulated against the rigorous climate, are located at each of these points. Short wave radio stations have been installed in each of the operators' dwellings; the one at Summit dam being capable of direct communication with Toronto Head Office. Messages or instructions for the operators at Waboose dam are relayed from the Summit station. In the event of the failure of the Toronto-Summit radio channel, messages may be relayed through the Commission's radio station at Cameron Falls. Information of gauge heights and flows will be transmitted by radio to Toronto daily. By these arrangements, it is expected that close and constant supervision of the operation may be secured. Up to the end of 1943, an average flow of approximately 4,000 cu. ft. per second has been diverted into lake Nipigon, the maximum diversion being at any one time about 5,000 cu. ft. per second. As already pointed out, considerable erosion is expected to occur from the height of land to lake Nipigon, and it is intended that the amount of diversion be progressively increased over a reasonable period, in order that this erosion may take place without violent and sudden changes in the various channels.

Benefits of Project—Power and Navigation

If the route of the diverted water be traced from its entry into lake Nipigon to Montreal, benefits to power and navigation are evident. In its course from the height of land, the water diverted will descend 220 feet to lake Nipigon where it will be available to the plants on the Nipigon river using the fall to lake Superior. The present developments on this river at Cameron Falls and Alexander have a combined head of 135 ft. and there is an undeveloped head of 105 ft.

The difference in level between lake Superior and lake Ontario is 356 ft., of which some 20 ft. is available for development in the St. Mary's river, and 315 ft. on the Niagara. In the International section of the St. Lawrence there is available a head of 85 ft. with a further fall of 135 ft. to Montreal.

Immediate benefits are secured at the plants on the Nipigon river and at Niagara, where the additional water permits of a greater energy output. In addition, this additional water has enabled the Commission to construct a 25-cycle generating station at DeCew Falls, where the first unit, with a capacity of 65,000 hp. has been placed in operation.

Over a period of time this diverted water will raise the levels of the lower Great Lakes and thus benefit navigation by increasing the carrying capacity of the lake freighters in their many journeys during the year.

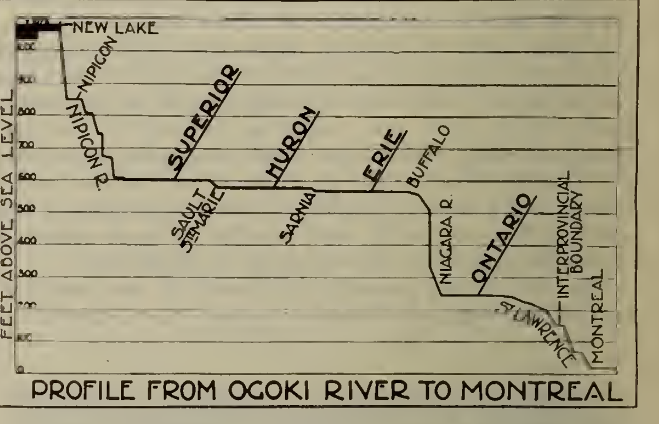


Fig. 10—Profile from Ogoki river to Montreal.

Should it happen that future development in the Ogoki area would warrant the re-establishment in its original channel of the water now being diverted, the sluiceway capacity at Waboose dam is sufficient to permit this and at such time the dam can be adapted to a scheme for development of power from the 65-ft. head available between the normal high water level above the dam and the foot of Waboose rapids. By that time, it may be expected that at least the capital expended on the then ulterior works, such as the Jackfish crossing, will have been retired.

The construction of the various works was carried out by the Commission's forces under David Forgan, M.E.I.C., Construction Engineer, with G. Mitchell, M.E.I.C., as assistant. W. B. Crombie, M.E.I.C., acted in the dual capacity of General Superintendent and Resident Engineer. The design and supervision of construction came under J. R. Montague, M.E.I.C., Assistant Hydraulic Engineer, with F. Grosvenor as principal assistant.

PROBLEMS IN DESIGN OF ALASKA HIGHWAY BRIDGES

RAYMOND ARCHIBALD, WILLIAM K. GREENE, AND JOHN W. GUPPY
Structural Engineers, Public Roads Administration, Federal Works Agency, Washington, U.S.A.*

Construction of the Alaska Highway required the building of many bridges over streams of all descriptions. In the initial penetration of the area in 1942 only temporary bridges were constructed. In the winter of 1942-43 an extensive programme of permanent bridge construction was laid out. In planning this programme many problems arose that required careful consideration in order to meet the planned schedule. Many culverts and some bridges were built of wood or salvaged steel. The new steel structures with span lengths of 40 ft. and over, which required approximately 16,000 tons of steel, are discussed in this article. For speed and economy it was essential to adopt construction standards suitable for the major portion of the bridges. A number of the river crossings required individual attention and design of special structures, but these could be taken care of during the course of the work as the need arose.

Raymond Archibald was in general charge of design and erection of permanent bridges. A design office was established in New York City with William K. Greene in charge and with John W. Guppy as his chief assistant. All of the standard spans and the special super-structures referred to in this article were designed in this office and the close contact with the fabricators and their knowledge of the shop methods were the chief contributing factors in the successful construction of the bridges. Substructures and timber bridges were designed in offices at Edmonton, Fort St. John and Whitehorse.

Standards Adopted

American Association of State Highway Officials specifications were used as general specifications for all spans. A basic unit stress of 20,000 lb. per sq. in., increased 20 per cent when wind stresses were included, was adopted. This unit stress was adopted to conform to the wishes of the War Production Board for design of steel bridges during the emergency. Provisions were made for a 24-ft. roadway and two 18-in. safety curbs. A clear height of 16 ft. was maintained over the full width of roadway. The loading was H20 except for a few special structures where H15-S12 loading was used. The temperature varies greatly and allowance was made for a total range of 160 deg. F. with a normal of 30 deg. F. Although the highway is in northern latitudes with extremely low winter temperatures, its location east of the coastal range places it in territory where the annual precipitation ranges from 10 to 20 in. For this reason no allowance was made for snow load. Designs and plans were adapted for either timber or concrete floors since it might be necessary to use timber floors on bridges finished during winter months. Provisions were made for steel guard rail, but wood was used in the original construction.

The material was to be transported to the bridge sites by railroad, steamship, narrow gage railroad, and truck. Many handlings were necessary with storage at docks, railroad yards, and bridge sites. An effort was made to keep shipping pieces under 40 ft. in length, but it was necessary to allow a maximum length of 55 ft. on some of the special bridges. Study of the transportation problem indicated the desirability of following the usual export practice of shipping with all large gusset plates loose. All small pieces were boxed or fastened to a larger piece for shipment. Identification of pieces was important. A different colour shop paint was used for each of the three geographical divisions of the highway, and a coloured symbol was adopted for each bridge. The symbols were painted on four sides of each piece and box and the bridge name was painted on the top chords and floor beams.

Elements of Design

Various types of river crossing had to be considered. There were streams with well-defined channels up to 1,000 ft. or more in width, carrying a large volume of water throughout the year. In order to minimize construction difficulties and troubles from icing, and to cut the cost, special construction would be needed. Some of the small streams, confined to narrow channels in ravines or gorges, could be spanned by simple construction. There were other small streams in broad valleys. For a good part of the year, these water courses carry only a trickle of water and are of a meandering, shifty nature. During flood season, the whole valley becomes a raging torrent of water, ice, and drift. A series of simple standard spans arranged so as to provide proper drainage channel and underclearance could be used for these crossings.

It was possible to classify nearly all the bridges on the Alaska Highway early in 1942 before detailed information was available. While the exact overall length of any crossing could not be determined with any certainty at that time, a fairly accurate estimate of requirements was obtained. On the basis of this information, it was decided to make standard designs for 40, 50, and 60-ft. beam spans, 100-ft. pony spans, 160, 200, 225, and 250-ft. through truss spans and 200-ft. deck truss spans. Preparation of detailed plans for both special structures and standard crossings, and the variations from standard such as skewed bridges, would have to await information from detailed surveys in the field. Aside from the six special bridges there was a total of 122 spans for structures that ranged in size from a single 50-ft. beam span to as many as nine 200-ft. through spans.

In the design of the standard spans several conditions were imposed in addition to those of the standard specifications. Simplification of shop and field requirements was essential. It was required that the standard spans be so designed that any arrangement of spans could be assembled for a single crossing without complications. Accordingly, the end details were standardized. Constant dimensions were established for all through truss spans from the crown of the roadway to the top of the pier or abutment, centre to centre of bearings at piers, and centre of bearing to face of backwall at abutments. Expansion joints were made alike insofar as the supporting steel was concerned. Both ends of all spans were made identical. This procedure made it possible to use the same abutment seat and backwall construction for all truss bridges and all pier tops could be made alike. A span could be used alone or in conjunction with spans of other length without changes in detail either in the concrete or steelwork.

Tapes used in the different shops had been standardized at different temperatures. Each shop was permitted to fabricate all parts of a span without temperature

*Mr. Greene and Mr. Guppy were on leave from the American Bridge Co. to assist the Public Roads Administration in constructing the Alaska Highway.

Fig. 1—Liard River bridge.

correction. However, actual span lengths at 30 deg. F. were calculated and used in making pier and abutment layouts for specific bridges.

All standard spans were designed and detailed as level structures with normal outline under full dead load. Where it was necessary to place a structure on a grade, appropriate correction was made in the spacing of piers and abutments.

The same floor arrangement was used for all truss spans. Six lines of framed stringers conforming with a 1½-in. crown supported a 6-in. roadway slab, the bottom of the slab being flush with the underside of the stringer flange. Curbs were cantilevered outside of the stringers. If it became necessary to lay a temporary wood floor on account of freezing weather, it was to be 2 by 8-in. laminated construction without crown. Different thicknesses of nailing strips were used on the stringers. Wood floors were to be surfaced with 2-in. running plank. Wood curbs and walks were made similar in form to those of concrete. With timber flooring, expansion joint openings were spanned with flat plates, but permanent standard expansion dams will be placed whenever a concrete deck is installed.

Beam spans consisted of five lines of beams placed level, and a roadway slab varying in thickness from 6¼ to 8¼ in. to obtain the crown. Should wood flooring be used it was to be similar to that on the truss spans, with all the nailing strips of the same thickness.

The main beams of the 40 and 50-ft. spans were not spliced. Those for the 60-ft. spans were shipped in two pieces with a field splice near a quarter point. Rocker shoes were used on the 50 and 60-ft. spans and sliding bearings were used on the 40-ft. spans. Adequate diaphragms connected the main beams.

All the standard spans were designed as Warren trusses with curved top chord since this type presents a good appearance and is economical of material. The panel arrangement was, 6 for the 100-ft., 8 for the 160-ft., and 10 for the 200, 225, and 250-ft. spans. With this arrangement most of the members were 40 ft. or less in length. A few were as long as 50 ft. Verticals were used at all panel points to obtain rigidity and provide intermediate supports for the compression chords. Such intermediate supports would be particularly desirable should the chords be distorted during shipment. Horizontal ties midway between the top and bottom chords shortened the unsupported length of the web members and made a rigid as well as an economical structure. Wide flange sections were used for all truss members except the end posts and top chords which were box sections built up of two channels and two plates. The bottom plates had openings of 8 by 14 in. to give access for riveting and painting. Top lateral struts of chord depth were provided at each panel point. Sway frames, extending to the clearance line, were located at alternate panel points. The lateral bracing was composed of single angles. The shoes were made by welding structural steel. Rockers were placed at the expansion ends. In designing and detailing, a good deal of effort was expended to obtain simple, substantial structures of good appearance with a minimum of strategic material.

Fabrication and Shipment

There was no time to be lost in making designs, advertising and letting contracts, detailing, getting material from the rolling mills, fabricating, and shipping by rail, steamship, and truck to the bridge sites. Perfect coordination was mandatory in order to meet the schedule required in 1943.

To avoid confusion and delay, steps were taken to prepare material lists and drawings of shop details for distribution to the various fabricators. A single fabricator was awarded a contract for preparation of material lists and shop details for all standard spans. Working in close cooperation with the designing engineers, this fabricator prepared detailed layouts of the various joints sufficient for making complete material lists. Meanwhile the work had been advertised on the basis of the design drawings and a few typical detailed drawings prepared by the design office to indicate the class of workmanship. Contracts were let to eight fabricating companies in the United States and Canada, in the area extending from the eastern seaboard to the Middle West. The work was coordinated closely, and immediately after an award for fabrication, the material lists were furnished the fabricators' shops. Each fabricator reserved all suitable material in his own stock, and ordered the remainder from the mills.

During the time material was being rolled, work went ahead on the shop drawings. A separate and complete set was made for each span length, including an anchor bolt setting plan, erection plans, and field rivet and bolt lists. These drawings were arranged so that each fabricator could add information about his part of the

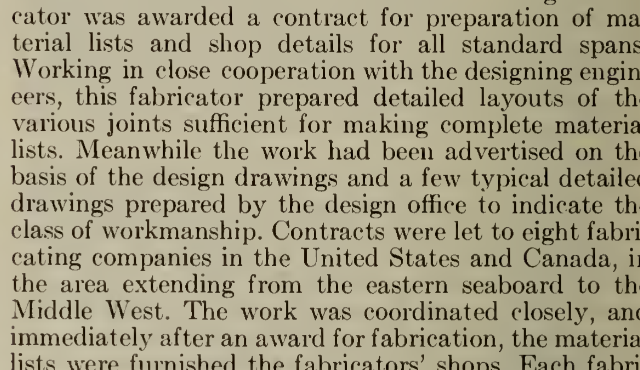


Fig. 2—Hyland River bridge.

work. Space was left for entry of name of bridge, number of spans, colour of shop paint identifying paint mark, instructions regarding shipment, matchmarking and temperature at which shop tapes were standardized. These drawings became the master set of detailed plans and reproductions were sent to each fabricator.

By the time the material was to be ordered, the requirements of each standard bridge crossing had been fairly well determined. The fabricators were furnished lists showing the bridge names, number of spans, identifying mark to be used and all other necessary instructions for the additions to be made on the plans.

The sequence of shipment was set up for all spans and, insofar as possible, the steelwork including the field rivets was shipped, by bridges, to avoid confusion at transfer and storage points.

As facts concerning the special bridges became available from the field, the type of structure and span lengths to be used were selected. Special bridges were required mainly across rivers of large size. Because of the difficulty of maintaining temporary crossings, construction of permanent bridges was of particular urgency.

Peace River Bridge

The Peace River crossing between Dawson Creek and Fort Saint John required the first special bridge. This river is normally about 1,600 ft. wide, with about 15 ft. of water. The current is swift and enormous cakes of ice come down the stream during the spring breakup. Falsework could be used during the winter freeze up or summer, but would be hazardous in the fall and destined for destruction in the spring. The planned schedule of field work made it necessary to avoid any falsework in the channel and this, together with other considerations, resulted in the selection of a suspension bridge. The main span is 930 ft., side spans 465 ft., and flanking approach deck truss spans 135 ft. Like many other rivers it had a high bank on one side and a low bank on the other, and the bridge had to be on a grade. For the sake of appearance the entire structure was made to conform to vertical curve with a middle ordinate such that at maximum live load and temperature the spans would not develop a sag in grade. Cable bents were used at the ends of the side spans, and these also support the river ends of the approach deck spans. The bents are of steel 60 and 77 ft. high, hinged at the bottom and set vertical, requiring that the cables be clamped to the cable bent saddles. The anchorages are located at the outer ends of the approach spans and serve also as the abutments supporting them. The main towers are 168 and 191 ft. high, the columns being made essentially of two wide flange beams 36 in. deep and two plates varying in width from 6 ft. at the bottom to 3 ft. at the top. A diaphragm dividing the column into two cells extends from the bottom for about two-thirds of the height. Ladders were placed in the cells. Cross bracing of cover-plated channels (turned in) with horizontal struts at the top and bottom of the tower and below roadway level, was used for tower bracing.

Open strand construction was adopted for the cables. There are 24 strands, 4 wide by 6 high, in each cable. The centre span sag ratio is one-tenth with the cables clearing the stiffening trusses at midspan by about 3 ft. The stiffening trusses are made entirely of wide flange sections 13 ft. centre to centre of chords with the floorbeams framed to the trusses at the bottom chord. Stringer panels are 19 ft. 8 in. in length with hangers located at alternate panel points. Temperature corrections were made in all members so that the structure would have a normal outline at 30 deg. F.

The trusses were designed using the deflection and sine series methods, taking into account grade change under live load and wind action. Equivalent loadings were used. The floor was designed for H15-S12 loading, cables for 600 lb. per lin. ft. of cable, trusses for 650 lb. per lin. ft. of truss. Wind load was assumed to be 270 lb. per lin. ft. of bridge. Unit stresses were increased 20 per cent for live load plus temperature stress plus one-half wind load or one-half live load plus temperature stress plus wind load.

Provisions were made for either concrete or wood floor. To avoid overstress should the wood floor be used, the details were arranged so that the outline of the trusses could be changed. Adjustment joints were located at the quarter and midpoints of the centre span, and provision was made for changing hanger lengths by inverting certain connecting diaphragms. The bridge was completed in the summer of 1943 by placing a concrete floor and the adjusting devices were not used.

Liard River Bridge

The Liard River bridge was the second special steel bridge on the programme. Many of the problems here were similar to those at the Peace river, and a suspension bridge was adopted. The Liard river is about 600 ft. wide with 5 to 25 ft. of water. The main span was made 543 ft. long and side spans 233 ft. Anchorages were placed at the ends of the side spans. This structure is symmetrical, but in general the construction was made the same as for the Peace River bridge. The floor was designed for H15-S12 loading, cables for a load of 650 lb. per lin. ft. of cable, trusses for 700 lb. per lin. ft. of truss, and wind load was assumed to be 310 lb. per lin. ft. of bridge. Unit stresses were increased 20 per cent for the combined loads as on Peace bridge. Small rocker cable bents 7 ft. 6 in. high, sloped to give equal tensions in the cable, support the cables at the anchorages. The towers are 94 ft. high with columns made of three wide flange beams 21 in. deep, one beam being used as a diaphragm between the other two. Cables are composed of twelve strands arranged three wide by four high, in each cable. The stiffening trusses are 8 ft. deep and the floor and hanger arrangement is the same as for Peace River bridge. Adjustment joints for use should a wood floor be used were placed near the third points, and provisions made for changing the hanger lengths. This bridge was built with wood floor and altered outline.

Hyland River Bridge

Conditions at the Hyland river crossing were such that partial or complete falsework could be used. A deck structure about 600 ft. long was needed. Such a structure had been designed and fabricated for the Rio Goascoran between Salvador and Honduras on the Inter-American highway, and it was decided that a duplicate structure could be used with a considerable saving in time. The bridge is a three-span continuous deck truss with curved bottom chord. The centre span is 222 ft., and the side spans 130 ft. The truss depth at the main pier is 25 ft., curving up to 15 ft. depth at the ends and centre of the main span. Wide flange sections are used for all members except the top chords which are built up of two channels and two plates with the bottom plate perforated. Flanking beam spans 60 ft. long were added to fit conditions at the site. Temperature corrections were applied in making the pier layout to get proper outline at 30 deg. F. The panels were 18 ft. 6 in. long, and the floor differed from other truss spans in that five lines of stringers were used. The

Fig. 3—Smith River bridge

floor slab was made 6¼ in. thick. For this structure, the loading was H15-S12.

The next bridges to be planned were some 50 and 60-ft. beam spans, 100-ft. pony spans and 250-ft. through spans, all of a skew. The plans for these, in general followed those for the standard spans. The 100 and 250-ft. spans were skewed one panel, and for simplicity the trusses of the 250-ft. skewed spans were made with parallel chords.

Upper Liard River Bridge

The Upper Liard River bridge crosses a channel about 500 ft. wide with 5 to 10 ft. of water. A two-span continuous through truss was selected. This could be erected either with partial falsework and as a cantilever, or completely on falsework. The main truss panels were made 40 ft. and subdivided to give 20-ft. floor panels. The subdivision also served to bring the ratio of l/r for the web and bottom chord members within the limits obtainable with wide flange beams. Rolled sections were used except for end posts, top chords and main diagonals adjacent to the pier which were built up of two channels and two plates, and the vertical at the pier, which was a built up H-member. The bridge is 640 ft. long, 50 ft. deep over the centre pier, sloping down to a depth of 35 ft., 120 ft. from the pier. Stresses from several methods of erection were considered in making the design.

Tanana River Bridge

The Tanana River bridge in Alaska crosses a channel about 900 ft. wide with water up to 10 ft. deep. A cantilever through truss was selected with a 430-ft. main span, and 258-ft. anchor arms. Here again, as at the Upper Liard, subdivided panels were used with lengths of 43 ft. for the main panels, and 21 ft. 6 in. for the subpanels. The trusses are 60 ft. deep over the piers, sloping to 30 ft. in both the main span and anchor arms. Wide flange sections were used throughout, except for top chords and end posts which were built up of two channels and two plates and the pier verticals which are built up H-members. This structure was placed on a one per cent grade. The plan provided for several methods of erection and closure at the centre of the main span.

Teslin River Bridge

Last of the special structures was the Teslin River bridge. Either a high-level bridge, or a movable span, was required because of the navigation requirements. A high-level structure was selected since less maintenance would be required and for other reasons. A clear channel 75 ft. wide with 62 ft. underclearance for a width of 45 ft. was needed. The channel is about 550 ft. wide with water up to 40 ft. deep. To reduce pier heights, a deck structure was used with the centre span a cantilever rising to provide the necessary clearance. The main span is 260 ft. and the anchor arms are 220 ft., with truss depth at the main piers 40 ft. 6 in., sloping up to 30 ft. in the anchor arms. The cantilever arms and the 60-ft. suspended girder span over the main channel are so designed that the bottom chords have an arched outline with a rise of 37 ft. at the centre. A standard 200-ft. deck span flanked the cantilever on each end, and beyond these were 100-ft. deck spans, making an overall length of 1,300 ft. The entire bridge is on a 2 per cent grade. Twenty-foot panels and standard floor construction were used throughout, except in the channel spans where the trusses were spaced so that the top chords served as the outside lines of stringers.

The designs and details of all standard and special structures were worked out in close cooperation with the fabricators. In all, there were 16 shops involved in the work. Questions involving the details, material, and fabrication were settled promptly and the work of the various fabricators coordinated as necessary within the limits of their own procedures and shop requirements. In making the designs for all the steel spans and in fabricating and erecting them, the foremost thought was to obtain bridges at the various sites as soon as possible. Careful consideration was given to design, details, fabrication, shipment, handling and construction affecting this aim.

DISCUSSION ON THE DEVELOPMENT OF STEAM PRODUCTION AT ARVIDA

(*Continued from page 346*)

No pre-treatment was used for feed water, chemicals only being supplied to the water in the feed line to the boilers with the exception of a stabilizer which was supplied through the feedwater heater.

With respect to blow down heat exchangers, the capacity is approximately 100 sq. ft. of surface to 100,000 lb. per hour boiler capacity. The average blow down is approximately 3 per cent and the heat recovery from blow down, 30 per cent of that available therein.

Operating experience has indicated that the coal bunkers with steep sides are an improvement over the ordinary catenary type. However, we have found it necessary to use a Syntron No. V-200 vibrator on the bottom part of these bunkers, the operation of which has been very successful. It is very rarely that there is any sticking of coal in bunkers which this vibrator will not dislodge.

With respect to Mr. Lawton's question on the wear of induced draft fan blades, we believe that this is almost entirely due to abrasion and that cavitation has very little, if any, part in the wear experienced.

Mr. Clark inquires regarding the life of induced draft fan wheels which have shown exceptionally good performance. So far, only one of these wheels has been replaced which had a life of 41 months and during this period, approximately 145,000 tons of coal were burned in the unit with which it was connected. Only two sections of casing liners were replaced at the time of wheel replacement. Blades have been built up after twenty months in service, the worn spots being repaired with electric arc welding. More frequent repairs have been found necessary after the first run.

Regarding the life of ball mill parts, the rolls and rings have given as long as twelve months life and have pulverized approximately 20,000 tons of coal. The average life is about nine months with 16,000 tons of coal per set of parts.

Upper mill liners last approximately the same time or somewhat less than the rolls and rings. Other small parts, such as scrapers last approximately from five to six months.

The author wishes to express his appreciation to all who have helped in the preparation of this paper and to those who contributed largely to it by the discussion given at this meeting.

A SUBWAY PLAN FOR MONTREAL

About a year ago, the Greater Montreal Economic Council decided that they would like, as a part of their Post-War Reconstruction Programme, to have a report on a subway plan for Montreal and asked the Montreal Tramways Company to prepare such a report. This, the company agreed to do and a report was submitted to the Greater Montreal Economic Council on May 19th 1944. It is the result of a year's study, including special surveys of traffic and population trends and engineering studies by the company's staff.

In order to obtain the benefit of the assistance of those who are familiar with such work, the Montreal Tramways Company retained the firm of DeLeuw, Cather & Company, of Chicago, who have had wide experience in transit planning in many large cities of the United States. The head of this firm, Mr. Charles DeLeuw, served as acting chief engineer on the State Street subway in Chicago, which was completed about a year ago and which is generally recognized as one of the most modern and up-to-date subways on this continent.

The report is a lengthy one, including many charts and plans, consequently a summary only, is reproduced below.

The Traffic Problem

The streets of Montreal constitute its sole local transportation arteries. They are used for a variety of purposes; by pedestrians; by private automobiles and taxicabs; by public transit vehicles such as trams and buses; and by commercial trucks for the transport, and delivery, of great quantities of goods. They are also utilized to an unfortunate degree for the parking of automobiles. In the central area the result is a conglomeration of vehicles having widely different functions and characteristics of movement, all concentrated on relatively few thoroughfares.

The location of Mount Royal, shutting off a considerable area to the north of the central business district, has a profound influence on all forms of local transportation. Traffic originating north of the mountain must take a circuitous route around the sides of this fine natural park in order to reach this district. Consequently, heavy concentrations of traffic occur on north-south arteries adjacent to the mountain. After skirting the mountain the preponderant mass of this traffic must approach the central business area by means of east-west thoroughfares. This is an important factor in traffic congestion and is largely responsible for the present unsatisfactory average speeds of all vehicles in the central area.

Except for the limited service provided by railways with stops in suburban areas, all transit service in the metropolitan area is furnished by street cars and buses operated by the Montreal Tramways Company. Its predominating position is revealed by recent average figures which show the following normal week day traffic:

Montreal Tramways Company...	1,085,000 passengers
All suburban railway traffic......	27,300 passengers

The major tramway routes are those converging upon the central business district. As a consequence of the unfortunate topographical conditions mentioned above, street car routes must necessarily overlap on approaching the business area. This means a high concentration of tramway traffic on most main streets with resulting low speeds.

The combination of increased use of private automobiles with prospective population growth will, in the absence of remedial measures, continue to slow down movements of all traffic rush hour periods until they reach walking speeds. Unquestionably the load on the existing street system will be doubled within the next generation.

It is apparent that saturation has already been reached on streets or portions of streets in the central area—notably parts of St. Catherine and Craig streets, and the east and west terminal loops at Place d'Armes where street cars are being operated on a headway as close as 22 seconds. This density of transit traffic is beyond the reasonable capacity of a surface track and results at times in virtual stagnation.

Methods of Improving Traffic Movement

Methods of improving local transportation fall into three general categories, the purpose of all three being to supplement existing arteries, provide new traffic paths, and segregate the various types of vehicles:

(*a*) Widening of existing streets.

(*b*) Construction of limited access, high speed automobile boulevards, elevated roadways, etc.

(*c*) Construction of subways for the operation of public transportation vehicles.

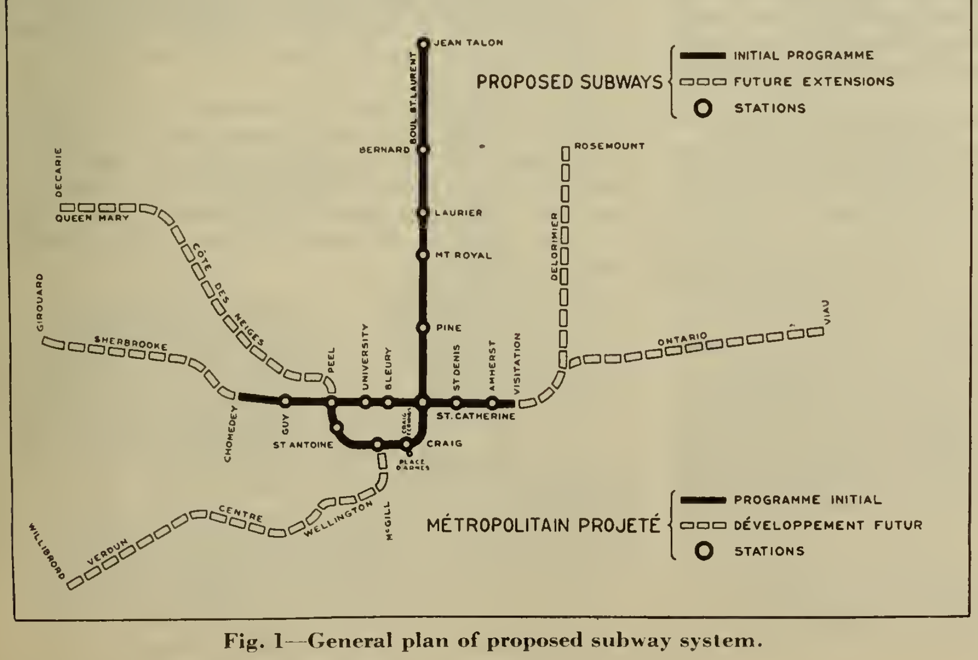


Fig. 1—General plan of proposed subway system.

(*a*) street widening

While street widening improvements do provide additional roadway capacity, it has been demonstrated that they do not

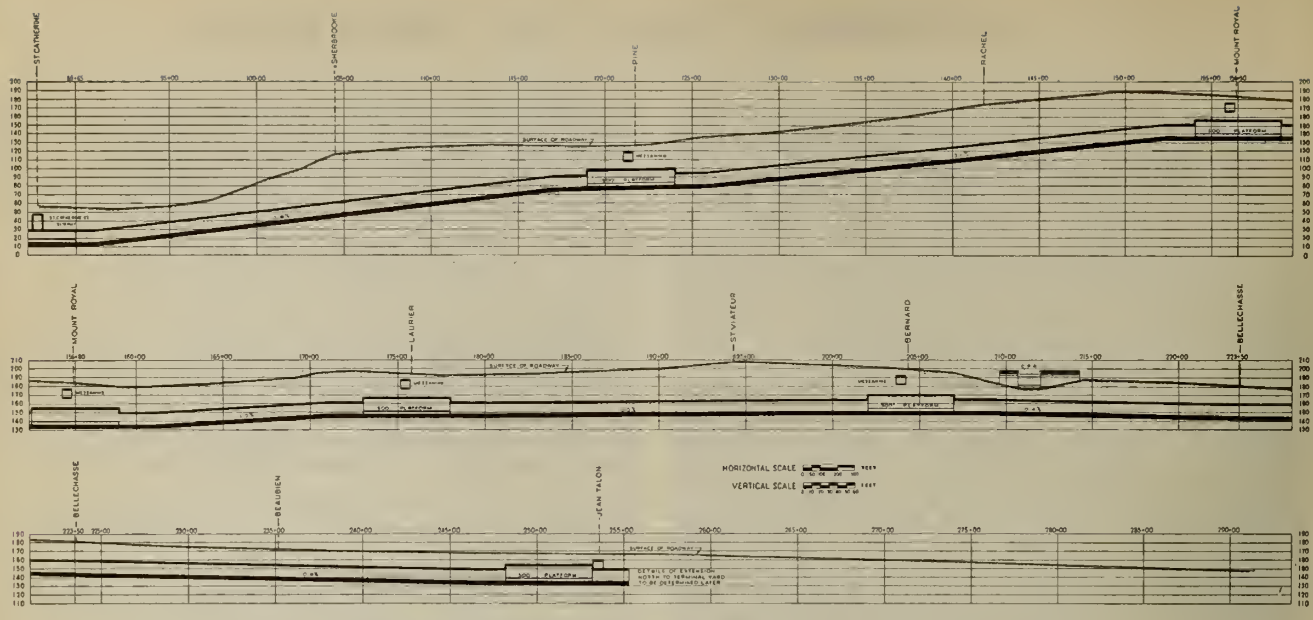


Fig. 2—Profile of north-south subway—St. Catherine to Jean Talon Streets.

effect any major improvement in traffic conditions.

Roadway widths sufficient for six lanes of traffic (three in each direction) have proved efficient. Efforts to effect major increases in capacity through building eight or 10 lane streets have been costly, inefficient and dangerous.

These wide streets incur the following disadvantages:

1. Longer stops at street intersections to permit cross traffic.

2. More traffic accidents. In one large American city, traffic accidents on an 8-lane highway were double those on a street 4 to 6 lanes in width.

3. An adverse effect on local shopping and business centres.

4. Their benefits are largely to one class—motorists.

5. An additional traffic lane will only provide for the movement of 1,400 persons per hour.

(*b*) EXPRESS HIGHWAYS AND NEW STREETS

Express highways provide for the segregation of through motor vehicle traffic from regular traffic. They successfully by-pass large volumes of motor traffic around congested business areas and provide exceptionally convenient and safe facilities for long business trips.

However, as a means of moving large numbers of people into and out of congested business areas for daily travel, the express highway has very definite limitations.

1. Automobiles carry, on an average, less than two persons per vehicle.

An express highway has a capacity of about 1,500 vehicles per lane per hour—or a carrying capacity of 2,800 persons per lane per hour.

2. The extension of these thoroughfares to points close in to the central business district involves tremendous expense to pay for wrecking useful commercial and industrial buildings and for valuable land. Adequate terminal facilities for radial thoroughfares in the central area to provide ramps and distribution plazas would involve almost prohibitive costs.

In Montreal, the best opportunities for developing express highways are found in the outlying sections. New York's splendid parkways—probably the outstanding development of this type in the world—are all on the periphery. No limited access highway has yet been built through the centre of Manhattan.

(*c*) SUBWAYS

The third method of dealing with the problem of urban transportation is to provide underground arteries for public transportation vehicles. Such improvements are in reality two-level streets, providing for the segregation of large capacity transit vehicles from all other forms of street traffic. A definite and measurable improvement for all forms of traffic results. Passengers formerly carried on trams or buses at street level are carried on cars or trains on a second level free from all interference from other vehicles and cross-traffic. Travel time in the central business area will be increased from present rush hour averages of six miles per hour to 15 miles per hour or more.

Such a separation of traffic planes is a permanent improvement of the highest character; it establishes a right-of-way upon which trains can be operated without being interrupted by or causing interruption to vehicular and pedestrian traffic. The operation of trains on railroads free from grade crossings is the best means yet developed for transporting large numbers of passengers.

The capacity, in terms of passengers carried, of each method of improving local transportation should be noted again: an additional lane on a surface street, 1,400 people per hour; a traffic lane on an express highway free from cross traffic interference, 2,800 persons per hour; a single underground railway track, 40,000 persons per hour.

It must not be assumed, from the foregoing outline of the various methods of planning transportation improvements, that street widening and new streets are not necessary and valuable measures in the re-planning of Montreal. Street widening, express motor highways and subways are all very costly undertakings. They must be constructed with public monies. It is maintained however, that the first use to which such money should be put should bring the greatest benefits to the greatest number of citizens. No extended proof is required, that a vastly greater number of people are users of public transportation vehicles than use private automobiles. Even under peace-time conditions, traffic surveys at sixteen of the principal intersections in the central business area show that 74.6 per cent of all vehicular passengers were tramway and bus riders. The remaining 25.4 per cent were passengers and drivers in all other types of vehicles including private automobiles, taxis, trucks, wagons and cycles.

It is impossible to escape the conclusion that in the expenditure of public money for traffic and transportation betterment, subways provide the greatest good to the greatest number per dollar spent, particularly when such facilities benefit not only the vast numbers of public transit riders, but also motorists and commercial vehicle owners, by the removal of transit vehicles from the surface roadways.

Benefits of Subway System

Time saving:—Speed of travel is more than double that which can be accomplished on surface transit lines.

Regularity:—Regularity of service in subways is insured through the complete segregation from all street traffic interruptions. The operation is entirely free of climatic hazards and winter road conditions.

Comfort:—Passengers wait in warm and sheltered subway stations.

Release of street space:—The elimination of tramway operation from some of the principal streets in the congested area will accomplish an improvement in street capacity.

Decrease of pedestrian traffic:—By shifting transfer points from the street surface to underground stations, the actual number of pedestrians on the sidewalks decreases.

Stabilization of property values:—No single factor has so great an influence in stabilizing property values and city development as the fixing of public transportation routes—particularly those operated in subways.

Suggested Initial Development

Extensive studies indicate the following pattern of initial subway construction for Montreal:

1. A north-south route beginning at St. Lawrence and Jean Talon and following St. Lawrence boulevard southward to Craig street, thence west on Craig and St. Antoine streets to a point near Cathedral street, thence northward through Dominion square to Windsor street and terminating at St. Catherine and Peel streets.

This comprises a route 5½ miles in length and would be operated with rapid transit trains. Maximum grade 3.25 per cent. Minimum radius of curves, 400 ft.

Estimates of cost:—

Excavation	$8,842,000	
Decking	870,000	
Backfill	278,000	
Concrete	5,221,000	
Structural and reinforcing steel	1,392,000	
Cast iron pipes and fittings	189,000	
Paving	140,000	
Waterproofing	95,000	
Auxiliary structures	3,146,000	
Mezzanines and entrances	2,526,000	
Underground utilities	528,000	
Maintenance of car tracks	197,000	
Restoration of car tracks	225,000	
Right-of-way and easements	300,000	
Engineering, administrative and contingent expenses	4,000,000	
		$27,949,000
Fixed subway equipment, including track, signal and interlocking plant, power, contact rail, supervisory control, telephone, emergency alarm and station control equipment as well as the necessary terminal yard, housing and shop facilities		5,200,000
120 modern rapid transit cars		4,800,000
Grand total St. Lawrence-Craig subway		$37,949,000

2. An east-west subway on St. Catherine street for the operation of street cars, between Chomedey and Visitation streets, 2⅓ miles in length. Maximum grade 3 per cent.

Estimates of cost:—

Excavation	$3,955,000	
Decking	1,542,000	
Backfill	323,000	
Concrete	1,977,000	
Structural and reinforcing steel	1,351,000	
Cast iron pipes and fittings	82,000	
Paving	230,000	
Waterproofing	135,000	
Auxiliary structures	1,360,000	
Stations and entrances	578,000	
Underground utilities	472,000	
Maintenance of car tracks	436,000	
Right-of-way and easements	425,000	
Engineering, administrative and contingent expenses	3,000,000	
		$15,866,000
Fixed subway equipment — including all items enumerated above for the St. Lawrence-Craig subway, a total of		2,200,000
120 modern tramway cars for the operation of the St. Catherine surface-subway trunk route		4,800,000
Grand total St. Catherine subway		$22,866,000

In preparation of the estimates of cost, the labour and materials for the completion of the subway structure proper and for fixed equipment and new cars have been estimated separately. In addition to the steel, concrete and excavation required to complete the basic subway structures, there must be included the cost of station finish, stairways and escalators, complete ventilating, lighting and drainage facilities. In other words, these items will provide for a complete separate way ready for installation of the power and other equipment necessary to the operation of cars or trains.

In the beginning it is recommended that the St. Catherine subway be operated with specially designed street cars, as part of a through route between the east and west ends of the city. Cars would operate on the surface on leaving the east and west portals of the subway. In future when subway extensions are made to the east and to the west, rapid transit trains would be operated. Entrance inclines at each end will be planned with false bottoms so as to permit future extensions of this subway without interruption to tramway operation.

It would require approximately four years to prepare the plans, and to construct and equip these subways for operation.

The initial routes fit into a comprehensive pattern of subways which, when completed, will provide all of the trunk line subway operation necessary for efficient co ordinated transit in Montreal for a number of years. Future extensions of the initial routes are proposed, as follows:

An extension of the St. Lawrence-Craig route northwest from St. Catherine and Peel to Snowdon;

Extensions of the St. Catherine route:

North-east to DeLorimier and Rosemount;

Fig. 3—Profile of St. Catherine Street subway.

East to Ontario and Viau; and
West to Sherbrooke and Girouard.

A subway from Victoria square to Willibrord park in Verdun.

On the initial north-south subway six stations are proposed on St. Lawrence at locations planned to facilitate transfer of passengers to and from distributor and feeder routes, as follows:—Jean Talon street, Bernard avenue, Laurier avenue, Mount Royal avenue, Pine avenue, and St. Catherine street.

Two important terminal stations are to be located under Craig street, both of which will handle large volumes of traffic. One is proposed opposite the existing Craig terminus. The station located at this point would be provided with a mezzanine level over the track level and a passageway extending about 400 ft. to the south to a connection with Place d'Armes, which would be reached by escalators at a surface entrance near the north west corner of the square. This station, providing access to the heart of the downtown district and also convenient transfer to numerous tramway routes at the Craig terminal and Place d'Armes, will undoubtedly be one of the busiest stations on the subway.

The second important subway station on Craig street is at Victoria square. This station will serve an important focal area in the downtown district and also provide convenient transfer facilities to the tramway routes terminating at, or passing through Victoria square. For these reasons, a centre platform station with mezzanine level above the tracks is also planned at this location.

A mid-town station is planned in the vicinity of Lagauchetiere and Cathedral streets. Ramps in underground passageways, extending from a mezzanine immediately above the track level would provide convenient connections to the C.P.R. Windsor Street station and to the new C.N.R. Central station. This station would also serve the mid-town centre proposed to be developed in the vicinity of the Central station.

The final station on this route would be at St. Catherine and Peel streets, where the St. Lawrence-Craig subway meets the St. Catherine Street subway. The route would terminate just north of this intersection.

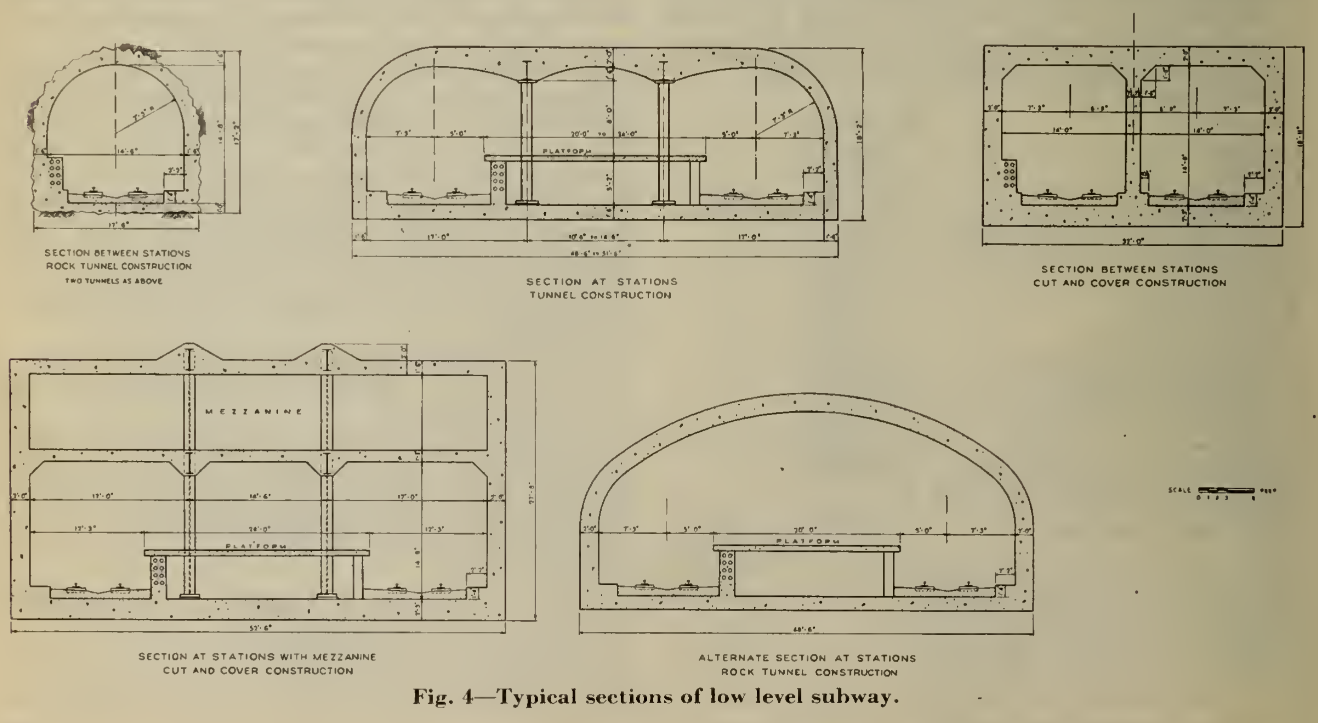


Fig. 4—Typical sections of low level subway.

On the completion of the St. Lawrence-Craig subway, tramway tracks would be removed from the greater part of St. Lawrence boulevard and probably from certain other streets. Bus services would be established to convey passengers to and from the subway stations and for local short-haul travel.

Existing east-west tramway and bus routes, modified to function as feeders to the subway, would serve as connecting links to the nearest subway station for most of those who now use the Park Avenue and St. Denis Street car lines.

Substantial indirect benefits will accrue to street car passengers who are not served by the initial subway plan. The number of street cars using Craig terminal will be greatly reduced. Some of the routes presently terminating at Place d'Armes could, therefore, be diverted to Craig terminal thereby bringing about faster movement of all remaining cars both on the Place d'Armes loops and on Craig street.

On the initial St. Catherine subway, stations are planned at the intersection of all of the major surface routes as follows: Amherst street, St. Denis street, St. Lawrence boulevard, Bleury street, University street, Peel street, and Guy street.

At St. Lawrence boulevard and at Peel street, carefully planned stations will provide the maximum of convenience to passengers transferring from one subway to the other. As the subways must cross at different levels, conveniently located escalators and stairs will provide for the movements between the two platform levels. This arrangement is illustrated in the typical layout of a subway transfer station reproduced in Fig. 8, while a typical layout for other stations along St. Catherine street is shown in Fig. 6.

On completion of the St. Catherine subway, tramway tracks would be removed between Chomedy and Visitation streets, and on Windsor street, between St. Catherine and Dorchester streets.

It is probable that a local surface bus service would be required on St. Catherine to serve those travelling short distances.

Subway levels should be established to afford the maximum convenience to the passengers. A structure located immediately below the street surface—reducing the number of steps from sidewalk to platform to the minimum—would be ideal. However, the sub-surface levels of city streets are utilized for necessary underground utility structures such as sewers, water mains, gas mains, power and communication facilities. These necessary works must be maintained during the subway construction and restored after its completion. This requires that the top of the subway be located a minimum of 6 to 7 feet below the pavement.

Where two subways intersect, obviously one must be located below the other.

Low level subways have certain advantages. Except where two subways intersect, a mezzanine concourse above the track level can be provided, thus giving underground access from every sidewalk entrance to trains travelling in either direction.

However, their greater depth below the street surface is a disadvantage. This greater climb from platform to sidewalk can be best overcome through the installation of escalators in all low level stations providing for upward movement of passengers from train platforms to the concourse level.

Two-track subways are recommended for Montreal. The enormous expenditures required for four-track subways would not be justified, when it is considered that a two-track subway has a capacity of more than 40,000 passengers per hour in each direction. This is double

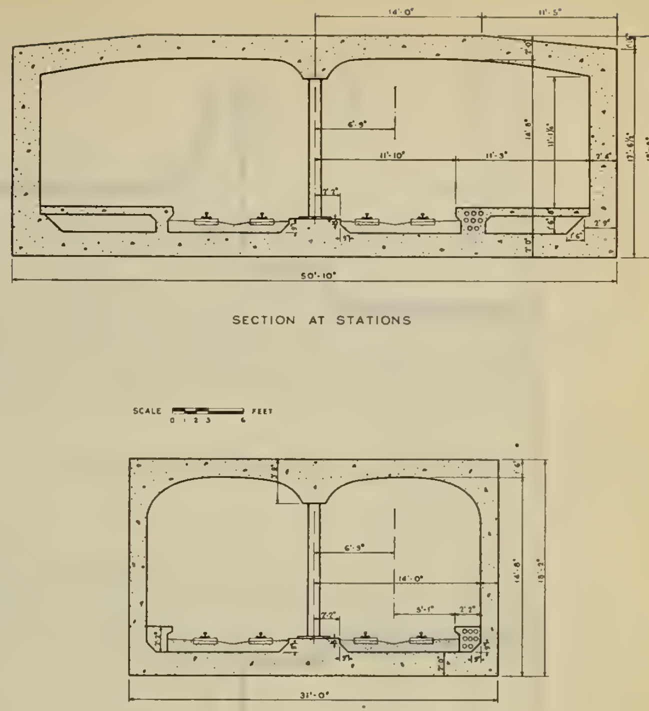


Fig. 5—Typical sections of high level subway.

the total present rush hour traffic on Park Avenue, St. Lawrence and St. Denis tramway lines combined.

The initial north-south route will be constructed as a low level subway, passing under the proposed east-west St. Catherine subway, and built in rock tunnel with mezzanine stations in the entire section between St. Catherine street and the north terminal. The maximum gradient in this section is less than 2.5 per cent providing an excellent operating condition.

A low level having been determined for the north-south subway, the St. Catherine Street subway must necessarily be at a high level both at St. Lawrence boulevard and at Peel street where the two subways intersect, and the St. Catherine Street subway must also be at a high level at McGill College avenue where it crosses over the Mount Royal tunnel of the Canadian National Railways. The existing street grades along St. Catherine street are favourable to the adoption of high level grades throughout. Consequently, the St. Catherine Street subway has been planned at a level as close to the existing pavement as restoration of necessary underground utility structures will permit.

Physical Features

Except for the sections of the north-south subway to be constructed by tunnelling in rock or in earth and rock, all subway construction will be carried on by cut and cover methods. All open cut excavations will be promptly covered with substantial timber decking to enable the major work of excavating and building the subway to be carried on under street decking. This will permit traffic and normal activities in nearby neighbourhoods to be carried on without any substantial interruption.

Underground utility services, such as water mains, gas mains, sewers, power and communication facilities, will be maintained throughout construction period.

Vertical and horizontal clearances are proposed in all subways to permit the operation of 10-ft. wide rapid transit trains of the most modern type. Station platforms flush with car floors are planned in the initial

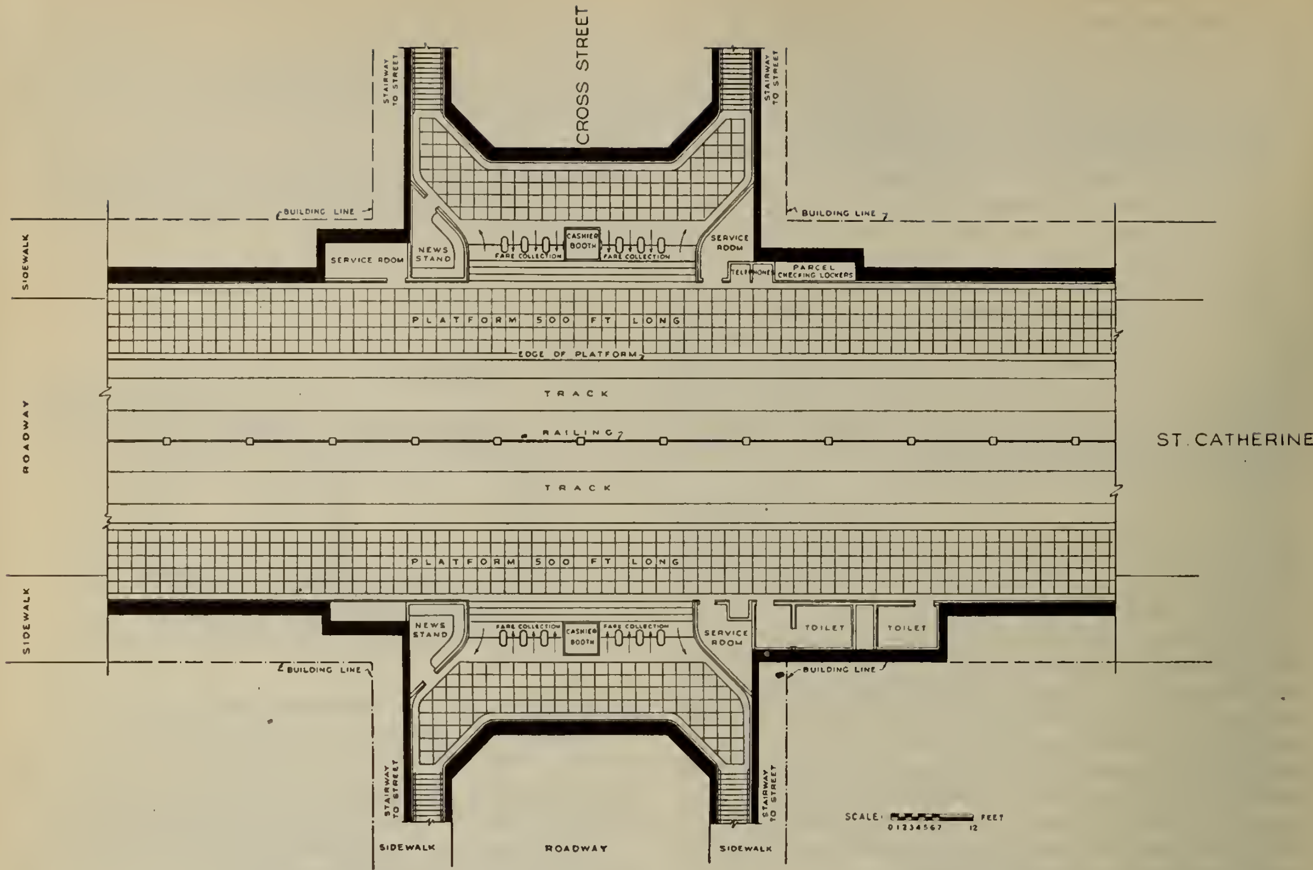


Fig. 6—Layout of typical high level station with side platforms.

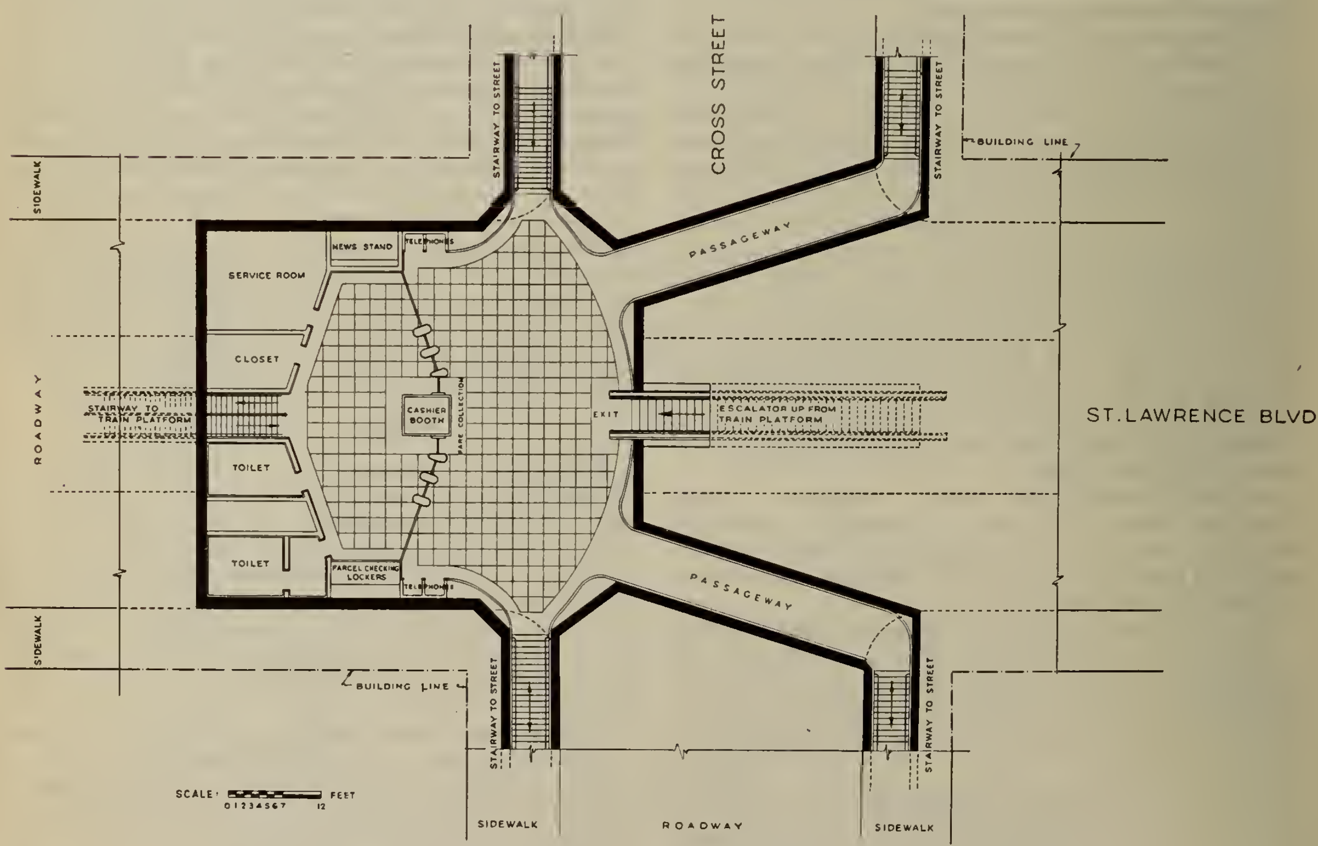


Fig. 7—Layout of typical mezzanine for low level station with centre platform.

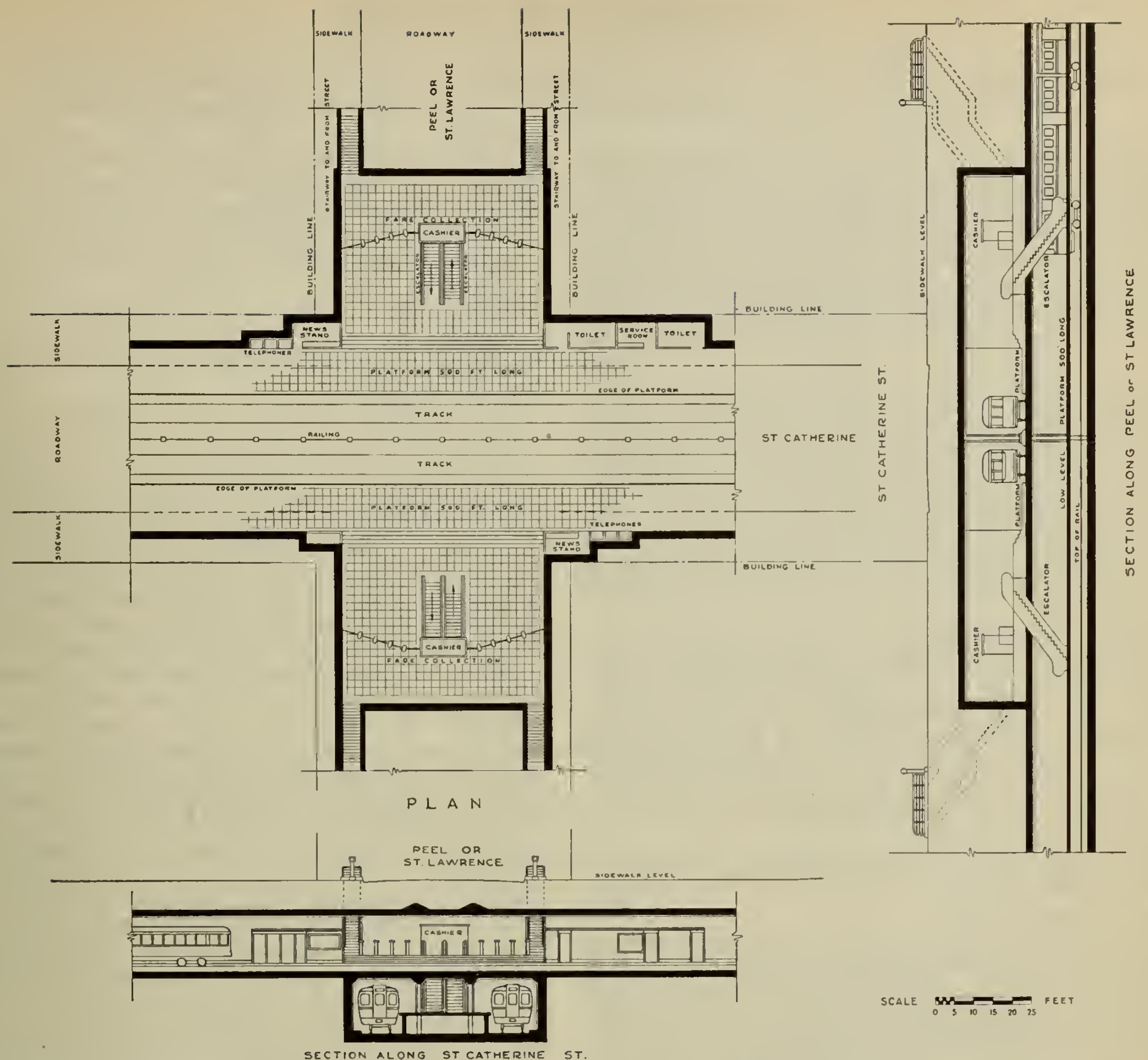


Fig. 8—Layout of transfer station at intersection of St. Catherine with St. Lawrence and with Peel Streets.

north-south route where rapid transit trains will operate from the start.

The proposed subways will be provided with all of the improvements which have been found necessary and desirable in subways elsewhere. Adequate drainage facilities will be provided throughout.

Adequate ventilation is planned, utilizing both natural ventilation resulting from the movement of the trains past suitably spaced vent shafts, and forced ventilation.

Emergency walks will be provided for the safe movement of passengers from any point in the subway to stations or to emergency exits.

Radical improvements have been made in subway car design during the past few years. By the liberal use of rubber, practically all noise attendant on the operation of the older type subway trains is eliminated.

Conclusion

The proposed initial subways would seem to meet all requirements for worthwhile post-war public work projects in that they are socially desirable; promote proper city development; are economically sound; would require but little expenditure or delay in expropriations of rights-of-way; and finally, would provide employment for a substantial number of men.

It is estimated that this project would provide a total of more than 4,000,000 man-days of direct employment; or in other words the employment of some 3,400 men for four years. Indirect employment afforded workers in quarries, cement plants, steel mills, transportation services and various industrial establishments would exceed 6,000,000 man-days, or approximately 5,000 men employed for four years. That is, the building of these initial subways would employ 8,400 men for four years.

Inasmuch as it is desirable that a uniform fare should be maintained, subway operation and the surface operations must be closely co-ordinated, in other words, operation of both subway and surface systems must be under one direction. No single method of local transportation can alone provide adequate transit service in a large city. Subways providing rapid transportation for large numbers of passengers naturally constitute the backbone of the system. These must be integrated with tram and bus surface routes, the whole forming a unified transit system, enabling all riders to obtain economical, convenient and rapid service.

A subway programme, as a means of improving traffic movement in Montreal, is of outstanding importance, and it can be said without question that subway construction would contribute to the general growth and prosperity of Montreal to a very high degree.

POST-WAR PLANNING

Summary of discussion following presentation of the paper on this subject at the Fifty-Eighth Annual General Professional Meeting of The Engineering Institute of Canada, at Quebec, on February 11th, 1944.

NOTE: Because of the length of several discussions and the restrictions on the use of paper, the Publication Committee has followed the well-established custom of re-writing the material in the third person and of abridging it substantially. Many statements and comments have been omitted entirely because, in the opinion of the committee, they were not related to the topic and, though interesting in themselves, did not advance the specific subject. Readers who desire to study any of the discussions in full may secure them by inquiring at Headquarters. —(Ed.)

E. M. Little, M.E.I.C., general manager, Anglo-Canadian Pulp and Paper Mills, Quebec, presided. Mr. Little observed that it was very proper for The Engineering Institute of Canada, representing a cross-section of engineers right across the country, to devote a day of their discussions to Post-War Planning. The object of the meeting was not only to determine the size of the problem, but also to suggest the means of approach to its solution.

John E. Armstrong, M.E.I.C., chief engineer, Canadian Pacific Railway Company, then presented Parts I and II of the paper—"What is the Post-War Problem?" and "What Can Industry Do to Create Full Employment?" He was followed by **John Stirling,** M.E.I.C., vice-president of E. G. M. Cape & Company, Montreal, who presented Part III—"What Can the Government Do to Assist Industry to Create Full Employment?"

With reference to Part I of the paper, the chairman remarked that the great magnitude of the problem should be kept in mind.

The authors of the paper had given some important figures, as to post-war employment, and had estimated an increase as of January 1st, 1947, of about 21 per cent over the 1939 employment level, in the division called in the paper "Industry and Service." They had also pointed out that even although the employment increase in industry and service may be in the order of 21 per cent there will be an even larger job in taking care of the various shifts of employment which will occur during the transition from war to peace. The paper also pointed out that the estimated percentages of distribution of total employment in Canada indicate a continuation of the shift from agriculture to other types of employment.

Mr. Stirling's presentation was followed by **H. E. McCrudden,** M.E.I.C., staff engineer, Bell Telephone Company, Montreal, who remarked on the difficulty which would arise in getting half a million people back into agriculture. How could agriculture be made sufficiently attractive for people who have become accustomed to three or four years of industrial life? Would the hired man go back and live under the conditions which existed in the 1930's?

Mr. Armstrong agreed with Mr. McCrudden and admitted the difficulty of the problem of making the farm attractive to the younger generation.

The next speaker was **Walter L. Saunders,** M.E.I.C., Department of Highways, Ottawa, chairman of the Ottawa Branch of the Institute. Mr. Saunders gave two specific instances illustrating the difficulties of retaining men in agricultural work. In both cases the men liked farm work but could not resist the attractions of city life.

Huet Massue, M.E.I.C., Shawinigan Water & Power Company, Montreal, followed. Mr. Massue said that in 1937, in Montreal, 29 per cent of the population was on relief, a condition worse than that in any other part of the country. This was due to the increase in population in the province of Quebec and an industrial development which did not keep up with the increase in population.

Gordon MacL. Pitts, M.E.I.C., Montreal, was of the opinion that the effects of immigration should be considered in connection with the size of the problem. Had this been done?

R. L. Weldon, M.E.I.C., president, Bathurst Power & Paper Company, Limited, explained that the authors had not been in a position to deal with this particular point. The nearest approach had been their statement that the present rate of annual increase in the number of workers in Canada is about 60,000 and that work has to be found for them. Some believe that if the figure were more, it would be easier to find employment for them. Others completely disagree with this view. Actually no attempt had been made by the authors to enquire into the advantages and disadvantages of immigration as a solution to the overall problem.

Eric G. Adams, M.E.I.C., Ottawa, was of the opinion that the authors' estimate of agricultural employment in 1947 was too optimistic, particularly since the present level of agricultural production is an all time high. Mr. Adams would like to see the figures for "Industry and Service" broken down into the various industrial service groups, for he felt that some of the categories (for example, the consumers' durable goods industry) would prove to be surprisingly small potential pools of additional employment. Suppose that the consumers' durable goods industry is now employing about 100,000 people, an increase of even 50 per cent on this would only employ a few of the men returning from the Armed Forces. In reply to a question from the chairman, Mr. Adams thought that the figure of over 4,000,000 for the total employed population is of the right order of magnitude.

R. K. Thoman, M.E.I.C., Montreal, thought that our basic thinking should be revised. He considered the problem one of distribution alone, not of production. He thought that the cost of production in Canada was very far removed from the selling price, that price having been greatly increased by the money which goes to big interests and maintains watered companies with their tremendous capital investments.

George E. Griffiths, M.E.I.C., Thorold, Ont., asked whether National Selective Service has any power to send people from agriculture into industry and then to send them back again. Mr. Little having enquired as to whether "anyone present knows anything about National Selective Service," asked **H. W. Lea,** M.E.I.C., the director of the Wartime Bureau of Technical Personnel, to make a statement.

Mr. Lea was of the opinion that under the present man-power regulations, National Selective Service had the power, but he could not say whether it had been used extensively or not. In the case of Technical Personnel the power did not exist.

J. Edouard Simard, vice-president, Sorel Industries Ltd., Sorel, Que., pointed out the difficulty of providing for the return of the agricultural population to the land after the war, and illustrated his point by the sad story of some moose which having enjoyed civilized life at a zoo near Quebec, were returned to their native woods, and in a few days found their way back to the zoo, where conditions were more comfortable. He thought it very difficult to get people who have spent five to six years in Montreal or Quebec back to the farm.

H. Napier Moore, editor, McLean's Magazine, Toronto, enquired as to the basis for the figures given in the paper, as they differed considerably from the results of some other surveys. He thought that the authors had been rather optimistic in respect to the actual number of jobs which will have to be found.

Mr. Weldon replied that the figures with which the authors started were those contained in the July issue of *Canada at War* coming from the Department of Labour. The authors had assumed that the best result possible for agriculture would be a return to the 1939 figures, leaving the remainder to be picked up in industry.

The estimated figures of 60,000 workers per year and of 120,000 as an increase in the population over 14 years of age were obtained from an approximate study of the growth in population supplied by the Census Department, and could be found in the Canadian Year Book. The authors had been unable to break down any of the current figures into detailed items as suggested, because such detailed figures did not seem to be available to the public. The figures they had given, however, had succeeded in provoking discussion, which was their objective.

Gordon MacL. Pitts remarked that war is socializing the country and everything is being centralized. He referred to taxation and the expropriation of the Montreal Light, Heat and Power Company. He did not see how private enterprise could be expected to provide employment in this country if it is to be treated in this manner. Mr. Pitts then discussed problems of education and the necessity for providing funds for universities which cannot get help from the Federal Government, education being a provincial responsibility, although governments are the only agencies that have money available for this purpose.

The morning session adjourned at 12.30 p.m. and reconvened at 2.15 p.m.

At the opening of the afternoon session a written communication from **L. E. Sillcox,** M.E.I.C., manager of the New York Brake Company, New York, was presented by Wilson G. Watkins of the New York Brake Company. Mr. Sillcox pointed out that our present economic system gives rise to many contrasting groups, for example, the employer and his employees, the educated and non-educated, privileged and underprivileged persons, political parties, and finally nations. Among these groups antagonisms arise, there is conflict, and the weaker party is crushed.

What was industry's responsibility in the present extraordinary crisis ? Could it possibly provide the needed full employment for returned men and immigrants as well as for all those who have stayed at home ?

He believed that Canada's industrial system had suffered because of the necessity of manufacturing products which had already been developed in other countries. In order to secure a market for these Canadian products, manufacturers would have to do better work, employ larger manufacturing units and display greater efficiency. These conditions would apply especially to agriculture and transportation. Mr. Sillcox pointed out, for example, the advantage possessed by Argentina as regards wheat growing, by reason of the short railway haul from the wheat fields to tidewater.

Important features in securing full employment in Canadian industry would be fuller local co-operation between employer and employee, together with better training for the employees in vocational schools and the like. Local planning would be essential for the education of skilled labour and the necessary supervisory staff.

Plant and facility deterioration should be made good by using an accrued depreciation fund. In the depression of the '30's many firms had been fortunate in having reserves for this purpose, but taxation had not been so heavy at that time, and conditions were different now.

Dr. Sillcox drew attention to the activities of the Committee for Economic Development in the United States. This body referred to as C.E.D. was an autonomous, privately operated, and privately financed organization, whose object was to encourage industry to make economic plans now for the purpose of alleviating unemployment in the post-war era. The country had been divided into districts and no less than 1,354 local groups or committees had been formed to stimulate planning. Information as to possible purchasing power was being gained by the local committees who are making surveys, by sampling methods, and by consultation with large manufacturers and trade organizations.

Much of the population in the United States is in a state of physical and psychological flux, remarked Dr. Sillcox. Great movements and changes have taken place. No region or community will be able to return to the exact status of 1939. These factors must be recognized in Canada. If the strong forces released by the increase in production and the breakdown of inertia and tradition can be guided toward positive goals, reconstruction can fill the needs and promise of modern life. Otherwise, only chaos and waste are likely to result.

The next speaker, **Hugh G. Cochrane,** M.E.I.C., Ste. Anne de Bellevue, Que., referring to the concluding section of the paper, dealt with the volume of public works which should be prepared for the post-war period, the capacity of the construction industry to carry them, and the number of jobs they would provide.

Dr. Leonard C. Marsh last year had proposed the expenditure of one billion dollars for public works during the first post-war year. Would this be possible ? In 1941 an expenditure of $640 millions had severely strained the resources of the construction industry.

Dr. Marsh advises the Institute that his figure of one billion dollars was for all reconstruction in the first post-war year. Perhaps only one half would be for construction work. (Ed.).

A recent estimate made by the industry, based on past experience had indicated that if $350 millions are expended in the last war year, it might be possible to work up to $800 millions in the third and succeeding post-war years. Any abnormal increase would inevitably cause reaction.

The building of public works normally represented less than a third of total construction volume, but no estimate could yet be made of private construction, although there is obviously a vast reservoir of unfilled building needs. Incentive taxation, and government loans at low interest, should be used to promote preparations for self-liquidating and self-supporting projects which would do more to provide permanent employment that would the building of post-offices, wharves and the like.

Mr. Cochrane estimated that *if provision were made for finance, and if plans were ready,* displaced war-workers and returning service personnel could be absorbed into the construction industry at the average rate of 13,000 a month during the three years following victory.

It should be noted, however, that unlimited numbers of unskilled workers cannot be put to work at short notice. A large proportion of all employees, usually more than one-half, must be skilled craftsmen. This point had been considered in the above estimates.

Mr. Cochrane was followed by **Paul Béique,** M.E.I.C., co-chairman of the Greater Montreal Economic Council, who spoke at some length on the organization and work of that body. His interesting and informative address merited a longer discussion than time would permit. He stated that the Greater Montreal Economic Council was started in 1943, and is actively endeavouring to initiate and co-ordinate post-war planning measures in Greater Montreal. For example, it is dealing with problems arising in the development of city-owned lots for housing estates. It is making a survey of business firms in the Montreal area, in order to forecast potential post-war employment. The replies to its questionnaires have so far not been numerous. Its Executive Committee has twelve members and two honorary secretaries, the latter being co-directors of the Montreal Industrial and Economic Bureau; the Bureau's data thus being available for the work of the Council.

The Council was to have had three major advisory technical commissions, dealing respectively with public works, with industrial, economic, and commercial reconstruction, and with economic and fiscal questions; each of these would necessarily have several working committees associated with it. The Technical Commission on Public Works is functioning, its six working committees dealing respectively with:

Subways
Tramways and Autobuses
Railways
Transportation
Public Buildings and
Traffic Problems

The City Planning Department, and the Public Works Department are engaged in studies substantially along the lines conceived for other proposed working committees of the Council, and their results will be available in due course.

Agricultural planning is being left to the Provincial Economic Advisory Board, Mr. Béique stated. The Council believes that the major responsibility of post-war planning in this city rests on the initiative of private enterprise. Mr. Béique noted with pleasure that the City of Montreal had at last undertaken the preparation of a master plan, a preliminary step urgently needed before a public works or post-war housing programme for Montreal could be prepared. The city had also under study a possible housing programme. He hoped for more positive action on the part of Canadian business; and felt that this would find a ready echo in government circles. The engineering profession could do a great deal to advance post-war planning, for an engineer's experience, his contacts with the business community, and his method of work well qualify him for this task.

The chairman thanked Mr. Béique, and remarked that as Professor Legget had said, two types of planning are necessary: one immediate and the other long-range. Mr. Little felt that an immediate start in planning should be made at the plant level. He would suggest in the strongest terms that employers should bring their workers into their confidence and into their planning immediately. Steps of this kind would greatly help by stimulating community organization and activity in industrial plants.

C. H. Wright, M.E.I.C., district manager, Canadian General Electric Company, Halifax, drew attention to conditions in that city, where the population had increased from 65,000 to 150,000 without sufficient funds to provide water, light, or sewerage for these newcomers. But the city had established a committee of the kind to which the chairman had referred. Mr. Wright felt that the problems now being discussed at this meeting are not merely problems of manufacture, but also involve the maintenance of Canada's exports. A large proportion of Canadians' income is derived from these exports, a number of which, like wheat and pulpwood, have only gone through preliminary stages of manufacture.

John B. Stirling, M.E.I.C., urged that in order to give effect to the discussions brought out by these valuable papers on post-war planning, constructive action should be taken by the Institute Council. He therefore moved

> That, in view of the vital importance of post-war planning to this country and of the special responsibility of the engineering profession in assisting with this immediate national task, the Council of The Engineering Institute of Canada be asked to consider the papers presented at this meeting and the accompanying discussions as early as possible with a view to taking appropriate and constructive action.

Mr. Stirling's motion, having been seconded by Mr. Heartz, was carried unanimously.

Hugh A. Lumsden, M.E.I.C., Hamilton, Ont., pointed out that agriculture constituted the work of about one-third of the population of Canada, and he thought that even if National Selective Service had the power to send a man back to the land, this method should be applied only after strenuous efforts had been made to equip farming communities with better light, power, water and other amenities so as to make country life attractive to workers.

H. Napier Moore remarked that in travelling around the country, he had been greatly impressed by the necessity of realizing that what a man earns per hour is not of as great importance to him as what he earns per year. In Mr. Moore's opinion employers would be relieved of many problems if the workers in their plants were able to budget for their requirements over a period of a year or five years. If this were possible he thought the worker would be far better satisfied.

The session adjourned at 4.00 p.m.

The following paragraphs refer to written discussions received after the meeting and therefore not presented at that time.

W. C. Miller, M.E.I.C., city engineer, St. Thomas, Ont., commented on Part III of the paper, in the light of the findings of the Institute's Committee on Post-War Problems, and his own experience in municipal work. This had shown him that public bodies hesitate to initiate programmes of public works at times when the earnings of the population are diminishing and when increased taxation would evidently be needed, much more of which would fall on business institutions than on industry and its employees. In fact, at the municipal level, part of the population cry out for a municipal public works programme and the business people caution against it.

He remarked that while the paper draws attention to the fact that publicly financed construction projects are needed to stabilize employment conditions, the authors say little about construction projects which are needed to keep pace with industrial expansion, such as water supply, highways, recreation facilities, public health and safety measures, and which should be publicly financed.

C. T. Russell, assistant to the vice-president, The Steel Company of Canada, Limited, Montreal, based his notes on those phases of his company's work which he felt were of most interest at the present time—He remarked that in the manufacturing industry the number of employed had risen from 650,000 in 1939 to 1,300,000 in 1943. But it seemed to him impossible that under post-war conditions this industry could continue to offer employment to all of its unduly expanded labour forces, so that means would have to be found to effect the orderly release of some of them.

The burdens of reconversion would fall particularly on the heavy industries. The task would be very great. In the steel industry in Canada, production is now more than double the previous production peaks of 1918 and 1939.

In his company the working force had increased by over 40 per cent since 1939 and including the 1,400 employees on active service, over ten thousand workers would have to be provided for. Production must therefore be maintained at a relatively high level.

This can only be done if the company's customers themselves plan to produce at high levels—a course which is being urged in the United States by the Committee for Economic Development.

Ninety-five per cent of the company's present production consists of war materials, but its reconversion problem is not a serious one because most of its equipment is standard or can be used to produce standard goods. It may, however, be difficult to operate continuously during a period while customers are converting to peace-time products.

The company has two committees preparing plans:

(1) Studies of problems of post-war markets and the distribution of the company's products;

(2) Surveys of the company's plant and equipment, so as to provide for maximum employment.

The first committee is considering first the period of reconversion and then the long term policies. The second committe is making recommendations as to desirable improvements and changes in plant and layout, machinery and equipment, and working conditions, not forgetting the need for keeping up with technological development and the results of research. Both committees have already made interim reports with a variety of recommendations.

The purchase and use of equipment for new and improved processes and products in the manufacture of steel goods would be possible only if the government's policy as to taxation, tariffs, and other levies, will allow of the installation of such equipment at a laid-down cost which would permit economic production in Canada in competition with U.S. producers.

The employment of disabled men, and of women, after the war is being studied; problems of long-term production budgets and employee relations are being considered.

Mr. Russell thought it essential that the Government should co-operate in such a way as to encourage the progress and expansion of private enterprise. It is necessary to remove to the greatest possible extent, all the taxes and restrictions which limit the expansion and productivity of industry.

F. P. Shearwood, M.E.I.C., consulting engineer, Dominion Bridge Company, Montreal, was not able to agree with the authors in considering that a high rate of production brings about prosperity. In his view prosperity required not so much a high rate of production, as the regulation of production "with a view of levelling the supply to the probably normal demand."

Turnover of employees in most branches of industry could be controlled or curtailed, though this would be difficult in the construction industry.

The loyalty of employees should be promoted by giving them a lasting interest in their work. To this end, why should not excess profits be passed on to those who helped to make them ? This might be done by giving them non-transferable shares in the industry for which they work. Capital thus provided could be used for development and for providing employment during dull times.

More expenditure should be "devoted to employment in connection with education, the fine arts, culture and beautifying our cities and countryside," thus contributing to the development of a higher standard of living for the nation.

Edgar A. Cross, M.E.I.C., Toronto, in a written communication, expresses his surprise at finding that Part III of the paper is largely devoted to telling the Government in very definite terms what to do in the way of taxation. He fails to see, in the aims and objectives of the Institute, any authority or jurisdiction for telling the Government how to set up its taxes.

He notes that in the March *Journal* reference was made to these papers as being one of the greatest contributions to a national problem ever made by the Institute, and that the impression gathered is that these papers met with unanimous approval at the annual meeting.

He expresses his disapproval of Part III of the papers and states that, in his opinion, the Institute is not justified by its charter in interfering in matters of taxation of the general public.

Section 1 of the by-laws lists, among the objects of the Institute, the following: "to advance the professional, the social and the economic welfare of its members."

Surely this can be interpreted to include an interest in things of such national and economic importance as taxes. Because of the engineer's position in industry, it is doubtful if anyone is better qualified to evaluate the effect of taxation on industry and employment. These are very important to the "economic welfare" of the members. (**Ed.**).

Professor R. F. Legget, M.E.I.C., *of Toronto, participated in the discussion at Quebec and subsequently submitted a written manuscript of four thousand words (three pages of the Journal) for inclusion with the printed discussions. This was abridged by the Publication Committee in the same manner as were all others, but Professor Legget found the abridgment unacceptable and has requested that it be not published. On the instructions of the committee, and in accordance with Professor Legget's request, it has been withdrawn from the Journal.* (**Ed.**).

From Month to Month

News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

WHEN IS AN ENGINEER NOT AN ENGINEER?

The answer seems to be "when he is in the new Royal Canadian Electrical and Mechanical Engineers Corps." The *Montreal Star* of May 13th carries an announcement of the establishment of the local unit of "the newest corps in the Canadian Army." Six commissioned officers are mentioned and two NCO's. As far as the *Journal* can discover, only one of the entire lot has any engineering education or experience. Apparently one of the qualifications for a commission in the new corps is that one *must not* be an engineer! The British corps, upon which the Canadian one is modelled, requires that every officer above 2nd lieutenant be a professional engineer with suitable practical experience. Such a group can be truly called an Electrical and Mechanical Engineers Corps. The word engineer in that title is not a travesty.

Engineers across Canada who were so severe in their criticism of the Ordnance Corps were fearful that the new corps, which replaces the engineering branch of the Ordnance Corps, would be commanded by persons who were not engineers. They could not see any hope for improvement while the selection of staff for the new corps was left with those who had staffed R.C.O.C. The outsider found it difficult to share their fears because such selection would be preposterous, but there it is—both preposterous and fantastic.

As near as one can judge from the sketchy information so far released, all that is new about the R.C.E.M.E. is the title. After all the complaints about non-technical persons on the engineering side of Ordnance, one can be excused for having expected a different set-up for the new corps, but apparently the same philosophy is to be followed, i.e., engineers are not administrators, and therefore all the senior appointments must go to salesmen, brokers, service men and so on.

Montreal Personnel

The officer commanding the Montreal unit is or was president of a "drive-yourself" taxi company. He is not an engineer and has never done engineering work. The second in command is an engineer and a member of the Institute.

Of the two captains appointed, one was a district service representative for a motor car company and the other was in the service department of a motor car agency. The civilian work of the two lieutenants was, in one case, tire sales and, in the other, insurance. These are the officers for the new engineers corps!

There Is A Law Against It

In civilian life it is a legal offence to use the word "engineer" or "engineering" in a title unless the person or persons referred to are registered professional engineers. It is true that these civil laws do not apply to the armed services, but morally the conditions are identical. Either the corps should not be called an engineers corps or it should be organized and commanded by engineers.

The use of such a title must mislead the public. To them the word "engineer" means something. Surely the authorities are not trying by a subterfuge to lift the corps to a level it could not attain as a non-technical, non-professional group. Engineers may well be disturbed at the prospect of the group being accepted by the public as engineers. The reputation of the profession can be injured seriously if unqualified persons are allowed to direct or execute engineering work. The protection that is afforded the public by the civil legislation should not be denied them in the active services.

Engineers must rouse themselves on this matter. A definite move should be made to demand that the government either employ engineers for such work or cease to use the word engineer in connection with it. Surely we have a right to control our own profession.

"The Privilege of Absurdity"

The *Star's* article which reads in part like an official release, concludes by saying, "This concentration of effort will simplify the direction and control of maintenance and repair . . . and will help maintain the high level of efficiency for waging effective mechanized warfare." It looks as though the person who wrote that did not know the meaning of the word engineer—or else he had a splendid sense of the ridiculous. Concentration of effort indeed!

Past Procedures

Some time ago the Institute wrote the Master-General of the Ordnance asking for the names of officers of the new corps as they were selected. The reply was evasive and negative. This announcement of the personnel of the Montreal unit gives the explanation. No official would feel comfortable about submitting such lists to a technical society. Information coming in from other cities indicates that appointments there are pretty much along the same line.

It isn't just that engineers are being deprived of their opportunities to serve their country to the best advantage. It actually bears on the progress of the war itself and the lives of people. If control of engineering work is given to non-engineers, the results will be disastrous, just as would be the case if medical work were controlled by persons who were not doctors.

How long must this sort of thing go on? For years the Institute has been pleading *politely* for fair treatment of the engineers. It has been pressing *courteously*. though firmly, for over a year for the formation of an electrical mechanical engineers corps, and has called official attention to the need of taking this new corps seriously. Apparently these methods are not the ones for producing results.

New Methods

A copy of this editorial is being sent to other technical organizations and to other publications in the hope that it will encourage them to publicize the story. There are about 30,000 professional technical persons in Canada and many more thousands who appreciate the value of engineering services. Surely an informed public will aid in protesting such miscasting. Let's try "shouting from the housetops"! It is a shame to have to descend to such methods but there is a war on and we must be practical. Other methods have failed entirely so far.

STAFF CHANGE

Members of the Institute in many parts of Canada will regret to learn that ill health has forced Miss Ellen Boyden to retire from the staff. For almost twenty-seven years she has been the accountant of the Institute, and throughout that period has given a most unusual service.

She has seen the Institute grow from a small membership to a figure that no one envisaged at the time she joined the staff. With this growth, her own responsibilities multiplied many times but, by intelligent planning and an unbelievable amount of application, she has met the situation without lowering her standards of workmanship.

Miss Boyden has served through three secretaryships. To all these and to the membership she has rendered a great service "unheralded and unsung," expecting no special praise for what she saw as her common duty.

In her time the membership has more than doubled. She has watched the number of branches grow from nine to twenty-five. She has been interested in every part of Institute life and has actually been a part of it all. She exemplifies perfectly the Rotary motto "Service above self."

She will be missed greatly by her fellow workers, but they are pleased that she will still be in Montreal and will drop in at Headquarters at least occasionally to see how goes the Institute.

COMMITTEE ON EMPLOYMENT CONDITIONS

At the May meeting of Council, R. E. Heartz, chairman of the committee, presented a progress report upon which the following notes are based.

The membership of the committee has been chosen to represent a variety of interests. All are employees, but within the meaning of labour legislation four would be classed as employers. The other three are definitely employees only. There is a wide spread in ages, representing graduates of 1913 down to a graduate of 1944. It is believed that such a committee will do the best job and will satisfy the membership as to its lack of prejudice and as to its competence. Following are the names and titles of the committee members:

R. E. Heartz (McGill '17), *Chairman*, Assistant Chief Engineer, Shawinigan Engineering Company, Montreal.

P. N. Gross (McGill '26), Vice-President and General Manager, Anglin-Norcross Quebec Limited, Montreal.

G. N. Martin (Polytechnique '34), Combustion Sales Engineer, Dominion Bridge Company Limited, Montreal.

A. D. Ross (M.I.T. '23), Manager, Canadian Comstock Company, Montreal.

I. R. Tait (McGill '13), Chief Engineer, Canadian Industries Limited, Montreal.

B. J. McColl (Queen's '44), Designer, Canadian Vickers Limited, Aircraft Division, Montreal.

J. D. Sylvester (Alta. '38), Electrical Engineering Draughtsman, C.N.R., Montreal.

The committee's terms of reference are:

1. To determine methods by which the Council through the committee could interest and inform the membership relative to Order-in-Council 1003 and collective bargaining in relationship to the profession.
2. To determine methods by which the opinion of the members of the Institute, either individually or by branches, might be obtained.
3. To make recommendations as to the future policy for the professions, and the Institute's part in it.

It is possible that a brief will be in the hands of every member before this number of the *Journal* is received, but it is not certain. The committee has felt that no word should go out until it is satisfied that the situation has been searched and studied thoroughly. It is new ground; engineers have had no experience in these things, and therefore caution and care should be exercised before distributing information or opinions.

It is not necessary to appear before the Board again until October. The intervening time should be used carefully for surveying, consulting, co-ordination and thinking. The problem is too far-reaching to be rushed unnecessarily; too serious to be settled without giving everyone the facts and an opportunity to express his preferences.

The committee has consulted three people who, it believes, are the best informed persons on the continent in matters such as these. The information being prepared for members will be based on these conferences and the committee's own observations which have been developed through a long series of meetings and much reading.

CHEMISTS CONSOLIDATE

At their annual meeting in Toronto on June 5th, final approval was given by the Canadian Chemical Association, the Canadian Institute of Chemistry and the Society of Chemical Industry to a proposal that the three societies should merge. After two years of intensive work it must be very gratifying to the officers of all societies to see their proposals accepted almost unanimously by the memberships.

L. E. Westman, M.E.I.C.

Newly elected president of the Canadian Institute of Chemistry, and chairman of the interim council of the new Chemical Institute of Canada. Mr. Westman is Associate Director, War Industries, National Selective Service, Ottawa.

The new organization will be known as the Chemical Institute of Canada. Elaborate plans are being made to set it up in such a way that greatly increased benefits will accrue to the members and profession. The plan is that each organization will continue its activities and identity for some time but that bit by bit, as it can be done, the interests will be joined. The next annual meeting will be called by the Chemical Institute of Canada, and from there on the identity of the others will disappear.

The new officers elected at the Toronto meeting are:

CANADIAN INSTITUTE OF CHEMISTRY

President:	L. E. Westman, Ottawa
Vice-Presidents:	E. P. Linton, L. R. Bryant, E. H. Boomer
Hon. Treasurer:	P. E. Gagnon
Secretary:	R. T. Elworthy (*on leave of absence*)
Acting-Secretary:	W. H. Pitcher

CANADIAN CHEMICAL ASSOCIATION

President:	C. J. Watson, Ottawa
Vice-President:	L. Lortie
Hon. Treasurer:	C. M. Jephcott
Hon. Secretary:	A. Labrie
General Secretary:	R T. Elworthy

SOCIETY OF CHEMICAL INDUSTRY—CANADIAN COUNCIL

Chairman:	R. S. Jane, Montreal
Hon. Secretary:	C. J. Watson

The interim council, consisting of the councils of the three societies, appointed a board of directors to carry on the organizational work of the new Institute. Its membership represents the three societies and is distributed across Canada in such a way as to give good geographic representation as well. Its membership is as follows:

Chairman:	L. E. Westman, Ottawa
Hon. Secretary:	R. R. McLaughlin, Toronto
Hon. Treasurer:	P. E. Gagnon, Quebec
Directors:	R. H. Clark, Vancouver
	T. T. Thorvaldson, Saskatoon
	C. C. Coffin, Halifax
	R. K. Stratford, Sarnia
	W. E. Pomeroy, Toronto
	R. V. V. Nichols, Montreal
	E. R. L. Streight, Montreal
	L. Lortie, Montreal

Members of the Engineering Institute will be interested in this latest example of co-operation and simplification. It has not been as simple as it appears to an outsider, but the fact remains that the members have accepted the compromises that were necessary to establish one strong group, made up of both professional and non-professional persons that could work to greater advantage in the interests of the profession and the industry.

The result is sure to be beneficial. The Engineering Institute of Canada congratulates the chemists on their courage and foresight, and wishes them the full attainment of their objectives. It looks forward to close association with the new Institute, similar to the helpful and pleasant relationship that has existed for so long with the original societies.

WASHINGTON LETTER

This is the first Washington Letter for several months. The *Journal* has been fully occupied with Annual Meeting papers and reports. Furthermore, about the middle of February the Australian Government decided that my chief here in Washington should return for an extended visit to Australia and appointed me Acting Director General to take charge in his absence.

The past three months have been unusually eventful. Not only is this an election year, but governmental policies and political thinking are no longer restrained and coordinated by the compelling necessities of total war to the same degree that has obtained heretofore. The Baruch report on post-war reconstruction is being implemented. The State Department has been reorganized. The Foreign Economic Administration is emerging with new policies and principles of its own. International conferences have been held on petroleum, monetary control, civil aviation, and post-war education. The important International Labour Office conference at Philadelphia is just over as this is written. Colouring all thinking, of course, are speculations regarding the outcome of the immense invasion plans.

As the outcome, if not the end, of the war comes into clearer focus, the factors which motivate governments and shape policies become more complicated and more diverse. These tendencies are seen quite clearly in connection with our day to day work in the procurement of supplies. We sat in on the hearings of the House Foreign Affairs Committee when the Lend Lease Act was under discussion and assisted in the preparation of briefs. After extensive and searching hearings, the Lend Lease Act was extended for another year. But, in the process, the problems of post-war business, of international trade, of the merits of governmental as compared with commercial buying and distributing were all aired and discussed. Never far from the surface were the related problems of currency stabilization, exchange levels, relative standards of living, and industrial autonomy.

Because of the paramount importance of supply in wartime, it is perhaps with respect to supply that the greatest strides have been made in international cooperation and pooling and in the joint direction of all our resources to a common end. Consequently the transitions which will have to be effected in the machinery of international supply will be attended by grave risks and great opportunities. Because of the inter-relation of supply and diplomatic problems, it has been necessary to wait frequently on either the Australian Minister or the British Minister for Supply or on the Australian High Commissioner in Canada. We have also had visits recently in Washington from Australia's Prime Minister Curtin and her Minister of Supply and Shipping.

In all this quickening activity it is somewhat alarming to have brought home the unbalance between the forces which divide and those which unite. It is sobering to discover how few people may initiate and direct a policy—how great decisions are often made on narrow grounds—how often personal and sectional interest apparently dominate judgment—and how compelling would appear to be the necessity of a compromise between practicality and idealism. How great, therefore, is the need for individual integrity and for a hard stratum of honesty in the mass of democratic people.

* * *

Just in passing, I would like to mention two personalities. Sol Bloom is one of the best known, best liked and most colourful men in Washington. Starting his career in the Gay Nineties as the successful impresario of "Little Egypt," the first of a particular school of dances, he made a fortune in the entertainment and music publishing business. Always a showman, a wit, a student of his fellow men and a shrewd business man, he is now the popular and dynamic head of one of the most powerful committees on the Hill. He is Chairman of the House Foreign Affairs Committee. The other figure is the British Minister for Supply—the Rt. Hon. Ben Smith. Impressed with his knowledge of Australia, I asked him if he had ever been there. "Been all round Australia twice," he said, "both times before I was sixteen. Shipped before the mast when I was twelve and sailed the South Seas run." Working up through the British Labour Movement until he finally attained Cabinet rank, he is one of the several Ministers who retain their Cabinet rank in positions abroad. Forthright, jolly, direct, salty, he is a popular and influential figure.

* * *

My growing interest in civil aviation received quite a fillip recently. The Director General of Civil Aviation in Australia arrived for a visit to the United States. In developing his contacts, mapping his itinerary, collecting data prior to his arrival and in accompanying him during his stay in Washington, I became acquainted with the civil aviation setup and with the leading Washington personalities. We also spent several days with the Canadian authorities at Ottawa. Civil aviation in the United States at present comes under the Department of Commerce. Our first call was on Mr. William A. Burden who is the Special Advisor on Aviation to Secretary Jesse Jones. The civil aviation facilities of the Department of Commerce were placed at our disposal. To illustrate latest techniques in the control and operation of aircraft, American authorities not only made available their latest information and records, but offered a conducted tour, by air, as a full demonstration of the various control procedures in modern aviation. Most of our discussions were with Civil Aeronautics Board, which is the regulating body, and with the Civil Aeronautics Authority, which is the administrative body. At C.A.B. we were taken in hand by its dynamic chairman, Mr. J. Welsh Pogue and, as would be expected, also spent considerable time with Dr. Edward P. Warner, who is reputed to be one of the world's outstanding experts in this field. It will be remembered that Dr. Warner delivered the Wilbur Wright lecture in London last year, which has since come to be regarded as one of the most authoritative statements on the subject of civil aviation. In the C.A.A. we were taken in hand by Mr. Charles I. Stanton who is the head of that body and who arranged a full dress conference attended by all his department heads.

The potentialities and ramifications of civil aviation are exciting. Transportation has always been a glamorous affair, but aviation promises to transcend all other means of transportation in the scope of the problems presented, the size of the stakes involved, the international complications which may arise and in the number of imponderables, both technical and administrative. In the international aspects we have the controversy regarding freedom of the air and the right of innocent passage, and we have the question of control ranging all the way from the "chosen instrument" to free and unlimited competition. In the field of operation, decisions will need to be made as between the extremes of full government ownership and full private ownership, with the problems of subsidies lurking in the background. On the technical side, we find that the emphasis has shifted from the sea plane to the land plane by virtue of the fact that the war has made it possible to build throughout the world great landing strips which could only have been justified by the necessities of war. Recent experiments, however, along the line perhaps of jet propulsion may make it possible to put a sea plane "over the hump" by some temporary power at take-off which will enable the wing loading design of the sea plane to be brought nearer to the range of the land plane. This may materially alter the international aviation picture. Some new design—some radical engine improvement—some step-up in fuel efficiency may also change over night the whole aspect of civil aviation.

* * *

In her isolated position, Australia has only been able to make the great industrial strides incident to her wartime production by an extensive exchange of technical information and "know how." It is part of our responsibility to look after the many technical missioners who come from Australia who, perhaps more than any other country, has learned the value of sending her technicians abroad. In the last few weeks I have worked in cooperation with a petroleum expert on his way to a London conference—with the Chief Inspector of the Australian Post and Telegraph Department— with the Manager of Australia's largest aeroplane engine factory —with the Chief Technician of the Civil Aviation Authority—with a mission of four textile experts and another of four aircraft production experts—with the Secretary of the Department of Aircraft Production and the Director General of Civil Aviation—with the Manager in charge of aircraft engine reconditioning operations—and so one might go on. From all of these one learns something of the problems being faced in these various spheres, and each new visitor opens up new vistas and new avenues of thought. With one of our recent visitors it was necessary for me to spend a most interesting day going over the great naval station at Norfolk, Virginia. While our work with Australian visitors is only a side line to the main job of securing supplies for the South West Pacific, it is in many ways closely related to procurement, and certainly adds considerably to the interests and variety of our work in Washington.

May 23, 1944 E. R. Jacobsen, M.E.I.C.

MEETING OF COUNCIL

A meeting of the Council of the Institute was held at Headquarters on Saturday, May 20th, 1944, at nine thirty a.m.

Present: President deGaspé Beaubien in the chair; Vice-President E. B. Wardle; Councillors J. E. Armstrong, R. S. Eadie, P. E. Gagnon, R. E. Heartz, J. A. Lalonde, J. A. Vance and H. J. Ward; Secretary Emeritus R. J. Durley, General Secretary L. Austin Wright and Assistant General Secretary Louis Trudel.

James Watt International Medal—Mr. Wright outlined briefly the history of the medal which was established by The Institution of Mechanical Engineers and which is awarded every two years for outstanding achievement in the mechanical engineering field. The decision is made by a board made up of representatives of four or five of the leading English institutions, and nominations are requested from seventeen of the leading engineering societies in the world. In response to several inquiries three members, including Lieut.-General A. G. L. McNaughton, had suggested the name of Major-General A. E. Macrae, O.B.E., M.I.Mech.E., Assoc.Inst.C.E., who is technical adviser to the co-ordinator of production in the Department of Munitions and Supply. General Macrae has done outstanding original work on the design of new weapons, the auto-frettage of guns, and the overstrain of metals. He is the author of the War Office textbook on the "Overstrain of Metals."

Following consultation with the president and other officers of the Institute, the general secretary had submitted General Macrae's name to London, the nomination to be confirmed after approval by this meeting of Council. On the motion of Mr. Armstrong, seconded by Mr. Lalonde, it was unanimously resolved that the nomination be approved.

Employment Conditions—Councillor Heartz, who had been appointed by the president as chairman of a Committee on Employment Conditions, asked and received Council's approval of the personnel of his committee.

He then presented a complete report on the Institute's activities and his committee's work relative to collective bargaining. The information appears elsewhere in this issue.

Financial Statement—It was noted that the financial statement to the end of April had been examined and approved.

Activity among Junior Engineers in Ottawa—Mr. Wright outlined briefly a movement initiated by two members of the Institute in Ottawa among junior graduate engineers who are endeavouring to organize themselves into a group which will have as its objective the promotion of the welfare of the junior professional engineer and the engineering profession as a whole. He had recently attended a meeting of this group in Ottawa at which a very lively interest was shown. Officers were elected but no decision was made as to the final form of the organization. This activity was noted with gratification.

Engineers' Council for Professional Development—Mr. Wright read a report on the proceedings of a meeting of the executive committee of the Engineers' Council for Professional Development (E.C.P.D.) held in New York on April 28th, submitted by Dean C. R. Young, the Institute's representative on the executive. Among other things the report referred to an E.C.P.D. programme for developing aptitude tests for student selection and made the comment that as the number and quality of civilian students in the States is rapidly falling, interest had been expressed in the possibility of some of the larger Canadian institutions participating in the tests.

Under the heading of "Technical Institutes" Dean Young referred to the report of the E.C.P.D. subcommittee. This report recommended that certification of educational programmes of such institutes be initiated by E.C.P.D., inasmuch as this is the only agency which has the status, backing and public recognition necessary to insure acceptance of such certification.

The report also dealt with the budget for 1944-45, from which it appeared that no additional financing would be required for that period.

The report was noted and Mr. Wright was directed to thank Dean Young for his very complete and comprehensive statement.

Meeting of Council in Kingston—A letter was read from the chairman of the Kingston Branch extending an invitation to Council to hold a meeting in Kingston during the coming year, and suggesting that September would perhaps be the best month for such a meeting. It was unanimously resolved that the invitation of the Kingston Branch be accepted.

ELECTIONS AND TRANSFERS

A number of applications were considered, and the following elections and transfers were effected:

Bash, Kenower Weimer, B.Sc. (Civil), (Univ. of Michigan), gen'l. mgr., Wartime Housing Ltd., Toronto, Ont.

Bendt, Joseph Philip, B.Sc. (Civil), (Univ. of Wisconsin), engr., Algoma Steel Corp'n, Ltd., Sault Ste. Marie, Ont.

Donnelly, John (Glasgow Tech. School), prof. engr., & elect'l. supt., Algoma Steel Corp'n., Sault Ste. Marie, Ont.

Lazier, Morley John Campbell, B.A.Sc. (Univ. of Toronto), 170 Bay Street, Toronto 2, Ont.

***McLellan,** John, checker, Dominion Bridge Co. Ltd., Toronto, Ont.

Pitcairn, John (Glasgow & West of Scotland Tech. School), engr., i/c struct'l. design, Aluminum Co. of Canada, Montreal (on loan from Dominion Bridge Co.).

Vince, Edward Raban, Colonel (R.C.E. (P.F.) Retired), Woodstock, N.B.

Watts, John Pollitt, B.Sc. (Elect.), (Queen's Univ.), asst. W. & C. engr., Canadian General Electric Co., Peterborough, Ont.

* Has passed the Institute's examinations.

Wilson, Vallentine William Gibson, B.Sc. (Mech.), (McGill Univ.), M.Sc. (Mass. Inst. of Technology), tech. asst. to Director-General, A.E.D.B., and staff engr., Directorate of Tank Design, A.E.D.B., Dept. of Munitions & Supply, Ottawa.

Neumann, Theodore Oscar, B.Sc. (Mining), (Univ. of Alberta), res. engr., Dept. of Transport, Lethbridge, Alta.

Borrowman, Ralph Willson, B.Sc. (Civil), (Univ. of Man.), bldg. mtce. engr., Winnipeg Works, D.I.L.

Gauthier, Gaston C., B.A.Sc., C.E. (Ecole Polytechnique), tech. advisor, elect. dept., Marine Industries Ltd., Sorel, Que.

Students Admitted

Brown, Roger Scott (Nova Scotia Tech. Coll.), 109 LeMarchant St., Halifax, N.S.

Hall, David Bruce (Univ. of Man.), Cupar, Sask.

Ives, Walter Jesse (Univ. of Man.), Glenboro, Man.

Lareau, Fernand (McGill Univ.), 5223 Lasalle Blvd., Verdun, Que.

MacKenzie, James MacRae (Univ. of N.B.), 2219 Osler St., Regina, Sask.

MacLeod, Frederick James Gordon, Constructor Sub-Lieut., R.C.N.V.R. (McGill Univ.), 6178 Durocher Ave., Outremont, Que.

Major, Roger E., L.A.C., R.C.A.F., Moncton, N.B.

Malkin, Louis (Mt. Allison Univ.), P.O. Box 255, Sackville, N.B.

Maughan, Ronald George (Univ. of Toronto), 481 Summerhill Ave., Toronto, Ont.

Ryan, Bernard Kimble, Prob. Sub-Lieut. (E) R.C.N.V.R. (N.S. Tech. Coll.), 74 Oxford St., Sydney, N.S.

Tovell, Joseph Allister (Univ. of Toronto), 134 Dublin St., Guelph, Ont.

Students at Ecole Polytechnique

Benoit, Louis H. Marc, 3166 Lacombe Ave., Montreal, Que.

Chevalier, Jean-Paul, 4568 De Lanaudiere St., Montreal, Que.

Langevin, Jean, 1216 Sanguinet St., Montreal, Que.

Laurin, Leopold, 2710 Reading St., Montreal, Que.

Lemay, Romuald, Ecole Polytechnique, 1430 St. Denis St., Montreal, Que.

Sicotte, Guy, 1006 Van Horne Ave., Montreal, Que.

Students at Queen's University

Abraham, Earl Michael, 393 Johnson Street, Kingston, Ont.

Beaudry, Roger J., 218 Bank Street, Ottawa, Ont.

Beckett, William Douglas, Queen's University, Kingston, Ont.

Brown, James Alexander, 372 Arthur Street, Port Arthur, Ont.

Fee, J. Kenneth, 61 Park Avenue, Ottawa, Ont.

Halme, Sulo E., 255 Queen Street, Kingston, Ont.

Meredith, William Ralph, 99 Nelson Street, Kingston, Ont.

Students at St. Francis Xavier University

Finn, John Richard, 1225 Bernard Avenue, Montreal, Que.

Frigon, Elie Roger, 2495 Park Row East, Montreal, Que.

Rossiter, Vincent, P., 150 Patrick Street, St. John's Newfoundland.

Zink, Joseph William, 241 Weldon Street, Moncton, N.B.

By virtue of the co-operative agreements between the Institute and the provincial associations of professional engineers, the following elections and transfers have become effective:

ALBERTA

Member

Furnival, George Mitchell, B.Sc. (Univ. of Man.), M.A. (Geol.), (Queen's Univ.), Ph.D. (Mass. Inst. Tech.), district geologist, Dominion Oil Co. Ltd. Calgary, Alta.

NOVA SCOTIA

Members

Acres, Harold Didsbury, B.Sc. (Mech.), (Queen's Univ.), asst. chief engr., Clare Shipbuilding Co. Ltd., Meteghan River, N.S.

Barry, Donald Ballantyne (McGill Univ.), Lieut. (E), R.C.N.-V.R., Cornwallis, N.S.

Ripley, Herbert Angus, B.Sc. (Civil), (Univ. of Alta.), Engineering Service Co. Ltd., 14 Prince Street, Halifax, N. S.

Personals

Relatives and friends of members in the active forces are invited to inform the Institute of news items, such as locations, promotions, transfers, etc., which would be of interest to other members of the Institute and which should be entered on the member's personal record kept at Headquarters. These would form a basis of personal items in the *Journal*.

Lieutenant-General A. G. L. McNaughton, C.B., C.M.G., D.S.O., M.E.I.C., was elected an honorary member of the Royal Society of Canada at their annual meeting held last month in Montreal.

K. M. Cameron, M.E.I.C., immediate past-president of the Institute and chief engineer of the Department of Public Works of Canada, received the honorary degree of Doctor of Science at the McGill Convocation last month. Dr. Cameron had also received the degree of Doctor of Science from Laval University, Quebec, during the annual meeting of the Institute last February.

At the McGill Convocation. Front row, *from left to right:* Principal F. Cyril James, Dr. E. A. Graham, Rt. Hon. Thibaudeau Rinfret, G. F. Towers, K. M. Cameron, and Chancellor Morris W. Wilson.

O. Holden, M.E.I.C., chief hydraulic engineer of the Hydro-Electric Power Commission of Ontario was made an Honorary Doctor of Engineering from the University of Toronto at the Convocation held early this month.

Dean C. R. Young, M.E.I.C., of the Faculty of Applied Science and Engineering, University of Toronto, has been appointed a member of the Board of Governors of the Ontario Research Foundation.

News of the Personal Activities of members of the Institute

E. R. Jacobsen, M.E.I.C., was appointed last February to the post of acting director general of the Commonwealth of Australia War Supplies Procurement. At that time the director general left for an extended visit to Australia from which he returned to Washington in May. Since then, Mr. Jacobsen has continued in active direction of the organization under the title of assistant director general. The Australian War Supplies Procurement is the agency for the purchase of supplies from North America, both military and civilian, for the Australian area.

Professor E. A. Allcut, M.E.I.C., has been appointed head of the department of mechanical engineering in the Faculty of Applied Science and Engineering of the University of Toronto, succeeding Professor R. W. Angus, HON.M.E.I.C., who has just retired.

Graduating from the University of Birmingham and later winning a master of engineering degree from the University of Toronto, Professor Allcut had 11 years engineering experience in England before his appointment to the university staff in 1921, as associate professor of mechanical engineering. He has been professor of mechanical engineering since 1931. Professor Allcut was awarded the Herbert Akroyd Stuart prize of the Institution of Mechanical Engineers, Great Britain, in 1930 and, in 1942, he received the Plummer Medal of The Engineering Institute of Canada.

E. D. Gray-Donald, M.E.I.C., chief engineer of the Quebec Power Company, is the newly elected chairman of the Quebec Branch of the Institute. A graduate of McGill University in electrical engineering in the class of 1926, he is also a master of science of Laval University, Quebec. Upon graduation from McGill he joined the staff of Shawinigan Water and Power Company, later transferring to the Quebec Power Company. He has held successively the positions of superintendent of the power division, assistant general superintendent of the company and general superintendent of the company. In 1942 he was elected councillor of the Institute to represent the Quebec Branch.

O. Holden, M.E.I.C.

Professor E. A. Allcut, M.E.I.C.

E. D. Gray-Donald, M.E.I.C.

Gustave St. Jacques, M.E.I.C.

M. F. Cossitt, M.E.I.C.

S. Gordon Naish, M.E.I.C.

Gustave St-Jacques, M.E.I.C., was recently elected secretary-treasurer of the Quebec Branch of the Institute, succeeding Paul Vincent. A graduate of the Ecole Polytechnique in the class of 1936, Mr. St-Jacques joined the Public Service Board of the Province of Quebec as an engineer at Quebec in 1938, after having spent two years in the pulp and paper industry.

J. L. E. Price, M.E.I.C., president and general manager of J. L. E. Price and Company Limited, Montreal, has been appointed president of the National House Builders Association.

Lt.-Col. W. F. Hadley, E.D., M.E.I.C., has been recently elected to the board of directors of Canadian Breweries Limited. He is also a director of International Hydro Electric System, Gatineau Power Company, and president and director of Ottawa Forum Limited.

B. K. Boulton, M.E.I.C., has resigned as general superintendent of the Beauharnois Power Company and has taken a position as engineer with the Department of Munitions and Supply.

C. G. Kingsmill, M.E.I.C., has been appointed general superintendent of the Beauharnois Light, Heat and Power Company, Beauharnois, Que., succeeding B. K. Boulton, M.E.I.C.

H. F. Abbott, M.E.I.C., has been appointed assistant plant superintendent of the Beauharnois Light, Heat and Power Company, Beauharnois, Que.

C. H. Pigot, M.E.I.C., is the new resident engineer of Beauharnois Light, Heat and Power Company, Beauharnois, Que.

A. M. Bain, M.E.I.C., has been appointed assistant director, Tank Design Branch, Department of Munitions and Supply at Longue Pointe, Que. He was formerly acting as a technical assistant to Professor R. E. Jamieson, M.E.I.C., director general of the Army Engineering Design Branch.

Bruno Grandmont, M.E.I.C., formerly district engineer, Department of Public Works of Canada, at Rimouski, Que., has been transferred to Quebec, where he holds the same position.

W. A. James, M.E.I.C., formerly with Tuckett Tobacco Company, Hamilton, Ont., is now with the Imperial Tobacco Company of Canada, Limited, Montreal.

James P. Rubush, M.E.I.C., has recently been appointed vice-president in charge of sales with The Goslin-Birmingham Mfg. Co., Inc., New York, N.Y. Mr. Rubush was formerly general manager, Douthitt Gray Johnson, Division of Whiting Corporation, Chicago, Ill.

M. F. Cossitt, M.E.I.C., is the newly elected chairman of the Cape Breton Branch of the Institute. He is city engineer of Sydney, having taken over that position in 1936. Previously he had had considerable experience in the field of engineering, having been with Bowaters Paper Company in Cornerbrook, Newfoundland; resident engineer in charge of construction of storage and shipping plant for Atlantic Gypsum Products at Cheticamp, N.S.; resident engineer on concrete paving work at North Sydney, N.S., and New Waterford, N.S., and also in charge of construction, storage and shipping plant for Atlantic Gypsum Products Co. at Dingwall, N.S.

S. Gordon Naish, M.E.I.C., is the new secretary-treasurer of the Cape Breton Branch of the Institute, succeeding S. C. Mifflen, Mr. Naish is the eastern district manager for Peacock Brothers Limited, having held that position since 1931. He is a graduate of Durham University, England.

C. D. McAllister, M.E.I.C., is the newly elected chairman of the Saint John Branch of the Institute. He is employed with the Department Public Works of Canada at Saint John, N.B.

F. L. Lawton, M.E.I.C., assistant chief engineer, Aluminum Company of Canada, Limited, Montreal, was recently elected chairman of the Montreal Section of the American Institute of Electrical Engineers, at their annual meeting.

Flight Lieutenant C. M. Brant, M.E.I.C., who was stationed at Bermuda with the R.A.F. Atlantic Transport Group, as Signals Officer, has been transferred to the Montreal Airport, Dorval, P.Q.

George H. Pringle, M.E.I.C., who has been with the Mead Pulp and Paper Company, Chillocothe, Ohio, since 1927, has recently been promoted to division engineer, in charge of engineering, steam and power.

William A. Hillman, M.E.I.C., who was formerly with the Foundation Company of Canada on the Shipshaw power project, is now employed by H. G. Acres Company as resident engineer on mill changes for Fraser Companies Ltd., Edmundston, N.B.

H. A. Cooch, M.E.I.C., is now vice-president and manager of sales of Canadian Westinghouse Limited, Hamilton, Ont. Mr. Cooch has been with the firm since 1912, with the exception of 3½ years when he was serving overseas in the last World War.

Lieutenant J. C. Watson, Jr.E.I.C.

Lieutenant (E) J. Crittenden Watson, R.C.N.V.R., Jr.E.I.C., is among the persons reported missing, as a result of the sinking of the frigate *H.M.C.S. Valleyfield* in the North Atlantic last month. Lieutenant Watson was a passenger on the frigate and was believed to be returning to Canada on leave after having been stationed recently in Northern Ireland. A graduate in science from Acadia University, Wolfville, N.S., in 1938, he graduated in mechanical engineering from McGill University in 1940 and then joined the Combustion Engineering Corporation, Limited, at Montreal, as service engineer. He joined the Navy in December, 1942, and after a short term of sea duty he qualified for his commission and studied at *H.M.C.S. Kings* at Halifax. Upon receiving his commission he was appointed instructor at Halifax and last January was posted to sea.

Jules Joyal, M.E.I.C., formerly on the staff of Consolidated Paper Corporation Limited, Grand'Mère, Que., is now employed with Price Brothers & Company, Limited, Chicoutimi, Que.

N. S. Braden, M.E.I.C., has retired from active duties as vice-chairman of the Board of Canadian Westinghouse Limited, Hamilton, Ont., although he will remain on the Board of Directors. Mr. Braden has been with the company since 1899.

Jean Lacombe, M.E.I.C., who was formerly on the staff of the Quebec North Shore Paper Company at Baie Comeau, Que., has now joined the staff of the Barrett Company as plant engineer at Joliette, Que. He is a graduate of McGill University in the class of 1937.

P. M. Sauder, M.E.I.C., formerly director of water resources for Alberta, at Edmonton, has been appointed general manager, Western Irrigation District, Strathmore, Alta., an organization recently created by an Act of the Legislature of Alberta. Mr. Sauder will also be employed part time by the Alberta Government as a member of the newly created Alberta Power Commission. He is also official trustee and colonization manager of the Lethbridge Northern Irrigation District.

Vernon Pearson, M.E.I.C., superintendent of the mechanical branch of the Department of Public Works, is a member of the newly created Alberta Power Commission.

B. Russell, M.E.I.C., senior consulting engineer of the P.F.R.A. at Regina, Alta., took over, early this month, his new duties as director of water resources, at Edmonton, Alta., succeeding P. M. Sauder, M.E.I.C.

P. C. Perry, M.E.I.C., formerly division engineer with the Canadian National Railways at Port Arthur, Ont., is now district engineer at Saskatoon, Sask.

Joseph V. McKenna, Jr.E.I.C., is now employed with the Canadian Blower & Forge Company, Kitchener, Ont. He was formerly with John T. Hepburn Company Limited, Toronto.

Leslie Wiebe, Jr.E.I.C., formerly with the Neon Products of Western Canada Limited, is now employed with Canadian Vickers Limited (Aircraft Division), Cartierville, Que.

Flying Officer R. L. Blackett, Jr.E.I.C., has been recently promoted from the rank of Pilot Officer in the R.C.A.F. He is now stationed at No. 10 B. and G. School, Mount Pleasant, P.E.I.

René Leduc, Jr.E.I.C., is now engineer with the Luceville Lumber Company, at Luceville, Que. He was recently invalided out of the army after having served for the past two years. Previously, he was with Consolidated Paper Corporation, at Montreal.

D. F. Lillie, S.E.I.C., who is one of this year's graduates in metallurgical engineering from Queen's University, is now employed with Aldermac Copper Corporation, Sherbrooke, Que.

W. H. Stevenson, S.E.I.C., who is one of this year's graduates in chemical engineering from Queen's University, has taken a position as assistant chemical engineer at Dunlop Tire Company Ltd., Toronto, Ont.

W. B. Scott, S.E.I.C., is employed in the engineering department of the Cornwall Division of Howard Smith Paper Mills, Ltd. He graduated in civil engineering from McGill University last month.

James Lundie, M.E.I.C., of the Canadian Pacific Railway Company, has been transferred recently from Regina, Sask., to Schreiber, Ont., as division engineer.

Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

William Bell Dawson, M.E.I.C., founder and, for 30 years, head of the Dominion Tides and Currents Survey, died at his home in Westmount, Que., on May 21, 1944.

Born at Pictou, N.S., on May 2, 1854, Dr. Dawson was the son of Sir William Dawson, principal of McGill University from 1855 to 1893. He received his early education at the Montreal High School, of which he was the oldest living graduate at the time of his death, and at McGill University, where he graduated in 1873 as B.A., winning the gold medal in geology and natural science. Two years later he graduated in engineering as Bachelor of Applied Science. He then entered the Ecole des Ponts et Chaussées, the Paris school for French Government engineers, to which foreign students were admitted after examination. There he took the three year course comprising all branches of civil engineering and graduated in 1890 with the diploma of special merit.

After private practice in Montreal he was with the Dominion Bridge Company as engineer from 1882 to 1884. From 1884 to 1893 he was assistant engineer for the Canadian Pacific Railway, engaged chiefly in bridge designing.

In 1894, his main career began inaugurating and carrying on the survey of tides and currents on both the Atlantic and Pacific coasts for the Dominion Government, on which he was engaged for 30 years.

As superintendent of the Dominion Tidal and Current Survey of Canada his surveys were instrumental in overthrowing many fallacies concerning the safety of navigation of the Gulf of St. Lawrence, the Strait of Belle Isle and the Bay of Fundy. Rival shipping centres in the early days of Canada's growing overseas trade made use of erroneous reports about the dangerous currents alleged to exist for the purpose of diverting business to older and better charted shipping routes.

When Dr. Dawson entered upon his task, Canada lacked dependable or scientific information about tidal action around the Dominion's shores and bays. The only tidal table in existence at that time was for Quebec harbour and that was said to be inaccurate and of questionable value to shipping interests.

It was in 1894 that Dr. Dawson, with a group of assistants, entered upon the task. At the beginning a lightship was commissioned for the purpose. Later a Government steamer named the *Gulnare* was employed in the survey work.

One of the theories current in marine circles in the early days of Canada's transatlantic traffic was that the Strait of Belle Isle, the passage of which was regarded as a perilous undertaking, had a one-way current. There had been many wrecks in those days principally as the result of going aground on Anticosti. The fact that these vessels were known to be on the correct course appeared to bear out the belief in the one-way current. As a result of Dr. Dawson's work the Belle Isle theory was disproved, it being found that the water in the strait was tidal as elsewhere.

Another branch of the work carried out by the survey was to calculate the tide levels at the various ports of Canada. The result is that the work commenced by Dr. Dawson has given marine circles authentic data. Dr. Dawson retired from the Government service in 1924.

During his career Dr. Dawson won the Watt Gold Medal of the Institution of Civil Engineers, London, Eng., of which he was a member, and two prizes for research in tide levels and currents from the Academy of Sciences, Paris. He was made a laureate of the latter body and a Fellow of the Royal Society of Canada.

In 1923, the Academy of Sciences, Paris, announced the award of the Becquerel award to Dr. Dawson for his tidal and current survey work and for his publications in that line of investigation. The award was given by the Henri Becquerel Foundation whose name was associated with the discovery of the Becquerel rays, and that given to Dr. Dawson was the largest of three awards given by the Academy under the head of scientific research.

This was the second time that Dr. Dawson had received a prize from the Academy of Sciences; the former being in 1904 when the Gay prize was offered in competition for the best determinations of mean sea level of the North Atlantic, he being the successful competitor.

Dr. Dawson was one of the, if not the oldest living members of The Engineering Institute of Canada, having joined in the first group on February 24, 1887. In 1923 he was made a Life Member.

Russel Sutherland Smart, K.C., M.E.I.C., died in the hospital at Ottawa on May 22, 1944. Born at Winnipeg, Man., on June 20, 1885, he received his education at the University of Toronto, where he graduated in engineering in 1904 receiving the degree of mechanical engineering in 1913. In the meantime he had taken a B.A. degree from Queen's University.

Upon graduating in engineering from the University of Toronto, he joined the office of Fetherstonhaugh Company, patent solicitors, engineers, and draughtsmen, at Ottawa.

He soon became an expert in the field of patent soliciting and trade mark law and became a partner in the firm. In 1927 he established the firm of Smart and Biggar, barristers, Ottawa, having qualified for admission to the bar in Ontario, Quebec, Alberta and New York State.

Unique in his field of law, Mr. Smart's services were sought by leading men throughout the world. Litigation was carried on by him to such an extent, that before the war it was not unusual for him to make several trips to England in a year to appear before the British Privy Council.

He was the author of several books which held authority in his special branch of the law.

In September 1942, Mr. Smart was appointed Real Property Administrator in the Wartime Prices and Trade Board and had since served without remuneration in such capacity.

Mr. Smart joined the Institute as Associate in 1908, transferring to Associate Member in 1911 and to Member in 1921.

John James Freeland, M.E.I.C., died at Temiskaming, Que., on February 20, 1944. Born at Montreal on October 21, 1891, he studied at Loyola College, Montreal, and later at McGill University, where he graduated in civil engineering in 1915. Upon graduation he joined the Peck Rolling Mills at Montreal and, until June 1918, he was employed as a draughtsman and clerk on production of rolled steel, and then until the end of 1918 he was in training with the Royal Air Force in Toronto. In 1919 Mr. Freeland joined the Kipawa Company, Limited, at Temiskaming, Que., thus engaging in the pulp and paper industry in which most of his career was to be spent.

He was successively employed as follows: 1919-1920, Fraser Companies Limited, Edmundston, N.B.; 1920-1923, Newton Falls Paper Company, Newton, N.Y.; 1923, McRitchie & Black, contractors, Montreal; and later in the same year Canadian Mead Morrison Company, Montreal; 1923 to December 1924, Canadian Vickers Ltd., Montreal; 1925, Peck Rolling Mills, Montreal; McIntyre Construction Company, Ltd., Montreal; Dominion Bridge Company, Montreal; 1926, St. Maurice Valley Corporation, Shawinigan Falls, Que; 1927-1930 Lake St. John Power and Paper Company; 1930-1932 E. B. Eddy Company Ltd., Hull, Que., and since 1935 he had been with Canadian International Paper Company Ltd., at Temiskaming, Que.

Mr. Freeland joined the Institute as an Associate Member in 1927, becoming a Member in 1940.

COMING MEETINGS

Canadian Electrical Association—Fifty-Fourth Annual Meeting, Manoir Richelieu, Murray Bay, Que., June 22-23. Secretary: B. C. Fairchild, Tramways Building, Montreal.

American Society for Testing Materials—Annual Meeting, Waldorf Astoria Hotel, New York, N.Y., June 26-30. Secretary: C. L. Warwick, 260 South Broad St., Philadelphia, Pa.

Mining Society of Nova Scotia—Fifty-Seventh Annual Meeting, Cornwallis Inn, Kentville, N.S., July 6-7, Secretary: Sydney C. Mifflen, Bank of Commerce Building, Sydney, N.S.

News of the Branches

Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

BORDER CITIES BRANCH

W. R. Stickney, m.e.i.c. - *Secretary-Treasurer*
G. W. Lusby, m.e.i.c. - *Branch News Editor*

The regular monthly dinner meeting of the Border Cities Branch was held in the Prince Edward Hotel on March 17, 1944. Thirty-six members and guests attended the dinner and 26 members and guests came to the meeting afterwards.

The guest speaker of the evening was E. L. Durkee, resident engineer for the Bethlehem Steel Company, who described the erection of the **Rainbow bridge** spanning the Niagara river at Niagara Falls, replacing the old Honeymoon bridge.

This bridge is the world's longest fixed arch having a span of 950 ft. and a rise of 150 ft. at the centre, carries two 22 ft. roadways separated by a 4 ft. mall, and a 10 ft. sidewalk on the side next to the falls. The bridge was built by a Joint Commission of Canadian and American members and the general contract for the main arch span was let to the Bethlehem Steel Company. The columns and floor steel were sublet for fabrication to the Canadian Bridge Company of Walkerville and the Hamilton Bridge Company of Hamilton, Ont.

Mr. Durkee first showed slides describing the schemes and calculations worked out for the erection of the arch ribs. Erection was carried out from each side of the river simultaneously as follows:

The ribs were first cantilevered out from the abutments for a short distance, then were supported by cables anchored by concrete blocks some distance back from the edge of the gorge and carried over a temporary tower-bent erected above and behind the abutment. As the erection of the ribs and bracing proceeded outward, these supporting cables were lengthened outward with the ends of the ribs until the arch girders and bracing were joined together at the centre of the span.

The roadway columns and roadway steel were then erected, progressing from each bank to the centre, and the concrete roadway and sidewalk finally completed. No lives were lost and there were no serious accidents during the entire construction.

A complete moving picture of the erection was shown and commented on by Mr. Durkee.

* * *

The April meeting was held at the Prince Edward Hotel on the 14th, with J. B. Dowler, chairman of the Branch, presiding.

The guest speaker of the evening was J. R. Montague, m.e.i.c., assistant hydraulic engineer for the Hydro-electric Power Commission of Ontario, who spoke on **The Ogoki Diversion.** The paper appears in this issue of the Journal.

Mr. Montague showed a number of slides, many of them coloured, illustrating various interesting features of this undertaking. A coloured sound film was also shown, describing the highlights of construction of the control dam, Jackfish channel and Cameron Falls powerhouse.

EDMONTON BRANCH

G. H. Milligan, affil.e.i.c. - *Secretary-Treasurer*

The annual general meeting of the Edmonton Branch of the Institute was held in the Jasper room of the Macdonald Hotel on Tuesday evening, May 9th. It was preceded as usual by a dinner at which 36 members and friends sat down.

In the absence, through illness, of the chairman, C. W. Carry, E. Nelson presided over the first half of the proceedings. After the minutes of the preceding meeting had been read and adopted, he called up the chairmen of the various committees to give their reports.

After the business part of the meeting, the newly elected chairman, B. W. Pitfield, took the chair and introduced the speaker of the evening, Mr. J. Moar, head of the planning and production department of Aircraft Repair Limited, mentioning that he was now on his way to his second million (miles in the air).

In his address Mr. Moar pointed out that the airplane was a creature of compromise. One quality such as speed could be obtained at the expense of another such as economy and all are subject to financial considerations. Whittle patented his jet propulsion in 1930 but could not get finances.

Some other form of aircraft may displace the present type, perhaps a combination of helicopter airplane with propeller and jet propulsion. He corrected the popular impression that the helicopter would be an easy plane to handle. It requires a very skilled pilot to land one in a confined space with even a moderate wind blowing.

He foresaw a future for the blimp in post-war, freighting off the established northern routes.

For airplanes, he advocated an extensive system of landing strips as pontoons for water landing craft are very expensive to maintain.

HALIFAX BRANCH

S. W. Gray, m.e.i.c. - - *Secretary-Treasurer*
C. D. Martin, m.e.i.c. - *Branch News Editor*

The regular monthly dinner meeting of the Halifax Branch was held at the Nova Scotian Hotel on Friday, April 21st.

At this meeting, under the chairmanship of G. J. Currie, the Branch was host to the presidential party.

The presidential party included deGaspé Beaubien, President of the Institute, G. L. Dickson, Maritime vice-president, Dr. L. Austin Wright, general secretary, and R. E. Heartz, councillor, Montreal Branch.

The special guests included Premier A. S. MacMillan, Air Vice-Marshal G. O. Johnson, Rear Admiral L. W. Murray, Commander D. W. Piers, and Mayor J. E. Lloyd.

After an introduction by Chairman G. J. Currie, and a few words of welcome from Premier MacMillan and Mayor Lloyd, deGaspé Beaubien addressed the meeting. Just to make sure that Mr. Beaubien would feel at home, the McGill graduates present gave the McGill yell.

In his address, the president placed emphasis on the part played by engineers in industrial relations, and also quoted examples of the amazing reduction of man hours in general manufacturing. Mr. Beaubien then spoke on Institute affairs, and also stated that the engineers controlled the best talent in Canada.

The president was given a hearty vote of thanks by C. G. Wright.

Dr. L. Austin Wright then addressed the meeting and mentioned the good wishes extended to the Halifax Branch by R. J. Durley and Louis Trudel. Dr. Wright's

PRESIDENT BEAUBIEN VISITS THE HALIFAX BRANCH

The president was invited to participate in a meeting of Council of the Professional Association. *From left to right:* S. W. Gray, registrar of the Association and secretary-treasurer of the Halifax Branch of the Institute; J. H. M. Jones, president of the Association; and Mr. Beaubien.

Head table at dinner of the Halifax Branch: J. H. M. Jones, Commander A. F. Peers, Mayor J. Lloyd, President Beaubien, Chairman G. J. Currie, Premier A. S. MacMillan, Air Vice-Marshal G. O. Johnson.

Monday evening, the president was host to local officers and their wives. *In front:* K. L. Dawson, Mrs. J. R. Kaye, Councillor Chas. Scrymgeour, Mrs. G. J. Currie, S. W. Gray. *Standing at the back:* Vice-President G. L. Dickson.

R. L. Norman, Chas. Scrymgeour, William Hunt, G. G. Dunbar and H. C. Loring.

A group of students from Nova Scotia Tech at the dinner. Third from left in front is J. P. Vaughan, recipient of the Institute prize.

The presidential party visited Acadia University at Wolfville. *Left to right:* Vice-President G. L. Dickson, Chairman G. J. Currie, Mrs. Currie, Sqn. Ldr. R. T. Steeves, dean of applied science at Acadia; Miss M. McLaren, President Beaubien, Mrs. S. W. Gray, R. E. Heartz, S. W. Gray, and B. N. Cain of the engineering department at Acadia.

Denis Stairs, G. A. Gaherty, J. B. Hayes and J. J. Sears.

address covered the various aspects of membership, finances, and the work of the committees of the Institute. In closing, Dr. Wright put before the meeting the present position of engineers with respect to the recent Order-in-Council PC-1003.

At this meeting Mr. Beaubien presented the Institute prize of $25.00 to Joseph P. F. Vaughan of the Nova Scotia Technical College.

The attendance at the meeting was about 150.

Excellent music for this occasion was supplied by a trio headed by Nick Schoester.

HAMILTON BRANCH

W. E. Brown, M.E.I.C. - *Secretary-Treasurer*
L. C. Sentance, M.E.I.C. - *Branch News Editor*

On Thursday, May 11, 1944, McMaster University was the scene of the regular monthly meeting of the Hamilton Branch of the Institute; 120 members and guests were in attendance.

H. A. Cooch, branch chairman, opened the meeting with a reference to the recently held "Student's Night" Papers Competition, and introduced E. G. Wyckoff, spokesman for the Judges' Committee. Mr. Wyckoff outlined to the audience the conditions of the competition and reminded the contestants that their papers were now eligible for entry in the John Galbraith Prize competition of the Institute.

In announcing the judges' decision, Mr. Wyckoff complimented the contestants on their efforts, awarding first prize to J. C. Buchanan, S.E.I.C., for his paper **The Economical Use of Power Hack Saw Blades.**

Second prize went to K. R. Knights, S.E.I.C., for his paper on **Electronics as Applied to Spot Welding.**

Mr. Cooch introduced the speaker of the evening, McNeely DuBose, vice-president of The Aluminum Company of Canada, Ltd., who had chosen for his topic **The Engineering History of Shipshaw.**

Mr. DuBose spoke at some length, and presented to his audience a wealth of highly interesting facts concerning the huge power development of the Aluminum Company of Canada. Such data were well illustrated by means of slides, and a short film depicting the falling of the concrete obelisk built to dam the Saguenay river, during construction of the Chute-à-Caron plant. Mr. DuBose's paper appeared in the April issue of the *Journal.*

At the conclusion of his talk, Mr. DuBose answered numerous questions posed by a highly appreciative audience, many of whom had participated in the design and manufacture of much of the electrical equipment now in operation in the Shipshaw plant.

Upon adjournment, refreshments were served.

KINGSTON BRANCH

J. D. Lee, Jr.E.I.C. - *Secretary-Treasurer*
C. E. Craig, S.E.I.C. - *Branch News Editor*

The annual meeting of the Kingston Branch of the Institute was held in Convocation Hall, Queen's University, on the evening of April 25. The programme consisted of the films, "Tested by Underwriters Laboratories," "The Failure of the Tacoma Narrows Bridge," and "Wings over the North."

The films were followed by the election of officers for the coming year. The list appears on page 337.

It was agreed to invite Kingston members of other professional societies to attend future meetings of the branch.

MONTREAL BRANCH

L. A. Duchastel, M.E.I.C - *Secretary-Treasurer*
H. H. Schwartz, Jr.E.I.C. - *Branch News Editor*

On Thursday, March 30th, Dr. Augustin Frigon, assistant general manager of the Canadian Broadcasting Corporation, spoke to the Montreal Branch on **Network Radio.** He outlined the development of radio broadcasting in Canada, and some of its future possibilities.

At present there are 89 broadcast stations in Canada, of which 10 belong to the CBC. Of these, four are of high power, 50 kilowatts. These are located at Waterford, Toronto, Montreal and Sackville. Through the network operation of private and public stations it has now become possible for the CBC to reach over 96 per cent of the homes with radios.

The most serious problem in Canada is the time zone. Canada is blessed with five zones. Thus, if a symphony orchestra plays in Vancouver at 8.00 p.m., the music will be heard in the east at 1.00 a.m. of the next day, an hour which is too late for the east. This difficulty has been met by rebroadcasts. For some programmes, such as a speech by Churchill, a rebroadcast loses some of the feeling of spontaneity.

Another point against rebroadcasting is the cost. At present the musician's union has a strict regulation concerning rebroadcasting. Since rebroadcasting necessarily means recording, the musicians demand payment of at least $30.00 per musician per recording. This added cost effectively bars the rebroadcasting of much music.

The Havana agreements which regulate radio broadcasting on the American continent are scheduled to go into effect on April 1st 1946. For Canada to fulfill her obligations, it will be necessary to construct an additional six stations, each of 50 kilowatts capacity, one station of 10 kilowatts, and one station of one kilowatt. These are minimum requirements. The maximum number of stations permitted by the agreements varies with the power ratings, but an additional 18 high-power stations which would give Canada a total of 22 stations was granted.

At the close of the talk, two short films were shown, one on the work of the CBC technical staff, and overseas engineering broadcasting unit; the other on the operation of frequency modulation.

Professor Christie was chairman of the meeting.

On April 5th, Col. W. R. McCaffrey spoke on **Canadian Engineering Standards Association.** Although at the start of the war there were some doubts as to whether the work of the organization should continue, these doubts were rapidly dispelled. It was soon found that the answer to the pressing needs for more and ever more materials of war was a thoroughgoing simplification and standardization of materials. In order to do this effectively, the C.E.S.A. was called in, and was able to provide a good deal of help.

In the post-war era, there is every indication that the work of the C.E.S.A. will be expanded greatly, to include not only engineering specifications, but also a good deal of non-technical matters. This will be of the utmost importance for international trade.

Following Col. McCaffrey's talk, W. J. Cale spoke on the development and operation of the Approvals Division of the C.E.S.A., and the Labelling Service. Mr. Cale illustrated his talk with an extensive series of slides, showing the building and equipment of the Division.

R. M. Coke was chairman of the meeting.

THE PRESIDENT AT MONCTON

Above: J. A. Blanchard, President Beaubien, Vice-President G. L. Dickson and Branch Vice-Chairman A. S. Donald.

Below: Branch Chairman J. A. Godfrey, Councillor R. E. Heartz, Sqn. Ldr. J. Gilchrist, Secretary-Treasurer V. C. Blackett and B. E. Bayne.

President Beaubien spoke to the students of Mount Allison University at Sackville.

On Thursday, April 13th, F. Nagler of the Allis-Chalmers Mfg. Co. of Milwaukee, spoke on **New Materials of Engineering with Special Reference to Gas Turbines.** Today, the rapid expansion of motive power generators necessitated by the war has brought with it a broader understanding of the properties of materials. One of the greatest drawbacks to the successful operation of gas turbines has been the requirements for a strong material capable of withstanding large forces at exceedingly high temperatures. However, it has now been proved feasible to construct large turbines which operate economically. The chief use for such turbines is in locations where there is a lack of water for cooling purposes. Another possible application is in ships, where the weight of the gas turbine is not a deterrent.

H. J. Roast was chairman of the meeting.

On Thursday, April 20th, H. R. Sills spoke on the **Design of Large AC Generators with Specific Reference to Accessibility for Inspection and Repair.**

E. V. Leipoldt was chairman of the meeting.

On Thursday, April 27th, A. E. Davison of the Hydro-Electric Power Commission of Ontario led a discussion on **Meteorological Services for Utility Systems.** A number of speakers from the local utility systems took part. It was the consensus of opinion that a reliable weather forecast, as far in advance as possible would be of very great value to the operating companies. For example, it would allow the maintenance crews to prepare their materials well in advance of an expected storm. Again, it would allow operating and dispatching engineers to control the level of the water in the dam, much closer than is feasible at present.

H. A. Downs, associate meteorologist of the U.S. Weather Bureau, discussed some of the information that is sent out daily to the U.S. utilities, and the arrangements made for handling the data.

W. R. Way was chairman of the meeting.

MONCTON BRANCH

V. C. Blackett, m.e.i.c. - *Secretary-Treasurer*

Technicolour films showing the construction of a four-lane super highway between Montreal and New York State, were shown at a branch meeting held on March 28th. The film emphasized the work done by machinery and the comparatively small amount of manual labour required. A vote of thanks to Major A. S. Donald, who procured the films, was moved by H. J. Crudge and seconded by J. B. Walcot.

After the screening of the pictures, the presiding chairman, J. A. Godfrey, extended the congratulations of the branch to G. L. Dickson on his election as regional vice-president for the Maritime Provinces. In his reply, Mr. Dickson reported on the annual meeting of the Institute recently held in Quebec. He was followed by E. B. Martin, the newly elected branch councillor who had also attended the meeting.

* * *

On April 17th, the branch received an official visit from the president of the Institute, Mr. deGaspé Beaubien, and the General Secretary, Dr. L. Austin Wright. Mr. R. E. Heartz, councillor for the Montreal Branch, also accompanied the president. During the afternoon, the visitors were taken to magnetic hill where they witnessed the phenomenon of the apparent suspension of the law of gravity. Later, on their return to the city, the arrival of the tidal bore of the Petitcodiac river was observed. In the evening, the presidential party were guests at a dinner meeting of the branch. J. A. Godfrey, the branch chairman presided and introduced the speakers. The first to be called upon was Dr. Wright who was heard with keen interest as he told of negotiations with the Federal Government in connection with compulsory collective bargaining. The address of the president was of an inspirational nature and warned engineers against any slackening of effort as Canada approaches the period of post-war competition. Vice-President Dickson spoke in appreciation of Mr. Beaubien. Brief remarks were made by R. E. Heartz, E. B. Martin, A. S. Donald and H. J. Crudge.

A highlight of the meeting was a musical interlude during which several soli were sung by Sgt. Ross Smith, R.C.A.F.

OTTAWA BRANCH

A. A. Swinnerton, m.e.i.c. - *Secretary-Treasurer*
R. C. Purser, m.e.i.c. - - *Branch News Editor*

At the joint evening meeting at the Victoria Memorial Museum on April 17 of the Ottawa Branch of the Institute and the Ottawa group of the Montreal Chapter of the Illuminating Engineering Society, an address **The Engineer Looks Ahead** was given by Morris J. McHenry. Mr. McHenry is a member of two special committees of the Institute and also a past vice-president for Canada of the A.I.E.E., besides being director of sales promotion and chief priorities officer for the Hydroelectric Power Commission of Ontario. Presiding jointly at the meeting were W. L. Saunders, m.e.i.c., and E. W. Moodie, a.m.i.e.s. Also present on the platform was Léon Beauchamp, of Montreal, Canadian regional vice-president for Canada of the Illuminating Engineering Society, who spoke briefly. Mr. McHenry's address was followed by a short period of discussion after which motion pictures of the Ogoki river diversion in northwestern Ontario were shown.

After commenting upon the part that the engineer has already played in the present war, Mr. McHenry remarked that there seemed to be no ground for anxiety in respect to technical employment in the post-war period. "Our natural resources have not been seriously impaired by the demand of war," he said, "and these together with excess of available power will provide the means whereby to meet the built-up consumer demand, plus new demands to be created by new products."

Conversion to industry would seem to be much more based upon new products than upon old, he thought. Citing the case of plastics as an example, he stated that "some authorities have already expressed the view that this group of materials will reduce the ferrous metals to a position of secondary importance, and that the age of iron and steel will be supplanted by an age of plastics and light metals."

Other trends cited as post-war possibilities include the complete overhauling of our transportation systems, re-equipment of buildings, improvements in the science of lighting, television, extended use of electronic devices, and the application of new ideas generally to industrial processes. In transportation there would be new and better fuels, and of course a more extended use of the airplane. Air conditioning would be further amplified as an adjunct to industry. Fluorescent lighting would be improved. "Cold light rivalling the firefly," he said, "is just over the horizon." Television will eventually become as commonplace as the telephone or moving pictures. And as for the extension of electronics "the engineer here faces a field of opportunity for the application of these devices in innumerable industrial processes." He instanced the report of Russian engineers having perfected "an automatic lathe operating with an electronic scanning device which follows the lines of a blueprint and translates these lines, by automatic operation of the cutting tool, into the form of metal desired."

These are technological advances, definitely and predominately the field of the engineer. But effective as they may be they do not present the whole solution to human problems. "Can the engineer take an equally important part in problems other than those connected directly with material needs?" the speaker asked at this point. "Is not the engineer, with his training and experience, well fitted to help in the solution of human problems?"

The engineer, he felt, through his knowledge of nature's laws has ample opportunity to contribute wise counsel. The problems of the future will cover a wide field, comprising industry, labour, distribution, as well as municipal, national and international projects and affairs. The engineer can bring to his own locality and beyond, the helpfulness of his understanding, his training and his ability.

A primary consideration should be the matter of education. So much stress has been laid on mathematics, science and technological phases that cultural subjects of considerable advantage have been submerged or neglected. An engineer should be able to study efficiently, he should know how to tackle problems in human, industrial and employee relations, he should be able to express himself well in speech and writing. There must in addition be full recognition of his profession on the part of the public—something that does not exist to-day except in comparatively low degree.

"At the moment," said Mr. McHenry, "a completely unified group of engineers capable of speaking for and acting on behalf of the profession does not exist." A movement to effect this is now under way but its accomplishment in suitable form to all engineering groups will require interest and support not only of each group concerned but of each individual engineer as well.

Engineering is not solely local or national in its scope but is practised on the same general and basic principles internationally. It therefore offers to the engineer an opportunity to play a part in better world-wide understanding and in working out international problems.

How important the post-war position of the engineer can be, stated the speaker in conclusion, will depend on the engineer himself. "Certainly the future presents a definite challenge to every engineer, and it should be the solemn obligation of each of us to do what he can to further the concept of the engineer as a thoughtful and conscientious member of a great and learned profession in all that it implies."

At an evening meeting at the National Research auditorium on May 4, a sound film in colour was shown on the manufacture and varied uses of "Laminated Plastics." Their method of manufacture in accordance with whatever purposes they are intended to be put, their lightness, their adaptability to a wide range of uses, their possibilities for decorative furniture or interior furnishings, and their many other attributes were illustrated.

PETERBOROUGH BRANCH

A. J. Girdwood, Jr.E.I.C. - *Secretary-Treasurer*
J. F. Osborn, Jr.E.I.C. - *Branch News Editor*

The Student and Junior Section arranged two first rate papers for the Student and Junior night, Thursday, March 16th.

D. L. Cole of the Canadian General Electric engineering staff spoke on **The Design and Manufacture of Alnico Magnets.** Mr. Cole said that his paper was primarily intended to assist those who might at some time wish to apply the various grades of Alnico.

Early permanent magnets were made of carbon steel, were bulky and not very resistant to demagnetization. Chrome and tungsten magnet steels and later cobalt steel had improved magnetic properties, permitting some reduction in size of devices employing permanent magnets. The introduction of Alnico made further large reductions in size practicable.

Alnico is the trade name for a family of alloys composed of varying proportions of aluminum—nickel—cobalt—iron. Common characteristics for all grades are extreme hardness, brittleness and coarse grain structure. The material is processed in two ways—by casting or by sintering finely divided powder which has been moulded and pressed to the desired shapes. Alnico is so hard that it can be ground with some difficulty, but cannot be machined at all. The magnetic properties of the alloys are such that they have high energy storage capacity and coercive force and exceptional stability.

It was stated that the advantages of Alnico had encouraged a rapid expansion of the industrial applications for permanent magnets.

In the second paper G. M. Nixon described the various theories on the existence of **Cosmic Rays** and briefly explained the current opinion on the subject.

Original cosmic ray theories developed from investigations to explain the ionization of air in sealed electroscopes. It was found that electroscopes discharged when left standing and also that shielding of the electroscope and altitude affected the rate of discharge. Later it was learned that the intensity of the rays varied with latitude, being fairly consistent for all locations of the same latitude north or south of the equator.

Mr. Nixon's lively presentation of a rather complex subject prompted considerable discussion.

At the March 30th meeting of the Branch, a paper was presented by M. J. Aykroyd, outside plant engineer of the Bell Telephone Co. of Canada, entitled **Blue Reels Turning.**

Subsequent to the paper, Mr. Aykroyd who is also president of the Association of Professional Engineers of Ontario, gave an informal account of the negotiations that had been carried on in connection with collective bargaining.

"This type of plant is subjected to all the vagaries of nature. Often we have severe physical damage from sleet and wind with resulting service interruption and heavy financial loss. The emergency restoration of our plant is costly as the work is carried on under abnormal conditions. With increasing demands for service, cable has been used as the connecting link between distant places.This has come to be known as storm-proof plant."

With the aid of coloured motion pictures, Mr. Aykroyd then described the engineering details and methods of burying long distance telephone lines directly into the ground.

"The ploughing operation varies, depending on soil conditions, nature and frequency of obstacles," he explained. "In clay soil, for example, with few obstacles, tractor, rooter plow, cable laying plow and tractor trailers can all be connected in the one train. The front plow roots through the earth with a three-and-three-quarter in. share loosening and breaking up the ground to a depth of from 30 to 50 in., thus insuring uninterrupted passage of the following plow which deposits the cable in the ground. The 100-ton train, with its more than 400 horse-power, moves at a brisk walk under such conditions. Pauses are needed only to change reels or remove major obstructions. This is the procedure that was followed across prairie country in placing the transcontinental cable in the United States.

In Southern Ontario the farming subdivisions, sideroads, streams, wooded sections and other frequent obstacles made a modified operation desirable. One crew with tractors and rooting equipment works about three to six miles ahead of the cable placing train. The job for this equipment is to open up the earth to a depth of 30 in. or more along the route of the buried cable, to remove boulders, tree roots and other obstacles, to grade steep banks at side roads or other places. The fences have to be so arranged as to facilitate the passage of the train.

TORONTO BRANCH

S. H. de Jong, M.E.I.C. - *Secretary-Treasurer*
G. L. White, Affil.E.I.C. - *Branch News Editor*

The annual meeting of the Toronto Branch of the Institute was held in the Music Room at Hart House on Tuesday, April 4th.

Dinner in the Great Hall was followed by some recorded music and by the showing of two films—"Wings Over the North" through the courtesy of Canadian Pacific Air Lines; and "Backfire" through the courtesy of the Ford Motor Co. of Canada.

The business meeting reflected the keen interest of members in the affairs of the Branch. S. H. de Jong, secretary-treasurer, read the minutes of the 1943 Annual Meeting and these were approved.

In a few brief remarks, W. H. M. Laughlin, retiring chairman, said that he had been honoured to head the branch over the past year and voiced his appreciation of the whole-hearted co-operation given by the executive and members generally. He referred briefly to the meetings held by the Branch during the year, with special reference to several joint meetings and also mentioned some of the special activities undertaken. Mr. Laughlin extended his best wishes to the incoming chairman, S. R. Frost, expressing the hope that he would also find a full quota of enthusiastic workers.

The secretary presented his report and the financial statement. The report outlined the year's programme showing an attendance of from 40 to 140 at the meetings sponsored wholly by the Toronto Branch. The membership statement showed a net increase over the 1943 report.

The report of the Junior Section, presented by J. Van Winckle, reflects the remarkable progress made by the Junior Section in its first year. Good attendance was reported at the Junior meetings with many subjects of particular significance to the young engineer discussed.

The report of the Policy Committee of the Toronto Branch was presented by Professor R. F. Legget. This report discussed thoroughly the various aspects of the activities of the Toronto Branch, its relationship to the Institute as a whole, and, in particular, its place amongst the large number of engineering and technical societies operating in the Toronto district.

A lively discussion followed the presentation of the report by the Policy Committee.

VANCOUVER BRANCH

P. B. Stroyan, M.E.I.C. - *Secretary-Treasurer*
J. G. D'Aoust, M.E.I.C. - *Branch News Editor*

A meeting of the Vancouver Branch was held on Monday, April 24th. Dr. Gilbert Hooley, assistant professor of chemistry at the University of B.C. addressed the meeting speaking on **The Manufacture and Uses of Glass.**

During his talk which was illustrated with slides and numerous samples of glass in its many forms, Dr. Hooley touched on the composition of industrial glasses, and described the various methods of hand and machine manufacture of tubing, glassware and other industrial forms.

Among the slides shown were illustrations of the 200-in. telescope mirror, which is still in the process of grinding, and which was cast at the Corning Glass Works in 1935 during which time Dr. Hooley was engaged with this firm.

Some of the modern types of glass which were briefly described by the speaker included the hard glass which replaces saphire instrument bearings, glasses transmitting ultra violet and infra red light, fluorescent glasses and fiber glass which can be spun into threads and woven into fabrics.

The chairman, Theo Berry, called on P. H. Buchan to thank the speaker, and members gave their hearty approval of the motion. Dr. Hooley's address was one of the most interesting of the season.

Library Notes

Book notes, Additions to the Library of The Engineering Institute, Reviews of New Books and Publications

ADDITIONS TO THE LIBRARY

TECHNICAL BOOKS

Twentieth Century Engineering:
C. H. S. Tupholme. N.Y., Philosophical Library, 1944. Illus. diags., 5¾ x 9¼ in. $3.00.

Aircraft Sheet Metal Work:
Clarence Allen LeMaster. Chicago, American Technical Society, 1944 (Canadian representative General Publishing Company, Toronto). Figs., diags. 6¼ x 9¼ in. $3.75.

Pile-Driving Handbook:
Robert D. Chellis. N.Y., Pitman Publishing Corp., 1944. 5¼ x 8¼ in. $4.50.

Arctic Manual:
Vilhjalmur Stefansson. Toronto, MacMillan Co. of Canada, 1944. 5 x 8 in. $3.50.

TRANSACTIONS, PROCEEDINGS

American Institute of Consulting Engineers:
Proceedings of the annual meeting January 17, 1944, and address of the guest speaker Dr. Harley L. Lutz on Something New in Engineering.

New Zealand. Electric Supply Authority Engineers' Association:
Transactions of the fifteenth annual conference held in Napier, New Zealand, August 23rd and 24th, 1943.

REPORTS

The Institution of Mechanical Engineers:
Award of the James Watt International Medal to Mr. A. G. M. Mitchell.

Southern California Metropolitan Water District:
Report for the fiscal year July 1, 1942, to June 30, 1943.

Canada. Dominion Water and Power Bureau. Bulletin No. 2126:
Water-power resources of Canada (copies of this review may be obtained free of charge on application to the Controller, Dominion Water and Power Bureau, Dept. of Mines and Resources, Ottawa.

Canada. Dept. of Mines and Resources. Lands, Parks and Forests Branch, Forest Products Laboratories:
Ethyl alcohol from wood and production of pine tar by the destructive distillation of Canadian softwoods by H. Schwartz and C. Greaves.

Canada. Dept. of Finance. Housing Administration:
The labour value of the building dollar by O. J. Firestone.

Quebec. Dept. of Mines. Geological Report:
No. 14;Barry lake area—No. 15; Buteux area.

Quebec. Dept. of Mines:
The mining industry of the Prov. of Quebec in 1942.

Ontario. Dept. of Mines:
Fifty-first annual report being vol. Li part lv and part vii; Geology of the Grimsthorpe-Barrie area and Geology of the Cunningham-Gernet area.

Bulletin No. 46 (rev. ed. Jan. 1944); Hydro-electric development for the mining industry of Northern Ontario.

U.S. Bureau of Mines—Bulletin:
No. 454; Fundamentals of coal sampling.

U.S. Geological Survey Water-Supply Paper:
No. 889-B; Water-table fluctuations in the Spokane Valley and contiguous area Washington-Idaho. No. 923; Surfaced water supply of the U.S. 1941; pt. 3—Ohio river basin. No. 954; Surface water supply of the U.S. 1942; pt. 4—St. Lawrence river basin. No. 958; Surface water supply of the U.S. 1942; pt. 8—Western gulf of Mexico basins. No. 964; Surface water supply of the U.S. 1942; pt. 14—Pacific slope basins in Oregon and lower Columbia river basin.

U.S. Geological Survey Bulletin:
No. 928-B; Geology and ore deposits of the Shafter mining district, Presidio County, Texas, No. 930-D; Spirit leveling in Illinois 1896-1942; pt. 4—Northern Illinois. No. 933-B; Geology of the Nutzotin mountains, Alaska, and gold deposits near Nabesna. No. 936-Q; The Coso quicksilver district Inyo County, California. No. 940-D; Vanadium-beyring magnetite-ilmenite deposits near Lake Sanford, Essex County, New York. No. 940-E; Occurrence of manganese in eastern Aroostook county, Maine. No. 940-F; Manganese deposits of the Lyndhurst-Vesuvius district Augusta and Rockbridge counties, Virginia. No. 941; Geology of the coastal plain of Georgia.

U.S. Geological Survey Professional Paper:
No. 199-A; Mollusca from the miocene and lower pliocene of Virginia and North Carolina. No. 201; Geology and ore deposits of the Cottonwood-American fork area, Utah. No. 203; Stratigraphy and fauna of the Louisiana limestone of Missouri.

Winnipeg. Hydro-Electric System:
Thirty-second annual report, December 31, 1943.

Du Mont Laboratories Inc., N.J.
A practical guide for cathode-ray design.

American Research Committee on Grounding:
Interim report January 1944.

Edison Electric Institute:
Line clearing manual for overhead electric conductors.

Harvard University. Graduate School of Engineering. Bulletin:
No. 382; A treatment of non-linear devices based upon the theory of related linear functions. No. 383; Studies on endamoeba histolytica. No. 384; The radiation field of a symmetrical counter-driven antenna of finite cross section.

Electrochemical Society—Preprints:
85-6; The reactivity of aluminium, zinc and a zinc base die casting alloy with various electrolytes. 85-7; Correlation of solution potentials with orientations of single crystals of high purity aluminium. 85-8; The effect of specimen position on atmospheric corrosion testing of steel. 85-9; The electrolytic reduction of acetophenone in alkaline solution. 85-10;A study of impurities in cobalt electrowinning. 85-11; Determination of small amounts of chloride in copper-refining electrolyte by potentiometric titration. 85-12; Electrolytic hydrogen cells of trail design. 85-13; Further experiments in rainbow plating. 85-14; Pressed and processes for metal powder products. 85-15; The determination of particle-size powder metallurgy. 85-16; Bonding metal particles by heat alone without pressure. 85-17; Publication has been delayed. 85-18; Why not a 50-50 cobalt and copper. 85-19; Publication has been delayed. 85-20; Passivity in copper-nickel and molybdenum-nickel-iron alloys.

BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet all of these books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

A.S.T.M. STANDARDS 1943 Supplement including Tentative Standards

Part I, Metals. 351 pp.
Part II, Nonmetallic Materials—Constructional. 167 pp.
Part III, Nonmetallic Materials—General. 539 pp.
American Society for Testing Materials, 260 S. Broad St., Philadelphia 2, Pa., 1944. Illus., diagrs., charts, tables, 9¼ x 6 in., cloth, $3 each part.

These volumes bring the 1942 Book of Standards up to date by giving the newly adopted and revised standards and tentative standards. Included are stickers for marking the standards in the 1942 Books that have been superseded.

A.S.T.M. STANDARDS ON ELECTRICAL INSULATING MATERIALS (with Related Information)

Prepared by A.S.T.M. Committee D-9 on Electrical Insulating Materials; Specifications, Methods of Testing, February, 1944. American Society for Testing Materials, 260 S. Broad St., Philadelphia 2, Pa., 1944. 502 pp., illus., diagrs., charts, tables, 9 x 6 in., paper, $2.75.

This pamphlet contains the latest report of the Committee on Insulating Materials, which presents a proposed routine method for testing the gas content of insulating oil, proposed methods of testing askarels and a discussion of the significance of tests of electrical insulating materials. It also contains the methods developed by the Society for testing varnishes and lacquers, molded insulating materials, plates, tubes, mineral oils, ceramic products, rubber, mica and other materials used as insulating materials.

A.S.T.M. STANDARDS ON RUBBER PRODUCTS (with Related Information)

Prepared by A.S.T.M. Committee D-11 on Rubber Products; Methods of Testing, Specifications, February, 1944. American Society for Testing Materials, 260 S. Broad St., Philadelphia 2, Pa., 424 pp., illus., diagrs., charts, tables, 9 x 6 in., paper, $1.75.

This compilation brings together the standard and tentative methods of test and specifications pertaining to rubber products. Additions to this issue include specifications for compounds of rubber and synthetic rubber for automotive and aeronautical uses and for insulating electric wire and cable, methods of testing rubber-coated fabrics, asbestos sheet packing and nonrigid plastics and electrical test methods applicable to rubber products.

ALTERNATING CURRENT BRIDGE METHODS

By B. Hague, 5 ed. Sir Isaac Pitman & Sons, London; Pitman Publishing Corp., New York, 1943. 616 pp., illus., diagrs., charts, tables, 9 x 5½ in., cloth, $8.50.

In this book, the purpose is to provide advanced students with an up-to-date account of methods and apparatus for alternating current bridge measurements of inductance, capacitance and effective resistance at low and telephonic frequencies. This is done thoroughly. The symbolic theory of alternating currents and its application to bridge networks, the principle underlying the various instruments involved, the classification of bridge networks and the choice of methods are discussed at length. Owing to war conditions, the text is that of the fourth edition, but errors have been corrected and many notes added covering later developments. Bibliographic footnotes are frequent.

BIBLIOGRAPHY AND ABSTRACTS ON ELECTRICAL CONTACTS

Prepared by Committee B-4 on Electrical-Heating, Electrical-Resistance, and Electric-Furnace Alloys. American Society for Testing Materials, 260 S. Broad St., Philadelphia, 1944. 137 pp., tables, 9½ x 6 in., cloth, $5.00.

This bibliography lists over eight hundred publications on electrical contacts, most of the entries being abstracted. The arrangement is chronological, but subject and author indexes are provided. Among the subjects included are Electrical contacts in general, Contact materials, Circuit breaker design, Contact resistance and temperature, the Electric arc, Spark and glow discharges, Contact wear and circuit parameters as applied to contact operations.

BOOT STRAPS, the Autobiography of TOM. M. GIRDLER in collaboration with Boyden Sparkes

Charles Scribner's Sons, New York, 1944. 471 pp., 8½ x 5½ in., cloth, $3.00.

As President of the Jones & Laughlin Steel Corporation and, later, Chairman of the Board of the Republic Steel Corporation, Mr. Girdler has for years been an outstanding steel man. To the latter position has been added in recent times the Chairmanship of the Board of the Consolidated Vultee Aircraft Corporation. His autobiography tells the story of a steady rise through a long career. Much of the book deals with the formation and growth of Republic Steel and the "Little Steel" warfare with the C.I.O., and with the author's views on labor problems. An interesting valuable contribution to our industrial history.

(THE) CHEMISTRY OF CELLULOSE

By E. Heuser. John Wiley & Sons, New York; Chapman & Hall, London, 1944. 660 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $7.50.

This book provides a compendium and critical digest of the literature, with due consideration of the microscopic and submicroscopic structure of the cellulose fiber. Emphasis has been laid on the scientific aspect rather than on the practical application of cellulose chemistry. An attempt has been made to consider all the essential literature up to October, 1943.

DAVISON'S RAYON AND SILK TRADES, including Nylon and Other Synthetic Textiles; the Standard Guide, 49th Annual Pocket Edition, 1944

Davison Publishing Co., Ridgwood, New Jersey, 1944. 414 pp., maps, tables, 7½ x 5 in., cloth, $5.50; de luxe office edit., $7.50.

This annual is a directory of manufacturers, importers, factors and others engaged in the silk industries and the rayon, nylon and other synthetic textile trades. The mills are classified by states, with information as to situation, officers, size and products. Subject indexes are provided.

ELECTRON-OPTICS

By P. Hatschek. American Photographic Publishing Co., Boston, Mass., 1944. 161 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $3.00.

In this small book Dr. Hatschek presents the fundamentals of electronics in such a simplified form that they can be comprehended by any one. Mathematics is avoided, as are special technical terms. The original German edition appeared in 1937. A chapter is added to this translation which describes briefly the developments since that date.

ENGINEERING MATERIALS, 2 Vols.

Vol. 1—The Ferrous Metals. 369 pp., $7.50 (25s. abroad).
Vol. 2—Non-Ferrous and Organic Materials. 479 pp., $8.50 (30s. abroad).
By A. W. Judge. 2 ed. Pitman Publishing Corp., New York 19; Sir Isaac Pitman & Sons, London, 1943. Illus., diagrs., charts, tables, 9 x 5½ in., cloth.

These two volumes form an admirable reference book for engineers, designers, constructors and others concerned with the selection and application of engineering materials. Volume 1, on ferrous metals, presents essential information on their properties, composition, heat treatments, machining, welding and other subjects. Volume 2, treats in similar fashion the non-ferrous metals and alloys, plastics, rubber and ceramics. The needs of aircraft and automobile engineers have been kept especially in mind.

FERROUS METALLURGY, 2 Vols. (Mineral Industries Series)

Vol. 1—Introduction to Ferrous Metallurgy. 484 pp.
Vol. 2—Manufacture and Fabrication of Steel. 487 pp.
By E. J. Teichert. 2 ed. McGraw-Hill Book Co., New York and London, 1944. Illus., diagrs., charts, maps, tables, 8½ x 5¼ in., cloth, $4.00 each.

The two books are part of a three-volume text based upon a correspondence course given during recent years by Pennsylvania State College. Volume 1 covers the fundamental chemical and physical background and the manufacture of pig iron, cast iron and wrought iron; volume 2, the manufacture of steel and its primary fabrication. The books give an excellent, up-to-date account of practice.

GENERAL COLLEGE CHEMISTRY

By M. C. Sneed and J. L. Maynard. D. Van Nostrand Co., New York, 1944. 861 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $3.75.

This text is designed for a first-year course in college chemistry in which theory and descriptive matter are carefully balanced. Historical material is introduced, and statistical and industrial material is used freely. The work aims to give the student the necessary preliminary information for a well rounded training in chemistry.

GRAPHICAL SOLUTIONS

By C. O. Mackey. 2 ed. John Wiley & Sons, New York; Chapman & Hall, London, 1944. 152 pp., charts, tables, 8½ x 5½ in., cloth, $2.50.

Further demand has made necessary the reprinting of this edition, which appeared first in 1940. It provides a course of instruction in the construction and application of curves, diagrams and charts for the graphical and mechanical solution of engineering problems. The treatment is elementary and practical.

Great Britain, Department of Scientific and Industrial Research, Advisory Council. Report of the Inquiry Committee on the STANDARDISATION of the ELEMENTS OF OPTICAL INSTRUMENTS

His Majesty's Stationery Office, London, 1920 (reprint, 1943), 39 pp., diagrs., tables, 9¼ x 6 in., paper 2s. (obtainable from British Information Services, 30 Rockefeller Plaza, New York, 65c.).

This report, which was published first in 1920, has been reprinted in 1943, because of continued demand. It gives tables of tolerances for tubing, threads, etc., and recommendations for gaging and inspecting the elements of optical instruments.

HANDBOOK OF CHEMISTRY

Compiled and edited by N. A. Lange. 5th ed. rev. and enl. Handbook Publishers, Sandusky, Ohio, 1944. 2,092 pp., with an Appendix of Mathematical Tables and Formulas compiled by R. S. Burington. Diagrs., charts, tables, 8 x 5½ in., fabrikoid, $6.00.

The fact that five editions of this handbook have been called for in ten years shows that it has met the needs of many for a convenient collection of basic data on chemistry. The new edition has been revised throughout, many tables have been extended or rewritten, and new tables on Flammable liquids, Flame temperatures, Plastics, Fluorescent substances and Water for industrial use have been added. A collection of mathematical tables and formulas is appended.

HANDBOOK ON DESIGNING FOR QUANTITY PRODUCTION

Prepared and edited by H. Chase. McGraw-Hill Book Co., New York and London, 1944. 517 pp., illus., diagrs., tables, 8½ x 5¼ in., cloth, $5.00.

The design of articles which are to be made in large quantities and which are partly or wholly made of metals or plastics must be predicated upon the use of one or more of the high-production processes: stamping, sand casting, die casting, screw machine, die forging, heading or plastic molding. In this book, which is for those interested in design of this type, the first part consists of chapters on design for quantity production by these various processes, each written by an authority. In the second part the cost of products by different methods is compared. A large amount of practical information is provided in convenient form.

ILLUSTRATED TECHNICAL DICTIONARY

Edited by M. Newmark. Philosophical Library, 15 East 40th St., New York, 1944. 352 pp., diagrs., tables, 9¼ x 6 in., cloth, $5.00.

This dictionary gives definitions for a wide selection of terms used in the applied sciences and in technology, with special attention to those generally encountered in the curricula of technical and vocational schools. Illustrations are infrequent and add little to the value of the book. The work will be useful to students and mechanics. Many recent expressions are included.

INDUSTRIAL ELECTRONIC CONTROL, a Guide to the Understanding of Electronic Control Circuits for Industrial Uses

By W. D. Cockrell. McGraw-Hill Book Co., New York and London, 1944. 247 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $2.50.

The purpose of this book is to supply a basic working knowledge of electronic control as a background for intelligent selling, installing or servicing of electronic equipment. It describes simply and non-mathematically, the fundamentals of electronic tube operation and the basic control circuits. The book is especially for electrical engineers with no previous experience with tubes, and radio servicemen interested in electronic service work.

IRON AND STEEL IN BRITAIN 1870-1930

By T. H. Burnham and G. O. Hoskins. George Allen & Unwin, London; distributed by W. W. Norton & Co., 70 Fifth Ave., New York, 1943. 352 pp., tables, charts, 8½ x 5½ in., cloth, $7.50.

In 1870 the British iron and steel industry held the first place in the world. In 1930 it was fourth in rank, both in production and exports. This volume studies the history of the industry during that period in order to discover the factors that were responsible for this decline in position, and endeavor to appraise the part played by each. The book is an interesting, carefully documented study. One author is a metallurgist, the other an economist.

KLYSTRON TECHNICAL MANUAL

Published by the Sperry Gyroscope Company, Manhattan Bridge Plaza, Brooklyn 1, N.Y., 1944. 94 pp., illus., diagrs., charts, tables, 9¼ x 6 in., cloth, limited free circulation, apply.

This manual describes the underlying principles of velocity modulation tubes, rather than their applications. It brings together, in simplified form, the material hitherto available only in articles in various journals, with additions of experimental and descriptive information. A useful bibliography and lists of American and British patents are included.

LATHE OPERATIONS

By L. E. King. The Macmillan Company, New York, 1944. 119 pp., illus., diagrs., tables, 8½ x 5½ in., paper, $1.75.

The essentials of various lathe operations are presented in a simplified text intended for use in technical high schools and trade schools.

MARINE PIPEFITTING

By V. E. Hase and R. W. Allen. McGraw-Hill Book Co., New York and London, 1944. 325 pp., illus., diagrs., charts, tables, 9 x 6 in., linen, $3.00.

This textbook describes and pictures all the major piping systems on ships and current methods of installing them. It explains shop practice clearly and discusses piping layout in detail. The book will meet the needs of beginners and also be useful as a reference book for skilled mechanics.

MATERIALS AND PROCESSES

Edited by J. F. Young. John Wiley & Sons, New York, 1944. 628 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $5.00.

This book aims to present, in a single volume, a broad study of the materials and manufacturing processes employed by engineering designers, and thus to provide information directly useful in the selection of materials. It is intended for classroom use and also for engineers who wish an overall picture. The book is based on a course of lectures given in the Advanced Engineering programme of the General Electric Company, and incorporates the lectures of many engineers.

MATHEMATICAL AND PHYSICAL PRINCIPLES OF ENGINEERING ANALYSIS

By W. C. Johnson. McGraw-Hill Book Co., New York and London, 1944. 346 pp., diagrs., charts, tables, 8½ x 5 in., cloth, $3.00.

This book is the outgrowth of a course given in recent years to students of engineering at Princeton University. Its purpose is to present the physical and mathematical principles and methods of approach that underlie the analysis of many practical engineering problems. The viewpoint is practical and utilitarian. Emphasis is placed upon physical concepts, the use of assumptions, procedures in setting up equations, the use of mathematics as a tool in accurate, quantitative reasoning, and the physical interpretation of mathematical results

MATHEMATISCHE GRUNDLAGEN DER QUANTENMECHANIK (Die Grundlehren der Mathematischen Wissenschaften, Bd. 38)

By J. von Neumann. Dover Publications, 31 East 27th St., New York 16, N.Y., 1943. 266 pp., diagrs., tables, 9½ x 6 in., cloth, $3.50.

Neumann's Mathematical Bases of Quantum Mechanics has long been esteemed by mathematicians and physicists for its thorough, logical development and discussion of the subject. The present edition has been produced in America, in response to demand, under license by the Alien Property Custodian. It reproduces the latest German edition, with the addition of a German-English glossary.

MECHANICAL PROPERTIES OF METALS AND ALLOYS (Circular of the National Bureau of Standards C447)

By J. L. Everhart and others. U.S. Bureau of Standards, Washington, D.C., 1943; for sale by U.S. Government Printing Office, Washington, D.C. 481 pp., charts, tables, 11 x 8 in., cloth, $1.50.

This circular is a summary of the data available on the strength and related properties, thermal expansion, and thermal and electrical conductivities of ferrous and non-ferrous metals and alloys at normal, high and low temperatures. Included are many metals and alloys which are not ordinarily considered as engineering materials. The data are presented in tables or graphs, and the source is given in each case.

MIRACLES AHEAD! Better Living in the Postwar World

By N. V. Carlisle and F. B. Latham. Macmillan Company, New York, 1944. 288 pp., 8¼ x 5½ in., cloth, $2.75.

Intended to give the layman an idea of some possible future developments in the way of transportation, housing, materials, foods, medicine, etc. An interesting description of possible advances, many of which do not seem probable in the near future.

MODERN TURBINES

By L. E. Newman, A. Keller, J. M. Lyons, L. B. Wales, and edited by L. E. Newman. John Wiley & Sons, New York; Chapman & Hall, London, 1944. 175 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $2.50.

Information concerning the characteristics of steam turbines and their generators is presented for the use of engineers who are interested in the selection of equipment for a given job, but are not concerned with the details of turbine design and maintenance. The four authors are all connected with the General Electric Company, and the material presented appeared originally in "Power Plant Engineering."

National Research Council of Canada—ABSTRACTS ON SYNTHETIC RUBBER

Part I—Articles (N.R.C. No. 1136), 362 pp.
Part II—Patents (N.R.C. No. 1137) 200 pp.
National Research Council of Canada, Ottawa, Canada, June 1943. Tables, 11 x 8½ in., paper, manifold, $2.00 each.

This publication provides abstracts of over eight hundred articles and over seven hundred patents dealing with synthetic rubber, together with a list of 123 articles and books that are not abstracted. A subject index to the abstracts and an index of patentees are included.

NOBEL-PRIZE DONOR, Inventor of Dynamite, Advocate of Peace

By M. Evlanoff. Published by The Blakiston Company, Philadelphia; distributed by Fleming H. Revell Co., 158 Fifth Ave., New York 10, also London and Edinburgh, 1943. 190 pp., illus., 8¼ x 5¼ in., cloth, $2.50.

This is the history of the Nobels, father and sons. The major part of the book is devoted to Alfred Nobel, the inventor of dynamite and creator of the Nobel prize. Attention is also given to the less known work of his brothers, Robert and Ludwig, and the immense oil industry which they founded in the Caucasus.

(THE) OXY-ACETYLENE HANDBOOK, a Manual on Oxy-Acetylene Welding and Cutting Procedures

Published by Linde Air Products Company, 30 East 42nd St., New York 17, N.Y., 1943. 587 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $1.50.

This is a practical basic manual intended for use in colleges, vocational schools and shop training courses. All topics connected with the subject are covered, from general principles to inspection of welds and the management of shops. The book supersedes the "Oxwelder's Handbook."

PHYSICS (United States Naval Academy Edition)

By E. Hausmann and E. P. Slack. D. Van Nostrand Co., New York, 1944. 857 pp., illus., diagrs., charts, tables, maps, 8½ x 5½ in., cloth, $5.50.

The essentials of physics are presented clearly and logically. Worked-out problems are numerous and illustrate the application of the principles to practical use. A great many problems are provided for solution. This edition has been prepared for the U.S. Naval Academy, the text being arranged to meet classroom needs there. The revision has been done by the teaching staff of the Academy.

PILE-DRIVING HANDBOOK, Theory-Design Practice of Pile Foundations

By R. D. Chellis. Pitman Publishing Corp., New York and Chicago, 1944, 276 pp., illus., diagrs., charts, tables, 8¼ x 5 in., cloth, $4.50.

This handbook, by an engineer of great experience in designing and driving pile foundations, discusses the theoretical and practical factors involved in that work. The discussion is detailed and covers the application of formulas, driving stresses, the selection of driving equipment and type of pole, pile spacing, deterioration, preservation, etc. Standard specifications of various bodies are appended, and comparative results of tests are summarized. Tables are included giving data on steel and wood piles and on the frictional resistance of piles in various soils. There is a bibliography.

PIPELINE TO BATTLE, an Engineer's Adventure with the British Eighth Army

By P. W. Rainier. Random House, New York, 1943. 302 pp., maps, 8½ x 5½ in., cloth, $2.50.

The author of this interesting account of the African campaign of the British Eighth Army is an experienced mining engineer who joined the Royal Engineers in 1940 and served through the African campaign. For most of that time his task was to get water to the men on the front lines, and he laid pipe lines, drilled wells and built water works throughout the campaign. His account of desert warfare is a vivid, readable one, largely written in the field.

PRACTICAL ANALYTIC GEOMETRY WITH APPLICATIONS TO AIRCRAFT

By R. A. Liming. The Macmillan Company, New York, 1944. 277 pp., illus., diagrs., charts, tables, 8½ x 5½ in., linen, $4.50.

This book is a comprehensive presentation of the application of analytic geometry to the practical mathematical definition of airplane contours and structure. Part one analyzes applications to two-dimensional space; Part two develops the application of rectangular coordinates to three-dimensional space; Part three applies a system of analytic analysis to curves commonly required in the lofting of streamline bodies. While the book deals exclusively with aircraft structures, the principles developed apply equally to such related fields as the automotive and marine industries.

PROTECTIVE AND DECORATIVE COATINGS, Vol. 4

Prepared by a Staff of Specialists under the Editorship of J. J. Mattiello. John Wiley & Sons, New York; Chapman & Hall, London, 1944. 419 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $5.00.

This volume of this treatise on coatings is devoted to studies of such subjects as wetting and grinding, the properties of the manufactured product, such as color, consistency and hiding, the adhesion, permeability and structure of the dried film, the uses of microscopy in the paint and varnish industry and the applications of high-vacuum technology. The chapters have useful bibliographies.

PUNCHES AND DIES, Layout, Construction and Use, Including Wartime Data Supplement

By F. A. Stanley. 3 ed. McGraw-Hill Book Co., New York and London, 1943. 509 pp., illus., diagrs., tables, 9 x 6 in., cloth, $4.00.

The text of the second (1936) edition of this well-known manual on the layout, construction and use of punches and dies is republished, with a thirty-three page supplement describing late developments in press tools and methods in connection with war work such as the use of contour machines on die work, the Guerin process cast dies, fabricated press tools and other novelties.

(THE) RADIO AMATEUR'S HANDBOOK, 21st ed. 1944

Published by The American Radio Relay League, West Hartford, Conn. 480 pp. text (Catalogue Section 174 pp), illus., diagrs., charts, tables, 9½ x 6½ in., paper, $1.00.

This standard manual of amateur radio communication, annually revised, consists of two main parts. The principles and design section has been considerably enlarged in the present edition, particularly the chapters on fundamentals and vacuum tube theory. The construction and data section includes a new chapter on carrier-current communication, and information on some fifty new tubes has been added to the classified vacuum-tube data tables. War emergency radio service is dealt with separately.

RAILWAY FUEL AND TRAVELLING ENGINEERS' ASSOCIATION, Seventh Annual Proceedings, 1943

Railway Fuel and Traveling Engineers' Association, 327 So. La Salle St., Chicago 4, Ill. 206 pp., illus., diagrs., charts, tables, 9¼ x 6 in., cloth, $3.00.

The Proceedings contain the reports of the officers and of various committees on gas-turbine locomotives, firing practice, Diesel locomotives, coal firing and the utilization of motive power, with discussions. There are also papers on efficiency and economy in steam-locomotive operation and on fast freight braking.

REPORTS ON PROGRESS IN PHYSICS, Vol. 9 (1942-43)

Edited by W. B. Mann. Published by The Physical Society, 1 Lowther Gardens, Exhibition Road, London, S.W.7; printed by Taylor & Francis, Ltd., Red Lion Court, Fleet Street, London, E.C.4, 1943. 353 pp., illus., diagrs., charts, tables, 10 x 7 in., cloth, $6.00.

The new volume of this valuable series covers two years, instead of one, owing to the need for economy. It includes ten reports on advances in our knowledge of atmospheric physics and chemistry, and reports on other important fields, such as solar physics, the structure of rubber, counter tubes, field emission of electrons, physics and the search for oil, sound, crystal dynamics and x-ray scattering, and the physics of paintings. As usual, the articles have useful bibliographies.

SHIPBUILDING COST AND PRODUCTION METHODS

By W. B. Ferguson. Cornell Maritime Press, New York 11, 1944. 232 pp., illus., diagrs., charts, tables, 7½ x 5 in., cloth, $3.00.

This little volume is written for shipbuilders who are interested in problems of cost and efficiency. It discusses shipyard organization, production control, and handling, methods of reducing man hours, increasing output and reducing costs.

(THE) STEAM LOCOMOTIVE, its Theory, Operation and Economics including Comparisons with Diesel Electric Locomotives

By R. P. Johnson. 2 ed. rev. and enl. Simmons-Boardman Publishing Corp., New York, 1944. 564 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $5.00.

This book, by the Chief Engineer of the Baldwin Locomotive Works, presents the fundamentals of steam locomotive design and operation. The information is presented concisely, in practical form, with many tables and diagrams. New chapters on Steam utilization, the distribution of locomotive weight, and braking have been added to this edition, and the original text has been revised.

SUPERCHARGERS FOR AVIATION

By S. A. Moss. 2 ed. National Aeronautics Council, 37 West 47th St., New York, 1944. 103 pp., illus., diagrs., charts, 8½ x 5½ in., cloth, $1.00.

The purpose of this book is to satisfy those "who are interested in superchargers in a general way, and want to know their how and why, and their historical background." It presents, revised and extended, material published in "Aeronautics," three years ago. No mathematics is used in the account. The author has been prominently connected with supercharger and gas turbine development, and writes with authority.

SYMPOSIUM ON MILDEW RESISTANCE

Presented at the meetings of Committee D-13, New York City, October 21, 1943. American Society for Testing Materials, 260 S. Broad St., Philadelphia 2, Pa., 1944. 36 pp.. illus., diagrs., charts, tables, 9 x 6 in., paper, 65c.

This pamphlet contains four papers presented at a meeting in 1943. The standardizing of methods for testing mildew and rot resistant treatments of textiles and various methods of testing mildew resistance are discussed.

(THE) TECHNIQUE OF MOTION PICTURE PRODUCTION

A Symposium of Papers presented at the 51st Semi-Annual Convention of the Society of Motion Picture Engineers, Hollywood, Calif.; published for the Society of Motion Picture Engineers by Interscience Publishers, New York, 1944. 150 pp., illus.. diagrs., charts, tables, 9½ x 6 in., cloth, $3.50.

This volume contains eleven papers presented at a convention of the Society of Motion Picture Engineers. These papers describe current technical practice in motion picture production, arranged in the general order of the steps taken in producing and presenting them. The book brings together much information that has not been accessible heretofore in a logical, convenient form.

TEN LECTURES ON THEORETICAL RHEOLOGY

By M. Reiner. Published by Rubin Mass, Jerusalem, Palestine; Nordemann Publishing Co., 215 Fourth Ave., New York, 1943. 163 pp., illus., diagrs., charts, tables, 7½ x 5 in., stiff cardboard, $4.50.

The mathematical basis of rheology is presented in these lectures, which form a brief introduction to the theory of the subject. The author was a pioneer in the field, as an associate of Professor Bingham.

TESTING OF ENGINEERING MATERIALS

By C. W. Muhlenbruch. D. Van Nostrand Co., New York, 1944. 200 pp., illus., diagrs., charts, tables, 9½ x 6½ in., cloth, $2.75.

This book is intended as a text for a one-semester laboratory course for engineering students. It aims to give the student, through comprehensive testing of a variety of materials and a careful analysis of the results of the tests, a clear picture of those properties that can be most readily illustrated in the testing laboratory, and to acquire an understanding of the physical properties of the common engineering materials and of the possibilities and limitations of the latter.

Theorie und Anwendung der LAPLACE-TRANSFORMATION (Die Grundlehren der Mathematischen Wissenschaften, Vol. 47)

By G. Doetsch. Dover Publications, 31 East 27th St., New York 16, N.Y., 1943. 439 pp., diagrs., tables, 9½ x 6 in., cloth, $3.75.

This reproduction of Doetsch's classic monograph makes it available in this country at a price very much below the original one. The book, first published in 1937, provides a comprehensive descriptive analysis of the theory and mathematical foundations of the Laplace transformation and its practical application to problems of physics and electrical engineering. A German-English glossary has been added to the reprint.

(THE) THEORY OF THE GYROSCOPIC COMPASS and its Deviations

By A. L. Rawlings. 2 ed. completely revised and reset. The Macmillan Company, New York, 1944. 182 pp., illus., diagrs., charts, tables, 8½ x 5½ in. cloth, $3.00.

The theory of this compass is presented by an authority who has invented various important improvements. Included are descriptions of the Sperry, Anschütz, Arma and other models in use to-day. Navigators and men concerned with the installation and maintenance of gyro-compasses, and advanced instructors in schools will want the book. This edition has been revised and extended, and made simpler than the previous one.

(THE) THERMAL TECHNICS OF STEAM BOILERS

By J. Webster. Emmott & Co., Ltd., 78 Palestine Road, Manchester 20, England, and 28 Bedford St., Strand, London, W.C.2, 1943. 66 pp., diagrs., tables, charts, 7¼ x 5 in., paper, 1s. 6d.

This pamphlet presents concisely information needed by boiler engineers in studying problems connected with such subjects as boiler limitations, rates of heat transfer, the estimation of efficiency, methods of determining the temperatures of gas and air, and steam and water, the proportioning of heat transmitting parts, the relationship of water content to fluctuating load, thermal storage and heat transmission.

THORPE'S DICTIONARY OF APPLIED CHEMISTRY, Vol. 6

By J. F. Thorpe and M. A. Whiteley. 4 ed. rev. and enl. with an Index to Vols. I-VI by J. N. Goldsmith. Longmans, Green and Co., London, New York, Toronto, 1943. 611 pp., illus., diagrs., charts, tables 9½ x 6 in., cloth, $30.00

This volume of the new edition of this well-known reference work follows the pattern of the earlier ones. In addition to a wide variety of topics treated succinctly, in dictionary style, it includes comprehensive articles on glazes and frits, beryllium, glue, glycerin, gold, hafnium, hydrogenation, helium, homogeneous catalysis, hydrogen, and gum inhibitors. An index to the first six volumes of this edition adds to the usefulness of the work.

TOOL STEELS

By J. P. Gill, R. S. Rose, G. A. Roberts, H. G. Johnstin and R. B. George. American Society for Metals, Cleveland, Ohio, 1944. 577 pp., illus., diagrs., charts, tables, 9¼ x 6 in., cloth, $6.00.

The aim in this book is to set forth concisely the existing theoretical and practical information on the types of tool steel that are commonly used. A description of the manufacture of tool steel is followed by chapters on testing, the principles of heat treatment and the effect of alloying elements on the steel. Succeeding chapters review in detail the various classes of tool steels, presenting the available data about their properties, treatment and uses. The work is intended for users of tool steel. The authors are members of the metallurgical staff of the Vanadium-Alloys Steel Company.

TWENTIETH CENTURY ENGINEERING

By C. H. S. Tupholme. Philosophical Library, 15 East 40th St., New York, 1944. 201 pp., illus., diagrs., charts, tables, 9 x 5½ in., cloth, $3.00.

Intended to give the layman an account of "some of the more spectacular engineering progress during recent years," this work deals with developments in mechanical power, workshop processes, air-conditioning, refrigeration, chemical and metallurgical engineering, electrical engineering, traction, marine engineering, aircraft and physics. The book is an American reprint of one published in England in 1942.

WHITE METALLING

By H. Warburton. Emmott & Co., Ltd., 78 Palatine Road, Manchester 20, England, and 21 Bedford St., Strand, London, W.C.2, 1944. 80 pp., illus., diagrs., tables, 7¼ x 5 in., paper, 2s.

The white-metal alloys used for lining bearings are described and directions given for relining bearings. The methods are described clearly and practically, and much information is presented in concise form.

WORK METHODS MANUAL

By R. M. Barnes. John Wiley & Sons, New York; Chapman & Hall, London, 1944. 136 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $1.75.

While the steps to be followed in doing given work, the selection of tools and equipment and the instruction of the worker are usually the function of staff engineers in plants on mass production, most work is not repetitive, and the worker may do several different jobs in a day or week. In these cases the supervisor usually must plan the job, select the tools and instruct the worker. This book is intended to give supervisors and foremen a working knowledge of the principles of work organization and motion economy which will enable him to plan for economy and efficiency.

PRELIMINARY NOTICE

of Applications for Admission and for Transfer

May 27th, 1944.

The By-laws provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described at the July meeting.

L. Austin Wright, General Secretary.

*The professional requirements are as follows:—

A Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science or engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainment or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

EAST—LAWRENCE A. W., of 5540 Queen Mary Road, Montreal, Que. Born at Walworth, England, July 7th, 1902. Educ.: B.A.Sc., Univ. of Toronto, 1925; 1925-27, post graduate studies in radio engrg., Gen. Elec. Co., Schenectady, N.Y.; R.P.E. Que.; 1926-30, radio engr., design & development, Gen. Elec. Co.; 1930 to date with the communications dept., C.P.R. Co. as follows: 1930-37, radio & equipm't. engr., 1937 to date, chief engr., Montreal.

References: J. E. Armstrong, J. A. Shaw, J. M. R. Fairbairn, J. A. Ouimet, J. R. Auld, H. B. Bowen, R. B. Jones.

EMERY—CHARLES ARTHUR, of 162 Elizabeth St., Chatham, Ont. Born at Mount Elgin, Ont., Feb. 9, 1890. Educ.: Graduate of Ontario College for Technical Teachers, 1930; 1906-10, ap'tice to Eastern Bldg. Co., gen'l. contractors, Hamilton, Ont.; 1910-15, erection of bldgs. at Hamilton, including blast freezing plant for the Steel Co. of Canada, several school bldgs., Standard Underground Cable Co., etc., also Post Office Bldg. and Methodist Church, Ingersol, Ont.; with the International Harvester Co., Hamilton, as follows: 1915-19, i/c tempering room, responsible for heat treating & carbonizing of steel; 1919-20, asst. chief of fire watch & safety: 1920-24, superv'n. outside constrn., Emery Bros., gen'l. contractors, Hamilton; 1925-28, prepared plans, specifications, etc. & supervised constrn. of 12 brick houses & several apt. houses, Wm. Theaker, builder, Hamilton; 1929 to date, instructor of bldg. constrn., carpentry & architectural dfting., Chatham Vocational School, Chatham, Ont. (Asks for membership as an Affiliate).

References: T. M. S. Kingston, G. A. McCubbin, E. J. Davies, C. L. Emery.

FOLEY—WILLIAM J., of 366 Frank St., Ottawa, Ont. Born at Ottawa, Aug. 11th, 1893. Educ.: B.A.Sc., Univ. of Toronto, 1922. With the Standard Paving Ltd. (Ottawa Branch), as follows: 1922-42, estimator & chemist, asphalt plant, 1942 to date, supt. & branch mgr.

References: W. L. Saunders, F. C. Askwith, L. M. Hunter, A. Hay, J. H. Irvine.

FORBES—HUGH DONALD, of Deloro, Ont. Born at Glasgow, Scotland, Oct. 17th, 1919. Educ.: B.A.Sc., Univ. of Toronto, 1943; 1940 (summer), International Nickel Co., Copper Cliff, Ont.; 1941 (summer), Can. Gen. Elec. Co., Toronto; 1942 (summer), Can. Gen. Elec. Co., Peterborough; 1943-44, Consldt. Mining & Smelting Co., Trail, B.C.; At present, junior metallurgist, Deloro Smelting & Refining Co., Deloro, Ont.

References: C. R. Whittemore, S. R. Frost, Wm. Dixon, R. L. Dobbin, H. R. Sills.

HALDANE—DONALD EDWARD, Lieut., of Canwood, Sask. Born at Canwood, Sask., July 11th, 1917. Educ.: B.Sc. (Mech.Eng.), Univ. of Sask., 1942; 1942-43, O.C., L.A.D., R.C.O.C.; At present, Armament Section Officer, 9 C.I.B.Wksp., R.C.O.C., Canadian Army Overseas.

References: I. M. Fraser, R. A. Spencer, G. W. Parkinson, N. B. Hutcheon, W. E. Lovell.

HIGGINS—JOSEPH JOHN. of 1050 Egan Ave., Verdun, Que. Born at Cote St. Paul, Montreal, Que., Jan. 2nd, 1904. 1924-36, redesigning old equipm't for new process dfting., layout & estimating, etc., Dominion Rubber Co. Ltd.; 1936-38, dfting. & preparing data for engr., International Power & Paper Co., Newfoundland; 1938-41, layout of new projects & estimating, McKay Boiler Works; 1941-42, dfting. & estimating, Dominion Engrg. Works; 1942 to date, tool designing, purchase of jigs & fixtures, checker, Canadian Car & Foundry, Montreal. (Asks for admission as an Affiliate).

References: D. Goldwag, J. A. Stairs, R. Ford, D. O. Stapleton.

JACKSON—PHILIP BERNEY, 2nd Lieut., of 162 Crescent Road, Toronto, Ont. Born at Toronto, Ont., Dec. 19, 1917. Educ.: B.Sc., Sheffield Scientific School, Yale University, 1941; 1941-43, i/c technical & produc'n. co-ordination with consumer demands, Research Enterprises, Ltd.; 1942 to date, director, Jackson Lewis Co. Ltd., civil engrs., Toronto; 1943 to date, O.M.E., R.C.O.C., Dept. National Defence.

References: L. Austin Wright, W. E. Phillips, D. C. R. Miller.

LEFEBVRE—PAUL, of Quebec, Que. Born at St. Hyacinthe, Que., Feb. 21st, 1904. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1930; R.P.E.Que.; 1927 (summer), dftsman., & 1928-29 (summers), leveller, topographical survey, Dept. of Interior; 1930 to date, senior engr., Dept. of Public Works (Prov. of Que.), Provincial Fire Commissioner's office.

References: I. E. Vallee, A. Frigon, A. Circe, R. Dupuis, P. Vincent, H. Cimon, A. Piche, L. Roy.

MATTHEWS—BENJAMIN FRANK, of Kitchener, Ont. Born at Bristol, England, Feb. 25th, 1888. Educ.: 1900-1903, Merchant Venturers Tech. Coll. (certificate in Applied Science); 1903-05, junior engr. in office of engr. to Urban Dist. Council, Somerset, England; 1905-12, work in various mach. shops & foundries in Ontario & U.S.A., also home study course in mech. engr.; 1912-16, dftsman, heating & ventilation, Sheldons, Ltd., Galt, Ont.; 1916-19, 1st class air mech., R.A.F.; 1919-20, chief dftsman. & estimator, Sheldons, Ltd.; 1920-21, sales engr., A. R. Williams Machy. Co., Toronto; With the Roelofson Elevator Co., Galt, Ont., as follows: 1921-26, chief engr., design & install'n. of elevators & ornamental iron work, struct'l. steel, etc., 1926-28, supt.: With the Dom. Truck Equipm't. Co. Ltd., Kitchener, Ont., as follows: 1928-41, chief engr., 1941-42, works mgr.. 1942 to date, vice pres. & works mgr.

References: S. Shupe, D. J. Emrey, A. M. Snider, M. Pequegnat, F. H. Midgley.

McKEE—NEAL TRIMBLE, of Westchester, N.Y. Born at Mt. Sterling, Kentucky, Jan. 7, 1882. Educ.: B.M.E. 1903, M.E. 1906, Univ. of Kentucky; M., A.S.M.E.; 1901, Tennessee Coal & Iron Co.; 1903-08, spec. ap'tice., L.S. & M.S. Rly. (Now N.Y.C.); 1908-11, in garage business for self; 1911 to date, with the Superheater Co. as follows: 1911-12, inspr., 1912-13, asst. mech. engr., 1913-20, mech. engr., 1920-22, director i/c engrg. & mfg. (England), 1921-22, director i/c engrg., shop constrn. & mfg., Ciedes Surchauffeurs, (France); 1922-29, asst. to vice-pres., N.Y., 1929-37, gen. service mgr., N.Y., 1937 to date, vice pres., i/c research & development, also at present, director, The Superheater Co. Ltd., Montreal, and director, Air Preheater Corp'n., N.Y.

References: C. E. Davies, W. A. Newman, J. G. Hall, F. Williams, L. H. Birkett, H. D. Nickle, H. M. Esdaile.

OTT—THOMAS EDWARD, of 2112 Arad St., Niagara Falls, Ont. Born at Montreal, Que., Nov. 25th, 1917. Educ.: B.Sc. (C.E.), Tri-State College, Indiana, 1940; 1940 (summer), rodman and later engr. i/c of finals on paving contract, Queen Elizabeth Highway, Ontario Dept. of Highways; 1940 (Oct. to Nov.), instru'mn. & dftsman., Air Navigation School, Port Albert, Dept. of National Defence; 1940-41, dftsman., detailing, struct'l. design in reinforced concrete structures, Truscon Steel Co. of Can., 1941-42, designer, Welland Chemical Wks., Niagara Falls, Ont.; 1942-43, engr., i/c concrete design, Atlas Steels Ltd., Welland, Ont.; 1943 to date, liaison engr., aircraft weight statements, wood & metal research work, and at present, stress engr., Fleet Aircraft Ltd., Fort Erie, Ont.

References: T. S. Glover, N. A. Eager, A. W. Sinnamon, R. V. Anderson.

PARKER—ARTHUR EVANS, of Montreal, Que. Born at Dover, England, June 21st, 1913. Educ.: 1933-37, Univ. of Manitoba (completed second year of elect'l. engrg.); 1937-38, engr's helper, Sachigo River Exploration Co., & Madsen Red Lake Gold Mines Ltd.; 1938-39, mine engr., Wendigo Gold Mines

Employment Service Bureau

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.

NOTICE

Technical personnel should not reply to any of the advertisements for situations vacant unless—

1. **They are registered with the Wartime Bureau of Technical Personnel.**
2. **Their services are available.**

A person's services are considered available only if he is—

(a) unemployed;
(b) engaged in work other than of an engineering or scientific nature;
(c) has given notice as of a definite date; or
(d) has permission from his present employer to negotiate for work elsewhere while still in the service of that employer.

Applicants will help to expedite negotiations by stating in their application whether or not they have complied with the above regulations.

SITUATIONS VACANT

MANAGER OR ASSISTANT MANAGER for building construction company in Quebec province; construction, sales and business ability desirable. Must be aggressive with pleasing personality and able to converse in French. Apply to Box No. 2779-V.

ENGINEERING SHOP SUPERINTENDENT wanted to keep up production and quality of output and handle labour under present conditions. Chance of advancement and good salary to right man. In replying give age, experience and references. Apply to Box No. 2780-V.

ENERGETIC ASSISTANT SALES MANAGER wanted by engineering company making power plant equipment. Chance of advancement and good salary to right man. In replying give age, experience and references. Apply to Box No. 2781-V.

CIVIL OR MECHANICAL ENGINEER wanted. See page 64 of the advertising section.

MECHANICAL ENGINEER DRAUGHTSMAN wanted. See page 61 of the advertising section.

SITUATIONS WANTED

STRUCTURAL ENGINEER, M.E.I.C., R.P.E. (Ont.). Designing engineer and estimator; all types fabricated steel and plate work. Experience covers positions as chief engineer, chief draughtsman, sales engineer and executive responsibilities. Apply to Box No. 2208-W.

GRADUATE ELECTRICAL ENGINEER, age 30, married, with seven years' experience in electrical engineering including maintenance, operation and engineering office experience. Available shortly. Apply to Box No. 2462-W.

GRADUATE CIVIL ENGINEER, B.A.Sc., Jr. E.I.C. Recently retired from Army due to injury. Previous experience in road and airport construction. At present temporarily employed at road construction with a large Canadian city, desires permanent position as municipal engineer either as an assistant in a small city or as a town engineer. Available on short notice. Apply to Box No. 2463-W.

CHEMICAL ENGINEERING GRADUATE '44 desires permanent employment. Keen, young, willing to accept any position with possibilities for the future. Apply to Box No. 2464-W.

INSTRUMENTS
FOR SALE

One Amsler's planimeter. Perfect condition. In case. Pamphlet of instructions.

One prismatic compass. Leather case, shoulder strap, 2½" dial. First class condition.

One 5¼" Gurley hand level. Leather case. Excellent condition.

Two prs. pattent plumbing bubbles for rectangular section rods or pickets.

Apply to Box No. 56-S.

WANTED

Askania magnetometers, preferably new, compensated models. Apply to Box No. 55-S.

PRELIMINARY NOTICE (*Continued*)

Ltd., Kenora, Ont.; 1939-40, mine engr. & underground supt., Straw Lake Beach Gold Mines Ltd., Emo; 1940-43, with Fraser Brace Ltd., Montreal as follows: engr. on field layout & constrn., D.I.L. explosives plant at Transcona, Aluminum Co. of Canada refining plants at Shawinigan Falls & La Tuque, Que., & office mgr., plant additions, C.I.L. at Shawinigan Falls; At present, material control engr., scrutinizing & approval of material requisitions, preparation of surplus material reports, etc., United Shipyards Ltd., Montreal.

References: G. H. Herriot, A. E. MacDonald, G. R. Stephen, F. S. Small, E. A. Pinto, D. M. Stephens, P. Brault.

PHILLIPS—ERNEST ALBERT, of 4849 Blenheim St., Vancouver, B.C. Born at Toronto, Ont., March 30th, 1904. Educ.: B.A.Sc., Univ. of Toronto, 1931; 1923-28, carpenter, bldg. constrn.; 1929-31 (summers), Anglin Norcross, Ltd., Toronto; 1932-36, asst. to works mgr., Bauer & Black Ltd., Leaside, Ont., responsible for all produc'n, functions, mtce. & repairs, etc.; 1936-39, supt., Empress Mfg. Co., i/c factory & warehouse, produc'n., inventories, personnel, steam plant, etc.; 1941 to date, with Can. Wood Pipe & Tanks Ltd. as follows: 1941-43 (Feb.) sales engr., dftsman., & structural designer, and at present, production mgr., i/c. mfg., mtce., personnel, and cost accounting, etc.

References: W. R. Bonnycastle, T. N. Louden, C. R. Young, M. L. Gale.

VOLLMER—GEORGE LATIMER THOMAS, of 163 Jackson St. West, Hamilton, Ont. Born at Eastbourne, England, May 20th, 1916. Educ.: B.Sc. (Chem.), Queen's Univ., 1938; A.M., Can. Inst. of Chem.; 1935-36 (summers), operator in press dept., English Electric Co. of Can., St. Catharines; 1937 (summer), helper on fitting crew, Foster Wheeler Co., & 2 mos. engr. asst. to City Engr., St. Catharines, dfting. & surveying of city property; 1938-39, chemist, foundry laboratory, routine analytical work for control of cast iron production, McKinnon Industries, Ltd., St. Catharines; 1939-40, chemist, Kodachrome processing dept., Can. Kodak Co., Toronto; 1940 to date, chem. engr., & deputy chief inspr., Can. Drawn Steel Co. Ltd., Hamilton, Ont., i/c inspec'n. of all war orders calling for government inspec'n., responsible for product'n records & inspec'n. of all aircraft steel produced, etc.

References: G. F. Vollmer, C. G. Moon, W. Campion, E. G. Cameron, W. E. Brown.

FOR TRANSFER FROM JUNIOR

PETERS—JAMES HORSFIELD, of 4661 Hampton Ave., Montreal. Born at Annapolis Royal, N.S., June 19, 1912. Educ.: B.Sc., Arts (Chem.) Univ. of N.B., 1933. 1932 (summer) Canadian geol. survey; 1935 (summer) Warren Bituminous Paving Co.; 1935-36, chemist, Research & Development Dept., 1936-39, chemist and work simplification investigator, Canadian Industries, Ltd., Brownsburg, Que.; 1939-41, shift supervisor, Brownsburg Works, 1941-42, development engr., Verdun Works, 1942-44, engr., plant design, Defence Industries, Ltd., Montreal. (St. 1935; Jr. 1940).

References: D. A. Killam, H. B. Hanna, E. L. Johnson, C. H. Jackson, Chas. H. Jackson, J. B. Francis.

FOR TRANSFER FROM STUDENT

HOUGHTON—JAMES SCOTT, F/O, R.C.A.F., Ottawa, Ont. Born at Guelph, Ont., Aug. 23, 1915. Educ.: B.Eng., (McGill Univ.), 1938. 1937 (summer) and 1938-40, dftsmn., 1940-42, engr., designing overhead cranes, hydro-electric regulating gates, etc., Dominion Bridge Co. Ltd.; 1942 to date, Engrg. Officer, R.C.A.F. now officer i/c engrg. developments twin engine training aircraft, A.F.H.Q., (St. 1938).

References: R. H. Findlay, K. O. Whyte, A. Ferrier, K. Y. Lockhead, C. M. McKergow, G. H. Kimpton.

RANKIN—ORLA JOFFRE FRENCH, Captain, R.C.C.S., Kingston, Ont. Born at Rockhaven, Sask., Sept. 24, 1915. 1934-37, carpenter and supervisor of bldg. crew; 1937-39, R.C.C.S. (PF); 1939-41, Canadian Army (Active) supervision of mtce. (inside plant) and traffic Army telephone system, Halifax, N.S.; 1941-42, instructional staff (signals), Officers' Training Centre, Brockville, Ont., instruct'n. in signals equipment & mathematics; 1942-44, General Staff Officers for Signals trng., Directorate of Military Training N.D.H.Q., Ottawa (supervision of all signals training for Canada, Army). (St. 1939).

References: K. H. Tremain, L. F. Grant, J. P. Carriere, L. C. Young.

REES—FREDERICK, of Wabana, Nfld. Born at Wabana, Nfld., Sept. 19th, 1915. Educ.: B.Eng. (Mining), N.S.Tech.Coll., 1938. With Wabana Mines as follows: 1931-38 (summers) and 1938-40, general mining, 1940-41, supervision sorting, 1941-42, assistant overman, 1942-43, asst. mine captain; 1943-44, representative of Dominion Steel & Coal Corp. Ltd. at Bathurst Iron Mine, Bathurst, N.B. (St. 1935).

References: C. B. Archibald, A. E. Flynn, J. B. Petrie, S. J. Hayes, C. M. Anson.

Industrial News

Industrial development — new products — changes in personnel — special events — trade literature

LIQUID SCREENS

Link-Belt Ltd., Toronto, Ont., have issued an 8-page book No. 1977 on liquid vibrating screens for recovering waste products and reducing pollution. Originally introduced for removing cuttings, shale and sand from rotary oil well drilling mud, it is said that these screens are now being used for extracting solids from industrial waste waters, sludge, sewage, oils and other liquids. In other installations, as with copra, cottonseed, fish and linseed or soybean oil, both the solids and oil are recovered, it is stated. The book contains numerous photographs of actual installations and gives construction details, dimensions and weights of the various sizes of screens available for this type of service.

MEASURING INSTRUMENTS

Photovolt Corp., New York, N.Y., represented in Canada by Canadian Line Materials Limited of Toronto, have recently issued a 4-page bulletin, which contains illustrations, descriptions and prices covering a large variety of photoelectric and electronic meters and timing devices for the measurement of colour, turbidity, hemoglobin, fluorescence, light, photographic exposures, reflection, gloss, smoke, etc. The electronic timer featured is for welding, printing, process timing, control of machinery, protection of electronic tubes and other applications.

APPOINTED GENERAL MANAGER

J. Y. Murdoch, K.C., president of Canada Wire & Cable Co. Ltd., recently announced the appointment of J. McKay-Clements as general manager.

Mr. McKay-Clements is president and managing director of Wabi Iron Works Ltd., New Liskeard, Ont., and Wabi Iron Works (Quebec) Ltd., Noranda. In 1941 he became associated with Federal Aircraft, being elected a director in August 1942. While serving with Federal Aircraft as executive assistant to the president, he continued his active direction of these two companies. Among his many other responsibilities, he has acted until recently as government controller of White Canadian Aircraft Ltd.

J. McKay-Clements

C.G.E. APPOINTMENTS

Canadian General Electric Co. Ltd. announces the appointment of W. F. Schmidt as manager, specialty transformer section of supply department at head office in Toronto.

Associated with the company since 1928, Mr. Schmidt graduated from the C.G.E. test course in 1931, and shortly after was transferred from Peterborough to the general merchandising department at the head office. In 1936 he was appointed manager of fractional h.p. motor and welding supplies section, and 1941 was transferred to the priorities division of the purchasing department.

The company has also announced the appointment of Bryce W. Kell to the post of manager, carboloy section of the supply department at head Office.

Mr. Kell became associated with C.G.E. in 1936 and shortly after joining the company, was appointed to the Quebec office sales staff, being transferred to the head office at Toronto in September 1943.

ROLLING DOORS

Bulletin No. 39, 40 pages, prepared by The Kinnear Mfg. Co., Columbus, Ohio, profusely illustrated, is divided into six sections dealing respectively with steel rolling service doors, steel rolling fire doors and window shutters, sectional overhead doors, bifolding doors, rolling metal grilles and special applications. Data given include construction details, installation types and clearances, operation methods and specifications relating to the various types.

HOT WATER AND HEAT CONTROL

Sarcotherm Controls Inc., Chicago, Ill., have recently issued a 12-page bulletin describing a fully automatic system to provide constant circulation of the heating medium at correct and uniform room temperatures under all weather conditions. The bulletin contains a number of typical installations and hook-up diagrams showing location of the control valve and related fittings in the system.

RECEIVES PROMOTION

According to a recent announcement by Dominion Rubber Co. Ltd., M. O. Simpson, formerly comptroller and treasurer, has been appointed to the position of vice-president and treasurer.

APPOINTED SALES MANAGER

Hamilton Bridge Co. Ltd., Hamilton, Ont., announce the appointment of J. Husband to the position of sales manager.

Mr. Husband has recently been associated with Wartime Merchant Shipping Ltd., Montreal, where he was manager of the steel department since June, 1941. From 1934 to 1939 he was chief draughtsman and chief designer of the structural division at Canadian Vickers Ltd., and from 1939 to 1941 was connected with the Montreal office of the Bethlehem Steel Company.

MAGNETIC LABORATORY EQUIPMENT

Dings Magnetic Separator Co., Milwaukee, Wis., have recently issued catalogue No. 11, entitled "Magnetic Separation in the Laboratory," describing the work carried on in the company's magnetic analysis laboratory and the equipment available for mining, metallurgical, and research laboratories. It includes data on magnetic tube testers, wet-type, cross-belt, and induced-roll separators, and gives details on submitting samples of everything from abrasives to soybeans to the Dings Laboratory for magnetic analysis.

LELAND CHANGES

The board of directors of Leland Electric Canada Ltd. held their annual meeting at Guelph recently and made several important changes in the officials of the company.

W. F. Lisman was elected president; G. Ernest Robertson was made vice-president, while still retaining the general managership of the company; G. R. Gaskell was elected secretary-treasurer.

G. Ernest Robertson

THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 27 | MONTREAL, JULY 1944 | NUMBER 7

"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

★ ★ ★

PUBLISHED MONTHLY BY

THE ENGINEERING INSTITUTE OF CANADA

2050 MANSFIELD STREET - MONTREAL

Price 50 cents a copy, $3.00 a year: in Canada, British Possessions, United States and Mexico. $4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, $2.00 a year. —Entered at the Post Office, Montreal, as Second Class Matter.

CONTENTS

A Corner of the High Voltage Laboratory, The English Electric Company, Limited, England . . . . Cover

SOME STRUCTURAL DESIGN FEATURES OF THE POLYMER CORPORATION STEAM POWER PLANT 394
J. H. Ings, M.E.I.C., and J. Hrilivitsky

ELECTRIC SYSTEMS IN MILITARY EXPLOSIVE PLANTS. . 400
J. R. Auld, M.E.I.C.

IMPROVED SOIL STABILIZATION 413
Guillaume Piette, Jr.E.I.C.

EMERGENCY REFRIGERATION OF CARGO SPACES. . . 419
W. H. Cook, M.Sc., Ph.D.

MONTH TO MONTH 421

PERSONALS 432

Obituaries 434

NEWS OF THE BRANCHES 435

LIBRARY NOTES 437

PRELIMINARY NOTICE 439

EMPLOYMENT SERVICE 441

INDUSTRIAL NEWS 442

THE ENGINEERING INSTITUTE OF CANADA

MEMBERS OF COUNCIL - 1944

PRESIDENT

deGASPÉ BEAUBIEN, Montreal, Que.

PAST-PRESIDENTS

*C. J. MACKENZIE, Ottawa, Ont.
‡K. M. CAMERON, Ottawa, Ont.
†C. R. YOUNG, Toronto, Ont.

VICE-PRESIDENTS

*W. P. BRERETON, Winnipeg, Man.
†G. L. DICKSON, Moncton, N.B.
†J. M. FLEMING, Port Arthur, Ont.
*L. F. GRANT, Kingston, Ont.
*C. K. McLEOD, Montreal, Que.
†E. B. WARDLE, Grand'Mère, Que.

COUNCILLORS

*J. E. ARMSTRONG, Montreal, Que.
*H. E. BRANDON, Toronto, Ont.
†H. L. BRIGGS, Winnipeg, Man.
*A. E. CAMERON, Halifax, N.S.
‡R. S. EADIE, Montreal, Que.
*J. W. D. FARRELL, Regina, Sask.
†G. H. FERGUSON, Ottawa, Ont.
†E. V. GAGE, Montreal, Que.
†P. E. GAGNON, Quebec, Que.
*R. E. HEARTZ, Montreal, Que.
*A. JACKSON, Kingston, Ont.
†J. A. LALONDE, Montreal, Que.
†ALEX. LOVE, Hamilton, Ont.
†P. A. LOVETT, Halifax, N.S.
A. M. MACGILLIVRAY, Antigonish Harbour, N.S.
*N. B. MacROSTIE, Ottawa, Ont.
†J. McMILLAN, Calgary, Alta.
*A. W. F. McQUEEN, Niagara Falls, Ont.
†E. B. MARTIN, Moncton, N.B.
*G. E. MEDLAR, Windsor, Ont.
†W. MELDRUM, Lethbridge, Alta.
*J. P. MOONEY, Saint John, N.B.
†A. S. G. MUSGRAVE, Oak Bay, B.C.
NELSON, Edmonton, Alta.
*H. G. O'LEARY, Fort William, Ont.
‡P. E. POITRAS, Montreal, Que.
†J. A. RUSSELL, Sydney, N.S.
*C. SCRYMGEOUR, Dartmouth, N.S.
†H. R. SILLS, Peterborough, Ont.
†C. STENBOL, Sault Ste. Marie, Ont.
*E. O. TURNER, Fredericton, N.B.
*J. A. VANCE, Woodstock, Ont.
*H. J. WARD, Shawinigan Falls, Que.
*J. W. WARD, Arvida, Que.
*C. E. WEBB, Vancouver, B.C.
†W. S. WILSON, Toronto, Ont.

*For 1944. †For 1944-45. ‡For 1944-45-46.

TREASURER

F. C. MECHIN, Montreal, Que.

GENERAL SECRETARY

L. AUSTIN WRIGHT, Montreal, Que.

SECRETARY-EMERITUS

R. J. DURLEY, Montreal, Que.

ASSISTANT GENERAL SECRETARY

LOUIS TRUDEL, Montreal, Que.

STANDING COMMITTEES

FINANCE
C. K. McLEOD, *Chairman*
J. E. ARMSTRONG
G. A. GAHERTY
F. C. MECHIN
R. M. CALVIN

LEGISLATION
P. E. POITRAS, *Chairman*
F. J. BLAIR
R. J. DURLEY

PAPERS
L. F. GRANT, *Chairman*

LIBRARY AND HOUSE
E. V. GAGE, *Chairman*
A. T. BONE
J. S. HEWSON
M. S. NELSON
G. V. RONEY

PUBLICATION
R. S. EADIE, *Chairman*
R. DeL. FRENCH, *Vice-Chairman*
R. C. FLITTON
J. A. OUIMET
C. A. PEACHEY

SPECIAL COMMITTEES

BOARD OF EXAMINERS
R. A. SPENCER, *Chairman*
I. M. FRASER
W. E. LOVELL
A. P. LINTON
H. R. MacKENZIE
E. K. PHILLIPS

GZOWSKI MEDAL
T. H. JENKINS, *Chairman*
E. G. M. CAPE
V. A. McKILLOP
W. H. POWELL
E. O. TURNER

DUGGAN MEDAL AND PRIZE
W. J. W. REID, *Chairman*
R. C. FLITTON
H. M. WHITE

PLUMMER MEDAL
P. E. GAGNON, *Chairman*

LEONARD MEDAL
F. V. SEIBERT, *Chairman*
A. E. MacRAE
D. H. McDOUGALL
G. W. WADDINGTON

JULIAN C. SMITH MEDAL
deGASPÉ BEAUBIEN, *Chairman*
C. J. MACKENZIE
C. R. YOUNG

MEMBERSHIP
J. G. HALL, *Chairman*
S. R. FROST
N. MacNICOL

PROFESSIONAL INTERESTS
J. B. CHALLIES, *Chairman*
J. E. ARMSTRONG, *Vice-Chairman*
G. A. GAHERTY,
A. SURVEYER
J. A. VANCE

STUDENTS' AND JUNIORS' PRIZES

H. N. Ruttan Prize—Western Provinces
W. P. BRERETON, *Chairman*
A. M. MACGILLIVRAY
C. E. WEBB

John Galbraith Prize—Province of Ontario
J. M. FLEMING, *Chairman*
H. E. BRANDON
A. W. F. McQUEEN

Phelps Johnson Prize—Province of Quebec (English)
C. K. McLEOD, *Chairman*
E. V. GAGE
R. E. HEARTZ

Ernest Marceau Prize—Province of Quebec (French)
E. B. WARDLE, *Chairman*
P. E. GAGNON
P. E. POITRAS

Martin Murphy Prize—Maritime Provinces
G. L. DICKSON, *Chairman*
J. P. MOONEY
C. SCRYMGEOUR

INTERNATIONAL RELATIONS
M. J. McHENRY, *Chairman*
E. A. ALLCUT
A. E. BERRY
C. P. EDWARDS
D. H. McDOUGALL
C. SCRYMGEOUR
L. E. WESTMAN

WESTERN WATER PROBLEMS
G. A. GAHERTY, *Chairman*
C. H. ATTWOOD
L. C. CHARLESWORTH
A. GRIFFIN
D. W. HAYS
G. N. HOUSTON
T. H. HOGG
C. J. MACKENZIE
H. J. McLEAN
F. H. PETERS
S. G. PORTER
P. M. SAUDER
J. M. WARDLE

THE YOUNG ENGINEER
H. F. BENNETT, *Chairman*
C. G. R. ARMSTRONG
J. BENOIT
J. B. deHART
RENE DUPUIS
J. N. FINLAYSON
R. F. LEGGET
A. E. FLYNN
R. DeL. FRENCH
A. JACKSON
G. R. LANGLEY
A. E. MACDONALD
H. W. McKIEL
D. A. R. McCANNEL

ENGINEERING FEATURES OF CIVIL DEFENCE
J. E. ARMSTRONG, *Chairman*
P. E. ADAMS
J. N. ANDERSON
S. R. BANKS
H. F. BENNETT
W. D. BRACKEN
W. P. BRERETON
J. M. DAVIDSON
R. S. EADIE
E. V. GAGE
G. A. GAHERTY
R. J. GIBB
A. GRAY
J. GRIEVE
J. L. LANG
R. F. LEGGET
I. P. MACNAB
J. A. McCRORY
H. J. McEWEN
C. B. MUIR
W. H. MUNRO
J. A. A. PICHÉ
G. MacL. PITTS
C. J. PORTER
M. G. SAUNDERS
W. O. SCOTT
T. G. TYRER
H. K. WYMAN

INDUSTRIAL RELATIONS
WILLS MACLACHLAN, *Chairman*
E. A. ALLCUT
J. P. BRIERLEY
J. C. CAMERON
E. R. COMPLIN
J. A. COOTE
RENÉ DUPUIS
T. W. EADIE
S. M. GOSSAGE
F. W. GRAY
E. G. HEWSON
I. F. McRAE
W. H. MUNRO
W. J. W. REID

DETERIORATION OF CONCRETE STRUCTURES
R. B. YOUNG, *Chairman*
E. VIENS, *Vice-Chairman*
G. P. F. BOESE
A. G. FLEMING
W. G. C. GLIDDON
J. A. McCRORY
C. J. MACKENZIE
J. H. McKINNEY
R. M. SMITH

THE ENGINEERING INSTITUTE OF CANADA

OFFICERS OF BRANCHES

BORDER CITIES
Chairman, J. B. DOWLER
Vice-Chair., A. H. MacQUARRIE
Executive, G. W. LUSBY J. M. WYLLIE
J. F. G. BLOWEY
(Ex-Officio), G. E. MEDLAR
G. G. HENDERSON
Sec.-Treas., W. R. STICKNEY,
1614 Ontario Street,
Walkerville, Ont.

CALGARY
Chairman, H. B. LeBOURVEAU
Executive, J. V. ROGERS F. C. TEMPEST
P. F. PEELE J. LANGSTON
(Ex-Officio) J. McMILLAN
S. G. COULTIS
J. G. MacGREGOR
K. W. MITCHELL
Sec.-Treas., A. B. GEDDES,
4716 Elbow Drive,
Calgary, Alta.

CAPE BRETON
Chairman, M. F. COSSITT
Executive, M. R. CHAPPELL
J. R. MORRISON
(Ex-Officio), J. A. MACLEOD
J. A. RUSSELL
Sec.-Treas., S. G. NAISH
Peacock Brothers Ltd..
Moore Bldg., Sydney, N.S.

EDMONTON
Chairman, B. W. PITFIELD
Vice-Chair., J. W. JUDGE
Executive, H. W. TYE
I. F. MORRISON
J. D. A. MACDONALD
J. E. B. CRANSWICK
R. SCOTT
R. H. LINKE
(Ex-Officio), E. NELSON
C. W. CARRY
F. R. BURFIELD
Sec.-Treas., G. H. MILLIGAN
Calgary Power Company,
214 McLeod Bldg.,
Edmonton, Alta.

HALIFAX
Chairman, G. J. CURRIE
Executive, R. J. BETHUNE J. W. MARCH
J. E. CLARKE C. D. MARTIN
K. L. DAWSON L. E. MITCHELL
D. C. V. DUFF H. A. RIPLEY
J. H. M. JONES R. B. STEWART
(Ex-Officio), A. E. FLYNN A. E. CAMERON
C. SCRYMGEOUR
P. A. LOVETT
Sec.-Treas., S. W. GRAY,
Wartime Bureau of Technical
Personnel, 84 Hollis Street,
Halifax, N.S.

HAMILTON
Chairman, H. A. COOCH
Vice-Chair., NORMAN EAGER
Executive, C. H. HUTTON
H. J. A. CHAMBERS
R. J. G. SCHOFIELD
A. R. HANNAFORD
(Ex-Officio), ALEX. LOVE T. S. GLOVER
Sec.-Treas., W. E. BROWN,
91 Barnesdale Blvd.,
Hamilton, Ont.

KINGSTON
Chairman, S. D. LASH
Vice-Chair., J. R. CARTER
Executive, F. A. ATHEY C. E. CRAIG
J. D. CALVIN H. D. ROGERS
(Ex-Officio), L. F. GRANT
A. JACKSON
K. M. WINSLOW
Sec.-Treas., J. DOUGLAS LEE,
Queen's University,
Kingston, Ont.

LAKEHEAD
Chairman, S. T. McCAVOUR
Vice-Chair., W. C. BYERS
Executive, S. E. FLOOK
E. L. GOODALL
O. J. KOREEN
W. H. SMALL
A. D. NORTON
W. E. MACLENNAN
J. LUNDIE
S. C. WILCOX
(Ex-Officio), R. B. CHANDLER
J. M. FLEMING
H. G. O'LEARY
Sec.-Treas., J. I. CARMICHAEL
367 N. Syndicate Ave.,
Fort William, Ont.

LETHBRIDGE
Chairman, A. L. H. SOMERVILLE
Executive, J. M. CAMPBELL
A. G. DONALDSON
P. E. KIRKPATRICK
R. S. LAWRENCE
(Ex-Officio), W. MELDRUM
Sec.-Treas., T. O. NEUMANN
Dept. of Transport,
Post Office Building,
Lethbridge, Alta.

LONDON
Chairman, R. S. CHARLES
Vice-Chair., H. G. STEAD
Executive, E. B. ALLEN
F. C. BALL
H. F. BENNETT
V. A. McKILLOP
G. N. SCROGGIE
(Ex-Officio), T. L. McMANAMNA
J. A. VANCE
Sec.-Treas, A. L. FURANNA,
732 Wellington Street,
London, Ont.

MONCTON
Chairman, A. S. DONALD
Vice-Chair., H. W. HOLE
Executive, H. J. CRUDGE A. GORDON
T. H. DICKSON E. C. PERCY
E. R. EVANS G. E. SMITH
(Ex-Officio), G. L. DICKSON
J. A. GODFREY
E. B. MARTIN
Sec.-Treas., V. C. BLACKETT,
Engrg. Dept., C.N.R.,
Moncton, N.B.

MONTREAL
Chairman, C. C. LINDSAY
Vice-Chair., J. B. STIRLING
Executive, C. E. GÉLINAS J. BENOIT
K. G. CAMERON L. H. BURPEE
G. H. MIDGLEY
M. S. MACGILLIVRAY
(Ex-Officio), deGASPÉ BEAUBIEN
C. K. McLEOD
J. E. ARMSTRONG
R. S. EADIE J. A. LALONDE
E. V. GAGE P. E. POITRAS
R. E. HEARTZ
Sec.-Treas., L. A. DUCHASTEL,
40 Kelvin Avenue,
Outremont, Que.

NIAGARA PENINSULA
Chairman, W. D. BRACKEN
Vice-Chair., A. G. HERR
Executive, M. H. JONES
A. D. SMITH
H. E. BARNETT
J. W. BROOKS
W. D. BROWNLEE
P. E. BUSS L. J. RUSSELL
(Ex-Officio), A. W. F. McQUEEN
G. E. GRIFFITHS
J. H. INGS
2135 Culp Street,
Niagara Falls, Ont.

OTTAWA
Chairman, W. L. SAUNDERS
Executive, W. H. B. BEVAN
J. H. BYRNE
D. G. KILBURN
J. M. WARDLE
C. D. WIGHT
(Ex-Officio), K. M. CAMERON
G. H. FERGUSON
N. B. MacROSTIE
Sec.-Treas., A. A. SWINNERTON,
Dept. of Mines & Resources,
Ottawa, Ont.

PETERBOROUGH
Chairman, C. R. WHITTEMORE
Executive, R. L. DOBBIN
A. L. MALBY
F. R. POPE
A. J. GIRDWOOD
W. T. FANJOY
(Ex-Officio), A. R. JONES
H. R. SILLS
Sec.-Treas., E. WHITELEY,
611 Weller Street,
Peterborough, Ont.

QUEBEC
Life Hon. Chair., A. R. DÉCARY
Chairman, E. D. GRAY-DONALD
Vice-Chair., J. O. MARTINEAU
Executive, A. E. PARÉ
CHARLES LEMIEUX
Y. R. TASSÉ W. J. MANNING
L. MARTIN J. M. PAQUET
(Ex-Officio), P. E. GAGNON
RENÉ DUPUIS
P. MÉTHÉ
PAUL VINCENT
Sec.-Treas., GUSTAVE F. ST-JACQUES
Public Service Board of
the Province of Quebec,
Court House,
Quebec, Que.

SAGUENAY
Chairman, CHAS. MILLER
Vice-Chair., G. B. MOXON
Executive, J. FRISCH W. E. COOPER
F. T. BOUTILIER
(Ex-Officio), R. H. RIMMER J. W. WARD
ALEX. T. CAIRNCROSS
Sec.-Treas., ALEX. T. CAIRNCROSS,
8-C Brittany Row,
Arvida, Que.

SAINT JOHN
Chairman, C. D. McALLISTER
Vice-Chair., J. M. LAMB
Executive, G. M. BROWN
W. J. LAWSON
H. A. STEPHENSON
R. M. RICHARDSON
(Ex-Officio), J. P. MOONEY
A. O. WOLFF
F. A. PATRIQUEN
E. O. TURNER
Sec.-Treas., L. O. CASS,
National Harbour Board,
P.O. Box 1393,
Saint John, N.B.

ST. MAURICE VALLEY
Chairman, R. DORION
Vice-Chair., H. K. WYMAN
Executive, G. B. BAXTER
A. G. JACQUES
A. W. PETERS
H. J. RACEY
M. EATON
W. E. A. McLEISH
W. H. HARVEY
J. JOYAL
E. E. WHEATLEY
(Ex-Officio), J. H. FREGEAU
H. J. WARD
E. B. WARDLE
Sec.-Treas., A. TRUDEL,
208-5th Avenue,
Shawinigan Falls, Que.

SASKATCHEWAN
Chairman, J. McD. PATTON
Vice-Chair., N. B. HUTCHEON
Executive, F. C. CHRISTIE
G. W. PARKINSON
W. B. RAMSAY
F. E. ESTLIN
E. K. PHILLIPS
J. I. STRONG
(Ex-Officio), J. W. D. FARRELL
Sec.-Treas., STEWART YOUNG,
P.O. Box 101, Regina, Sask.

SAULT STE. MARIE
Chairman, A. M. WILSON
Vice-Chair., G. W. McLEOD
Executive, G. W. HOLDER
C. O. MADDOCK
H. W. SUTCLIFFE
(Ex-Officio), N. C. COWIE
C. STENBOL
Sec.-Treas., T. F. RAHILLY,
174 Pim Street,
Sault Ste. Marie, Ont.

TORONTO
Chairman, S. R. FROST
Vice-Chair., C. F. MORRISON
Executive, C. D. CARRUTHERS
E. A. CROSS
D. G. GEIGER
A. H. HULL
R. F. LEGGET
J. F. McLAREN
(Ex-Officio), H. E. BRANDON
W. S. WILSON
C. R. YOUNG
W. H. M. LAUGHLIN
F. A. DAVIS
Sec.-Treas., S. H. deJONG,
Dept. of Civil Engineering,
University of Toronto,
Toronto, Ont.

VANCOUVER
Chairman, T V. BERRY
Vice-Chair., A. PEEBLES
Executive, J. P. FRASER F. H. BALLOU
E. S. JONES R. C. PYBUS
G. W. ALLAN J. A. TAMES
(Ex-Officio), C. E. WEBB
W. N. KELLY
Sec Treas., P. B. STROYAN,
2099 Beach Avenue,
Vancouver, B.C.

VICTORIA
Chairman, H. L. SHERWOOD
Vice-Chair., A. L. FORD
Executive, P. B. HUGHES
C. M. TRIPP
S. R. WESTON
J. N. ANDERSON
(Ex-Officio), A. S. G. MUSGRAVE
KENNETH REID
Sec.-Treas., R. BOWERING,
41 Gorge Road West,
Victoria, B.C.

WINNIPEG
Chairman, T. H KIRBY
Vice-Chair., C. P. HALTALIN
Executive, B. B. HOGARTH N. M. HALL
R. A. SARA W. F. RIDDELL
E. V. CATON
(Ex-Officio), W. P. BRERETON
H. L. BRIGGS
J. T. DYMENT,
Sec.-Treas., T. E. STOREY,
55 Princess Street,
Winnipeg, Man.

SOME STRUCTURAL DESIGN FEATURES OF THE POLYMER CORPORATION STEAM POWER PLANT

J. H. INGS, M.E.I.C. and J. HVILIVITZKY

Designing Engineers, H. G. Acres & Company, Niagara Falls, Ont.

As its title implies, the object of this article is to describe some phases of the design of a steam power plant, the largest of its kind in Canada and one of the largest on the continent.

A building had to be provided to house five boilers and space for a sixth, if necessary, a water treating plant, power generating units, numerous steam and electrical control stations, and to support all the equipment. In addition, convenient operating levels had to be established that would take into consideration ordinary maintenance and the occasional moving in or out of rather large and bulky pieces of equipment.

Because of the continuous progress in steam and power engineering there is no end to improvements and changes that can be made in an operating steam plant. This, of course, very often entails the fitting of new equipment into an existing frame; which may become a problem when adequate provision has not been made accordingly. Hence, in steam power plant work, it is good practice to use a structural steel frame which provides a high degree of flexibility for reframing. Such reframing can easily be accomplished with the help of cutting and welding torches.

But, unfortunately, when faced with war emergencies, an engineer frequently can be no chooser of best materials or best practice. Adaptability to existing conditions is perhaps the major requirement of good wartime engineering.

The construction of this plant began in 1942, in the days when steel was designated for ships and munitions, and structural steel could not be used for building. This naturally led the designers to select reinforced concrete as the material for the structural frame, thus allowing an early start of the job, but, of course, creating a number of additional problems for the designers. The function of the plant is to supply steam and power for the manufacture of synthetic rubber, a material of utmost importance to war industries; hence, the schedules set for the whole job did not leave much time for preliminary studies and layouts which, under ordinary conditions, would have preceded a job of this nature.

As a matter of fact, the foundations were poured before the designers had a complete picture of the mechanical layouts, and so a good deal of foresight and judgment was required for the making of rational structural assumptions.

One can form a fair idea of the structure from a few figures. The building is 286 ft. long by 173 ft. wide and 122 ft. high. The structure required some 23,000 cu. yd. of concrete, over 1,000,000 sq. ft. of forms, and 110,000 sq. ft. of masonry.

The first attempt at the design was made in July 1942, excavations completed the following September, the building closed in the spring of 1943, and the first boiler installed and ready to deliver steam on September 17th, 1943, almost exactly twelve months from the day the sod was first turned. A view of the almost completed steam and powerhouse is shown in Fig. 1.

Foundations

Soil investigation was quite exhaustive, consisting of deep borings, laboratory analysis and loading tests. The soil structure can be described as consisting of a ten-foot layer of a well packed, hard brown clay with a considerable admixture of granular material. This brown clay is super-imposed on a thick stratum (75 to 100 ft.) of a highly plastic and unstable blue clay. The latter material if used to support foundations would require some form of stabilizing, and even then its bearing value would be extremely low. Hence the obvious choice was to carry the structure on the top layer of brown clay.

The loading tests on brown clay were carried on with 1,000 lb. increments of load up to 20,000 lb. per sq. ft., at which loading the settlement did not exceed 5/16 in. This fact, combined with the behaviour of the soil at lower loadings, led the designers to establish a permissible designing soil value of 5,000 lb. per sq. ft. This figure, which at first glance appears somewhat on the low side, has its justification in the fact that, because of a high percentage of the load on the footings being live load distributed over a large number of columns, there arose the problem of providing for unequal settlements in different portions of the structure.

The problem can be summarized as a case of a large number of columns with a considerable variation of spacing and live load, and a comparatively low bearing value of soil. Therefore the job logically lent itself to a raft type of foundation, which turned out to be a 3 ft. thick mat with a series of inverted beams built on top, the beams being T-beams in the centre and rectangular beams at the columns.

This type of foundation proved to be an easy and speedy form of construction. The excavation, consisting of scooping out the entire building area to required depth, was a cheap and a fast operation as performed by Le Tourneau scrapers. A 3-in. unreinforced concrete slab was poured at the bottom of the excavated pit, thus providing a clean and hard working surface for setting up forms, carting concrete, and excluding dirt and foreign matter from the foundation mat concrete. It also prevented the trucks from churning the surface into mud during the wet fall season.

Because of the size of the area and the amount of concrete involved in a continuous pour, the foundation

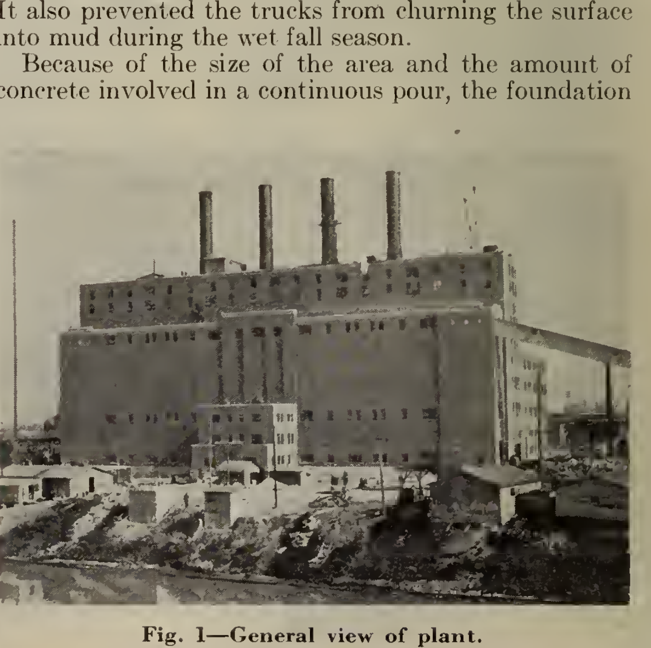


Fig. 1—General view of plant.

mat had to be divided into panels that fitted the daily production of the central mixing plant, some 600 cu. yd. per day. Expansion joints and shear keys were provided between panels.

Upon completion of the building, and from the time the first boiler went into operation, regular fortnightly readings were taken in order to establish the rate of settlement of the structure. Figure 2 shows the settlement curve, which indicates that a definite decrease in rate of settlement occurred sometime last spring. This coincided with the completion of installation of major equipment, the filling up of the coal bunkers, and the start up of all rotating equipment transferring a certain amount of impact to the soil. The curve for the last two months is definitely approaching a horizontal straight line, and it is reasonable to assume that the initial settlement of the structure has already taken place and that no distortion of the structure need be anticipated.

It should be noted at this point that a careful examination indicated that neither the concrete frame nor the masonry show any cracks that could in any way be traced to differential settlement.

The typical cross-section through the plant, shown in Fig. 3, not only illustrates the type of foundation, but also shows the various structural areas that are discussed in the paper.

Boiler Suspension

One of the most unusual features of design was the method of boiler suspension. In the usual layout this type of boiler is supported on its own columns, which are structurally independent of the main building frame. For this job it would have meant at least four extra columns for each boiler, each of which would have had to be 96 ft. high and be located right beside a building column.

To avoid cutting down clearances, to minimize the use of a critical material, and for general simplification it was decided to suspend the boilers from the main reinforced concrete building frame. The main complication arising out of this decision was the necessity of providing for boiler expansion and contraction.

The solution was to erect a steel suspension frame anchored to the concrete framework at the rear of the boiler, and to concentrate all movement at the front boiler suspension beam. This steel beam in turn rested on a special expansion bearing plate carried on concrete brackets cast into the column tops. This feature is illustrated in Fig. 4, and deserves some special mention.

The end load applied at each end of the boiler beam amounted to 282 kips. Assuming a conservative coefficient of friction of 0.3, this meant that a horizontal pull of 84.6 kips had to be taken up by the lower bearing plate. To care for this, two tie rods $2\frac{1}{4}$ in. dia. were used, attached as shown, to opposite bearings. Bolt stress resulting was 14,000 lb. per sq. in. This placing of contractions in opposition to each other relieved the reinforced concrete of heavy tensions and bending moments. On the other hand, expansions due to boiler heat were opposed to each other through the concrete strut beam which spans the bay between the column tops. To prevent the freezing of expansion surfaces a copper plate was used between the steel surfaces.

Vertically the concrete bracket has to take a total load of 285.3 kips, and the bracket was limited in size by the required clearances of the nearby boiler, but by a few adjustments it was possible to work in a bracket 1 ft. 6 in. long, 2 ft. 8 in. wide and 8 ft. deep. The resulting shear of 110 lb. per sq. in. was allowable

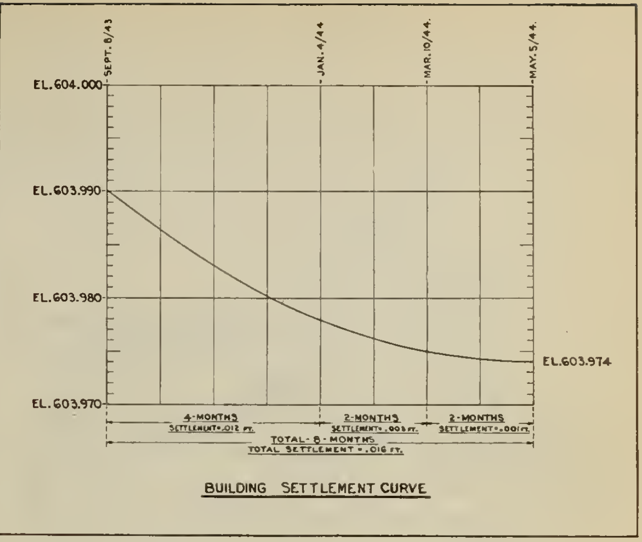


Fig. 2—Settlement graph

using 3,500 lb. per sq. in. concrete and plenty of stirrups, it being obvious that bond governed. To keep within a bond stress of 140 lb. per sq. in. a series of $1\frac{1}{8}$ in. and 1 in. square closed loops were used. The size of the lower bearing plate kept bearing stresses on concrete down to 630 lb. per sq. in.

The above paragraph is based on ordinary cantilever analysis, and one may ask with some justice whether or not a bracket eight feet deep acts as a cantilever at all. The physical situation is somewhat analogous to the case of load on a dam pier gate check. This case has been studied by others both analytically and by photoelastic analysis.

Assuming the cases to be similar, our boiler support bracket has a load of 103,000 lb. per foot of width and, if considered as acting at the centre of gravity, is 0.75 ft. from the outer face. Maximum intensity of tension stress occurs under the load about 4.8 in. down from the surface and amounts to 315 lb. per sq. in. which obviously indicates tension reinforcement.

The total tension amounts to about 36,700 lb. and will require 1.83 sq. in. of steel per foot of bracket.

This amount has been more than amply supplied, and furthermore the heavier $1\frac{1}{8}$ in. square loops are spaced in the area of maximum intensity, the remaining 1 in. dia. loops being spaced out over the rest of the tension diagram.

It was realized, of course, that the actual movement of the upper bearing plate would be to some extent a diagonal one. This will throw some shear into the tie rods, requiring side clearances as well as longitudinal clearances on the plates.

After the boilers were steaming, micrometre measurements of the upper bearing plate movement were made. These indicated the bearing to be functioning as desired, with most of the movement in a direction parallel to the tie rods.

Fan Floor

The fan floor, at elevation 696 ft. 7 in., could not be treated in the usual manner as the loadings and construction procedure made the design problems entirely different from the ordinary floor job.

The method of boiler suspension adopted necessitated the use of very large beams to carry the heavy load concentrations; the framework of the floor must carry and dissipate large expansion and contraction forces, and also, because of boiler erection procedure, it was

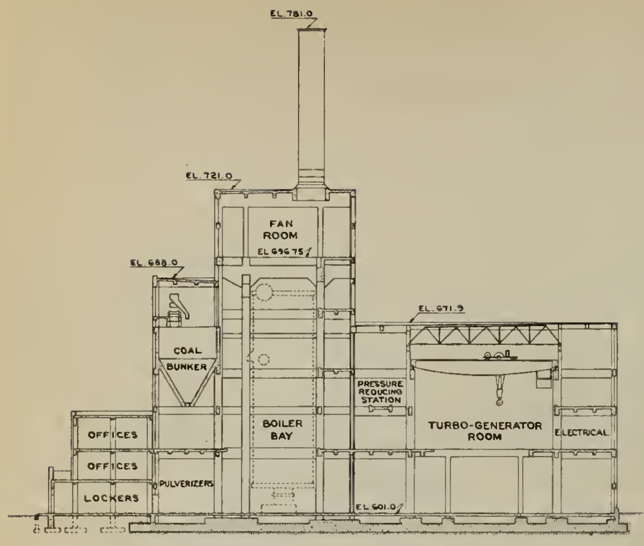


Fig. 3—Typical cross section.

necessary to pour the floor in several lifts. That is, the heavy framework of primary beams was poured first, then part of the boilers erected and then the secondary beams and slabs were poured, and finally the floor over the boiler tops.

This is illustrated by Fig. 5 which shows a part plan and elevation of one end of the fan floor.

The heavy boiler suspension loads being located at the top of 96-ft. columns, it was considered desirable that the whole fan floor framework be made extremely stiff, allowing at the same time for the erection of the boilers in any order.

The lower framework of heavy primary beams was designed by the moment distribution method, which also gave a quick appraisal of the bending moments in the columns above and below.

As an illustration of the procedure involved, a typical analysis is shown on the diagram in Fig. 6.

The figures on the diagram are the stiffness factors of the members. The beam has a uniform load over its entire length and the portion from D to C has in addition ten concentrations varying from 10 to 95 kips and at varied spacings. The letters indicate column rows. The moment distribution is given in Table I.

Having found the final end moments it is an easy next step to compute the positive moments, compare the various loading cases, and establish maximum moments for reinforced concrete design.

The design of the second pour or upper lift of this floor presented no unusual problems. It is a beam and slab structure, resting on the primary beam and carrying forced and induced-draft fans, boiler breeching, motor bases and miscellaneous piping.

The necessary provision of a construction joint on a vertical plane between the bunker and boiler bays created a minor problem in that some of the fan floor beams had to be designed as temporary cantilevers, to be later turned into regular beams as the bunkers and their columns were constructed up to the fan floor level.

The heavy type of construction used for this floor is well shown in Fig. 7, which was taken to show the beams and columns under the fan floor.

Coal Bunkers

The design of the reinforced concrete coal bunkers was, from a structural point of view, one of the most interesting features of the whole building. The selection of reinforced concrete as the structural material was dictated by the scarcity of critical materials due to wartime conditions.

The bunkers extend in a row of twelve pockets along the length of the boilers, each pocket being about 21 ft. square, with the hopper bottom at elevation 641 and the top of bunker at elevation 670.75 (See Fig. 3). Each pocket has a capacity of approximately 200 tons of coal, and as there are two pockets per boiler, this is sufficient to last about 30 hours depending, of course, upon the quality of the coal being used.

The method of supporting the hoppered bottoms of the bunkers was given considerable study and several types of support were given a rough preliminary design. Finally, in spite of the large size, a suspended hopper was chosen as being the simplest structural form both for design and appearance.

SUSPENDED HOPPER DESIGN

Because the location of the pulverizers and coal scales were governed by the boilers, it was necessary to make the hoppers unsymmetrical, that is, the outlets at the discharge gates were not concentric with the upper portion of the bunkers.

Therefore, in designing, the hopper slab with the 50 deg. slope was used, as this gave the severest loading. Unit stresses were kept low to care for impact and to cut down hair cracks.

TABLE I

TYPICAL MOMENT DISTRIBUTION TABULATION

	Col. A	Col. B	Bm	Bm	Col. A	Col. B	Bm	Bm	Col. B	Col. A	Bm	Bm	Col. B	Col. A
K/ΣK	.01	.03	.96	.56	.02	.18	.24	.23	.15	.01	.61	.90	.09	.01
F.E.M.	—	—	+18	−18	—	—	+642	−970	—	—	+13	−13	—	—
Dist.	0	−1	−17	−350	−12	−112	−150	+220	+143	+10	+582	+12	+1	0
C.O.	—	—	−175	−9	—	—	+110	−75	—	—	+6	+291	—	—
Dist.	+2	+5	+168	−57	−2	−18	−24	+16	+10	+1	+42	−262	−26	−3
C.O.	—	—	−28	+84	—	—	+8	−12	—	—	−131	+21	—	—
Dist.	0	+1	+27	−51	−2	−17	−22	+33	+21	+1	+87	−19	−2	0
C.O.	—	—	−25	+13	—	—	+16	−11	—	—	−9	+43	—	—
Dist.	0	+1	+24	−16	−1	−5	−7	+5	+3	—	+12	−39	−4	0
C.O.	—	—	−8	+12	—	—	+2	−3	—	—	−20	+6	—	—
Dist.	0	0	+8	−8	0	0	−4	+5	+3	+1	+14	−5	−1	0
Totals	+2	+6	−8	−400	−17	−153	+571	−792	+160	+33	+596	+35	−32	−3

(a) Direct tension reinforcement:

Weight of coal in bunker	400,000 lb.
Weight of inclined slabs	181,000 lb.
Weight of hopper bottom and gate	1,400 lb.
Total—about	582,000 lb.

Then with a total hopper top perimeter of about 84 ft. the tension per foot will be:

$$T = 6960 \; cosec \; 50 = 9100 \text{ lb.}$$

and the required $A_s = 9100/16{,}000 = 0.57$ sq. in. per ft.

(b) Pyramid bottom acting as slab:—

The normal pressure on the slab is obtained from the formula:—

$$p_n = wh(cos^2\theta + \frac{1 - sin\phi}{1 + sin\phi} \times sin^2\theta) = whK$$

Where h = height from coal surface to point
ϕ = angle of repose
θ = angle of slab slope with horizontal
w = unit weight of coal.

Thus values of p_n can be tabulated for each foot change in h or elevation. Similarily values of

$$p_h = wh \left(\frac{1 - sin\theta}{1 + sin\theta}\right) \text{ may be tabulated also.}$$

With the hopper thickness used, plus two inches of gunite lining, the slab normal weight is 187 lb. per sq. ft.

Now at any horizontal elevation the sloping hopper slabs will form a closed ring, and between faces each slab forms a beam with a bending moment, $M = \frac{wl^2}{12}$ where $w = p_n + 187$.

Again on a vertical section through the hopper, there will be tension from the effect of p_n tending to burst the hopper. The value of this tension is $T = p_h \times l/2$, where l is the span parallel to the vertical section.

The moment of this tension about the centre of the reinforcing steel reduces the gross bending moment. The required horizontal reinforcing steel is therefore that required to resist the net bending moment plus that required for tension.

For instance, suppose at a given elevation that we have:—

$h = 18.5$ ft. $\quad l = 20$ ft. $\quad$ coal = 50 lb. per cu. ft.
$p_n = 527 \quad p_h = 250 \quad d = 11.5$ in.

Then we will have $w = 527 + 187 = 714$.

$$\text{Gross bending moment} = \frac{wl^2}{12} = \frac{714 \times 20^2}{12} = 23{,}800 \text{ ft. lb.}$$

$$\text{Horizontal tension, } T = \frac{p_h \times l}{2} = \frac{250 \times 20}{2} = 2500 \text{ lb.}$$

$$\text{Net bending moment} = 23{,}800 - \frac{2500 \times 5.75}{12} =$$

22,600 ft. lb.

Steel required is $A_s = A_1 + A_2$

$$A_1 = \frac{M}{ad} = \frac{22600}{1.44 \times 11.5} = 1.36 \text{ sq. in.}$$

$$A_2 = \frac{T}{f} = \frac{2500}{16000} = 0.16 \text{ sq. in.}$$

And total $A_s = 1.52$ sq. in.

Check the unit shears and bond.

The above type of data was worked out and tabulated for enough elevations to establish zones of equal bar sizes and spacings. This will inevitably over-reinforce the upper limits of eash zone selected, but will simplify the layout and placing of bars.

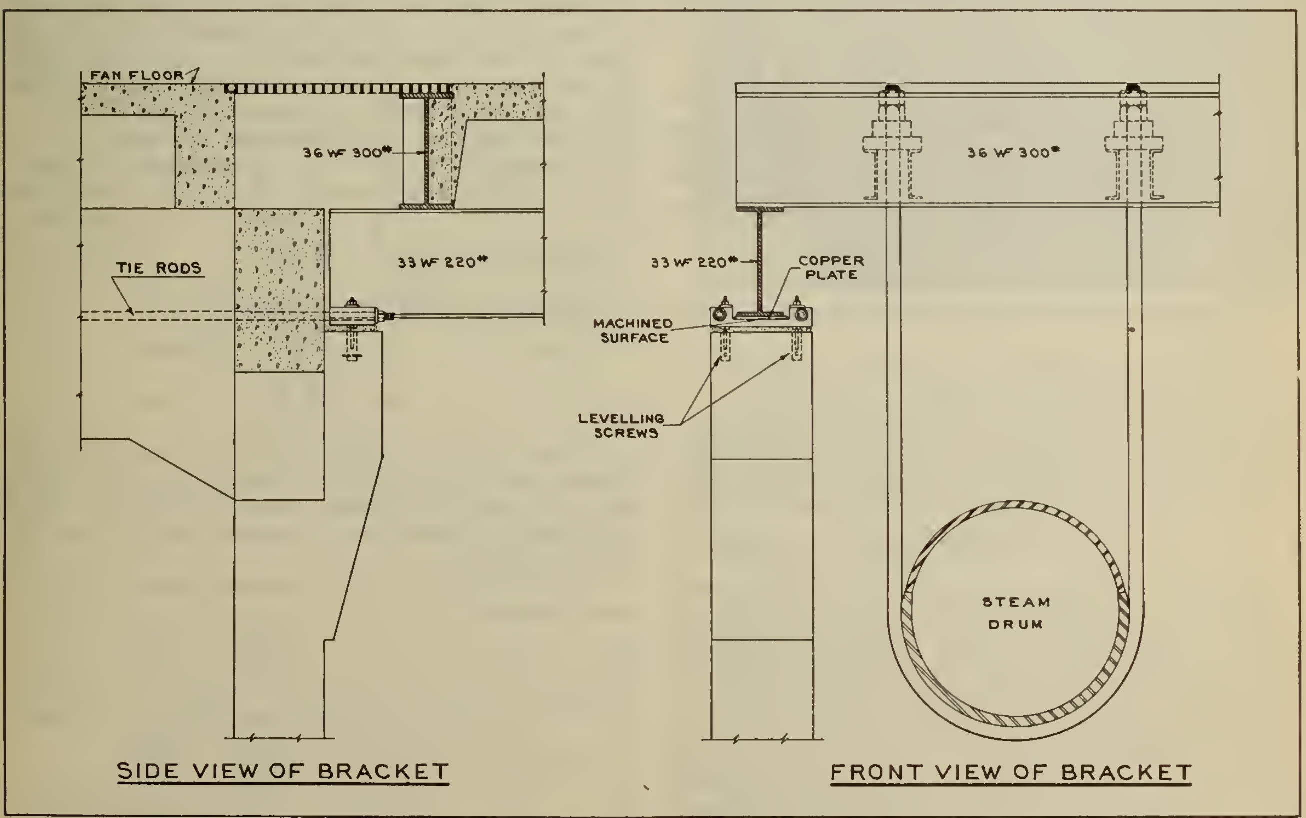


Fig. 4—Boiler suspension bracket.

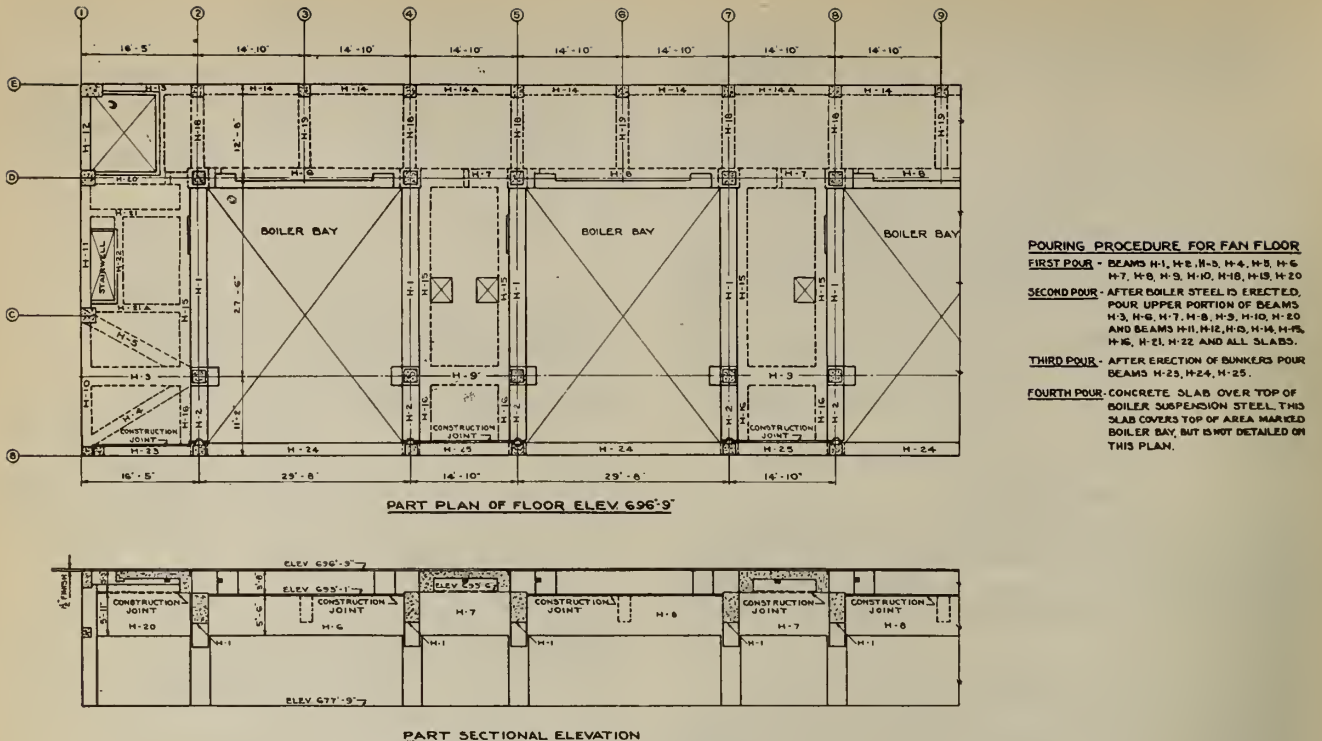


Fig. 5—Part plan of fan floor framing

VERTICAL SECTION OF BUNKER

The walls of the upper section of the bunkers act in two ways, first, they form the bunker sides and as such, are subject to horizontal loads; second, they act as beams supporting the suspended hoppers and all vertical loads.

In the vertical plane, the dividing and longitudinal walls were first designed as ordinary fixed and continuous beams and then were checked as deep diaphram girders, as, with the sections used, the ordinary straight line theory of stress distribution is open to question.

In the horizontal plane these walls are treated as vertical bin walls and are designed in somewhat the same manner as the horizontal design of the hopper.

By way of illustration let us consider a section of the vertical wall facing the boiler. We have the following data:

Alternate spans of 29 ft. 8 in. and 14 ft. 10 in.

Beam size — 18 in. wide by 17 ft. 9 in. deep.

Concentrated loading from bunker cross wall reaction is 216,000 lb.

Uniformly distributed load, from wall weight, coal, hoppers and walls above is 11,715 lb. per ft. run.

A unit of one long span and two short spans was taken and analysed with loadings in the different spans to get the maximum moments over supports and in the centres. The results indicated that the simple relation of $M = \frac{wl^2}{10}$ could have been safely used in this instance.

The above analysis is based on the usual beam theory, that is to say Navier's law of straight line distribution of stresses. It has been shown by Dischinger, however, that for beams whose depth is great compared to their span, Navier's law ceases to be correct.

Therefore, for the bunkers under consideration, it was felt that it would be desirable to see if the deep beam theory would entail much extra steel, and to place such extra steel, if called for and where indicated, as insurance against stresses occurring where not indicated by the usual theory.

The best exposition of the deep beam theory is Dr Dischinger's "Contribution to the Theory of Wall-Like Girders," published in 1932 by the International Association for Bridge and Structural Engineering.

Dischinger's curves of stress distribution show that, for deep beams (such as we have in these bunker walls), the distance from centre of compression to centre of tension instead of being $d = 2/3$ beam depth, as in shallow homogeneous beams, may be very much less.

Calling B the beam depth and L the span, then up to a proportion $B/L = .45$ at the support and $B/L = .65$ at the centre, the straight line theory can be used, but beyond these limits the lever arm of the interior forces does not increase with an increase in depth B.

For the bunkers under discussion we have:—

L = span = 29.67 ft. B = depth = 17.5 ft.
C = support width = 3 ft. d' = lever arm of internal couple.

$$\text{Ration } B/L = \frac{17.5}{29.5} = 0.59$$

Then from Dischinger's curves we obtain:

$$\text{At supports } d' = .65 \times \frac{29.67}{2} = 9.64 \text{ ft.}$$

$$\text{At centre } d' = .85 \times \frac{29.67}{2} = 12.6 \text{ ft.}$$

Noting the $d' = jd$ of reinforced concrete design, then the reinforcing steel areas can be computed on the basis of corrected effective beam depth. Also check unit shears and required stirrups on basis of corrected effective depth.

Table II illustrates the variation between the two beam theories.

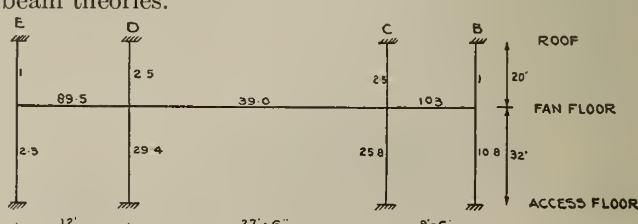


Fig. 6

TABLE II
REINFORCEMENT AREA COMPARISON
OF
ORDINARY BEAM (O.B.) AND DISCHARGER DEEP BEAM THEORY

Location	Rear Wall		Front Wall Centre Span		Front Wall End Span		Dividing or Cross wall	
	O.B.	Disch.	O.B.	Disch.	O.B.	Disch.	O.B.	Disch.
Centre.......	7.6	9.2	2.8	6.0	1.94	4.32	4.14	6.47
Support......	7.6	12.0	2.8	8.2	1.94	4.55	1.66	3.36

In the final design and drawings, the reinforcement as required by the Dischinger deep beam theory was used, and was placed as indicated by the general shape of the stress distribution diagram and the lever arm of the internal couple. For example, over the supports the tension steel was spread over a depth of 4 ft. with the centre at 0.4 beam depth.

In the finished structure, the entire absence of cracks or failure of any part of the bunkers has fully justified the design theory used.

After completion of the bunkers the hoppers were lined with 2 inches of dense shot gunite. Primarily this was done to protect the reinforcing from the capillary action of moisture in the coal, which of course will carry some sulphur.

Figure 8 shows one of the deep bunker walls and suspended hopper bottoms.

Main Roof

The main roof, here defined as that portion over the boilers, is at elevation 721 and is the only roof area that is structurally interesting.

This roof area design was governed primarily by the six boiler stacks which it supports. These stacks are 10 ft. 6 in. dia. at the base by 60 ft. high and are attached at the base to an octagonal concrete ring by heavy anchor bolts. In addition, the roof loading consisted of the usual snow load plus 150 lb. per sq. ft. to allow for the possible future installation of fly-ash collection equipment.

The stacks, weighing some 20 tons each, are of the self-supporting type and when subjected to wind produce a downward reaction of 60.8 kips on the leeward side and an upward reaction of 20.8 kips on the windward side. These heavy loads were carried into the heavy concrete base ring by an appropriate steel base ring and anchor bolts. The concrete base ring was built monolithically with four supporting roof beams, which in turn framed into the main roof girders supported on columns.

From the designer's viewpoint this roof system obviously became very interesting. As the framing consisted of a series of longitudinal beams of alternate long and short spans with loads, that may act up or down, depending on the wind, these longitudinal beams being in turn framed into a continuous roof girder of three different spans. It was further necessary to assume that the future 150-lb. live load might act over any or all areas.

Such a framing situation lends itself admirably to the moment distribution system of Hardy Cross for solution of the bending moments. For instance, in the design of the main roof girders (three spans of different lengths), there are only five steps necessary:—

(a) Establish the loads and beam concentrations.
(b) Find the stiffness factors for each span.
(c) Find the fixed end moments.
(d) Carry out moment distribution.
(e) Find maximum positive moments.

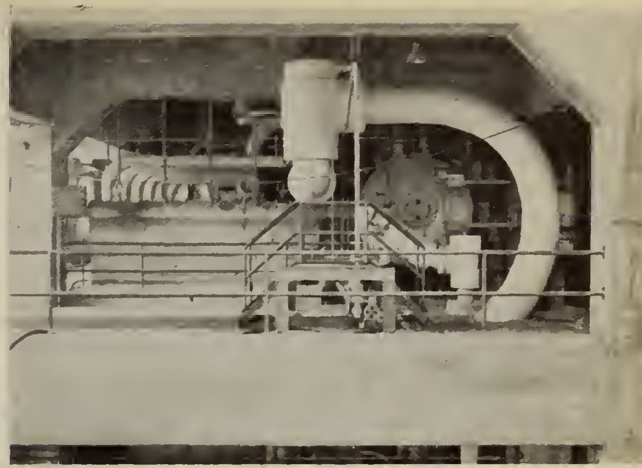


Fig. 7—Fan floor framing.

Usually three or four cycles of distribution are sufficient to bring results accurate within the limits of original load estimates.

For simple continuous spans of this type it is believed that the moment distribution solution is even easier and faster than Ehler's four-and six-moment equations using cross-line ordinates.

The roof frame as designed, while fairly heavy, had a minimum of beam size variation and lent itself to comparatively simple reinforcing. Stirrups were used somewhat generously to "toughen" the beams, and to care for variations from the assumed shears of the future possible loads.

Fig. 8—Coal bunker wall and hoppers.

Acknowledgments

In closing, the authors would like to point out that they have only attempted to touch on some of the highlights of the structural design of the steam power plant. This building however, is but one unit of the huge synthetic rubber plant built for the Polymer Corporation, a Crown company.

Other units designed by H. G. Acres and Company included the pump house, the dock and coal handling system, steam, water and all electrical distribution.

Acknowledgment is also due to Carter-Halls-Aldinger Limited, the general contractors, for excellent workmanship under difficult conditions of time available and man power shortages, combined with the handicap of winter construction, and to K. C. Fellowes, resident engineer for H. G. Acres and Company, for able and constant supervision, and the handling of many details which usually accompany a job of this magnitude.

ELECTRIC SYSTEMS IN MILITARY EXPLOSIVE PLANTS

J. R. AULD, M.E.I.C.
Electrical Engineer, Canadian Industries Limited, Montreal

Paper presented before the Montreal Branch of The Engineering Institute of Canada, on January 20, 1944

The purpose of this paper is to describe in general terms the main features of the electric systems used in various plants recently constructed in Canada for the manufacture and handling of military explosives and ammunition, and to outline the reasons for the adoption of the various arrangements and special features employed. For obvious reasons, it is not possible at this time to treat the subject in as direct a manner as might be desirable from a straight engineering point of view, but in spite of this limitation, it is hoped that the subject will be of interest.

In the first part of the paper, general methods of design are dealt with, and the factors which influenced the type of designs which were employed are outlined. Some data on costs are also included. In the second part of the paper, brief descriptions of the electric systems in several plants are given, illustrated by single line diagrams.

Electric Distribution Systems

In the operation of explosive plants it has been learned by experience that the process should be divided and carried on in buildings separated from each other by adequate distances. For reasons of safety, it is also necessary that a plant in which large quantities of explosives are handled be located on a site remote from centres of population.

With the exception of the small arms ammunition plants, practically all the plants described in this paper are small communities in themselves. One of the larger plants occupies about 2,500 acres and has in it 400 buildings. Each building is supplied with electric service for lighting and most of the buildings also require power for electric motors.

The electric system required to supply an explosive plant is similar in many respects to that employed in a small town.

To make it possible to proceed rapidly with the design and construction of the systems to supply general power services such as electric power, water, steam, compressed air, etc., a data sheet was made up to be filled in for each building by the engineer or engineers responsible for the design of the process or operation to be carried out in the building.

The following data involving electric power was collected in this manner:

(1) Estimated number and horsepower of motors to be used.

(2) Expected demand factor $= \dfrac{\text{maximum demand}}{\text{installed capacity}}$

(3) Estimated floor area of the building

(4) Type of work to be carried on—
(Required to estimate the intensity of illumination).

(5) Materials to be handled and their condition—
(To determine the type of wiring required, i.e., standard, vapour-proof, acid plant type, hazardous dust-tight, Class I Group D explosive proof, or special external type.)

From the building data sheets, and a preliminary plot plan showing the proposed location of buildings, roadways, and fences, an estimate was made of the electric power requirements of the plant.

A typical estimate is given in Table I.

Table I

Typical Load

Circuit	Connected hp or kw	Estimated Load kw	Estimated Load kva	Actual Load kw	Actual Load kva
No. 1	1500 hp	1200	1200	1300	1340
" 2	1450 hp	900	1000	1080	1100
" 3	1000 hp	700	900	900	1100
" 4	1252 hp	700	1000	750	1030
" 5	1281 hp	800	1000	740	942
" 6	1151 kw	800	900	1025	1187
" 7	1400 hp	1000	1300	690	873
" 8	1119 hp	900	1200	880	1080
" 9	960 hp	450	700	250	350
Total connected hp.	9972	7450		7615	
" " kw	1151				
Diversity factor		0.87		0.86	
Plant load		6450		6600	

The electric utility company serving the territory in which the plant was to be located was then consulted to determine the location of the nearest point on the utility system from which the power could be obtained. After determining (with the assistance of the power company's engineers) the voltage, frequency, reliability and other characteristics of the available power supply, a single line diagram was made out to show the main items of equipment required, and the general type of distribution to be used.

Because of the necessity of completing each plant in the shortest possible time, it was not feasible to investigate many alternative schemes, nor was it possible to make estimates in sufficient detail to determine accurately the economic advantages of minor variations in design. Certain general considerations, however, were used to select equipment and they will be dealt with briefly for each section of the system.

Determining the Type of Distribution

The major factors influencing the selection of the type of electric distribution to be employed were, low initial cost, the rapidity with which the system could be completed, the ease of installation, the expected life of the plant, and the type of personnel likely to be available for maintenance work in the plant.

In the smaller plants or in the plants occupying a limited area it was found that a 550 volt, three phase primary system was economical, could be installed rapidly, and it was known that it would be relatively easy to maintain with a small maintenance crew. In all plants in which this system was employed, air circuit breakers feeding radial circuits were used. In some instances the plant layout made it possible to install tie disconnects so that two feeders could be connected to form a loop, but more complicated distribution systems, such as secondary networks or unit-substations, could not be justified. They were considered but it was felt that the slight decrease in the probability of a service outage, which might be expected from their use, would not warrant their additional cost or the longer time required to complete their installation.

In this connection it should be remembered that, in an industrial plant, the problem of maintaining service is very considerably different than in a city distribution system. In most plants, apparatus and circuits can be taken out of service for inspection and maintenance at times when no service is required. It is only in the larger plants or for special services that duplicate internal feeders can be justified if their installation adds to the cost.

For many of the plants to be described, a primary voltage of 2,200 was selected. This voltage is low enough to permit the larger motors to be supplied directly. Transformers for stepping down to 550 and 110 volts were available from stock or could be obtained rapidly. Radial feeders supplied from a switchboard in the powerhouse were employed in most instances. By using this system it was possible to install simple switching equipment and protective devices. The radial feeders made it easy to divide the load so that, in the event of trouble, it would be possible to automatically or manually cut-off the less essential circuits. By keeping motors on feeders by themselves, it was possible to obtain satisfactory voltage regulation on the lighting circuits without using special regulating equipment.

In some of the larger plants higher distribution voltages were found to be economically desirable and also to be more suitable from the point of view of existing designs of switching equipment. In one instance the layout of the plant made it feasible to install a 13 kv loop, to which a number of three phase transformers were connected to step down the voltage to 2,200 volts for the large motors and to 550 volts for the smaller ones. In most of the plants, adequate space was available for the location of pole lines and overhead distribution was used. This type of construction is the lowest in initial cost, it can be changed more readily to suit changes in layout, and it can be constructed rapidly. If overhead lines are damaged the fault can be located quickly and permanent or temporary repairs can be made readily by the plant maintenance crew. Under emergency conditions, overhead lines can be loaded considerably in excess of their normal rating. The maintenance cost of overhead lines will in general be greater than for underground systems but, in wartime plants, this advantage does not usually outweigh the other factors.

Since the outside lines were located in areas free from trees, bare copper conductors were used for voltages in excess of 550 volts. The saving in cost with this type of construction was considered great enough to warrant the slight increase in probable line outages. Weatherproof wire was used for the lower voltages because it has some value as an insulator where voltages are low and clearances small. It also serves as a means of identifying the lower voltage wiring.

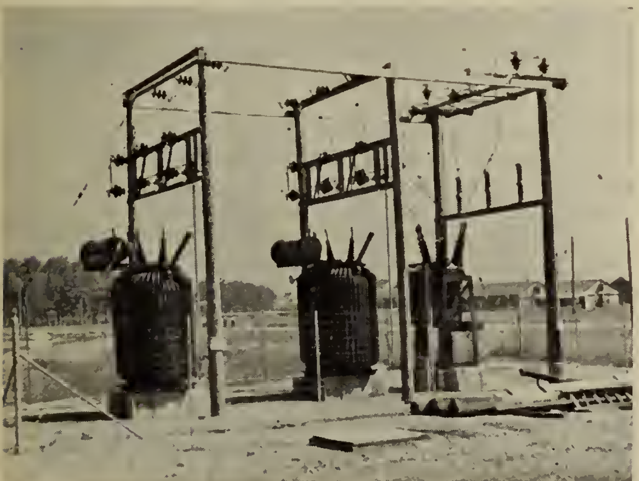


Fig. 1—Substation 44 kv-2300 v.

Fig. 2—550 volt feeders in large punchpress building.

In areas in the plant where the hazard of explosion was present, outside electric lines were kept at a distance not closer than 100 ft. from the buildings. An overhead ground conductor was installed on the main pole lines to reduce overvoltages due to lightning. All building services were carried underground to the buildings by means of rubber insulated multi-conductor cable. Secondary fuses were installed where service cables were tapped to the overhead lines. Sufficiently large fuses were used to allow the ordinary service switch fuses time to clear faults on the load side of the service switch.

In one plant, where a number of large motors were installed, an underground distribution system was used. Outdoor circuit breakers were installed to feed each of the large motors as well as a number of radial feeders. The breakers were installed near the main step-down substation, and underground cables were run in ducts from the circuit breakers to the motors and to small step-down substations. Control cables were run from cubicles near the motors to a central control room located near the main substation. A relay panel and a main control panel were located in the central control room.

A low voltage starting bus was used for starting the larger motors.

Selection of Equipment

main transformers

After deciding on the general scheme of power distribution to be used, it was necessary to decide on definite ratings for the main items of equipment. The following considerations were kept in mind in selecting apparatus. Standard ratings were specified in practically all instances to insure prompt delivery and to obtain equipment which would not require adjustments or changes after installation. In most plants, sufficient capacity was provided to enable the largest main unit, either generator or main transformer, to be taken out of service without overloading the other units. For the larger plants, where the power was obtained at voltages above 13 kv., three phase transformers were used, because of their low cost and the simple layout required. Where possible, transformers were obtained, built to conform to the general specifications of the power company to whose system they were to be connected. The power company's engineers were consulted as to the arrangement of the windings which would likely prove to be most generally useful in the event that they became available for other plants.

In some instances a small premium was paid to obtain transformers with an additional tap or units which could be connected for two different secondary voltages.

GENERATING EQUIPMENT

In most plants, electric generating equipment was installed to provide for emergencies. In some of the plants where a large process steam load made its operation economical, a steam turbine driven generator was installed and arranged to be operated in parallel with the main power system. The turbine was connected to exhaust into the steam system supplying the feed water heater. A unit was chosen at least large enough to supply the plant lighting load and the other essential services such as the boiler plant auxiliaries and the plant pumping station. In one plant, because of the limited amount of power available, it was necessary to obtain a turbo-generator large enough to carry about one-half the plant load. A condensing unit with automatic extraction was required to give economical power at this plant.

In all plants, a relay scheme was employed to protect the generator in the event of failure of the purchased power supply and to drop sufficient load so that the essential loads could be carried.

In two plants, small turbo-generators and several small gasoline-engine driven generator units were installed. The turbo-generators were set up for automatic starting on failure of the normal power supply. The switching and control was arranged so that they could be operated in parallel with the main power source, during periods when this method of operation was economical.

The small gasoline engine sets were located at various places throughout the plant to provide emergency lighting service. The plants in which this scheme was employed were very spread out and the individual emergency supply sources were considered to have an advantage over a large single unit in that they would provide light even in the event of trouble on the normal plant circuit feeding their area.

In some of the plants where steam loads in the summer would be very small, it was not considered desirable to use turbo-generators, and gasoline engine sets of considerable size were installed. These units were also arranged to start automatically and take over the emergency lighting system on failure of the normal power supply.

In one plant, 125 volt storage batteries were employed to provide emergency lighting. A separate battery was used for each of the main buildings with enough capacity to keep exit lights and other emergency lights burning for two or three hours.

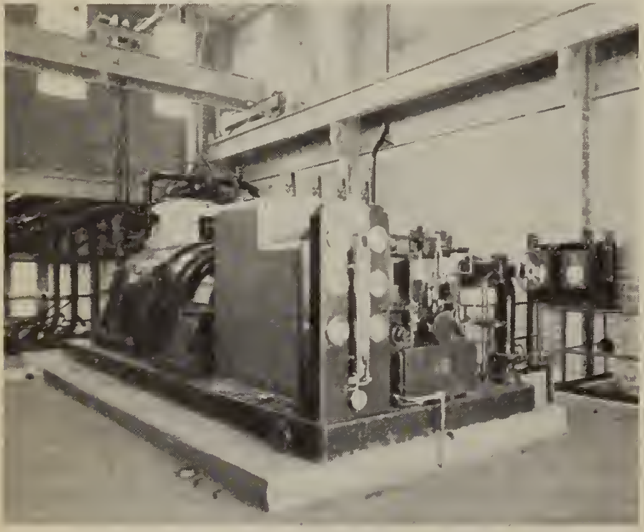


Fig. 3—3500 kw. turbo-generator set.

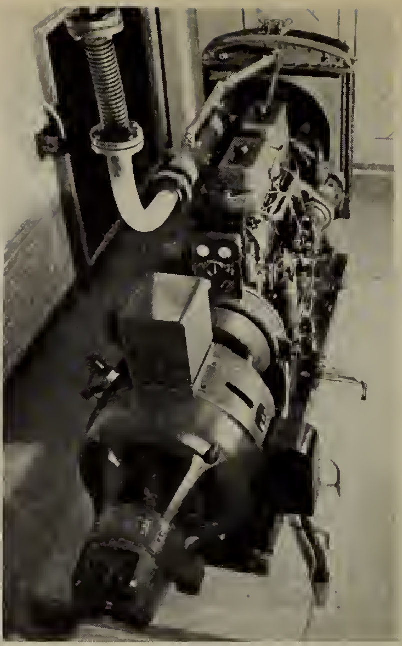


Fig. 4—Emergency lighting gasoline engine generator set, 50 kw.

MAIN DISTRIBUTION SWITCHING

In many of the plants, a considerable percentage of the total plant load was located in the main powerhouse. Since the turbo-generator units were also located here, it was economical to install the main supply transformers near the powerhouse and locate the switching equipment in the engine room. Because of its low first cost and prompt delivery, the so-called industrial switchboard was used in many of the plants. In this type of switchgear, an open bus is mounted on a built up structural steel frame work, gang operated disconnects are mounted above the control board and the oil circuit breakers are mounted at the back. The disconnects are interlocked with the breaker mechanism. The complete unit is factory assembled and shipped in sections suitable for handling. In most cases, electrically operated breakers were used and a 110 volt DC battery installed to provide control power. The battery was used also as a source of emergency light for the powerhouse.

Lighting Systems

In most plants, single phase, three wire, 115-230 volt distribution was used for lighting service. In one plant in which a considerable number of small motors were required, three phase, four wire, 120-208 volt distribution was used in all process buildings.

Oil immersed self-cooled transformers mounted on poles or in vaults were used in the plants having a distribution voltage of 2,200 volts or higher.

Where 550 volt primary distribution was employed, dry type transformers were used in the larger buildings, thus reducing the amount of large 115-230 volt wiring to a minimum.

In all plants handling military explosives, it is important that strict control be maintained over persons entering the plant property. In the plants built in Canada, a special police guard is used to patrol the plant fence. To make this guarding effective, a fence lighting system was installed. This system in most plants was designed to illuminate the fence and the outside area adjacent to it. The area inside the fence was kept in shadow so that the guards would not be too easily seen from the dark zone outside the lighted area. An intensity of not less than three times that of bright moonlight (0.075 foot-candles) at any point along the fence was selected as the minimum.

In the first plants to be built, radial wave reflectors with a special shielding visor were used. In some of the more recently designed plants, refracting glass street lighting fixtures equipped with shields were employed. By using the glass fixtures it was possible to increase the spacing and reduce the power required. The overall cost of the system with refracting glass globes was less than for an equivalent installation using radial wave reflectors.

In the plants employing a large enough turbo-generator to supply all the lighting load, the fence lighting units were supplied from transformers connected to the general lighting primary circuits. Primary lines and transformers were kept at least 100 ft. from the fence to avoid the possibility of damage from outside. Not more than sixteen lighting units were supplied from one transformer but all sections were connected in parallel, through secondary fuses.

The fence lights were controlled by means of contactors connected to control each section of lights. In the smaller plants, the contactors were controlled by a switch in the powerhouse through a pilot wire. In some of the larger plants, special relays were used controlled by a 3,000 cycle voltage carried on the primary lines. The voltage was generated by a small motor driven three phase alternator located in the powerhouse and fed into the primary system through capacitors. The alternator was operated only during the time required to send out the opening or closing signal. The same unit was used to control relays and contactors for controlling the yard lights.

To provide shelter for the guards patrolling the fence, small guard houses were built at intervals. The houses were well insulated and electric heaters were installed to provide sufficient heat to keep them above about 50 deg. F.

Motor Power Supply

Three phase, 550 volt service was used in most plants to supply power to motors under 100 hp. In many plants, three phase transformers ranging from 150 to 1,000 kva. were located near load centres. Ratings were selected to avoid too many different size units and some margin in transformer capacity was provided over the expected maximum load to permit the installation of

Fig. 5—Lighting service and motor starters for acid plant building.

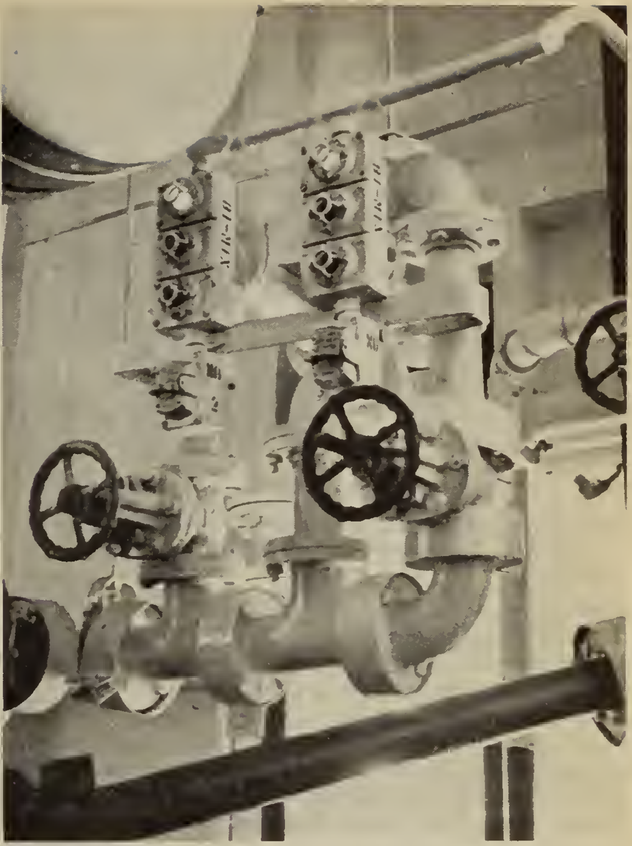


Fig. 6—Signal lights for process line valves.

additional motors, and also to make it possible, in the event of a transformer failure, to carry on by running temporary circuits to adjacent units. As far as possible, the electrical system was arranged so that duplicate process buildings were not supplied from the same transformer. The transformer units were mounted either on shallow concrete slabs, wooden cribs filled with stone, or low platforms on poles.

Ground detector lamps were connected to the secondary of each transformer unit. In some instances, these lamps were mounted outside, and in others, in an adjacent building served by the transformer.

The transformers were protected by fuses and lightning arresters.

Type of Wiring in Buildings

The type of wiring suitable for use in the various buildings of a plant handling explosives depends entirely on the specific process carried out in the building and the characteristics of the materials being handled.

In most of the service buildings, standard industrial wiring is satisfactory. In many of the plants, extensive use was made of non-metallic sheathed cable for the lighting system wiring. This material was preferred for the service because of the ease with which it can be installed in wood frame buildings and the saving in critical material made possible by its use.

In buildings where acids are processed or manufactured, it has been found desirable to avoid conduit work as much as possible, and to keep all service equipment outside the buildings. In many of the buildings of this type designed for military explosive plants, a modified form of knob and tube wiring was used for the lighting system. Porcelain well glass fixtures were employed. In most instances, rubber insulated wire was used but in one building, in which trouble was experienced, a considerable amount of "flamenol" insulated

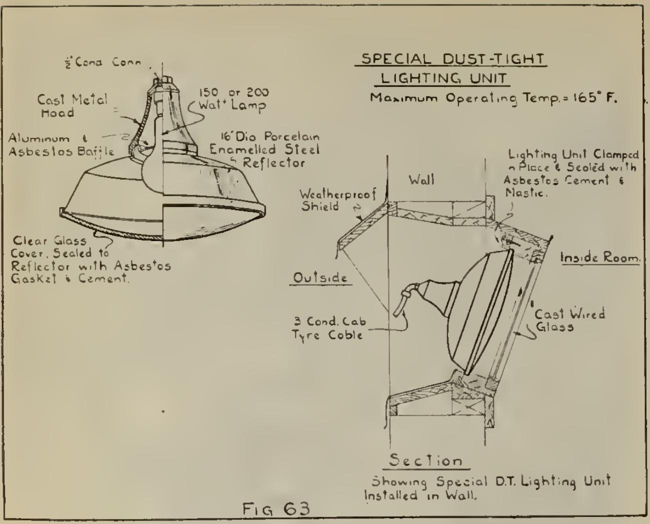


Fig. 7—Special dust-tight lighting unit.

wire was installed and to date it has proved satisfactory. Wiring for motors was run in conduit and kept on the outside of the building as much as possible. All conduit was painted with asphaltic acid resisting paint. Service switches, magnetic motor starters and distribution panels were mounted on the outside of the building and protected by means of wooden cupboards built after the wiring was completed. Lights were usually installed in the cupboards to prevent moisture from collecting in cold weather and to provide illumination for servicing the equipment.

Oil immersed pushbutton stations or water-tight manual motor starters located near the process equipment were used for motor control.

This type of installation is low in intial cost and avoids the use of equipment difficult to obtain on short notice.

The materials used in the initial stages in the manufacture of nitro-cellulose are not highly inflammable when kept sufficiently moist. Standard conduit wiring and dust-tight vapour-proof lighting fixtures and wiring devices are considered to be satisfactory in the buildings housing the initial processes. In these buildings, the motor controllers, with the exception of pushbutton stations, were located in a separate control room.

In some locations where the motor requirements were known well before the work was started, combination distribution and motor control cabinets were installed. In other places, standard combination switched and fused starters or safety switches and starters were used.

In some buildings, inflammable solvents in the Class I Group D Electrical Code classification are present, and in these buildings, explosion-proof conduit wiring was installed. Lighting fixtures suitable for use in gaseous atmosphere were employed. Service equipment and motor control devices were located, in some instances, in separate control buildings built some little distance from the main building, and in others, in cabinets on the outside of the process building.

The advantage of keeping control equipment away from hazardous areas is twofold. Standard equipment can be used, and it is much more quickly obtained than special equipment. It is also much easier and safer to maintain with the plant in operation.

During the final processing of many explosives, small quantities of the material can get into the air in the form of dust. For these processes, great care is taken in the design to make the buildings easy to clean and every precaution is taken to avoid the possibility of igniting explosive material. In all buildings used for this purpose no wiring was installed inside. Illumination was provided by lighting fixtures accessible from outside the building and located in specially built-in wall boxes. Conduit wiring was used, the conduits being run on the outside of the structure. The service equipment was often located on a pole 50 or 60 ft. from the building or outside the building barricade. In buildings of this type requiring power, the driving motors were installed in a separate motor house and a line shaft run into the building. In some instances, the motor was controlled by shipper rods actuating a control station mounted outside the building.

The majority of the processes in plants manufacturing small arms ammunition are very similar to those in any metal forming industry. Most operations are performed in punch presses or similar type machines. In all recent plants built in Canada, individual motor driven machines were used. In some cases several motors were employed on each machine. A type of motor wiring which has been found suitable for the larger ammunition plants consists of an enclosed bus mounted about 12 or 15 ft. above the floor. The bus is provided with fused disconnects which can be plugged into the bus at 12-in. intervals. The bus thus serves the purpose of an extended power distribution panel. The use of this type of power distribution made it possible to install a large number of machines in a very short period.

Because of the low ratio of actual load to operating horsepower in plants using individual motor drive, the power factor of the load is usually low. In the larger ammunition plants, three phase capacitor units of about 40 kva. were used to supply leading reactive kva. The units were mounted on building columns or walls throughout the plant and connected to the enclosed buses supplying the motors. By using this scheme, the distribution system was not burdened with large reactive current loads.

In explosive plants, it is important that the best type of wiring be employed. The circuit and equipment grounding should be installed in accordance with the best modern practice. Adequate conductor sizes should be used and adequate circuits should be provided so that over fusing of circuits will not become necessary to keep equipment operating.

Threaded conduit fittings and cast iron pull boxes are preferred to sheet metal fittings. Solderless connectors are used because alterations and additions can be made after the plant is in operation without the use of blow torches.

Lighting

Lighting requirements for most processes in plants manufacturing explosives are similar to those of a chemical plant. Except for special locations, a high level of illumination is not required, and an intensity of 8 to 12 foot-candles is satisfactory. In most locations incandescent lamps mounted in fixtures to suit the conditions in the building were employed. Porcelain enamelled metal reflectors were used extensively.

In some of the small arms ammunition plants where it was desirable to keep the level of lighting intensity over 20 foot-candles, fluorescent lighting units were used. For locations not requiring a dust-tight unit, reflectors made from Masonite were employed.

In some of the shell filling plant buildings, the process carried on made it desirable to use a dust-tight lighting fixture for both incandescent and fluorescent lamps. No fixtures exactly suitable were available in Canada, and since a large number of units was required, specifications were drawn up and sample fixtures obtained from several firms. The important features of these units

Fig. 8—Special dust-tight fluorescent lighting fixtures.

were a smooth easily cleaned exterior, low outer surface temperature and ease in relamping.

Motors and Controls

With a few exceptions, motive power for process and service equipment was provided by electric motors. Squirrel cage induction motors were used on most drives in all ratings up to 300 hp. For drives requiring larger motors, and for slow speed service, synchronous motors were employed. A few wound rotor induction motors were required for drives requiring a slow starting or an adjustable speed motor. In most plants, motors below ¾ hp. were single phase, 100 volt; motors from ¾ to 100 hp. were three-phase, 550 volt; and motors above 100 hp. were three-phase, 2,200 volt.

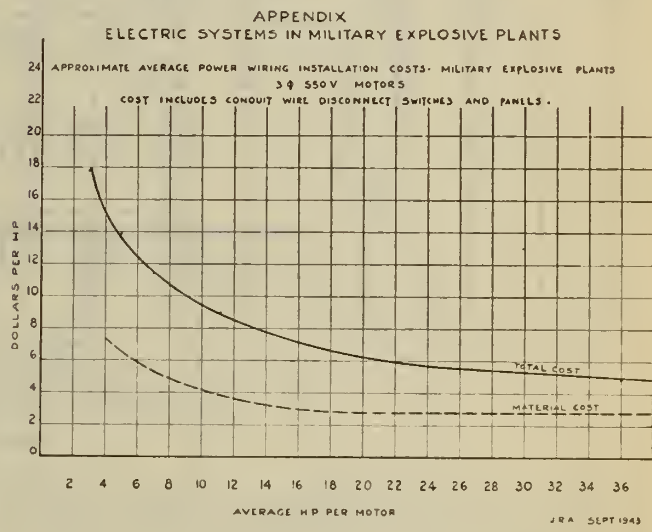
In practically all cases, full voltage starting equipment was used except for the 550 volt motors from 50 to 100 hp. These sizes were controlled in most locations by hand compensator starters.

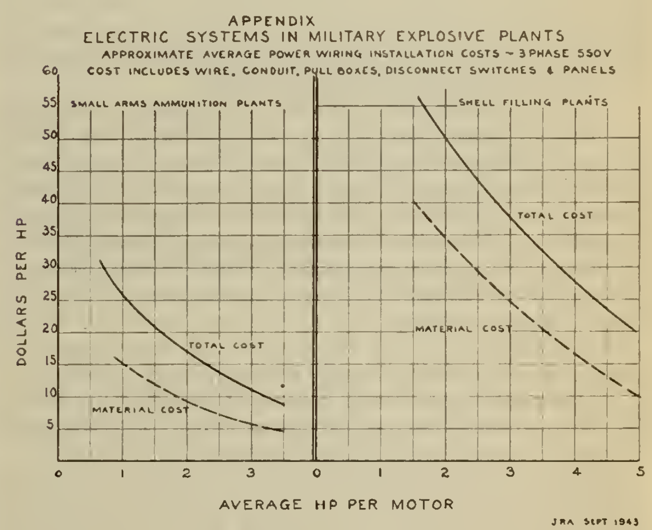
In several plants, it was desirable to control certain pump motors from the discharge end of the process line. Motor starters with 110 volt control were used for these units and red and green six watt indicating lights were located beside the remote control station.

Type of Motor Enclosure

In selecting motors for use in explosive plants, the type of enclosure is important. In locations where the motor will be exposed to corrosive fumes a totally enclosed or totally enclosed fan-cooled motor is preferred. It is desirable that any external air passages be accessible since the motors must be carefully cleaned and painted every few months with an acid resisting finish. In certain process buildings, the materials handled are non-hazardous when wet, but inflammable when dry. Motors used in such buildings must be dust-tight, reasonably moisture-proof, and easily cleaned. In fractional hp. sizes, explosion-proof Class I Group D motors are about the only ones made in Canada that meet this requirement. In ratings up to about 7½ hp., totally enclosed motors are suitable and, in the larger sizes, a pipe ventilated motor with flanged connections for intake and discharge air makes a satisfactory unit. Where long air ducts must be used, a forced ventilation system is necessary. Motors cooled by forced ventilation may be damaged if the cooling air supply is cut off. A thermal relay mounted on the motor winding was employed to protect motors cooled by forced air circulation. Totally enclosed fan-cooled motors in standard or explosion-proof Class I Group D frames are not, in general, suitable for use in locations where explosive material is present. The material can become lodged in the external air passages and in most designs it cannot easily be cleaned out.

For those who are not familiar with its design, the designation "explosion-proof" on electrical apparatus is confusing. Such apparatus is usually designed for use in atmospheres containing gasoline or solvent vapours. It is designed to resist an internal explosion of a gas air mixture in the enclosure and to cool the resultant flame by allowing it to escape through small enough and long enough passages to prevent the flame from igniting an explosive mixture of the same gas outside the housing. Such apparatus is not necessarily suitable for use in explosive plants except in locations where the solvents or gases for which the apparatus was specifically tested are present, and other more powerful explosives are not.



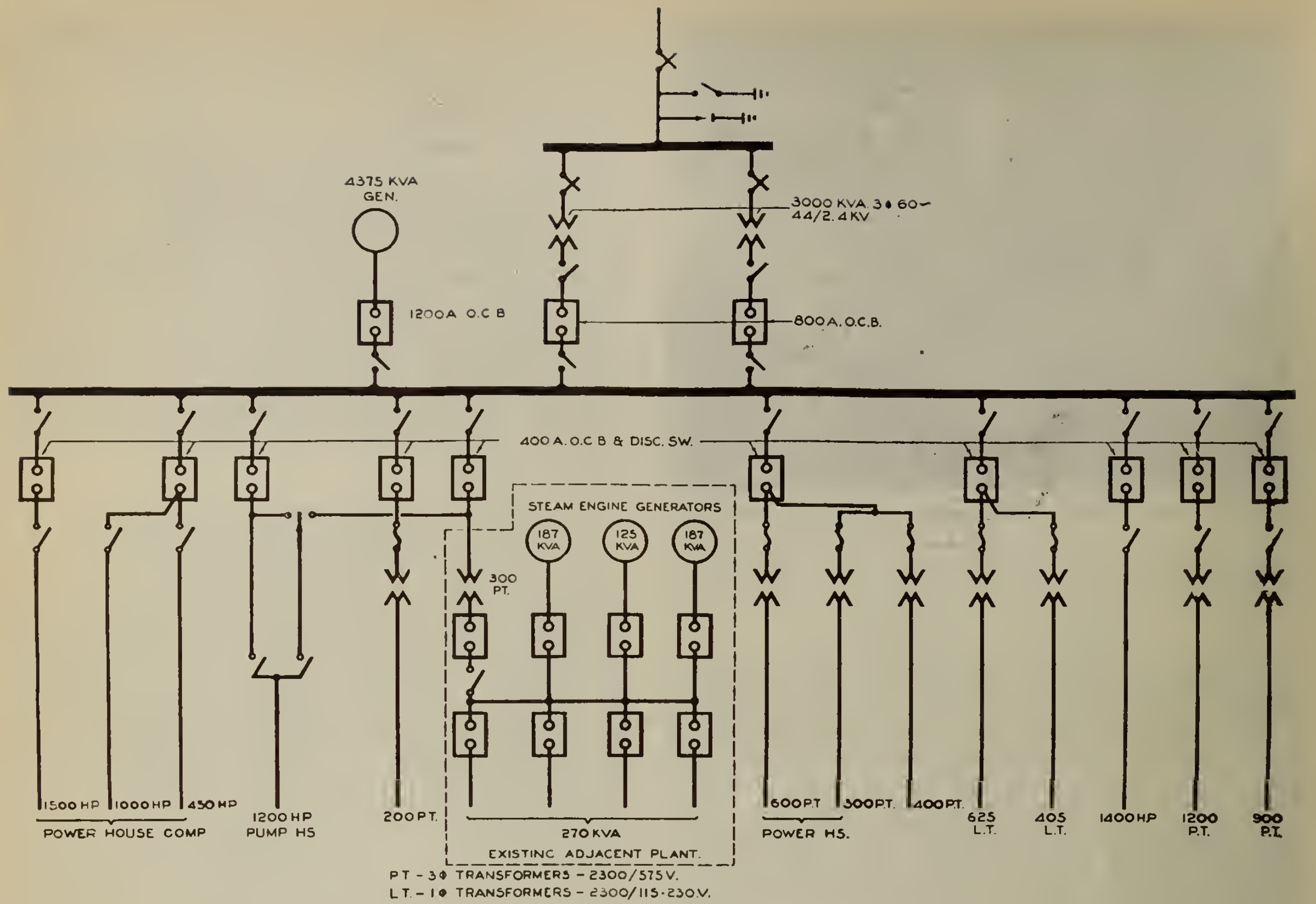


Typical Layouts

Brief descriptions follow of the electric systems in some of the Canadian ammunition and explosive plants. A simplified line diagram of the electrical layout accompanies the description.

PLANT NO. 1

Electric power is supplied to this plant over a single circuit 44 kv. wood pole transmission line and also from a turbo-generator set installed in the powerhouse of the plant.



Plant No. 1

Two three-phase transformers are installed near the powerhouse. The high tension bus, lightning arresters and air break switches are mounted on a steel structure. The 2,300 volt secondary of each transformer is carried overhead to a distribution switchboard located on the turbine floor of the powerhouse.

Distance impedance, power directional, and line ground relays are installed to clear the incoming 2,300 volt circuit breakers in the event of trouble on the high tension transmission line. Gas detector relays are mounted on the main transformers. These relays are arranged to trip the low tension incoming circuit breakers and also to trip a grounding switch connected to the high tension line, thus causing the supply end oil circuit breaker to trip.

Under-frequency and over-frequency relays are installed to trip the incoming circuit breakers and certain plant motor feeders in the event of failure, or overfrequency of the incoming power supply. The turbo-generator carries the remaining plant load.

Special lightning arresters and a capacitor unit are connected to the 2,300 volt bus to protect the powerhouse motors and the generator from overvoltages caused by lightning on the 2,300 volt outside lines.

A 125 volt storage battery is used to supply control power for the switchboard and to the emergency lighting system in the powerhouse.

The turbo-generator is made up of a 3,600 r.p.m. A.C. generator and exciter direct connected to a multi-stage condensing turbine, arranged for automatic extraction. The turbine exhaust flange is connected to a double pass surface condenser mounted below the turbine. A three unit, forced draft cooling tower supported on a concrete basin is located close to the powerhouse to provide cooling water for the condenser. The condenser air pump is a steam jet type. The condensate pump and the circulating water pump are motor driven. The extraction line from the turbine is carried through a non-return check valve to a low pressure header which supplies steam to the boiler plant feed water heater. Multi-disc, spring loaded type, atmospheric relief valves are used to protect both the condenser and the extraction line.

The motors in the main pump house are supplied at 2,200 volts and a special system of lightning protection is installed to protect them. High capacity arresters and a three phase capacitor are installed on the pump house bus. A choke coil is connected between the cable pothead and the bus, and at the line end of the cable a set of line arresters is installed. A shielding ground wire is also mounted over the line conductors for a distance of 2,000 ft. from the pump house.

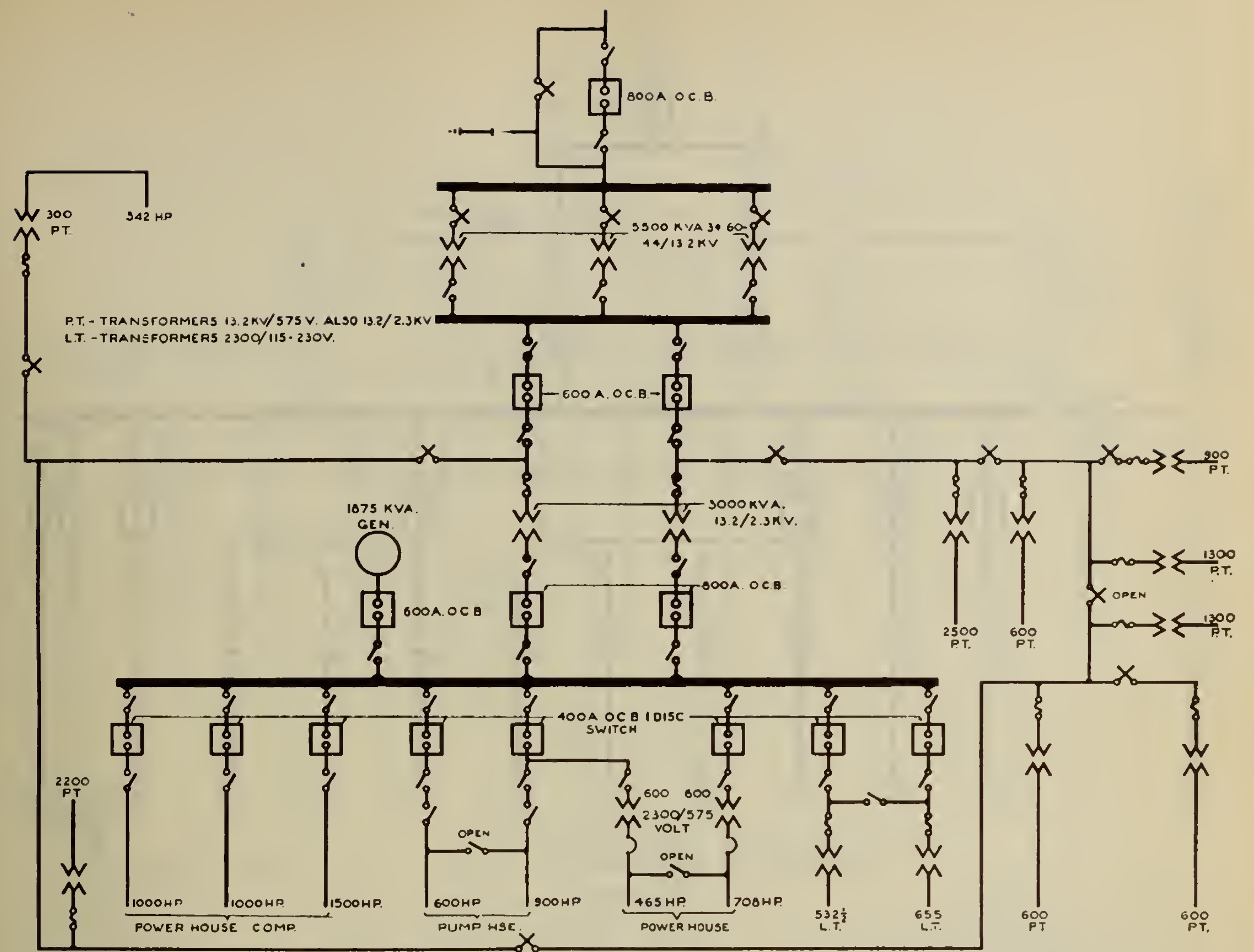
At least seventeen miles of pole lines are required to distribute the power in this plant.

PLANT NO. 3

A single circuit 44 kv. line on wood poles supplies the main bulk of the power used in this plant.

Three three-phase transformers are installed near the plant powerhouse to step down the line voltage.

Two 15 kv. outdoor oil circuit breakers are located under the 13.2 kv. bus and an overhead circuit is carried from each breaker. The two lines are carried on wood poles to form a loop around the plant, and power transformers are connected to the lines. By means of pole top air break switches installed at various points on the loop, it is possible to isolate sections of the system. Normally, the system is operated with the loop open at the mid point opposite the main substation.



Plant No. 3

Two three-phase transformers are installed near the powerhouse to supply 2,300 volt energy to a switchboard on the turbine floor of the engine room. Power for the powerhouse, the plant pump house, and the plant lighting system is supplied from this switchboard. The control switches and relays for the main outdoor circuit breakers are located on this board as well as the switching equipment for a turbo-generator set.

Two underground armoured cables are used to supply the plant pump house with 2,300 volt power.

A 2,300 volt loop circuit (installed on the same poles with the 13.2 kv. lines) is used to supply the lighting transformers in the plant.

Differential relay protection is provided for the main transformers and the turbo-generator. Ground relay protection is installed to clear the 13.2 kv. oil circuit breakers in the event of a ground fault on this system. A ground detector is installed on the 2,300 volt bus in the powerhouse.

The turbo-generator is a three bearing, 3,600 r.p.m. machine. The turbine is a straight back pressure unit arranged to exhaust into the boiler plant's feed water heater. Excitation for the generator is provided by a small turbine driven exciter with a motor driven set installed as a stand-by.

Three-phase transformers are used to supply the plant motors. Some units have 575 volt and some have 2,300 volt secondaries.

PLANT NO. 4

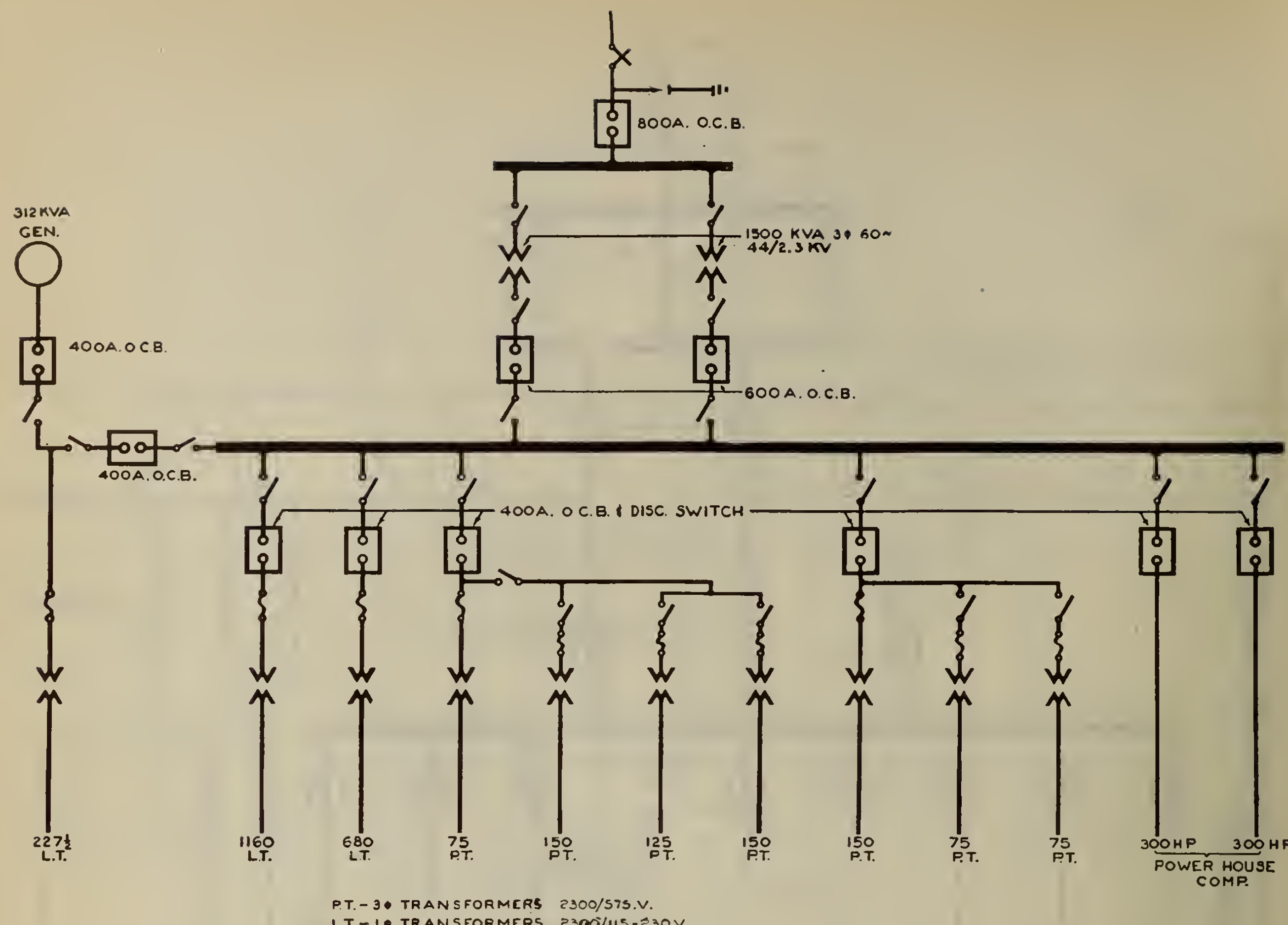
Power is supplied over a single circuit wood pole line at 44 kv. Two three-phase transformers are installed near the plant powerhouse. A high voltage oil circuit breaker is installed ahead of the transformers.

The secondary lines from the transformers are carried in lead covered cables to a 2,300 volt switchboard in the power plant engine room. The switchboard is of the industrial type and provides control for four plant circuits, two air compressor motors, and one circuit for supplying the fence lights and some other lighting load. This latter circuit can be energized either from the main bus or from a small turbo-generator, or from both.

The turbo-generator is arranged either to be operated in parallel with the incoming power supply or to start automatically and pick up the special lighting load.

Over-power and under voltage relays are installed to separate the generator and the special feeder from the main bus when the generator is operating in parallel with the main power supply and the latter source fails.

When the turbine is set for automatic starting, the exhaust line is left open to atmosphere. The drain lines from the casing are left open and the special throttle valve is held closed by a latch which can be tripped by a solenoid plunger. The solenoid plunger is normally held up by the voltage from a potential transformer connected to the main 2,400 volt bus. When the voltage fails on the main bus, the solenoid plunger trips the holding latch, the throttle valve opens and the turbine comes up to speed in about 20 seconds. After a time delay, the tie breaker between the special lighting feeder



Plant No. 4

and the main bus is tripped and when the generator voltage builds up to normal, the generator breaker is automatically closed. Should voltage be restored to the main bus before the tie breaker is tripped, the generator breaker will not close.

Approximately 27 miles of pole lines are installed to distribute power in the plant. As in the plants previously described, sectionalizing fuse cutouts are installed in the lighting primary circuits to assist in isolating line faults and to allow sections of the overhead system to be disconnected for maintenance work.

Each individual section of the plant is provided with one or more 7 or 10 kilowatt, single phase, 110-220 volt, gasoline engine driven generator sets. These units are installed in small separate buildings. They are provided with automatic starting equipment, voltage regulators, and automatic throw-over switches. The emergency lighting system is entirely separate from the main system. It consists of exit lights which are kept burning at all times, and a number of other lights in each building which are automatically switched on should the normal lighting voltage fail. This entire system is supplied under normal conditions from a transformer located near the emergency generator house, but if this supply fails, the engine starts and the automatic throw-over switch connects the generator to the emergency system.

PLANT NO. 11

Electric power is obtained for this plant from an overhead 13 kv. three-phase line.

Three single-phase transformers are installed near the main building of the plant. The transformers are protected by an air break switch, a set of high tension fuses having an interrupting rating of 20,000 amperes and by lighting arresters.

The 575 volt secondary from the transformer bank is carried into a cubicle type switchboard located in a small switchroom.

Power is distributed to the main building by four three-phase, 575 volt circuits. Each circuit consists of three weather-proof cables carried on split porcelain insulators mounted under the roof beams. The circuits are arranged to form three loops. The outside buildings are fed from a single circuit carried on wood poles.

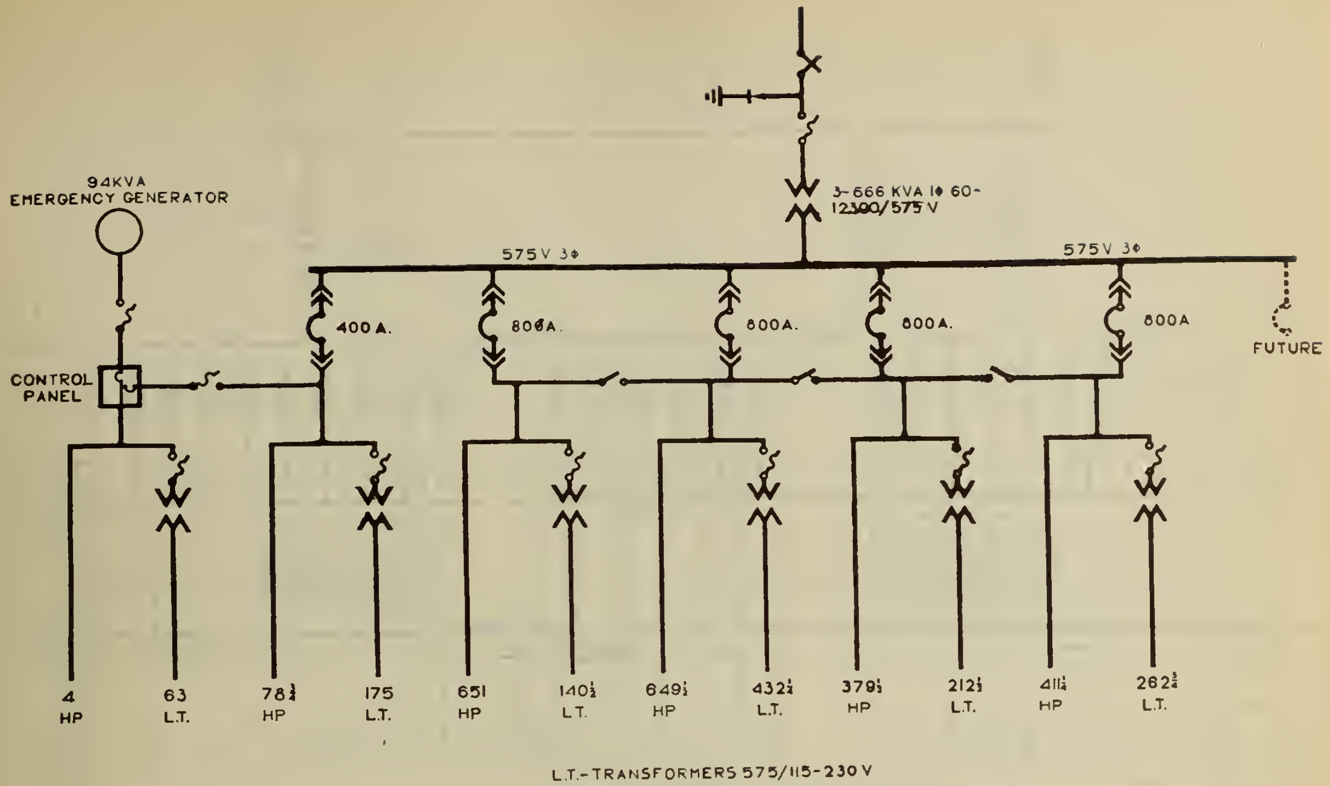
Many of the individual machines were received with the main motors wound for 550 volts and the smaller auxiliary motors for 110 volts. To save wiring, small transformers rated 550/110 volts were mounted on each machine to supply the auxiliary motors.

For general lighting, fluorescent lighting fixtures are used. The units are spaced to give an intensity of about 20 ft. candles at the working surface. In this plant, non-metallic sheathed cable is used for wiring. For some of the main runs, conductors on outdoor type porcelain insulators are installed.

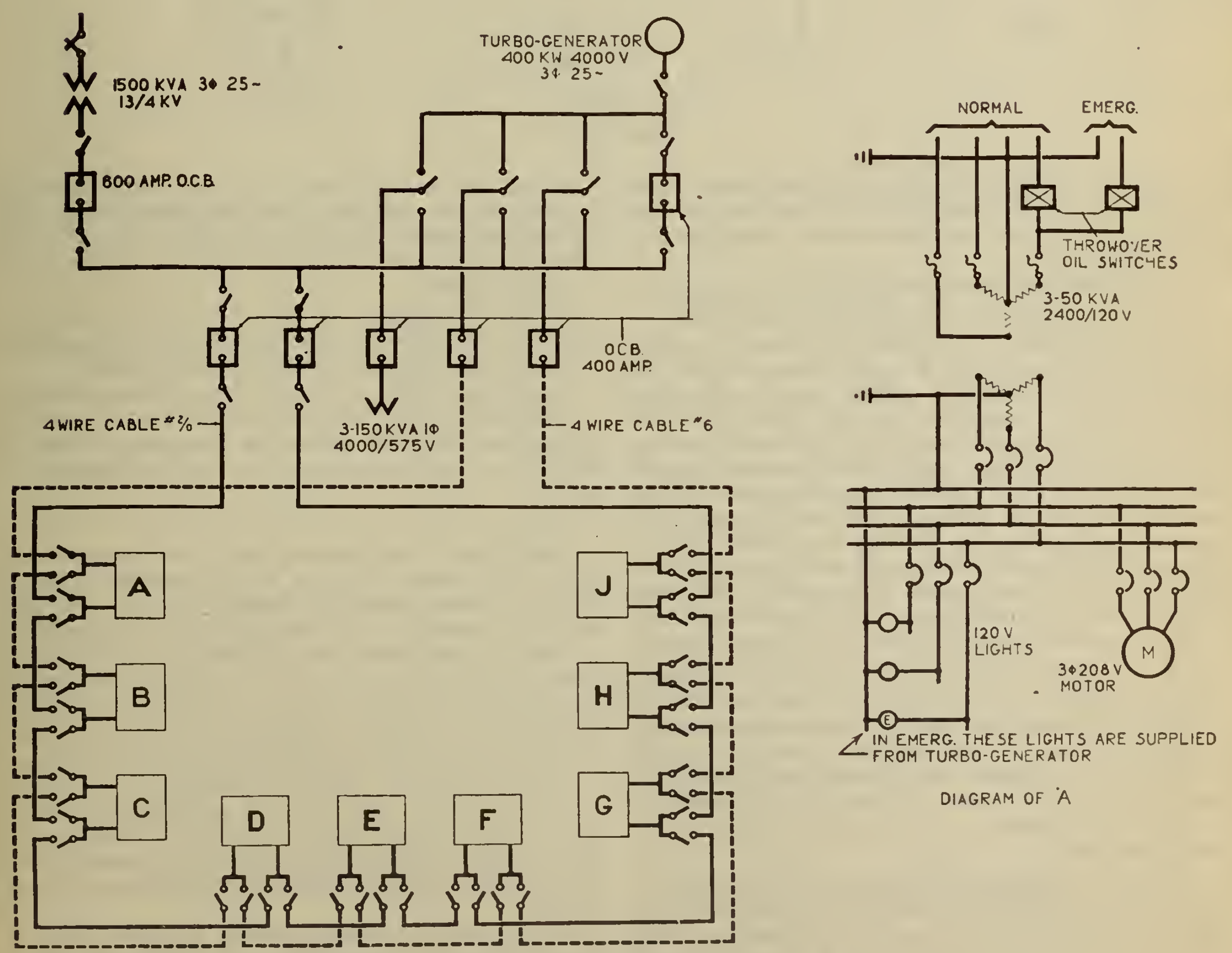
A small geared steam turbine driven generator is installed in the powerhouse to provide emergency lighting for the plant. It is arranged to start automatically on failure of the main power supply. Automatic throw over contactors are used to connect the generator to the emergency lighting system. The guard fence lights, and exit lights in the plant are supplied from the emergency system.

PLANT NO. 12

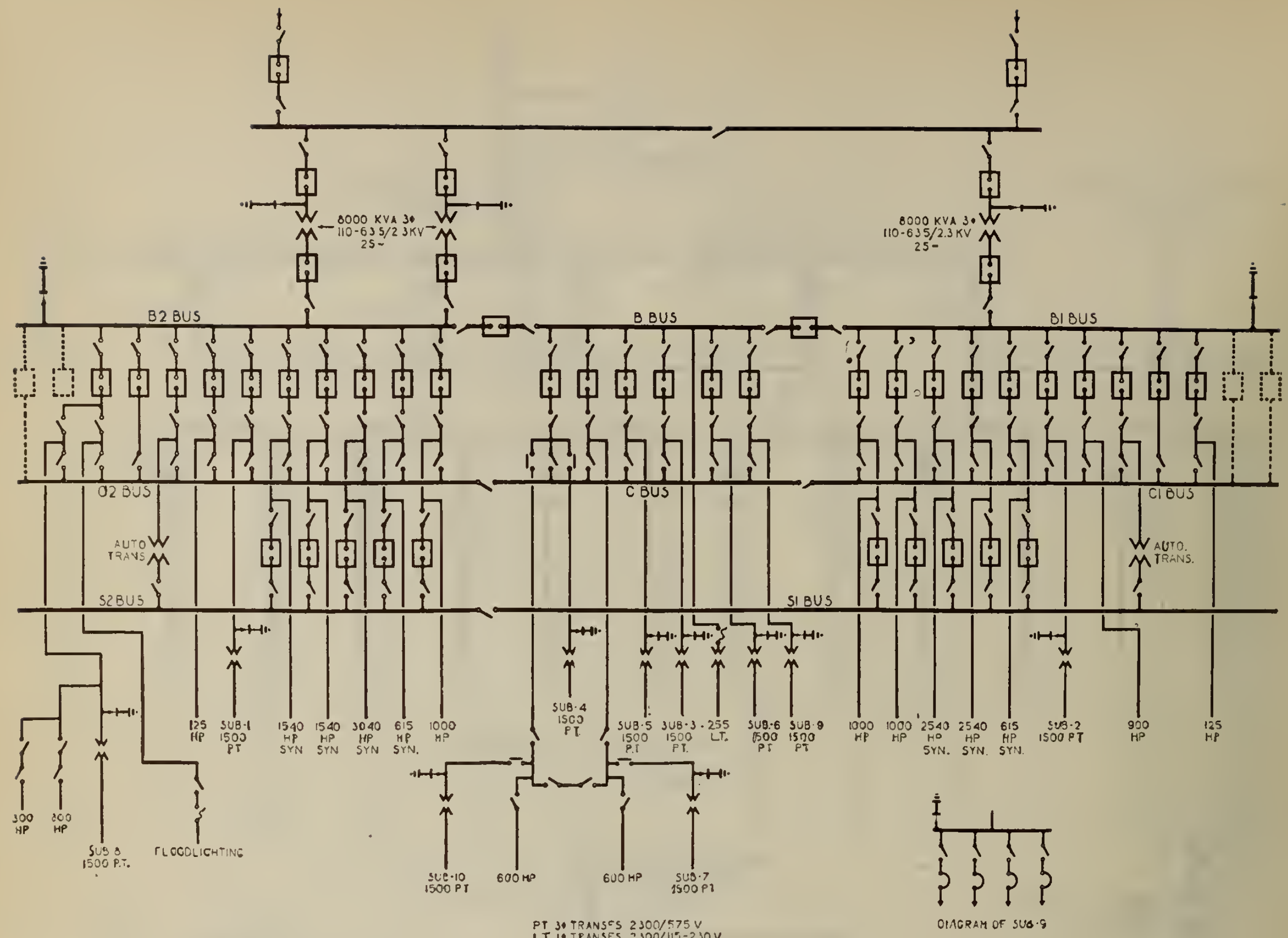
This plant is supplied with power over a 13 kv. single circuit line on wood poles.



Plant No. 11



Plant No. 12



Plant No. 13

A unit substation consisting of a three-phase transformer and metal enclosed switching equipment is used to supply 4,000 volts to a distribution switchboard of the industrial type.

The switchboard together with a geared turbo-generator unit is installed in a small separate building.

Power is supplied to the plant by means of a 4,000 volt paper insulated lead covered armoured cable installed on the ceiling of a special tunnel built under some of the main passageways in the plant. The cable forms a loop circuit and it is carried into special switching vaults built off the walls of the tunnel. In each switching vault, gang operated disconnects and special fuse disconnects are installed in a metal cubicle. By means of the disconnects, the cable loop can be opened. Fuses are used to protect a transformer bank which is made up of three single-phase, oil insulated, self-cooled transformers. The transformers are connected to supply a four-wire, three-phase, 208-120 volt secondary system.

Low votage air circuit breakers in metal enclosures are connected in the secondary of the transformer banks.

Both the motors and lights of the process buildings are supplied from the four-wire, three-phase low voltage systems. Motors, starters and lighting panels are located on the walls of the tunnel and the wiring is carried in conduit to the passageway above and from there to the process buildings.

To provide emergency lighting, a second 4,000 volt cable loop is installed. This cable can be energized either from an auxiliary bus on the main switchboard, or from the main bus. The emergency cable is looped into each switch vault and by means of small oil immersed switches, provision is made to transfer one of the transformers of the vault bank from the normal cable feed to the emergency cable. The transfer is made automatically by means of voltage relays, on failure of the normal voltage.

The turbo-generator is connected to the auxiliary bus in the switchroom and it can be synchronized with the main bus through a bus tie circuit breaker.

In addition to the main cable loop, a radial circuit is installed which supplies a transformer bank to provide three-phase 550 volt power for the larger motors in the boiler room, pumphouse, and service shops of the plant.

PLANT NO. 13

This is one of the largest plants so far described and obtains its power over two 66 kv. circuits. A single tank oil circuit breaker is installed on each line and the high tension bus is arranged with sectionalizing switches. Three three-phase transformers are supplied from the high tension bus. The transformers supply 2,200 volts to the low tension bus. Provision has been made so that the high tension system can be changed later to operate with a grounded neutral at 110 kv.

The low tension switching system supplies twenty-six radial circuits. A main bus, an auxiliary bus and a starting bus for the large motors are installed. The circuits are controlled by means of disconnects and outdoor type oil circuit breakers mounted above a cable tunnel.

At one end of the cable tunnel, a control room is located housing a bench board, a relay panel and a panel for the recording meters. (*Continued on page 416*)

APPENDIX

Man Weeks for Electrical Installations

Plant Numbers	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11
1940 April...	60										
May...	112										
June...	130										
July...	191		23								
Aug....	401		56								
Sept...	343		110								
Oct....	478		217								
Nov...	318	38	248								
Dec....	156	144	426								
1941 Jan....	30	237	720			75					
Feb....	30	283	950			121					
March.	27	422	1160	50	120	167					
April...	16	426	670	135	201	185					
May...		590	326	295	401	127					
June...		542	100	397	630	91					
July...		489		467	575	35					
Aug....		481		709	600	35					
Sept...		129		593	914	12					
Oct....		83		497	616						
Nov...				441	398						
Dec....				379	340						
1942 Jan....				395	216						
Feb....				222	90						
March.				275	64						
April...				125				40			
May...								96			
June...								203			
July...							2	510			
Aug....					48		15	342			20
Sept...					111		27	213		8	34
Oct....					252		37	136		103	111
Nov...					254		33	35		177	182
Dec....					320		70			207	275
1943 Jan....					450		93			308	368
Feb....					416		97			72	412
March.					371		98				547
April...					428		117				734
May...					287		103				183
June...					161		89				116
July...					64		76				40
Aug....					37		30				78

APPENDIX

UNIT COSTS OF TYPICAL LIGHTING INSTALLATIONS

Cost Includes Switching and Plug Outlets—Direct Costs Only Included

Type of Building	Average Intensity	Type of Wiring	Type of Fixture	Units Based on Sq. Ft. of Floor Area			
				Watts	Labour Costs	Material Cost	Total Cost
General Storage	2 ft. Cdls.	Rigid Conduit	Shallow Bowl	.44	$0.0226	$0.0251	$0.0477
Office	15 " "	Metallic	Opal Glass	2.38	$0.079	$0.0920	$0.171
Laboratory	25 " "	Metallic	Opal Glass	2.50	$0.187	$0.230	$0.417
Staff Hotel	4 " "	Non Metallic	Drop Cord & Opal	.78	$0.0694	$0.074	$0.1434
Acid Building	3-8 " "	Knob and Tube	Porcelain Well Glass	.73	$0.0522	$0.0335	$0.0857
Process Building	3-10 " "	Conduit	R.L.M.	.52	$0.0331	$0.0932	0$0.1263
Process Building	3-10 " "	V.P. Conduit	Dust Tight R.L.M.	1.04	$0.984	$0.1000	$0.1984
Process Building	3-10 " "	Exp. Proof Class I, Group D.	Exp. Proof Lighting Fixtures	1.40	$0.1300	$0.319	$0.449
Process Building	3-10 " "	Conduit Outside	Wall Boxes and Dust Tight R.L.M.	1.37	$0.153	$.0257	$0.410
Large Shop	15 " "	Conduit	R.L.M.	1.43	$0.1021	$0.1945	$0.2966
Large Tool Shop	35 " "	Conduit	Fluorescent	1.40	$0.201	$0.295	$0.496
Large Punch Press	25 " "	Non Metallic	Fluorscent	1.53	$0.137	$0.250	$0.387
Fence Lighting	Min. 0.07	Pole Line	300 Watt B. Way Refractor				Linear foot $0.65

APPENDIX

APPROXIMATE UNIT COSTS

Direct Cost with Sales Taxes and Duty are Included but with no Construction Overhead, Contractors Fees, or Engineering Costs Included

Plant	Voltages	High Voltage Sub-Station		Distribution Switching		Distribution Substations		Lighting Transf. includes Aux. & Installations		Generating Equipment includes Bldg.
Number	Kv.	$/Kva. Capacity	$/Kw. Load	$/Kva. Capacity	$/Kw. Load	$/Kva. Capacity	$/Kw. Load	$/Kva. Capacity	$/Kw. Load	$/Kw. Rating
1	44—2.3	6.50	8.50	2.70	4.50	6.00	14.40	12.50	15.60	$ 56.
2	66—2.3	5.50	10.00	3.65	7.30	6.00	14.20	12.70	17.00	$ 69.
3	44—13—2.3	5.75	9.25	2.50	4.10	6.00	9.50	13.50	17.00	$ 32.
4	44—2.3	9.50	17.00	7.25	14.50	11.00	27.00	12.30	27.00	$100.
5	30—2.3	7.50	15.75	7.80	17.00	11.00	37.00	10.50	21.00	$100.
6	69—2.3	8.00	26.75	2.90*	5.80	8.90	30.00	17.50	21.00	$145.
7	44—.575	10.50	11.50	2.50*	4.20			13.00	24.00	$195.
8	13—2.3	9.00	23.00	.30	1.00	12.80	15.00	12.80	23.00	$198.
9	13—.575	8.00	10.00	3.00	9.00			11.00	14.60	
10	13—.575	6.75	14.00	1.55	6.90			12.00	20.00	
11	13—.575	6.00	6.75	2.10	4.20			12.00	22.00	$115.

*Includes a small Switch House Building.

IMPROVED SOIL STABILIZATION

GUILLAUME PIETTE, Jr.E.I.C.
Soils Engineer, Department of Highways of the Province of Quebec, Quebec

Paper presented at the Fifty-Eighth Annual General Professional Meeting of The Engineering Institute of Canada, at Quebec, on February 11, 1944.

It has long been supposed that the best way to improve dirt roads is to lay on them a certain thickness of gravel. This has been a common practice in this province as well as everywhere else on the continent.

Earth and Gravel Mixtures for Road Construction

The use of raw gravel, although it improves earth roads by adding to their bearing capacity, has its inconveniences. Washboards develop rapidly under traffic and require costly and continuous blading; the road becomes dusty during dry weather and a large quantity of material is lost on shoulders and in ditches by the severe action of traction wheels. During the last fifteen years, in all parts of the United States and Canada, highway engineers have tried to develop a method of overcoming this condition: they have experimented with soil aggregate mixtures.

Soil stabilization, according to Hogentogler,* is "the process of giving natural soils enough abrasive resistance and shear strength to accommodate traffic or loads under prevalent weather conditions, without detrimental deformation.

"The methods employed include the use of admixtures, compaction and densification by specific technical theory and laboratory control. Optimum water content is fundamental with gradation. Admixtures may be soil materials, deliquescent chemicals, solutions of electrolytes, soluble cementitious chemicals, primes and neutralizers and insoluble binders."

That definition covers the subject of soil stabilization as conceived in the last decade. But the Research Bureau of the Highways Department of the Province of Quebec, under the direction of E. Gohier, M.E.I.C., chief engineer, basing its work on the first principles of soil mechanics and on many tests, has tried to obtain conclusive results on a subject which may be called improved soil stabilization and may be defined as the process of supplying a granular soil with such cohesive materials as will develop under all circumstances its maximum efficiency.

The cohesive material may be clay, cement, waste sulphite liquor, asphalt, or any substance which meets the requirements of the case.

Characteristics of Granular and Cohesive Soils

All engineers, especially those specializing in highways, airports, and other structures made with soils, are interested in soil mechanics, since the final foundation of all constructions must rest on soil. So, we shall first recall some of the fundamental principles of that subject.

For the purpose of this study, we shall consider two main classes of soils, namely the granular and the cohesive. In general, soils in their natural deposits cannot be regarded as either absolutely granular or purely cohesive, but contain both kinds of material.

A sample of pure gravel moulded to the shape of a cylinder 6 in. dia. by 12 in. high will collapse under a small applied vertical pressure, that is a simple push by hand.

Now, if to the gravel we add some clay, in certain definite proportions, the same cylinder will carry the wheel of a ten-ton loaded truck. The explanation of such a phenomenon is that the clay has supplied cohesion to the gravel; it has formed a cemented solid block capable of carrying loads even without the help of adjacent support.

As an engineer's mind always welcomes the mathematical solution of any question, it may be helpful to give an elementary discussion of the stabilization problem.

Stability of Granular Materials

The internal stability of a granular mass is that property which produces resistance to displacement by the mutual support of adjacent particles in the mass, involving static forces and reactions between particles too large to be noticeably affected by molecular forces of attraction.

Let us consider three spheres in contact, which form the most elementary arch that can be devised (Fig. 1). The angle θ of pressure transmission is 30 deg. This angle is included between the vertical line passing through the centre of the top sphere and the inclined

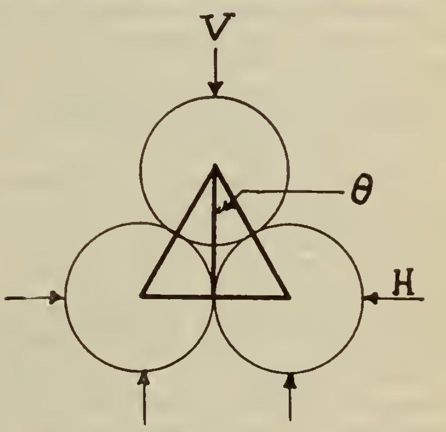


Fig. 1.

line passing through the centre of the same sphere and the point of contact, or rather the point of force transmission.

Now let us call the vertical applied force V and the horizontal force H; it is easily seen then that the equation of equilibrium conditions of this soil arch will be

$$H = V \tan \theta$$

Next, let us consider an elementary cube of unit dimensions taken from the interior of a *granular* mass, its vertical faces being subjected to a horizontal pressure of intensity P_h, while its horizontal faces carry a vertical pressure of intensity P_v per unit area. Then, the total vertical force V acting on that portion of the horizontal plane which is held in equilibrium by the horizontal thrust on the vertical face of unit area, is $P_v \tan \theta$, as shown in Fig. 2. The horizontal force H acting on the unit area of the whole vertical face will be P_h. But $H = V \tan \theta$, so that the equation for the relation of principal pressures in a granular soil becomes

$$P_h = P_v \tan^2 \theta \quad \ldots\ldots (1)$$

or $P_v = P_h \cot^2 \theta$.

*C. A. Hogentogler, U.S. Bureau of Public Roads. Cited in Engineering Terminology, by V. J. Brown and D. G. Runner, Gillette Publishing Co., Chicago, U.S.A.

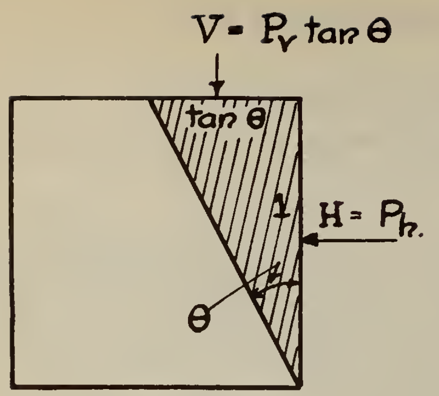


Fig. 2.

Stability of Cohesive Materials

On the other hand, the internal stability of cohesive soils is that property which produces resistance to displacement by molecular or electrical attraction between the particles and the molecular water layers at their surface. This resistance can be compared to that of any homogeneous and isotropic material and can obey the same laws. It is independent of any normal pressure applied on the plane of failure.

In this case, considering an elementary unit cube of the material, whose faces are subject to horizontal and vertical pressures of intensities P_h and P_v, a shear stress will be set up along some inclined plane of failure, because the material is cohesive. Let the intensity of the shearing resistance along this plane be *s;* then the forces acting on the portion ABC of the cube, as shown in Fig. 3, will be V, H, and S where $V = P_v \times BC$, $H = P_h \times AC$ and $S = s \times AB$. The equilibrium of these forces is expressed by the equation

$$S = V \cos\theta - H \sin\theta$$

$$s \times AB = P_v \times BC \cos\theta - P_h \times AC \sin\theta$$

$$\text{Thus } s = P_v \sin\theta \cos\theta - P_h \cos\theta \sin\theta =$$

$$(P_v - P_h)\frac{\sin 2\theta}{2} \text{ or } P_v - P_h = \frac{2s}{\sin 2\theta} \quad \ldots\ldots\ldots (2)$$

Evidently a cohesive soil carries its maximum shear stress when $\theta = 45$ deg., $\sin 2\theta$ then being equal to unity.

Bearing Capacity of Mixed Soils

Stabilization is obtained by a combination of the two kinds of soils in such a proportion that each type develops its maximum efficiency, in other words, we have to combine the equations (1) and (2)

$$P_v = P_h \tan^2\theta$$

$$P_v - P_h = \frac{2s}{\sin 2\theta}$$

In this case, there will exist a specific relation between the principal pressures controlled by the angle of pressure transmission in the granular material and independent of cohesion.

From equation (2) it will be seen that shearing resistance exists in cohesive material as a separate factor and controls the difference between the two principal pressures namely the vertical and the horizontal (lateral) pressures.

But when there is no cohesion, $P_v = P_h \cot^2\theta$, (θ being the angle of pressure transmission) and there is no shearing stress in the material. If however cohesion exists, there is resistance to shearing in the material and a shear $s = \frac{1}{2}(P_v - P_h)\sin 2\theta$ is set up, which further affects the value of P_v for any particular value of P_h.

Thus it follows that, for a stabilized granular and cohesive material, the total P_v will be the sum of two quantities, $\frac{2s}{\sin 2\theta}$ due to the cohesive action, which does not depend on the lateral pressure, and $P_h \cot^2\theta$, which varies with the lateral pressure.

These relations are illustrated in Fig. 4.

The resulting equation is

$$P_v = \frac{2s}{\sin 2\theta} + P_h \cot^2\theta \quad \ldots\ldots\ldots\ldots (3)$$

This defines the bearing capacity of a stabilized material.

From this expression it follows that in any stabilized mixture where we have only granular and cohesive soils, the load carried is a maximum when the angle of pressure transmission is zero or when the shearing resistance of the cohesive soils is infinite. In practice, it is impossible to obtain these ideal conditions, but we can approach perfection. The solution is to decrease the angle of pressure transmission by using a well graded granular material from the coarser to the smaller aggregates; in other words, by filling the interstices and moving inside the point of contact of force transmission.

It was found experimentally by Professor W. S. Housel,* of the University of Michigan, that No. 12 lead shot had an angle θ of 27.3 deg., which is close to that with perfect spheres; that for Ottawa sand θ was about 24.5 deg.; that a well graded concrete sand passing No. 10 sieve, maximum size, gave about 18.7 deg.; and finally that a well graded aggregate, ¾ in. maximum size, had about 18.6 deg. as the value of angle θ. This is the smallest value obtained so far.

The lateral support necessary to supply enough resistance to increase the final bearing capacity is much less in the last two cases than in the cases of the lead shot or the Ottawa sand. This last principle was confirmed in our laboratory, where an extensive enquiry was made to determine what gradation would produce the best density and the best resistance to compression.

After having varied the coarse, the medium and the fine aggregate; we have adopted the following gradation:

Passing sieve	*Per cent.*
¾″	100.0
⅜″	73.0
No. 10	45.0
No. 40	27.0
No. 200	13.0

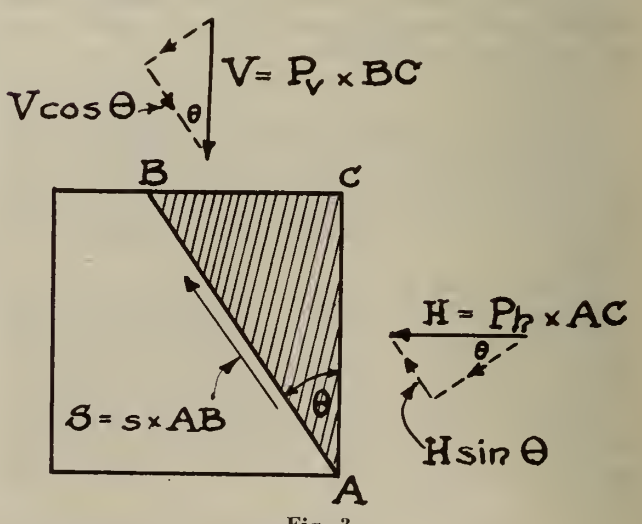


Fig. 3.

* Proceedings of the American Society for Testing Materials, Vol. 36, Part II, P. 426.

With that gradation, we have obtained, in the field, at six per cent moisture content, a density of 144 to 145 lb. per cu. ft.

The correct blend recommended is highly important. Cohesive soils are able to develop enough lateral support to keep stable almost any type of granular material but, here again, the amount to be added is limited by sound practice. If there is too much clay, during wet weather the mixture will absorb water above its liquid limit, will lose all stability and will develop pot holes under traffic.

Addition of Other Substances to Improve Stability

After having found that it was necessary to adopt a definite gradation band and a definite cohesive material in reasonable amount, we discovered that certain properties of our stabilized mixture could be improved by adding other materials having definite functions.

Among those products added were waste sulphite liquor, cement, asphalt and calcium chloride; waste sulphite liquor and cement to increase the cohesive properties of natural clay; asphalt to prevent decrease of stability by water absorption, and calcium chloride, on a wearing surface, to prevent dust formation. Sometimes it is as easy to obtain a proper gradation as it is hard to locate a suitable cohesive soil. Waste sulphite liquor and cement remedy that weakness and give such a lateral support to our applied vertical pressures that a stabilized mixture containing those products reaches, when bone dry, almost one third of the strength of plain concrete.

Production and Properties of Waste Sulphite Liquor

Soil cement stabilization is well known all over the United States and Canada, though waste sulphite liquor has been employed satisfactorily only in the last two or three years. As the use of this material as a road binder is rather new in Canada, a brief account of its origin, nature, properties and available quantities may be of interest.

In the manufacture of chemical pulp by the sulphite process the cellulose fibres are freed from the non-cellulosic portions of the wood by digesting the chipped wood with a solution of sulphurous acid and calcium bisulphite. A typical sulphite cooking liquor contains one per cent of sulphur dioxide combined with lime and 4.5 per cent free sulphur dioxide. The actual cooking is carried out in steel digesters lined with acid-resisting bricks. These digesters are about 15 ft. in diameter and 50 ft. high, holding about 30 cords of chipped wood. The cooking period and temperatures employed depend upon the quality desired; average figures may be nine hours, with a maximum temperature of 145 deg. C. and maximum pressure 75 lb. per sq. in.

By this means, approximately 50 per cent of the wood goes into solution. On completion of the fibre liberation, the material is blown from the digester into large vats fitted with perforated bottoms of acid resisting material, through which the cooking acid, or waste liquor as it is called at this point, drains off. So far there has been no general re-use of this waste material and in the large majority of sulphite operation in this country it is disposed of by sewering into the streams and other water courses.

The dry powdered material may be manufactured by concentrating the partially thickened material in a vacuum dryer, spray dryer or other approved type of equipment.

During the past year, Canada produced approximately 1,500,000 tons of sulphite pulp and an equal

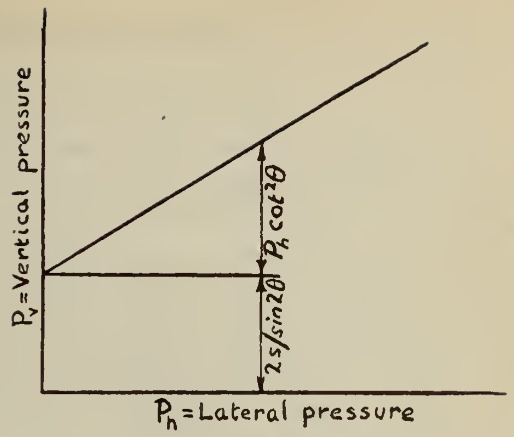


Fig. 4.

amount of wood substance was dissolved. To produce this quantity of pulp approximately 3,000,000 cords of spruce and balsam wood were required, half of which served no economic purpose in its final disposition.

Of this 1,500,000 tons of waste material, part must be assumed to be difficult to remove from the pulp in sufficiently high concentration to be readily utilizable, but undoubtedly 75 per cent could be easily recovered. Thus 1,125,000 tons of material are available for utilization. This would yield 2,250,000 tons of the liquor, 50 per cent solid material, or 1,125,000 tons of the dry powder annually.

Bituminous Material Improves Performance of Stabilized Base Courses

Asphalt, on the other hand, is used in the stabilized mixture as a waterproofing agent. Mechanically stabilized mixtures consisting of gravel, sand, and clay binder, have high bearing capacity when dry, but lose bearing capacity rapidly as moisture is absorbed. At the moisture content of from 5 to 7 per cent often found in these mixtures in the field during the spring of the year, their bearing capacity becomes quite low. A recent advance in the field of soil stabilization, therefore, has been the waterproofing of mechanically stabilized mixtures by incorporating from 1 to 2 per cent of liquid asphalt. The presence of this small amount of liquid asphalt keeps the moisture content of mechanically stabilized base courses low, and their bearing capacity high.

In the following sections, some information on the characteristics of waterproofed mechanically stabilized base courses is given. Much of these data were obtained from research carried on in the laboratory of the Quebec Highways Department, under J. B. Garneau, chief chemist.

The rapid decrease in compressive strength which occurs as the moisture content of a mechanically stabilized mixture is increased, is illustrated by the fact that cylinders 6 by 12 in., bone dry, collapse at 500 lb. per sq. in. pressure, while at 4 per cent moisture content they fail at 100 lb. per sq. in. All mechanically stabilized mixtures behave in this manner, for the clay binder progressively softens and loses cementing power as its moisture content is increased.

It has been previously pointed out that the moisture content of mechanically stabilized base courses may be as high as from 5 to 7 per cent during the spring of the year. From the above data, it is clear that the compressive strength of stabilized mixtures at these moisture contents is very low.

It is obvious then, that if high bearing capacity is to be preserved, the moisture content of mechanically stabilized mixtures must be kept as low as possible, and this suggests the use of a water-proofing material.

Bitumens are the cheapest waterproofing materials, and very effective even when used at the rate of 1 to 2 per cent of liquid asphalt. This has been demonstrated by comparing the moisture absorbed by 6 x 6 control cylinders of soil aggregate without asphalt with that taken up by others containing 1 and 2 per cent of asphalt.

Regardless of whether the initial moisture content is zero, 1, or 3 per cent, the rate of water absorption was very high for control cylinders which were not waterproofed, but was very slow for the cylinders of waterproofed material. Waterproofed stabilization therefore seems to make a very fine base course material, according to experience with it to date, for it resists the entrance of water from rains or other sources, and thereby maintains a high uniform bearing capacity throughout the year.

Below is given an approximate analysis of sulphite waste liquor leaving the digester.

	Per cent Liquor
Total solids	10
Organic	
Lignin (as calcium salts of lignin sulphonic acids)	6
Sugars	2
Acetic Acid	0.5
Methyl Alcohol	0.1
Inorganic	
Lime	0.8
Sulphur	1.1

Lignin is the chief non-cellulosic constituent of wood and acts as the cementing material to hold the fibres together. The search for a profitable outlet for such material has long received the active attention of the pulp and paper industry; recently, since its adhesive and plastic properties have been recognized, it has been used to some extent as a raw material for plastics manufacture.

The sugars are fermentable to the extent of about 75 per cent and these are at present being used for the production of alcohol by at least one Canadian sulphite pulp mill. This group also possesses definite adhesive properties.

The adhesive and binding properties of waste sulphite liquor, conferred upon it by the above constituents, have long been known and the material is used as a core binder in foundry practice, as a linoleum cement, as a glue in various applications and as a road binding material.

In such applications, it was early found that to avoid handling large quantities of water and to reduce transportation charges it was necessary to concentrate the material. The problem of concentration has been satisfactorily worked out and the material is now marketed as a liquid containing approximately 50 per cent solids, and also as a dry powder.

To manufacture the former material the waste liquor as it comes from the pulp is first filtered to remove any foreign material, neutralized with lime and concentrated in multiple effect evaporators. Such a material can readily be shipped in standard tank cars without injurious effect and may be handled with ease. Below is given a typical analysis of the 50 per cent solids material:

Solubility in hot and cold water	99.5 %
Total solids content	50.0 %
Ash content	5.5 %
Free acids	0.25%
Lignin	30.0 %
Sugars	9.0 %
Lime	3.5 %
Total sulphur	3.0 %
Specific gravity at 60 deg. F.	1.25

For drier climates, one per cent of liquid asphalt is considered to be adequate waterproofing material for mechanically stabilized base courses, while two per cent is required for regions of higher rainfall. Experience over a number of years may indicate that more asphalt is required, or that even less is sufficient. The type of liquid asphalt generally used as waterproofing material is R.C.1.

It may be of interest to add that about five million sq. yd. of waterproofed mechanically stabilized base courses have been constructed on highways and air ports in Canada since 1939. This is equivalent to over four hundred miles of roadway 20 ft. wide.

To-day, whatever may be the problems the various highways departments have to solve in soil stabilization, it is our belief that reasonable answers can now be found.

Advantages of Stabilized Mixtures for Wearing and Base Curves

An improved stabilized mixture may be used as a wearing course or as a base course. As a wearing course, it binds the loose material, keeps the aggregate in place and is almost dustproof. The role of calcium chloride here is important. It keeps the wearing surface moist and prevents loss of binder by dusting. Its wide use has proved valuable and efficient. As a base, an improved stabilized mixture increases the bearing capacity of the natural soil, while lowering the cost of construction by decreasing the thickness of gravel required for the same imposed load.

ELECTRIC SYSTEMS IN MILITARY EXPLOSIVE PLANTS (*Continued from page 410*)

Control switches for all circuit breakers are located on the bench board. The field control for the large synchronous motors is also located here.

A large 125 volt control battery with its charging equipment is located in the basement of the control building.

Lead covered cables installed in duct lines carry the radial circuits from the low tension switching station either directly to the large motors or to small outdoor substations. Ten small substations consisting of three single-phase 2,300/575 volt transformers are located in various sections of the plant to serve the smaller motors. Secondary cables are used to carry the 575 volt supply to power distribution centres in the buildings or to 575/115-230 transformers for building lightning.

Emergency lighting for each main building is supplied from a 125 volt storage battery, located in a special battery room in the building. The batteries have sufficient capacity to keep exit lights and a few other lights burning for two or three hours.

EMERGENCY REFRIGERATION OF CARGO SPACES

W. H. COOK, M.Sc., Ph.D.
Director, Division of Applied Biology, National Research Council, Ottawa

Paper presented before the Montreal Branch of The Engineering Institute of Canada, on February 3, 1944

The Bacon Problem

In the decade prior to the war the volume of bacon exported to Britain attained a level that was of considerable importance in Canadian agricultural economy. Since the outbreak of war it has increased several fold, and during 1943 attained a volume of about 300,000 long tons. It therefore represents an important part of the meat ration for both civilian and service personnel in wartime Britain.

Ordinarily, this perishable product is shipped in refrigerated vessels at a temperature of about 32 deg. F. During periods of war, the use of convoys extends the time required for a round trip, and losses of vessels through enemy action establish a premium on shipping space of any kind. A shortage of specially fitted space such as refrigerated cargo holds is felt even more acutely, and this at a time when perishable cargo shipments are about four times their maximum pre-war volume.

This condition arose in the last war of 1914-1918 and, at that time, bacon had to be packed in boxes in a mixture of salt and borax so that it could be shipped in ordinary unrefrigerated holds. This embalmed product may have been nourishing if consumed, but it was not a desirable product and was frequently discarded. The impression this product left with the British public lasted for a decade after the last war and during that period Canada had a negligible export bacon market.

With the outbreak of the present conflict, a similar shortage of refrigerated shipping space was anticipated. Extensive experiments were undertaken at the National Research Council on preservative and packing methods that might permit bacon to be shipped in ordinary holds and still deliver a product of satisfactory quality to the civilian and service personnel in Britain. Some of these helped, but none were considered satisfactory. Since this line of attack offered little promise, consideration was given to the possibility of applying emergency measures for keeping the cargo cold.

Estimation of Refrigerating Load

It was a well-established fact that bacon could be delivered in satisfactory condition if it was maintained at 35 deg. F. or lower. Lacking refrigerated chambers, some alternative method of maintaining the product at a low temperature had to be devised. The first point was to estimate the refrigerating load. Since the bacon is ordinarily unloaded off refrigerated railway cars at an average temperature of 35 deg. F., and since it generates little or no heat in transit, it is evident that refrigeration for cooling the product was unnecessary. On the other hand a substantial heat leakage was to be expected in an uninsulated cargo space.

It was assumed that if some form of emergency refrigeration became necessary, a suitable cargo hold could be selected. In this connection a space having a low surface-volume ratio, removed from hot engine-room bulkheads, would be desirable. The minimum surface-volume ratio occurs in lower holds. Those aft are cut by the screw tunnel which often attains engine room temperature and appeared therefore to be the least desirable. Of the forward holds, No. 1 is of awkward shape. No. 2 was considered most satisfactory, particularly on six-hatch vessels where another hold or a coal bunker lies between the after end and the engine room.

Since the lower hold will always be below the water level when the vessel is stowed to capacity, the prevailing water temperatures in the North Atlantic are an important item in the heat transfer relations. A survey of available records showed that 65 deg. F. was the maximum prevailing at any season while at sea, although higher temperatures might prevail during periods in port. While it seemed desirable to maintain the product at 35 deg. F., laboratory studies showed that even if the temperature of the bacon rose to 45 deg. F. during the voyage it would still be fit for immediate consumption on arrival. The maximum temperature difference to be maintained was therefore 30 deg. F. and the minimum 20 deg. F. The difference between these levels left some margin to take care of the extra heat leakage during periods in port.

The bale capacity of an average No. 2 hold is about 50,000 cu. ft., or round figure dimensions of 50 by 50 by 20 ft. The 4,000 square feet of metal surface in the sides and buklheads is extended further by the framing members, lined only with spar ceiling or cargo battens on wide spacings. Here the only effective resistance to heat transfer is the film coefficient. Theoretical considerations indicated a K value between 1.8 to 2.0 B.t.u. per sq. ft. per hr. per deg. F. but this estimate was subject to considerable uncertainty. The tank-top and deckhead had a surface of about 5,000 sq. ft. The tank top is usually 2-in. wood laid on 2-in. sleepers, and although the condition varies considerably with respect to wear and moisture, the K value should not exceed unity. The deckhead is of essentially the same construction as the sides and bulkheads except for the hatch area which is wooden planking. Heat gain through a horizontal overhead plane is less than for vertical planes, and this combined with the hatch area and the wooden dunnage on the deck above indicated a K value of unity or less.

If the above assumptions are correct, the refrigerating load is approximately one ton per deg. F. temperature difference, or 20 tons to provide the minimum requirement of 20 deg. F. below prevailing ocean temperatures. The application of rigid insulation to reduce these values seemed out of the question since this would have delayed the vessel for a considerable period. Emergency methods for reducing the load by partial temporary insulation were therefore considered. Nothing could be devised for the tank top since the cargo must be carried and worked on on this surface. The deckhead presented similar difficulties to rapid and effective emergency treatments. The sides and bulkheads, however, were the greatest source of heat leakage and it was felt that these could be treated with blankets to reduce the coefficient of heat transfer from 2 to 0.5 B.t.u. per sq. ft. per hr. per deg. F. This reduced the estimated refrigerating load to about 12 tons for minimum requirements.

With this information it was possible to assess the merits of various procedures for keeping the cargo at the required temperature. Assuming a 20-day voyage, the minimum amount of water ice required was about 240 tons. This procedure, used extensively on railway cars, was obviously impossible from space considera-

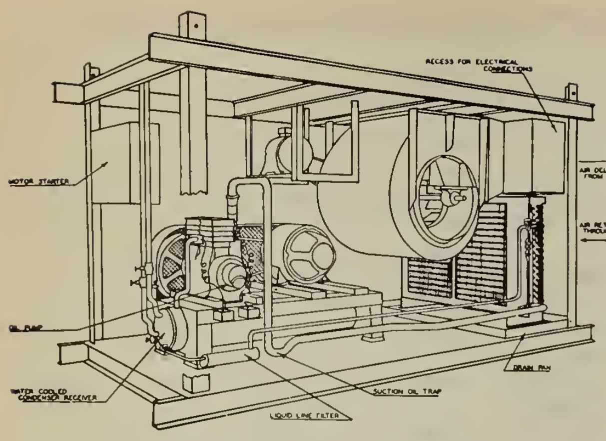


Fig. 1—Assembled refrigerating unit.

tions alone quite apart from the problems of water disposal, stowage, and cargo shifting as the ice melted. Dry ice would reduce the material required to about 125 tons, but most of the difficulties of water ice remained. Freezing the cargo prior to stowage and stowing the space with a lining of an insulating product such as lard most nearly met the theoretical requirements and was successfully tested in shipments from United States ports. This procedure was not generally practicable from Canadian ports. Freezer capacity is generally inadequate; there is not sufficient export volume of lard or similar products to provide an insulating layer, and this procedure would demand additional handling in congested areas. Mechanical refrigeration appeared to be the only means of meeting the required conditions.

The anticipated requirement of prompt installation to avoid delaying the vessel brought up the question of designing satisfactory equipment. Obviously it would have to be a pre-fabricated and pre-tested unit. This and other considerations demanded a forced air system involving motor, compressor, water cooled condenser, evaporator, fan and accessory equipment completely assembled. Such a unit could only be installed readily in a cargo hold where it might be inaccessible during the voyage. In such a space the hazards of fire, refrigerant, and water damage to the cargo and vessel must be avoided. Complete metal enclosures with water-tight bottom sections draining to the scuppers or bilge would therefore be required. The use of freon provided a safe refrigerant. Electric motors were necessary to meet fire and remote control requirements.

This brought up the matter of power and water services on cargo vessels. A survey showed that water for the condensers could be provided from existing pumps on practically all vessels but that the power requirements would limit general applicability of the proposed equipment. In general, motor ships with electrically operated winches had sufficient generator capacity to provide the necessary power. The applicability of the proposal was therefore limited initially to selected motor vessels.

The foregoing summarizes the status of the problem in the spring of 1941 when the shipping situation became serious and consideration had to be given to all possible methods for shipping bacon in unrefrigerated space. Since the use of borax or other preservatives did not seem to provide a satisfactory solution, attention was turned to emergency refrigeration, as described above. There were many doubts as to the ability of this equipment to protect the cargo and many new requirements had to be met. It was finally agreed that the proposal was worthy of a trial. Through the co-operation of Mr. T. C. Lockwood, Transport Controller, a suitable motor vessel was named for the test. The Bacon Board arranged for the necessary cargo and financed the equipment. Mr. T. A. Steeves, Refrigerating Engineer at the National Research Council, was responsible for most of the detailed design and supervision, and the project enjoyed whole-hearted support and assistance from the firms supplying and manufacturing the equipment.

Mechanical Equipment

In order to keep the equipment within the capacity of the ship's gear and avoid "heavy lifts", the gross weight of the assembled unit had to be less than three long tons. In order to minimize the cargo space occupied by the equipment, comparatively small compressors were operated at high speed, and an extended suface coil with 54 fins per ft. was employed. Even with these modifications, the maximum gross refrigerating capacity that could be obtained in a complete unit of three tons weight was about 90,000 to 100,000 B.t.u. per hr., or 7.5 tons of refrigeration. This meant that two or three units would be required to provide the necessary capacity. The use of several units had one advantage in that it gave some assurance against complete failure through mechanical breakdown.

The layout of one of these units is shown in Fig. 1. All of the equipment was enclosed in a space about 5.5 ft. wide, 11 ft. long and 6 ft. high. The appearance of the unit under test at McGill University (where D.C. current was available) is shown in Fig. 2. Since the double-width, double-entry fan drew air in through the evaporator (cooling coil) the enclosure acted as a plenum chamber, and exposed surfaces were insulated after installation.

While the water-cooled condenser removed most of the heat, that generated by the fan motor and the compressor motor head and connecting piping were added to the air stream. This caused a reduction in the gross capacity of the equipment. In addition the air

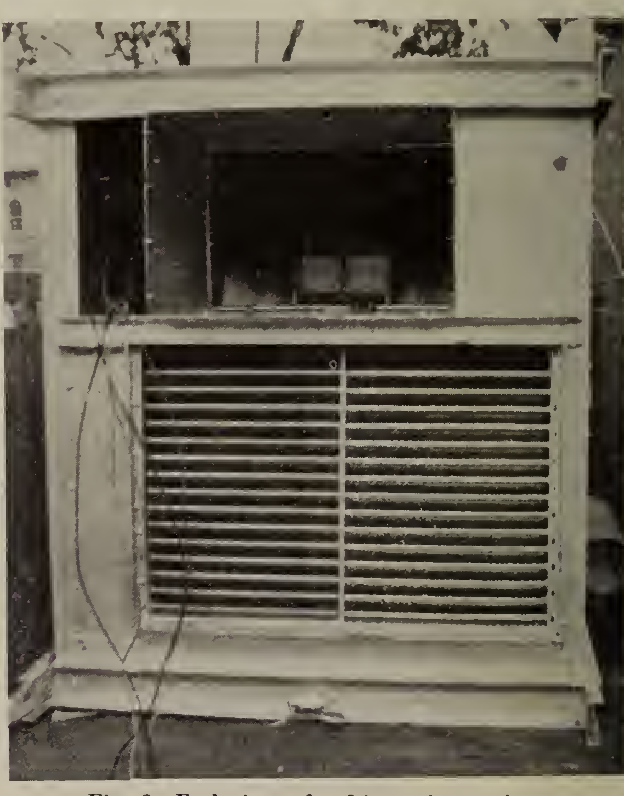


Fig. 2—End view of refrigerating unit.

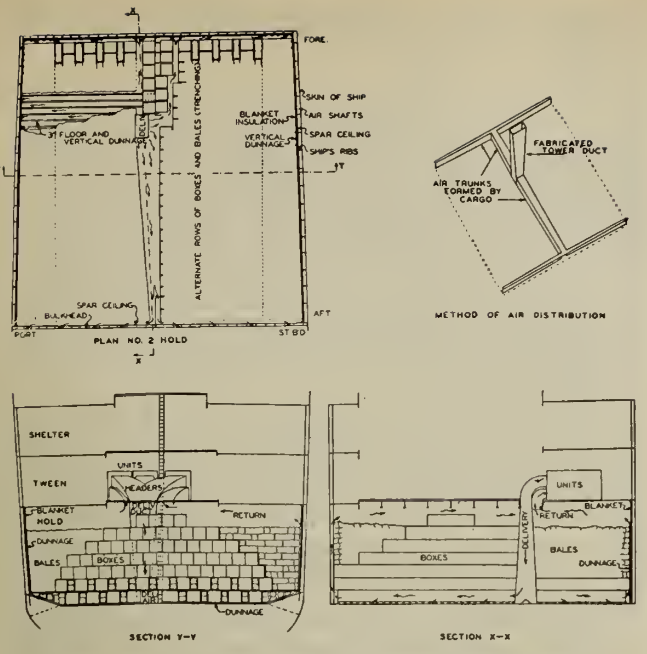


Fig. 3—Method of stowage and air distribution.

temperature required demanded that the coil operate below the freezing point and under these conditions a closely finned coil freezes over and becomes ineffective. In practice, the compressor had to be stopped about one hour in six for defrosting, with a proportionate reduction in capacity. As a result of these two factors the net refrigerating effect averaged about 60,000 B.t.u. per hour, or five tons per unit. For these reasons, three such units were required to provide the estimated net requirements of 12 tons or more per hold.

Stowage and Air Distribution

The method of installing this equipment is shown in Fig. 3. The units were mounted on the 'tween deck, above the lower hold to be cooled, at a point adjacent to the hatch to provide for air delivery and return. The necessary electrical and water connections could usually be completed in from two to three days. Meanwhile, the lower hold was lined on the sides and bulkheads with blankets 20 by 30 ft. made from ¾-in. eel grass batts stitched between two layers of 8-oz. duck. Three-inch dunnage was laid athwartships on the tank top and similar material was erected vertically inside the blankets on the sides and bulkheads.

One of the new requirements was that the lower hold was not to be obstructed with permanent air trucks and ducts. This problem had been anticipated in part since it seemed unlikely that elaborate duct work could be constructed in the estimated time available. Since the heat to be removed entered entirely from the outside surfaces it seemed desirable to enclose the cargo in a jacket of moving cold air. The dunnage arrangement described above provided the jacket space, but the trunks leading the cold air to this space had to be fashioned in the cargo.

The method employed is shown diagrammatically in Fig. 3. The cold air deliveries from the three machines entered a common header leading to a vertical prefabricated wooden "tower" duct. This tower duct was movable and was placed in position before stowage started. From the bottom of this duct the air was led fore and aft through a channel formed by the proper spacing of the first layer of boxes. Similar channels are also provided athwartships by leaving a space between the boxes and the bulkheads. When the first layer is stowed it is covered over with lumber and remaining layers of boxed or baled meats stowed right up to the vertical dunnage on all surfaces.

The air therefore travelled down the tower duct; along the tapered fore and aft channel and continuously spilling out between the 3-in. dunnage beneath the cargo; along the bottom and up the side returning to the space between the cargo and the deckhead. Some of the air passes into the athwartships channel at the foot of the bulkheads and hence up the bulkheads between the dunnage. The air above the cargo was continuously returned to the units, through an opening in the hatch.

Normally a vessel has to remain in port five or six days to discharge ballast, take on cargo and permit minor repairs. It was found that this installation could be made in sufficient time to provide refrigeration in the converted hold one to two days before sailing. This left sufficient time for stowing upwards of 1,000 tons of perishable cargo in the converted space.

Air and Product Temperatures

It is extremely difficult to make extensive measurements of an experimental character on a merchant vessel at any time and the conditions existing during the war emergency have made an adequate investigation impossible. The fact that the cargoes have been delivered in a satisfactory condition is recorded as sufficient proof of the value of the equipment. In the early stages an effort was made to obtain more detailed information so that the equipment could be improved or modified to suit requirements. The results of one of these tests, made under maximum temperature conditions, appear in Fig. 4. These show the temperature of the sea water and air, the cargo air temperatures, and the extremes and temperature differentials throughout the voyage. The histograms at the bottom show the temperature of the bacon at the time of stowage and discharge.

At the time of stowage this cargo had an average temperature of 34.5 deg. F. and a maximum of 46 deg. F. Water temperatures in port reached 76 deg. F. and averaged 62.9 deg. F. for the entire voyage. The temperature of the air in the cargo space averaged 36.8 deg. F. The temperature difference between the air in the cargo space and sea water was 25.7 deg. F. for the en-

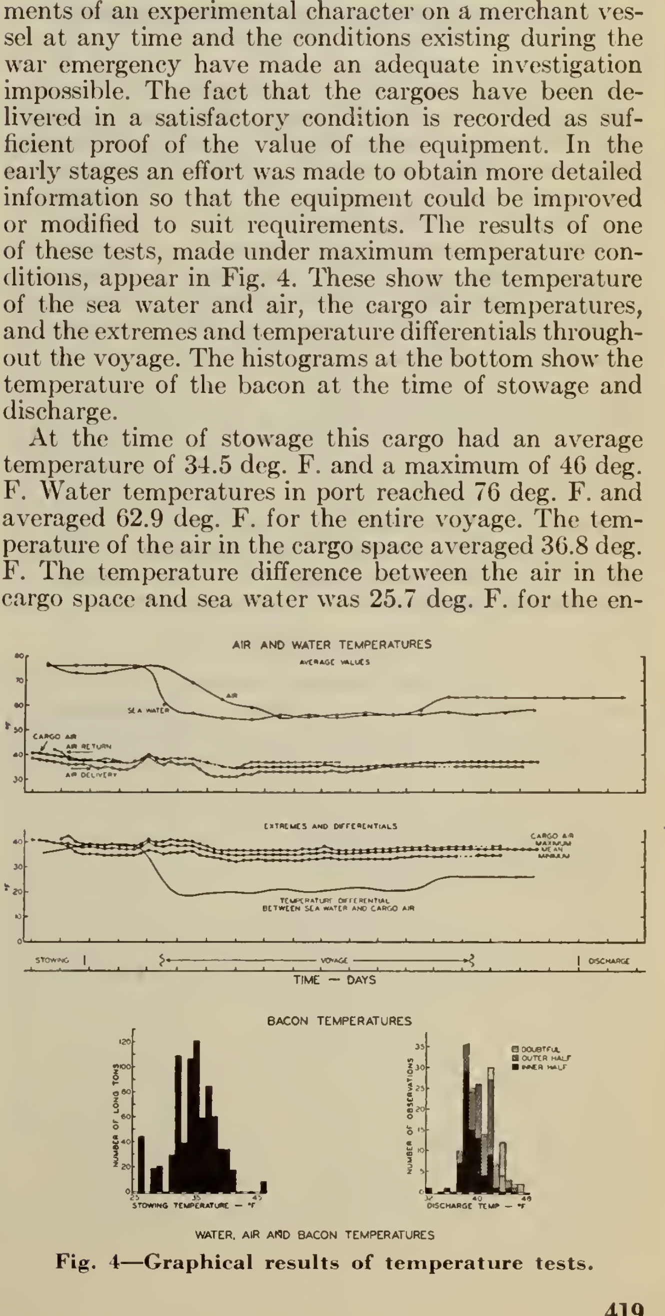


Fig. 4—Graphical results of temperature tests.

Fig. 5—Coil fitted with copper plates providing electrical defrosting.

tire voyage and 20.8 deg. F. for the period at sea. The temperature of the bacon when discharged was 39.9 deg. F. (average) and 46 deg. F. maximum. These results showed that the majority of the earlier assumptions were essentially correct and that the conditions maintained were satisfactory.

On this particular voyage a study of the limited data obtained indicated that the three units had a net refrigerating effect of about 174,000 B.t.u. per hr. While this figure is subject to some uncertainty it indicates that the average thermal transfer coefficient for the entire hold was about 0.85 B.t.u. per hr. deg. F. per sq. ft. The earlier assumptions of $K=1.0$ for the tank top and deckhead, and $K=0.5$ for the sides and bulkheads after insulation, yield an average value of $K=0.78$ for this particular hold. Considering the uncertainty of the original estimates and the errors inherent in the limited experimental observations that were possible, the computed and observed values appear to be in reasonable agreement.

Coil Defrosting

The results of these measurements also indicated a need for improving the equipment by increasing the net refrigerating capacity. In this connection the period the equipment was shut off for defrosting resulted in the greatest loss of potential refrigerating capacity. In the early units, the units were turned off manually for defrosting. Ammeters in each compressor motor circuit were placed in the engine room. As the coil frosted over heat transfer was reduced, and the low side pressure and current consumption fell off together. The operator was instructed to shut off the machines when the current consumption fell to a given value. Since the air was above the freezing point the coil defrosted and the compressor motor was started when the current consumption was normal.

This practice did not prove satisfactory as it called for excessive attention on the part of the operator. Furthermore the compressor motor was frequently started before the coil was completely defrosted. The next scheme adopted was a fixed schedule in which the compressor was operated for five hours and shut off for one hour. This showed some improvement but also called for considerable attention and gave no assurance, with changing temperature conditions, that the coil was adequately defrosted. The next step was to arrange for automatic defrosting through a pressure switch controlling the motor.

This device, plus a modification in the design of the coil, gave increased performance, but the loss of capacity during defrosting was still in excess of 10 per cent of the gross capacity. About this time, requests were received to maintain air temperature below 32 deg. F. for the transport of frozen cargo. At these air temperatures it was, of course, necessary to use heat for defrosting the coil.

When extended surface coils of this type are employed for freezer installation on land, they may be defrosted by a number of methods. These include spraying with water, brine, steam, or by electrical strip heaters placed in air beneath the coil. The methods employing liquid or steam could not be employed in an inaccessible cargo space, and the electrical methods were slow and inefficient since they involved the transfer of heat from the heater to air and then from air to the coil.

An improved method of electrical defrosting was developed which involved replacing some of the fins with copper plates. These plates were firmly bonded both to the coils and to the electrical heating elements to insure good heat transfer. A coil of this type, shown in Fig. 5, can be completely defrosted in less than half an hour with a current consumption equivalent to that required by the compressor motor. Through the use of pressure switches this defrosting cycle can also be made fully automatic. When the pressure falls to a predetermined value the switch stops *both* the fan and compressor motor, and turns on the heaters, arranged to have an equivalent current consumption. When defrosting is complete, the pressure rises and the process is reversed. Through a delay-action relay the compressor motor starts a few seconds after the fan to insure that the coil is thoroughly dried before it reaches freezing temperatures.

In the early part of this report it was indicated that the equipment was applicable only to certain holds in certain vessels on which adequate power was available. While the limitations still apply, many have had to be overlooked or overcome in subsequent applications. The equipment has now been applied to a wide range of holds both fore and aft, and Diesel driven generators have been installed to provide power when it was otherwise lacking. Like many war jobs, this emergency equipment has not been a spectacular development but it has been useful.

From Month to Month

News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

COLLECTIVE BARGAINING

There is little to be reported now about this absorbing topic, due to the fact that every member will receive the brief issued by the Committee on Employment Conditions shortly before reading this issue of the *Journal*. The latest news and comment will be in that document.

As time goes on, the complexities of the situation increase due to contrary decisions that are being reached by different groups. To meet the situation precipitated by Order in Council 1003 it is absolutely necessary that the engineers present and maintain a united front. This seems to be getting farther and farther from realization, but perhaps the situation can be regained before it is necessary for the group to appear again before the Board in October.

The Institute committee has made a real study of the problem, and has met at times almost daily. It is doubtful if any other meetings of Institute members will produce as much discussion, debate and sound thinking as has been developed at the meetings of this committee.

In appreciation of the time and thought contributed by the members of the committee, and with a realization of the importance of the question, it is hoped every member will complete the questionnaire and return it promptly, so the committee may go on to the next stage in its deliberations.

COUNCIL PROTESTS TO MINISTER OF NATIONAL DEFENCE

Expresses Concern over Appointments to R.C.E.M.E.

At the regional meeting of Council held in Toronto on June 17th, there was a very full discussion of the apparent policy of giving the majority of commissions in the Royal Canadian Electrical and Mechanical Engineers to non-technical persons. It resulted in a decision to send a protest to the Minister of National Defence, and accordingly the following message was approved and transmitted:

Montreal, June 22, 1944.

The Hon. Colonel J. L. Ralston,
Minister of National Defence,
Ottawa, Ontario.

Dear Colonel Ralston,

This letter is sent under instructions of the Council of The Engineering Institute of Canada. At a meeting held in Toronto on June 17th the following motion was made and unanimously approved:

THAT the General Secretary send a communication in the following form, relative to the appointment of non-technical officers to the Royal Canadian Electrical and Mechanical Engineers, to the Minister of National Defence, the Master-General of the Ordnance, and such other officers and civilians as may be decided upon.

The Council of The Engineering Institute of Canada is disturbed to learn through newspaper announcements that the commissioned officers selected for units of the newly created Royal Canadian Electrical and Mechanical Engineers (R.C.E.M.E.) are mostly persons who have no engineering training or experience.

For about two years the Institute has advocated the adoption by the Canadian Army of the procedure followed in the Imperial Army, i.e., the establishment of a separate corps for electrical and mechanical work officered entirely by professional engineers. During that time members of the Institute's committee have called on several officers of the Department of National Defence and have presented a brief to the Minister, the Hon. Colonel J. L. Ralston, urging such action.

In response to the committee's recent comment that the order establishing the new Canadian corps did not require that officers be professional engineers as in the British corps, the Minister stated, in his letter of April 8th—"The academic and practical qualifications of R.C.E.M.E. officers will remain the same as they are at present for officers on the "E" side of Ordnance. These qualifications are and have always been equal to those demanded by R.E.M.E. with the exception that they do not require candidates for O.M.E. appointments to serve three years' apprenticeship in electrical and mechanical engineering."

Council's knowledge of appointments to the new corps has been limited to those reported in the press, although a request was made to the Master-General of the Ordnance for an official list or lists. This information is so at variance with the Minister's statement that Council desires to bring it to his attention and to inquire if this type of selection has been adopted as a standard policy or if there is some chance that the work of the corps, both at Headquarters and in the districts, will be carried out under the administration and control of engineers.

The seriousness of assigning control of engineering work to non-engineers is a matter of concern to all engineers and to the public as well. It denies to engineers their best opportunities to serve their country. It has an adverse effect on the progress of the war and it robs the profession of the prestige which it has built up over a long period of years.

Council will be very grateful to you for an early reply to its enquiry. This matter has stirred all engineers from coast to coast and we are confident should have your very early consideration.

Yours sincerely,
(Signed) L. Austin Wright,
General Secretary.

Two weeks have passed between the date the message was sent and the time of writing, but so far the only word received has been an acknowledgement from the Minister, advising the president that the matter has been referred to the Master-General of the Ordnance. Informally and unofficially the general secretary has been told—not by the Minister— that the Institute's protest is unwarranted, but in the course of the discussion no evidence was submitted that was convincing.

It would be a great pleasure and relief to know that the protests were unwarranted. It would be wonderful news to all engineers and to the public to know that the engineering positions were beign given to engineers.

The *Journal* would be quickly ready to apologize and to congratulate the responsible officials on their good judgment. But the evidence appears to be still quite unfavourable to any such hope.

As a precaution against being unfair, equal space and prominence has been offered to any statement that the Department would like to make in response to the Institute's inquiry and complaint. The Institute's interest in this is not selfish—it is national, and therefore it is equally ready to publicize the story from the Department's point of view.

There have been several editorial comments in other publications. Prominent among these have been the *Globe and Mail*, Toronto, The *Standard*, Montreal, and the *Daily Commercial News*, Toronto. It is likely the story will be reviewed many more times in the immediate future, particularly if there is no apparent change in policy. This looks like the occasion to settle once and for all the necessity of making technical appointments to technical positions. Surely the support of the profession and the public should be influential enough to establish such practices in the armed services.

What the Institute is asking for is not unreasonable. Surely the efficiencies demanded by competitive industry are equally required by the active services. These can be obtained only if the administrative positions are given to those whose education and experience qualify them for such responsibilities.

CO-OPERATION ADVANCES

Since the passing of the amendment to by-law No. 78, whereby provincial associations of professional engineers having cooperative agreements with the Institute may appoint one of their members to the Council of the Institute, three appointments have been made. The fourth one—Alberta—will not be made until the next meeting of their council in October or November.

So far the appointments are as follows:

Nova Scotia	Dr. Alan E. Cameron, Halifax
New Brunswick	Dr. E. O. Turner, Fredericton
Saskatchewan	Major J. W. D. Farrell, Regina

The presence of one or all of these councillors at Institute meetings will be a manifestation of real institutional co-operation which should be beneficial to the organizations and to the profession. Many engineers in different parts of Canada see in the development a real hope for improved integration of thought and effort between societies. There is a genuine need for the continuation of efforts in this field.

It is gratifying to the Institute to see that the associations have chosen such outstanding and well qualified representatives. Each one has had a leading part in the development of the profession in his province, and brings to the Institute an experience and a spirit that will be very helpful.

ENGINEERS AS ADMINISTRATORS

Every now and then some uninformed person makes a public or private reference to the effect that engineers are not administrators. This has been the argument offered by Department of National Defence officials against the claims that engineers should be given command of their own services in the Ordnance Corps and now in the Royal Canadian Electrical and Mechanical Engineers.

By way of an interesting high light on these references, the *Journal* publishes herewith a list of thirteen engineers who, during this war, have become major- or lieutenant-generals. So far as the writer has been able to discover not one of them is a product of the Ordnance Corps, (Engineers) although practically every other service is represented.

It seems a reasonable observation that if engineers are good enough to head up all these branches they should be good enough to have headed up the engineers in the Ordnance—and to head them up now in the Royal Canadian Electrical and Mechanical Engineers.

Lt.-Gen. A. G. L. McNaughton, C.B., C.M.G., D.S.O., G.O.C.-in-C. 1st Cdn. Army, now on leave.

Lt.-Gen. K. Stuart, C.B., D.S.O., M.C., Chief of Staff, C.M.H.Q.

Lt.-Gen. E. L. M. Burns, O.B.E., M.C., G.O.C. 1st Cdn. Corps.

Maj.-Gen. C. S. L. Hertsberg (deceased).

NEW COUNCILLORS OF THE INSTITUTE REPRESENTING THE PROFESSIONAL ASSOCIATIONS

J. W. D. Farrell, Regina

Alan E. Cameron, Halifax

E. O. Turner, Fredericton

Maj.-Gen. H. F. H. Hertzberg, C.M.G., D.S.O., M.C., Comdt. R.M.C.
Maj.-Gen. T. L. Tremblay, C.M.G., D.S.O., E.D., Inspr. Gen. Eastern Canada.

Maj.-Gen. H. F. G. Letson, C.B.E., M.C., E.D., Adjt.-Gen.
Maj.-Gen. J. P. MacKenzie, D.S.O., E.D., Q.M.G. Insp. Gen. Western Canada, (retired).
Maj.-Gen. G. R. Turner, C.B., M.C., D.C.M., now on leave pending retirement.
Maj.-Gen. C. R. S. Stein, G.O.C. 5th Cdn. Armd. Div. now on leave pending retirement.
Maj.-Gen. H. Kennedy, C.B.E., M.C., Q.M.G.
Maj.-Gen. C. Vokes, D.S.O., G.O.C. 1st Cdn. Div.
Maj.-Gen. G. B. Howard, Joint Inspection Bd. of U.K. & C.

WASHINGTON LETTER

The Future of Civil Aviation

The *Constellation*, the new four-motor passenger plane which crossed the Continent in the record-breaking time of six hours, was on display in Washington recently. The plane is most impressive and, while it foreshadows the trend to be expected in long distance civilian air transportation, the designs at present on the drafting boards in this country and England are understood to embody advances even on the present *Constellation* with respect to both size and speed. I recently flew from Washington across the Continent and up to Vancouver and back, and during the trip took the occasion to observe a wide cross section of the civil aviation facilities available at the present time, particularly with respect to airports and terminal facilities. The major impression gained was that it will be necessary to make considerable revisions and enlargements to these facilities to take care of the additional post-war air travel. Even with the reduced number of planes available for civilian use and with the rigid passenger priority system at present in operation, existing facilities, both ground and operational, appear to be taxed to the limit. It is also an interesting question as to what provisions in the actual design of landing fields the new and larger planes at present being built will require. At a small luncheon given the other day for heads of the American and Australian civil aviation authorities, these questions were discussed at some length. One of the interesting aspects of the problem is that the newer, larger planes do not necessarily require commensurately larger landing strips, although there appears to be some divergence between American and British practice in this regard, with the British favouring considerably longer runways. This is probably due to the fact that weather conditions in England require a more frequent use of blind landings. While larger planes are in prospect for long distance and trans-continental flying, the present type of passenger plane would still appear to be economical for normal inter-urban traffic. With respect to terminal facilities themselves, some considerable increase in traffic to be handled can probably be effected by streamlining and consolidating present passenger and baggage handling techniques. It may also be necessary to cut out the present personalized type of service on the shorter runs. There has, of course, also been considerable publicity regarding the possibility of helicopter service. Passenger capacity on the basis of present designs is still fairly low and the resultant cost per passenger mile is still on the high side. Nevertheless, plans are being laid to establish helicopter service coordinated with existing bus lines and servicing runs between fifty and two hundred and fifty miles.

In the international sphere the whole question is still under discussion. Mr. Adolf Berle has recently returned from London and Dr. Edward P. Warner, who accompanied him, has, as might be expected, some interesting stories to tell of encounters with Lord Beaverbrook. As is usually the case these days, Canada is taking an important and leading place in civil aviation discussions.

In the meantime, U.S. aircraft production for military craft continues at a high level. Willow Run plant recently announced a production level of one bomber every working hour, including, of course, a considerable number in component form shipped elsewhere for final assembly. A new U.S. stainless steel cargo plane called the *Flying Catfish* is now in mass production. Improvement in the design of aero engines continues and an engine recently placed in service has a rating of 3,000 hp.

Synthetic Rubber Programme Completed

About eighteen months ago these letters commented on the tremendous nature of the undertaking which confronted the United States in developing a synthetic rubber programme capable of making good the loss of most of the world's crude rubber sources. It is gratifying to report at this juncture that the original programme for making synthetic rubber in this country has virtually been completed. The last major plant has recently come into operation at Houston, Texas. This huge plant, manufacturing butadiene, has an actual rated capacity of 50,000 short tons which is sufficient in conjunction with other ingredients to make 60,000 long tons of synthetic rubber a year. This will amount to about 10 per cent of the country's normal needs of natural rubber. Since early in 1943 the output of synthetic rubber has been increasing steadily and in the present year it is expected that over 800,000 long tons will be produced. Not only has the technical problem in the production of synthetic rubber been a tremendous one but the difficulties in converting the whole rubber manufacturing industry from the use of crude rubber products to synthetic rubber products has been very considerable. This conversion has only been made as a result of wholehearted co-operation on the part of the rubber industry and as a result of the tireless and painstaking research and testing which the industry has been able to bring to bear on the problem. We have been having recent conferences between Australian and American rubber authorities and between the Australian Minister of Supply, who was recently in Washington, and Mr. Bradley Dewey—the Rubber Director. During our discussions we reached a fuller appreciation of just how great the difficulties have been and the extent to which the rubber companies have contributed their knowledge and resources to the common cause.

Visiting Old Virginia

A recent ceremony at William and Mary College, Williamsburg, afforded the opportunity to visit that particularly interesting section of Virginia which is so rich in both British and American history. The country between Norfolk and Richmond was the scene of a number of important historical developments in the early British colonial days and during the War of Independence and later in the American Civil War. The visitor is, therefore, enabled to follow, in many cases in the same place, developments in respect to these three important phases of American history. Williamsburg is particularly fascinating and the Rockefeller Foundation has done a most remarkable job of restoration and of recreating again the atmosphere of the early colonial days prior to and leading up to 1756.

From an architectural point of view also, Williamsburg is an interesting experience. While the restorations are very complete, the high spot of a visit from an architectural point of view is the original building of William and Mary College which still stands as it was designed and built to plans prepared by Sir Christopher Wren. The head of the Williamsburg Foundation told me that Prime Minister MacKenzie King is an occasional and enthusiastic visitor to Williamsburg. On his last visit to this country Prime Minister Churchill also spent some time at Williamsburg, and people there are still talking with appreciation about his visit to them.

Richmond is also very interesting from an historical point of view and has always wielded a strong influence on the thinking and developing of governmental processes of the United States. The State of Virginia has contributed a number of American presidents and other famous people including Alexander Hamilton. Four of the first five presidents came from Virginia. Eight presidents to date have been Virginians—George Washington, Thomas Jefferson, James Madison, James Monroe, William H. Harrison, John Tyler, Zachary Taylor, and Woodrow Wilson. The inter-twining of British and American tradition which can be found in Williamsburg, Yorktown, Richmond and the surrounding country, and the feeling and atmosphere which is engendered carries with it an experience which should be much more widespread throughout both countries. In the interests of international relations and understanding, anyone who has an opportunity of visiting this section of the country should most certainly avail himself of the privilege.

June 1944. E. R. Jacobsen, M.E.I.C.

MEETING OF COUNCIL

A regional meeting of Council was held at the Royal York Hotel, Toronto, on Saturday, June 17th, 1944, convening at ten o'clock a.m.

Present: President deGaspé Beaubien (Montreal) in the chair; Past-Presidents K. M. Cameron (Ottawa) and C. R. Young (Toronto); Vice-President L. F. Grant (Kingston); Councillors J. E. Armstrong (Montreal), R. S. Eadie (Montreal), E. V. Gage (Montreal), R. E. Heartz (Montreal), A. Jackson (Kingston), A. Love (Hamilton), H. R. Sills (Peterborough), J. A. Vance (London), and General Secretary L. Austin Wright.

There were also present by invitation—Past Vice-Presidents R. L. Dobbin (Peterborough) and E. P. Muntz (Montreal); Past-Councillors J. G. Hall, E. G. Hewson, Nicol MacNicol, W. A. McLean, A. U. Sanderson, D. C. Tennant and J. J. Traill, all of Toronto, R. A. Spencer (Saskatoon), H. F. Bennett (London), also chairman of the Institute's Committee on the Training and Welfare of the Young Engineer; W. P. Dobson, president of the Dominion Council of Professional Engineers; M. J. Aykroyd, president of the Association of Professional Engineers of Ontario; W. C. Wiren, chairman-elect, and W. H. Hewitt, secretary-treasurer, Ontario Section of the American Society of Mechanical Engineers; W. D. Bracken, chairman, and J. H. Ings, secretary-treasurer, of the Niagara Peninsula Branch; S. H. deJong, secretary-treasurer of the Toronto Branch; T. S. Glover, immediate past-chairman, and A. H. Wingfield, representing the Hamilton Branch at a conference to be held on "technical institutes."

President Beaubien extended a cordial welcome to all councillors and guests. It was of great assistance to Council to have guidance and expressions of opinion from members of Council and past officers in different parts of the country, and regional meetings of Council provided this opportunity. He hoped that all persons present would take part in the various discussions.

Annual Meeting 1945—Further consideration was given to the suggestion that the next annual meeting might be held in Winnipeg. The matter had been discussed at the regional meeting in Halifax in April and at a meeting in Montreal in May, and at both meetings the suggestion had met with enthusiastic approval.

It was pointed out that in order to make the meeting a success it would be necessary to have quite a large delegation from the eastern branches. The desirability of avoiding week-end travel was again discussed, and the possibility that the holding of meetings on Sunday might be an advantage.

Following the discussion it was unanimously agreed that it would be desirable to hold the next annual meeting in Winnipeg, but that serious consideration should be given to the question of travelling arrangements and hotel accommodation.

Employment Conditions (Collective Bargaining)—Mr. Heartz presented a progress report in which he outlined the activities of his committee since the last meeting of Council. He reported on the trip which he had taken with the president on which he had spoken to the branches in Hamilton, London, Windsor, Niagara Falls and Toronto. He reported also that two more persons had been added to the committee, i.e., J. D. Sylvester, chairman of the Junior Section of the Montreal Branch, a graduate of the University of Alberta (1938), and B. J. McColl, a graduate of Queen's University (1944). The report concluded with the statement that it was expected that the brief and questionnaire would be in the hands of the printers within a week's time.

Following the presentation of the report, a very wide discussion took place. Some regret was expressed that it was not possible for Mr. Heartz to speak to Council as he had at branch meetings. Colonel Grant was of the opinion that many persons were like himself and had not at first fully grasped the implications of the new Order in Council 1003. He emphasized the desirability of everyone reading over the brief from the committee before becoming too fixed in their ideas.

Mr. Bennett, as chairman of the Committee on the Training and Welfare of the Young Engineer, commented on the interest which this subject had developed among young engineers. He emphasized the importance of the Institute's position in such a discussion inasmuch as young engineers were looking to it for leadership.

Mr. Sills thought it was a mistake to differentiate between salaried employees at the different levels. He thought junior engineers and senior engineers should not be divided. He also thought that any request for change in the act that might be made to the government should include in it consideration of the other professionals as well as engineers.

Mr. Dobson agreed with the previous speakers and emphasized the need of doing something for the young engineer. He referred to the recent annual meeting of the Dominion Council at which regret was expressed that engineers had become involved in collective bargaining. He thought, with Mr. Sills, that the engineers must be prepared to work with other professional persons. He referred to the responsibility which was upon the profession in taking care of the young engineers and expressed the hope that all organizations would work together to accomplish the best results.

Mr. Armstrong inquired as to whether or not any of the other professions were doing anything about the order and, in reply, Mr. Heartz was of the opinion that the lawyers and the doctors were not worrying about it.

Mr. Ings reported that in the Niagara Falls district there had been considerable discussion about the word "confidential" and it was the opinion of many there that the word "trust" should be part of the order in relationship to the interpretation of the word "confidential."

Professor Spencer expressed his great interest in the subject of collective bargaining. He desired as much information as possible so that he could report back to the Saskatchewan Branch. He explained that by reason of the co-operative agreement in that province, the Association administers the professional engineers' act and the Institute does everything else. He thought that it would be appropriate for the associations to handle collective bargaining as they had been set up for such purposes.

Mr. Heartz, replying to Professor Spencer, stated that his committee had stuck strictly to matters of general policy. He thought that the question of who should handle collective bargaining was of secondary importance. The first thing to decide was—Should the engineers bargain, and, if so, should it be under Order in Council 1003, or under some modification of it, or under a new order? He stated the committee had no idea who should do the bargaining because the membership had not yet told the committee what they wanted.

He thought that provincial organizations would be necessary and a federal one also. The latter body was essential inasmuch as many industries such as railways, steamships, air transport, telephones, telegraphs, radio, etc., were all under federal administration. He thought the best results would be obtained if a new order could be secured for the engineers, but he thought there was no chance of getting such a new order if there was even one dissenting organization in the group.

Mr. Sills agreed with the necessity of unanimity of opinion. He stated that he had already received three questionnaires, the answers to which would not promote unanimity.

In order to determine the results which had attended the effort of the Ontario Association to obtain the opinion of its members, the president called on Mr. Aykroyd. Mr. Aykroyd was of the opinion that the answers would be obtained without any difficulty. The Ontario Association had sent out 3,200 questionnaires and approximately 80 per cent had been returned. He pointed out the difficulty of submitting a brief or a questionnaire that was not biased, and he explained that the Ontario Association, basing its decision on the experience it had had in the province, was naturally inclined to give leadership to its members in a specific direction. He explained that the results of the ballot indicated that a very large percentage desired collective bargaining for the engineers but under the control of engineers.

Mr. Muntz thought the Ontario Association had made a genuine contribution inasmuch as the circulation of the brief and questionnaire had kept many young men from joining unions. He was of the opinion that all the societies should get together behind a proposal for a new order.

Mr. Hall inquired as to the distinction that would be made between strictly professional organizations and those which are mixed in their memberships. In reply to this Mr. Dobson explained that the Dominion Council was working on a definition of a professional person and he thought that such a statement would be necessary before the collective bargaining issue could be settled. He reported that at the annual meeting of the Dominion Council it was the opinion that the provincial associations might or could form, either under their own acts or by new organizations, collective bargaining units. He outlined the resolution which had been passed at that meeting and circulated to all associations.

He emphasized the fact that it would probably cost a lot for the engineers to organize themselves for collective bargaining. He thought that the proper approach for the engineers would be by means of job evaluation on a scientific basis. He again expressed the belief that the societies could get together before appearing before the Board again.

Colonel Grant asked as to the urgency of time, in reply to which Mr. Heartz stated that he expected the questionnaire would be back in the committee's hands very shortly. He thought that the group should get together early in August if they can agree on a policy and appear again before the Board.

Professor Spencer stated that the Dominion Council was urging the associations to approve its proposals immediately. He felt the associations were somewhat worried about the emphasis placed on time by the Dominion Council and the determination of the Institute to take no action until it had examined the ground thoroughly. By way of explanation Mr. Heartz pointed out that the committee had been working intensively on the problem for six weeks during which time it had travelled considerable distance and had interviewed outstanding consultants in Canada and the United States. He explained that the committee appreciated the desirability of having the brief in the hands of the members at as early a date as possible but that it was determined not to send out anything until it was confident that it had all the information before it and that the possibilities of all the various moves were thoroughly understood. The committee felt that it was better to have the brief arrive late and have it adequate, than to get it there early and to find out later that it was inadequate.

The general secretary stated that at the time the six months' period was selected by the group of fourteen societies at Ottawa, reference was made to the fact that it would probably not be sufficient time to do the job justice. He pointed out that it was not necessary to appear before the board again until October 12th, and therefore there was no need of being too hasty in the original stages of exploration and thinking.

Post-War Planning—Mr. Wright reported that although the committee had held several meetings since the last meeting of Council, and had a definite project under consideration, it was not yet ready to make a written report to Council. It was continuing its investigations and hoped to make some definite recommendations at an early date.

Resolution from Toronto Branch—The general secretary presented the following resolution which had been submitted to the president by the executive of the Toronto Branch:

> "That the executive of the Toronto Branch of The Engineering Institute of Canada is concerned over recent developments with regard to Institute and Post-War Planning and Reconstruction and requests that the opinion of all members of Council be canvassed in a review of the whole matter with respect to the stated objects of the Institute."

The president explained that upon receipt of the resolution he had given instructions that it be put on the agenda for a full discussion at this regional meeting of Council.

In response to the president's request Mr. deJong explained what the executive had in mind at the time the resolution was prepared. Mr. deJong pointed out that he had not come prepared to make this explanation inasmuch as it had been thought that other officers of the executive would have been present for the purpose. Unfortunately many different uncontrollable factors had combined to prevent almost every member of the executive of the Toronto Branch from being present.

Mr. deJong explained that the executive's interest arose in the first instance from the fact that the paper on post-war planning, which had been delivered at the annual meeting, was published without the discussions. The executive thought that the opinions of the discussors should have accompanied the paper itself, particularly where it was being sent to government officials and other organizations, both in and out of Canada. The executive thought the adverse opinion expressed in the discussions would have demonstrated to the persons receiving the paper that the opinions expressed in it were only those of the authors and not necessarily those of the Institute. Mr. deJong admitted that a statement to this effect was printed on the cover of the paper, but thought it would have been more clearly demonstrated had the discussions been attached.

He stated that another factor prompting the resolution from the branch was contained in the third section of the paper on post-war planning wherein reference was made to the federal taxation procedures. The executive thought the Institute was outside the field established by its charter in interesting itself in taxation matters.

The general secretary explained that due to the late presentation of discussion it would not have been possible to have printed them with the original paper unless the distribution of the paper was delayed for about two months, particularly in view of the fact that the April issue of the *Journal* was devoted entirely to Shipshaw. Usually the practice was for the discussions to be printed in the *Journal* at a considerable period after the paper had been delivered and published. He also explained that it was the opinion of both the Committee of Authors and the Publication Committee that the principal part of the discussions were not related to the subject of the paper, and that the decision as to the final handling of the discussions was made by the Publication Committee.

It was pointed out that the Publication Committee had agreed that the discussions should be abridged substantially and rewitten in the third person so that paper could be conserved and the reader could cover the material in a much shorter time. This procedure is followed frequently in situations of this kind.

Relative to the matter of taxation, the general secretary pointed out that sub-section c of Section 1 of the by-laws relative to the objects of the Institute reads, "to advance the professional, the social and the economic welfare of its members." It was generally thought that the welfare of the members was very closely allied to taxation policy, and that the Institute, therefore, was well within its established interests in discussing federal taxation in relationship to the production of employment in the post-war period.

The president explained that in his opinion taxation was of interest to everybody and therefore was appropriate for discussion as part of an Institute paper.

Mr. Cameron gave some of the history back of the preparation of the original paper, explaining that the whole idea had developed during his term of office. He pointed out that the engineers' relationship to matters of national importance had been changing. In the last war they had been interested principally in construction but now more and more engineers were associated with business and manufacturing, and therefore to such people the question of taxation was one that was very appropriate. He thought that the presentation of such material was educational for all members of the Institute and that the Institute's interest in such matters was a demonstration of its desire to enter more and more into the life of the country and to take a leading part in it.

Mr. Eadie, as chairman of the Publication Committee, explained the committee's decision to print as quickly as possible and not to delay it for the discussions. There was no intention of avoiding the discussions as both the Committee of Authors and the Publication Committee believed that the discussions themselves had very little material in them that was specifically adverse to the proposals made by the paper. It was thought that most of the criticism in the discussions was not related to the subject of the paper.

In response to the president's inquiry, Mr. Armstrong stated that in the opinion of the Committee of Authors the principal parts of the discussion were not relevant to the paper. He explained that the purpose of the paper was to start people thinking along the line of post-war planning. He believed that it had accomplished that purpose.

In speaking of the proposal to establish a Bureau of Economic Research and Development Mr. Armstrong referred to the fact that at the annual meeting a resolution was passed asking the Council to proceed along the lines indicated in the paper. In recommending that the Institute exercise its influence to assist in the establishing of such a bureau the committee was but carrying out the instructions contained in the Quebec resolution.

Dean Young thought that the recommendation of the Committee of Authors relative to the bureau was a very constructive one; that one reason the profession of engineering had not received proper recognition was that they had not taken a proper interest in such matters. He thought that engineers should develop their interest in the vital proposals of policies or measures to be adopted in Canada. In his opinion there was no more suitable body in Canada than the Institute to put forward such a proposal inasmuch as it might very well be to the advantage of the social and economic welfare of the country. He thought that the Institute was only doing its duty in offering its sponsorship to the proposal made by the Committee of Authors.

Junior Graduate Engineers in Ottawa—Mr. Wright reviewed briefly the activities of the group of young engineers in Ottawa who have recently organized under the name of "Ottawa Junior Graduate Engineers Association." A dinner was being held in Ottawa on Monday, June 19th, at which the Hon. C. D. Howe would be the principal speaker. President Beaubien had been invited to represent the Institute but as he was unable to attend, Vice-President Grant had agreed to represent the Institute on that occasion. Mr. Wright explained that the movement had been initiated by two members of the Institute.

Committee on Professional Interests—On behalf of the Montreal Branch Committee on Professional Interests, Mr. Eadie presented a revised draft of a proposed agreement between the Institute and the Corporation of Professional Engineers of Quebec. This draft had already received the unofficial approval of the Institute's Committee on Professional Interests and with the authorization of Council, the Montreal committee had consulted the other branches in the province of Quebec. The draft had received unanimous approval with the exception of one clause, with which the Quebec Branch is not in agreement, and which has to do with the admission of members to the Engineering Institute of Canada after the agreement goes into effect.

Mr. Eadie explained that the Montreal committee is very anxious that negotiations with the Corporation be entered into as quickly as possible. Accordingly, following some discussion, on the motion of Mr. Armstrong seconded by Mr. Gage, it was unanimously recolved that if the draft as now presented by the Montreal committee is satisfactory to the Committee on Professional Interests, upon that committee so reporting to the president, the president shall appoint a committee to negotiate with the Corporation of Professional Engineers of Quebec.

Committee on the Engineer in the Active Services—The general secretary called Council's attention to the recent developments in the corps of the Royal Canadian Electrical and Mechanical Engineers (R.C.E.M.E.). He pointed out that in the newspaper announcements the persons selected for the commission in the Montreal unit were, with the exception of one, all non-technical persons. They included an officer of a taxi cab company, field representatives of motor car companies, tire sales, insurance, etc. In the Toronto area it had been reported to him that there, of the nine officers whose names were given in the newspapers, only two were engineers. He stated that several members had called his attention to these appointments and were of the opinion that the Institute should make a protest.

Dean Young pointed out that in the letter received by the Institute under date of April 8th from Mr. Ralston, Minister of National Defence, a statement was made that only persons with professional qualifications (the same as those for the Royal Electrical and Mechanical Engineers) would be used in the Canadian organization. He said he was puzzled to hear of the recent appointments in the light of Mr. Ralston's statement.

The president was of the opinion that it should be called to the government's attention that if engineers were not given control of this corps the word "Engineers" should be removed from the title.

There was some discussion as to the advisability of having someone call on the Master-General of the Ordnance, but it was pointed out that the committee had already called on him twice and apparently he was not impressed with the argument that engineers should be appointed to engineering positions of an administrative type. The general secretary explained that in interviews with Mr. Ralston and General Young (M.G.O.), both had stated that in their opinion engineers were not administrators and that it was because of this fact that the senior positions were being given to non-technical persons.

Mr. Traill suggested that others besides those engaged in engineering were interested in this matter. He thought the successful prosecution of the war had a definite relationship to the employment of engineers. He thought the public would have the same view and for that reason a resolution such as was being discussed would be of interest to the general public.

It was proposed that a resolution protesting such appointments should be sent to the Minister.

Mr. Cameron thought that in presenting a resolution no suggestion should be made of removing the word "Engineers" from the title of the corps. He pointed out that for a long time the Institute had advocated the establishment of such an engineering corps, and there was no doubt but that the work of the corps was engineering, and therefore it should be officered entirely by engineers. He made certain suggestions as to how the resolution should read, which met with the approval of the meeting. He believed the resolution should go forward immediately.

Accordingly, it was moved, seconded and approved unanimously, that the general secretary send a communication relative to the appointment of non-technical officers to the Royal Canadian Electrical and Mechanical Engineers, to the Minister of National Defence, the Master-General of the Ordnance, and such other officers and civilians as may be decided upon. (See Month to Month for the resolution and comment.)

Committee on the Training and Welfare of the Young Engineer—Mr. Bennett, chairman of the committee, presented a progress report giving the following information:

"A second edition of the booklet 'The Profession of Engineering in Canada' has been prepared and will be released almost immediately. Already requests have been received for 3,200 copies from the universities. The distribution to high schools and vocational guidance officers will require an additional 7,500. The report recommends the purchase of 3,000 in addition to the above requirements.

"A special edition of 5,000 copies of the booklet was prepared for the Canadian Legion Educational Services to be used in the rehabilitation of returned men.

"Following a practice already established, literature has been sent to the engineering graduates of all Canadian universities. This included Dr. D. W. Mead's booklet 'Standards of Professional Relations and Conduct,' which was accompanied by a letter from the president; a paper 'The Engineer's Need of Humanities' especially written by Dr. R. C. Wallace, HON.M.E.I.C., principal of Queen's University, was also distributed, as was Dr. Wickenden's 'The Second Mile' in a revised form.

"The branch committees are continuing to act for the Wartime Bureau of Technical Personnel in matters relating to science students. Also joint meetings have been held with representatives of the Canadian Institute of Mining and Metallurgy and the Canadian Institute of Chemistry. This group held a conference in Ottawa in April of this year with noted success."

Dean Young commended the booklet very highly. At the University of Toronto, on receiving a request for information, it was the practice to ask the applicant if he had already received a copy of the booklet, and, if not, to put him in touch with Mr. Bennett's committee.

The report was adopted, and the president expressed Council's appreciation of the splendid work which had been accomplished by Mr. Bennett's committee.

Technical Institutes—Dean Young reported briefly on the progress being made in Ontario with regard to the establishment of technical institutes. The Department of Education was definitely interested and was recommending that four technical institutes be established in the province. One was already in the process of organization at Haileybury, and will be known as the Haileybury Mining and Metallurgical Institute. A meeting of representatives of Ontario branches of the

Institute was being held immediately after this Council meeting to discuss this matter.

Mr. Wright reported that branches in the other provinces had shown considerable interest in this subject. Several meetings had been arranged and they wished to be kept in touch with progress in Ontario. Many requests had been received for copies of Dean Young's memorandum, both in Canada and from the United States.

Dean Young reported that the Engineers' Council for Professional Development was giving serious consideration to this subject with a view to setting up a system of accrediting these technical institutes, a number of which have already been established in the States. In response to an inquiry from Professor Jackson, Dean Young stated that the entrance requirements for these institutes in Canada would probably be junior matriculation.

Professor Spencer reported that in Saskatchewan this matter had been considered last fall in connection with their plans for the rehabilitation of returned men. It had been suggested that this might possibly be taken up by the federal authorities, possibly leading to national certificates.

Dean Young thought it would be very difficult to set up national certification in Canada similar to that now existing in Britain, but he felt that a great deal could be achieved by having these institutes set up under provincial auspices.

Town Planning—The general secretary reported that recently be had had conversations with Mr. Forsey Page, president of the Royal Architectural Institute of Canada, and Mr. Harold Lawson, of the Quebec Association of Architects, relative to the work that the two institutes might do to develop an interest among their members and the public in town planning. These conservations were the outcome of an editorial appearing in the publication of the R.A.I.C. in which the suggestion was made that the two organizations endeavour to get together. He also pointed out that an endeavour was being made to have some papers on town planning by engineers contributed to the *Engineering Journal.*

Council gave support to the endeavour to increase the interest in the subject, and the general secretary reported that he expected to have further conversations with the architects relative to what could be done cooperatively by the two groups.

Canadian Lumbermen's Association Prize—A report was presented from the committee appointed by Council to draw up rules governing the award of the Canadian Lumbermen's Prize, and on the motion of Mr. Eadie, seconded by Mr. Vance, it was unanimously resolved that they be adopted.

Engineers' Council for Professional Development—The question of the appointment of an Institute representative on the executive of E.C.P.D. to replace Dr. J. B. Challies, whose term expires in October, was left with the president.

President's Western Trip—In response to Mr. Vance's inquiry, the president stated that he would visit the western branches as soon as possible after the opening of the universities, probably leaving Montreal at the end of September or the beginning of October. The Sault Ste. Marie and the Lakehead branches would also be included in the itinerary, and the president would be very pleased if any member of Council could accompany him on all or any part of the trip.

ELECTIONS AND TRANSFERS

A number of applications were considered, and the following elections and transfers were effected:

Members

Alder, William Robert, B.Sc. (Queen's Univ.), div'n. engr. Dept. of Highways of Ontario, London, Ont.

Anderson, Alexander Gordon, B.Sc. (McGill Univ.), chief engr., Eastern Area, The Bell Telephone Co. of Canada, Montreal.

Bailey, Edward Thomas Walter, B.A.Sc. (Univ. of Toronto), combustion engr., Steel Co. of Canada, Ltd., Hamilton, Ont.

Barbour, Robert, B.Sc. (Civil), (Univ. of Man.), 303 Wolfe St., London, Ont.

Bland, Percy Newcome, chief engr., Canadian Sumner Iron Works, Ltd., Vancouver, B.C.

Bright, William James, Major, B.Sc. (Mech.), (Queen's Univ.), O.C., 1st Canadian Field Coy., R.C.E., 1st Canadian Div'n., Canadian Army Overseas.

De Leuw, Charles Edmund, B.S. (Civil), (Univ. of Illinois), pres., De Leuw, Cather & Co., consltg. engrs., Chicago, Ill.

Ernst, Carroll A., B.A.Sc. (Mech.), (Univ. of Toronto), asst. to chief engr., Smart-Turner Machine Co. Ltd., Hamilton, Ont.

Gendron, Henri, B.A.Sc., Ch.E. (Ecole Polytechnique), industrial research engr., Sorel Industries, Ltd. (On loan from Marine Industries, Ltd.).

Haskins, Reginald Eric, B.A.Sc. (Mech.), (Univ. of B.C.), asst. supt., Light, Heat & Power Dept., D.I.L., Transcona, Man.

Hogg, William MacDougall, B.A.Sc. (Univ. of Toronto), designing engr., hydraulic dept., Hydro-Electric Power Comm'n. of Ont., Toronto.

Kirby, William Edward Gordon, B.Eng. (Chem.), (McGill Univ.), asst. office mgr., Price & Pierce Ltd., Montreal.

Langlois, Charles, B.A.Sc., C.E. (Ecole Polytechnique), town engr., Corporation of Sillery, Que.

Lee, Roy Eugene, B.Eng. (Univ. of Sask.), area engr., D.I.L., Ajax, Ont.

Leuthold, Armin, B.Sc. (Swiss Federal Inst. of Tech., Zurich), chief engr., Swiss Electric Co. of Can. Ltd., Montreal.

Meier, Charles, Mech.Engr. (Tech. Coll., Burgdorf), sales & mech. engr., Swiss Electric Co. of Can. Ltd., Montreal.

Morris, Carl Reynolds, chief dftsman., Shawinigan Chemicals, Ltd., Shawinigan Falls, Que.

Napier-Hemy, Hubert John (Royal Naval Engineering Coll., Keyham, England), supervising dftsman., Yarrows Ltd., Esquimalt, B.C.

Peart, John Walton, B.A.Sc. (Univ. of Toronto), gen'l. mgr. & engr., St. Thomas Public Utilities Comm'n., St. Thomas, Ont.

Poirier, Cuthbert, B.A.Sc. (Ecole Polytechnique), div'n. engr., Drainage Bureau (Prov. of Que.), Montreal.

Ross, Cecil Middleton, B.Sc. (McGill Univ.), representative (Prov. of Que.), Mathews Conveyor Co. Ltd., Montreal.

Wellwood, Robert William, B.A.Sc. (Univ. of B.C.), Master of Forestry & Ph.D. (Duke Univ., Durham, N.C.). wood technologist, Commonwealth Plywood Co. Ltd., Ste. Thérèse, Que.

Youmatoff, Serge (Naval Academy, Petrograd), field representative, Wartime Shipbuilding Ltd., Montreal.

Juniors

Brazier, Jack Henry, P/O, R.C.A.F., B.Sc. (Queen's Univ.), navigation instructor, Special Reserve, R.C.A.F., St. Johns, Que.

Gow, Kenelm Vere, B.A.Sc. (Univ. of Toronto), refractories engr., Arvida Works, Aluminum Co. of Canada, Arvida, Que.

Johnston, James Stuart, B.Eng. (McGill Univ.), field engr., Dominion Oxygen Co. Ltd., Toronto, Ont.

Leonard, Hugh Anthony, Lieut. (E) R.C.N.V.R., B.Eng. (McGill Univ.), asst. inspr. of gun mountings, Directorate of Naval Ordnance, N.S.H.Q., Ottawa, Ont.

McMeekin, George Rex, B.Sc. (Chem.), (Univ. of Alberta), tech. librarian & tech. records chief clerk, Alberta Nitrogen Products, Ltd., Calgary, Alta.

White, John Robertson, B.Eng. (Mech.), (Univ. of Sask.), asst. project engr., engrg. dept., D.I.L., Montreal.

Affiliate

Carson, Elmer F. (McGill Univ.), branch mgr., Northern Electric Co. Ltd., London, Ont.

Transferred from the class of Junior to that of Member

Cosser, Walter Geoffrey, Lieut., R.C.E., B.Sc. (Mech.), (McGill Univ.), Halifax Fortress Detachment, No. 6 E.S. & W. Coy., Halifax, N.S.

Franklin, Robert Lawrence, Colonel, R.C.O.C., B.Sc. (Mech.), (Queen's Univ.), director mech. mtce., N.D.H.Q., Ottawa, Ont.

Turnbull, John G., B.Sc. (Mech.), (Queen's Univ.), constrn. engr., Brunner Mond, Canada, Amherstburg, Ont.

Transferred from the class of Student to that of Junior

Becker, Sidney, B.Eng. (Mech.), (McGill Univ.), engr., J. Becker, Inc., Montreal.

Cameron, Adam Kirkland, B.Eng. (McGill Univ.), field investigator, employee relations dept., D.I.L., Montreal.

Craig, Clarence Edward, B.Sc. (Mech.), (Queen's Univ.), production development engr., Aluminum Co. of Canada, forge div'n., Kingston, Ont.

D'Amours, Albert, B.A.Sc., C.E. (Ecole Polytechnique), dftsman., Marine Industries, Ltd., Sorel, Que.

Merritt, Robert J., B.A.Sc. (Univ. of Toronto), supervisor, process engrg. dept., D.I.L., Westmount Tool Works, Westmount, Que.

McElroy, George Robson, B.Sc. (Mech.), (Univ. of Sask.), mech. engr., Demerara Bauxite Co. Ltd., Mackenzie, British Guiana, S.A.

McGeachy, Duncan Donald C., Sub-Lieut., Engineering Branch, R.C.N.V.R., B.Sc. (Queen's Univ.), 114 Balmoral Ave. S., Hamilton, Ont.

Norton, Howard William, B.Eng. (McGill Univ.), aeronautical engr., R.C.A.F., St. Johns, Que.

Students Admitted

Berg, Arnold J. (Univ. of Alberta), 10005-103rd St., Edmonton, Alta.

Cohen, Israel Louis (McGill Univ.), 4326 Laval Ave., Montreal.

Garland, Cecil John (Univ. of N.B.), 74 Gordon St., Moncton, N.B.

Gibson, Ronald Theodore (Univ. of N.B.), Red Head, Saint John Co., N.B.

Gillies, James Robert (Univ. of N.B.), Lady Beaverbrook Residence, Fredericton, N.B.

Gosset, Max Emile, B.Eng. (McGill Univ.), 7430 Durocher St., Montreal, Que.

L'Ecuyer, J. Maurice Fernand, 1880 Galt St., Montreal.

Lefebvre, Paul Emile, B.Eng. (McGill Univ.), 970 De Bullion St., Montreal.

Logue, Ottis Irvine (Univ. of N.B.), 65 Elliott Row, Saint John, N.B.

Mersereau, Oliver Smith (Univ. of N.B.), McAdam, N.B.

By virtue of the co-operative agreements between the Institute and the provincial associations of professional engineers, the following elections and transfers have become effective.

Alberta

Member

Smith, Walter Alexander, B.Sc. (Civil), (Univ. of Alberta), supt. of utilities, Burns & Co., Ltd., Calgary, Alta.

Saskatchewan

Junior

Cameron, Alan Malcolm, Sub-Lieut. (E) R.C.N.V.R., B.Sc. (Univ. of Sask.), c/o F.M.O., Halifax, N.S.

Student

Tomkins, Robert Vernon, B.Sc. (Chem.), (Univ. of Sask.), 1154 Grafton Ave., Moose Jaw, Sask.

COMING MEETINGS

Canadian Good Roads Association—Inter-provincial conference of highway ministers, their deputies, engineers, and other department officials of the provincial governments, September 26-27th, 1944, Cornwallis Inn, Kentville, N.S. Secretary: Mr. G. A. McNamee, New Birks Building, Montreal, Que. Attendance will be restricted to those mentioned above.

Canadian Institute on Sewage and Sanitation—Annual Convention, Royal York Hotel, Toronto, November 2-3, 1944. Secretary: Dr. A. E. Berry, Ontario Department of Health, Toronto, Ont.

THE ENGINEERING INSTITUTE OF CANADA PRIZE AWARDS 1944

Twelve prizes known as "The Engineering Institute of Canada Prizes" are offered annually for competition among the registered students in the year prior to the graduating year in the engineering schools and applied science faculties of universities giving a degree course throughout Canada.

Each prize consists of twenty-five dollars in cash, and having in view that one of the objects of the Institute is to facilitate the acquirement and interchange of professional knowledge among its members, it has been the desire of the Institute that the method of award should be determined by the appropriate authority in each school or university so that the prize may be given to the student who, in the year prior to his graduating year, in any department of engineering has proved himself most deserving as disclosed by the examination results of the year in combination with his activities in the students' engineering organization, or in the local branch of a recognized engineering society.

The following are the prize awards for 1944:

Nova Scotia Technical College	Joseph Philip Vaughan, S.E.I.C.
University of New Brunswick	Frederick William Davidson, S.E.I.C.
McGill University	Geoffrey H. Yorke Slader, S.E.I.C.
Ecole Polytechnique	Jean Bouthillier, S.E.I.C.
Queen's University	John Arthur Harvey
University of Toronto	Werner Buchholz
University of Manitoba	John Edward Page, S.E.I.C.
University of Saskatchewan	Harry Marker Graham
University of Alberta	Anatol Roshko
University of British Columbia	Richard Mountford Bibbs
Laval University	Gilles Marchand
Royal Military College of Canada	No award—regular course discontinued during the war.

RECENT GRADUATES IN ENGINEERING

Congratulations are in order to the following Junior and Students of the Institute who have completed their courses at the various Universities:

McGILL UNIVERSITY

HONOURS, MEDALS AND PRIZE AWARDS

Brown, Donald Robertson, Montreal, B.Eng. (Mech.); The Jenkins Brothers Limited Scholarship (June 1943).

Mroz, Boris, Montreal, B.Eng. (Mech.); University Scholar; British Association Medal; Honours in Mechanical Engineering; The Engineering Undergraduates' Society's First Prize for Summer Essay.

White, Hubert Edward, Lachine, Que., B.Eng. (Ci.); University Scholar; British Association Medal; Honours in Civil Engineering; The Robert Forsyth Prize in Theory of Structures and Strength of Materials.

Wildi, Theodore, Montreal North, Que.; B.Eng. (Elec.); British Association Medal; Honours in Electrical Engineering; Montreal Light, Heat & Power Consolidated First Prize.

DEGREE OF BACHELOR OF ENGINEERING

Bloomberg, Allan David, Montreal (Chem.).
Boucher, Fernand Rodolphe, Shawinigan Falls, Que. (Mech.).
Bourgault, Lawrence Alexandre, Parkhurst, Que. (Ci.).
Brandt, René Edmond, Scotstown, Que. (Mech.).
Brasloff, Reuben Isaac, Montreal (Mech.).
Brennian, Frank Hugh, Lachine (Chem.).
Cohen, Abbey, Montreal (Elec.).
Collet, Marc Armand, Westmount, Que. (Chem.).
Corbet, Villiers Sankey Blakely, Edmonton, Alta. (Mech.).
Cumming, Edwin Keith, Carley, Alta. (Mech.).
Dunne, Gerald Joseph, Otterburn Park, Que. (Chem.).
Everett, Francis Edwin, Montreal (Mech.).
Filion, Marcel, Montreal (Chem.).
Fowler, Charles Allison Eugene, Halifax, N.S. (Mech.).
Freeman, Rex Morton, Montreal (Mech.).
Gosset, Max Emile, Montreal (Ci.).
Hendershott, Frederick William, Montreal West, Que. (Chem.)
Lareau, Fernand, Verdun, Que. (Civil).
Leach, John Gordon, Westmount (Chem.).

Lefebvre, Paul Emile, Montreal (Mech.).
Levinoff, Samuel, Outremont, Que. (Mech.).
Levitt, Morton, Montreal, (Chem.).
McKellar, Arthur Donald, Winnipeg, Man. (Mech.).
MacLeod, James Gordon, Montreal (Ci.).
Maclure, James Hubert Crocker, Montreal (Ci.).
Mendel, Arthur Hesse, Montreal (Elec.).
Miller, Thomas Arthur, Winnipeg, Man. (Chem.).
Nachfolger, Nathan, Montreal (Elec.).
Rice, William Bothwell, Montreal (Mech.).
Scarth, Robert Lloyd, Macdonald College, Que. (Ci.).
Scott, Walter Barrett, Stanstead, Que. (Ci.).
Webster, David Richan, Yarmouth, N.S. (Ci.).
Weinstein, Saul Arnold, Montreal (Mech.).
Worembrand, Carl Hyman, Montreal (Mech.).
Yosipovitch, Joseph, Outremont, Que. (Miech.).

UNIVERSITY OF ALBERTA

PRIZE AWARD

Forster, John William, Edmonton, Alta., B.Sc. (Ci.), The H. R. Webb Memorial Prize in Civil Engineering, offered by the Association of Professional Engineers of Alberta.

DEGREE OF BACHELOR OF SCIENCE

Hole, Harry, Edmonton, Alta. (Ci.).
Hole, Robert Walter, Edmonton, Alta. (Ci.).
Martin, William David, Edmonton, Alta. (Ci.).
Ripley, Charles Farrar, Edmonton, Alta. (Ci.).
Sinclair, Stewart Ronald, Edmonton, Alta. (Ci.).
Webb, John Arthur, Edmonton, Alta. (Ci.).

UNIVERSITY OF MANITOBA

HONOURS, MEDALS AND PRIZE

Davis, Gordon Thurlow, Winnipeg, Man., B.Sc. (Elec.); Honours in Electrical Engineering; University Gold Medal; J. H. Schumacher Memorial Prize for the highest standing in Electric Lighting and Power Distribution.

Dutton, Vernon LeRoy, Winnipeg, Man., B.Sc. (Ci.); Honours in Civil Engineering; University Gold Medal.

McCord, John Erskine Donald, Winnipeg, Man., B.Sc. (Elec.); Engineering Graduation Thesis Prize of the Manitoba Power Commission.

DEGREE OF BACHELOR OF SCIENCE

Berry, William Murray, Winnipeg, Man. (Ci.).
Cann, John Leonard, Montreal, (Ci.).
Carrick, Stanley Mirus, Winnipeg, Man. (Ci.).
Cross, Ivor Frederick, Winnipeg, Man. (Elec.).
Haig, Douglas Ernest, Winnipeg, Man. (Elec.)
Hall, David Bruce, Cupar, Sask. (Elec.).
Ives, Walter Jesse, Glenboro, Man. (Elec.).
Lewis, Hymie, Winnipeg, Man. (Elec.).
MacLean, Duart Alan, Winnipeg, Man. (Ci.).
Millar, Donald Mowbray, Winnipeg, Man. (Ci.).
Mudry, Nestor, Winnipeg, Man. (Ci.).
Peebles, James Arthur, Winnipeg, Man. (Ci.).
Roy, Douglas John, Winnipeg, Man. (Ci.).
Simpson, Leslie Charles, Winnipeg, Man. (Ci.).
Tant, Verne Everet, Winnipeg, Man. (Elec.).
Wight, Clarence Calvin, Winnipeg, Man. (Elec.).

UNIVERSITY OF BRITISH COLUMBIA

HONOURS

Bentall, Robert Gilmour, Vancouver, B.C., B.A.Sc. (Ci.); Honours in Civil Engineering.

Burton, John Albert, Vancouver, B.C., B.A.Sc. (Mech.); Honours in Mechanical Engineering.

DEGREE OF BACHELOR OF APPLIED SCIENCE

Abbott, Hugh Martin, Vancouver, B.C. (Met.).
Carrothers, Percival John Godber, Vancouver, B.C. (Chem.).
Clay, Charles Herbert, Vancouver, B.C. (Ci.).
Cooper, Alexander Charles, New Westminster, B.C. (Ci.).
Frost, Paul Joseph, Vancouver, B.C. (Chem.).
Jagger, Paul S., Hollyburn, B.C. (Mech.).
Mosher, Vaughan Lockhart, Vancouver, B.C. (Ci.).
Narod, Alvin Jackson, Victoria, B.C. (Ci.).
Scarisbrick, Richard Gilbert, Vancouver, B.C. (Ci.).
Slater, John Stuart, Vancouver, B.C. (Ci.).
Smith, Harold Leslie, Vancouver, B.C. (Ci.).
Syme, Thomas Duff, Vancouver, B.C. (Chem.).
Swerdfeger, John Harvey, Vancouver, B.C. (Ci.).
Wallace, John Merritt, Vancouver, B.C. (Ci.).

NOVA SCOTIA TECHNICAL COLLEGE

PRIZE

Coish, Harry Oswald, Fogo, Nfld., B.Eng. (Elec.); Association of Professional Engineers of Nova Scotia Prize.

DEGREE OF BACHELOR OF ENGINEERING

Albert, Leo Maurice, Edmundston, N.B. (Elec.).
Ball, William Henry Warren, Badger, Nfld. (Elec.).
Brown, Roger Scott, Halifax, N.S. (Mech.).
Colpitts, Rolfe Reynolds, Moncton, N.B. (Mech.).
Cook, George Hamilton, Dorchester, N.B. (Elec.).
Cosgrove, Edward Thomas, Halifax, N.S. (Mech.).
Cox, Burnell Bigelow, Amherst, N.S. (Mech.).
Cummings, George William, St. John's, Nfld. (Ci.).
Dunham, Donald Francis, Halifax, N.S. (Mech.).
Forbes, Cyril Robert, St. John's, Nfld. (Elec.).
Gillis, Harold George, Whycocomagh, N.S. (Mech.).
Horne, Lawrence Fraser, Dartmouth, N.S. (Mech.).
Merchant, John Anthony, Sydney, N.S. (Ci.).
Mitchell, Kenneth Roscoe, Dartmouth, N.S. (Ci.).
Moore, John Frederick, Liverpool, N.S. (Ci.)
MacKinlay, Russell Anthony, Trenton, N.S. (Mech.).
Nutter, James Ryan, Truro, N.S. (Ci.).
Parsons, Robert Lloyd, Moncton, N.B. (Ci.).
Poirier, Leo Joseph, Cheticamp, N.S. (Ci.).
Rice, Robert MacNeill, Sydney, N.S. (Mech.).
Ryan, Bernard Kimble, Sydney, N.S. (Mech.).
Schafheitlin, Frederick Blake, Canning, N.S. (Mech.).
Steele, Owen Stevenson, St. John's, Nfld. (Elec.).
Trenholm, Carman Lawrence, Fort Lawrence, N.S. (Mech.).
Wilcox, Robert Bernard, Dartmouth, N.S. (Elec.).

UNIVERSITY OF SASKATCHEWAN

WITH DISTINCTION

Lavers, Cyril George, Regina, Sask., B.Sc. (Chem.); Great distinction in engineering.

McKay, James Francis, Falkland, B.C., B.Sc. (Chem.); Distinction in engineering.

Pearson, Roderick Frank, Hanley, Sask., B.Sc. (Engrg. Physics); Distinction in engineering.

Siddall, James Norman, Hanna, Alta., B.Sc. (Mech.); Great distinction in engineering.

Tomkins, Robert Vernon, Moose Jaw, Sask., B.Sc. (Chem.) Distinction in engineering.

DEGREE OF BACHELOR OF SCIENCE

Adams, Jack, Saskatoon, Sask. (Mech.).
Bradley, Charles Jensen, Mossbank, Sask. (Mech.).
Bobyn, Edward Joseph, Blaine, Sask. (Engrg. Physics).
Breslin, William James, Cadillac, Sask. (Ci.).
Chan, Lloyd George, Weyburn, Sask. (Ci.).
Cherniak, Jack Joseph, Saskatoon, Sask. (Ceramic).
Chomyn, Michael William, Carpenter, Sask. (Mech.).
Clarke, Gerald Wallbridge, Regina, Sask. (Mech.).
Cramer, David, Saskatoon, Sask. (Ci.).
Dokken, Earl Kenneth, Saskatoon, Sask. (Mech.).
Durrant, Morgan Powell, Moose Jaw, Sask. (Ceramic).
Eastwood, George Edmund Peter, Spiritwood, Sask. (Geol.).
Elsey, Wilbert Roy, Avonlea, Sask. (Mech.).
Farnam, Arlington Bruce, Saskatoon, Sask. (Ci.).
Fisher, Earl Holden, Wilkie, Sask. (Mech.).
Gawley, Howard Nelson, Weyburn, Sask. (Mech.).
Gibson, Ronald Franklin, Bladworth, Sask. (Mech.).
Grant, Roderick Eugene, Mawer, Sask. (Ci.).
Green, George Henry, Saskatoon, Sask. (Mech.).
Hawkeye, Michael, Limerick, Sask. (Mech.).
Huddleston, William MacDonald, Kinistino, Sask.
Humphrey, Kenneth Floyd, Nokomis, Sask. (Ceramic).
Kallio, Willard, Lucky Lake, Sask. (Mech.).
Kennett, Douglas Arthur, Oxbow, Sask. (Ci.).
L'Heureux, Leon Joseph John, Gravelbourg, Sask. (Physics).
Lepp, Henry, Saskatoon, Sask. (Geol.).
Loden, Carl Allan, Wilcox, Sask. (Mech.).
Matthews, John Gordon, Saskatoon, Sask. (Geol.).
McNally, Reginald John Brian, Bethune, Sask. (Mech.).
Purdy, Clayton Charles, Hanna, Alta. (Mech.).
Rowbotham, William Redfern, Stranraer, Sask. (Mech.).
Watson, Howard Douglas, Maple Creek, Sask. (Geol.).
Wesa, Gustave, Regina, Sask. (Mech.).
Williams, James Luther, Rosetown, Sask. (Ceramic).
Wylie, Lewis, Hutchinson, Oxbow, Sask. (Physics).

QUEEN'S UNIVERSITY

HONOURS, MEDALS, SCHOLARSHIPS AND PRIZES

Abraham, Earl Michael, Sherbrooke, Que., B.Sc. (Mi.); Honours in Mining Engineering; Departmental Medal in Mining Engineering; Reuben Wells Leonard Resident Fellowship, $500.

Bourgeois, Joseph Patrick Ovila, Kenogami, Que., B.Sc. (Ci.); Andrina McCulloch Scholarship in Public Speaking, $100.

Follows, Alan Greaves, Cornwall, Ont., B.Sc. (Chem.); Honours in Chemical Engineering.

Gaffney, Oliver Joseph, West Monkton, Ont., B.Sc. (Ci.); Honours in Civil Engineering; Departmental Medal in Civil Engineering.

Gove, Harry Edmund, Niagara Falls, Ont. (Physics); Honours in Engineering Physics.

Holloway, Arthur Francis, Hamilton, Ont., B.Sc. (Physics); Honours in Engineering Physics; Governor-General's Medal; Departmental Medal in Engineering Physics.

Merrill, Robert James, Wabigoon, Ont., B.Sc. (Mi.); The Rattray Scholarship in Economy Geology.

Orr, James Campbell, Niagara Falls, Ont., B.Sc. (Physics); Honours in Engineering Physics.

Page, Lorne Albert, Crystal Beach, Ont., B.Sc. (Physics); Honours in Engineering Physics.

Pearson, George Beverley, Chatham, Ont., B.Sc. (Elec.); Honours in Electrical Engineering; Departmental Medal in Electrical Engineering; U.N.T.D. Scholarship, $100.

Rush, Charles Kenneth, Sault Ste. Marie, Ont., B.Sc. (Mech.); Honours in Mechanical Engineering; Departmental Medal in Mechanical Engineering.

Sweet, William Harold, Kirkland Lake, Ont. (Mech.); Honours in Mechanical Engineering.

Whelen, Douglas Armstrong, Victoria, B.C., B.Sc. (Ci.); Honours in Civil Engineering.

Williams, Lloyd Stephen, Toronto, Ont., B.Sc. (Chem.); Honours in Chemical Engineering; Departmental Medal in Chemical Engineering; Reuben Wells Leonard Resident Fellowship, $500.

Wood, Willard Carnal Everett, Arnprior, Ont., B.Sc. (Mech.); Honours in Mechanical Engineering.

Yamanaka, Richard Hiroji, Toronto, Ont., B.Sc. (Physics); Honours in Engineering Physics.

DEGREE OF BACHELOR OF SCIENCE

Baker, Charles Archie Newman, St. Catharines, Ont. (Chem.).
Beaudry, Roger Joseph, Ottawa, Ont. (Elec.).
Brown, James Alexander, Port Arthur, Ont. (Mech.).
Burbidge, Harrison Griffin, Port Arthur, Ont. (Chem.).
Burgess, Bernard Whittaker, Ottawa, Ont. (Chem.).
Campion, William Kingsley, St. Catharines, Ont. (Mech.).
Camplong, Charles Hugh Ramsay, Melville, Sask. (Elec.).
Colby, William David, Chatham, Ont. (Ci.).
Connor, Eric James, Hamilton, Ont. (Chem.).
Denyes, Blake Burley, Napanee, Ont. (Mech.).
Edwards, Herbert Martell, Brockville, Ont. (Ci.).
Fee, John Kenneth, Ottawa, Ont. (Elec.).
Fritsch, Karl Herbert, Denbigh, Ont. (Mech.).
Gordon, Ian Mainfred Percy, Ottawa, Ont. (Ci.).
Haakonsen, Haakon M., Shawinigan Falls, Que. (Elec.).
Hager, Fritz, Hamilton, Ont. (Chem.).
Halme, Sulo E., Nipigon, Ont. (Elec.).
Hillgartner, Harry Leonard, Binbrook, Ont. (Mech.).
Kirk, Jack Willsie, Sarnia, Ont. (Ci.).
Lappi, Donald Matthews, North Cobalt, Ont. (Elec.).
Lillie, Douglas Fairfield, London, Ont. (Met.).
Mosher, Malcolm Charles, Loch Lomond, N.B. (Chem.).
McColl, Bruce John, Forest, Ont. (Mech.).
McLeod, Donald Morley, Stoney Creek, Ont. (Mech.).
McWhirter, Donald Crawford, Brantford, Ont. (Chem.).
Patzalek, Stanley Philip, Hamilton, Ont. (Mech.).
Quirk, Raymond Wilfred, Fort William, Ont. (Elec.).
Ralph, Harold Davidson, Kemptville, Ont. (Mech.).
Richards, James Leslie, Pembroke, Ont. (Elec.).
Runge, Walter Arthur, Ottawa, Ont. (Elec.).
Spencer, John Donald, Port Colborne, Ont. (Mech.).
Stevens, John Clement, Renfrew, Ont. (Mech.).
Stinson, William Geoffrey, Cobourg, Ont. (Elec.).
Waghorne, Murray Ashton, Windsor, Ont. (Elec.).
Whillians, Thomas George Douglas, Ottawa, Ont. (Mech.).
Wright, Gordon Maguire, Wallaceburg, Ont. (Physics).
Wrong, James Stuart, Westboro, Ont. (Ci.).
Young, Kenneth Buchanan, Toronto, Ont. (Met.).

UNIVERSITY OF NEW BRUNSWICK

MEDALS AND PRIZES

Beattie, Ira MacIntosh, Fredericton, N.B., B.Eng. (Ci.); The Ketchum Silver Medal for the highest standing in fourth year Civil Engineering.

Stone, Rodney Edward, Fredericton, N.B., B.Eng. (Elec.); The Brydone-Jack Memorial Prize of $45.00 for the highest standing in fourth year Electrical Engineering.

DEGREE OF BACHELOR OF SCIENCE

Acker, Sydney Eugene, Fredericton, N.B. (Ci.).
Armstrong, Gordon Millard, Lawrence Station, N.B. (Elec.).
Belyea, James Louis, Saint John, N.B. (Elec.).
Cogsley, Roscoe Cochrane, St. Martins, N.B. (Ci.).
Donahue, John Joseph, Saint John, N.B. (Elec.).
Fairley, Randolph Douglas, Fredericton, N.B. (Elec.).
Hussey, Cletus Harold, Fredericton, N.B. (Elec.).
Levesque, Paul Carmel, Fredericton, N.B. (Elec.).
Merzetti, Herman John, Jr., Saint John, N.B. (Elec.).
McKinney, Charles Donald, Saint John, N.B. (Elec.).
McSorley, Thomas Holland, Fredericton, N.B. (Ci.).
Overend, Arthur Vincent, Fredericton, N.B. (Elec.).
Simpson, Douglas Beverley, Fredericton, N.B. (Elec.).
Turnbull, John Arnold, Saint John, N.B. (Elec.).
Zides, Murray, Fredericton, N.B. (Ci.).

LAVAL UNIVERSITY, QUÉBEC

DEGRÉ DE BACHELIER ÈS SCIENCES APPLIQUÉES

Beauchesne, Louis-Alfred, Parisville, Qué. (Elec.).
Boulet, Lionel, Québec, Qué. (Elec.) Avec très grande distinction.
Brûlé, Marcel, Québec, Qué. (Génie chimique) Avec distinction.
Dumont, Gilbert, Québec, Qué. (Elec.).
Fournier, Gaston, Québec, Que. (Génie chimique) Avec distinction.
Fraser, Daniel, Québec, Qué. (Génie chimique) Avec distinction.
Gareau, Grégoire, Québec, Qué. (Elec.) Avec grande distinction.
Hamel, René, Québec, Qué. (Génie chimique).
Legendre, Rosaire, Québec, Qué. (Génie chimique).
Pouliot, Jean-Louis, Village Montgomery, Qué. (Met.).

ECOLE POLYTECHNIQUE

DISTINCTIONS ET PRIX

Leclerc, André, Montréal, B.Sc.A. (mécanique-électricité), I.C., avec grande distinction. Médaille de Son. Exc. le Lieutenant-Gouverneur de la Province. Médaille d'argent de l'Association des Diplômés de Polytechnique.

Roy, Léo-Paul, Montréal, B.Sc.A. (travaux publics-bâtiments), I.C., avec distinction.

Lalande, Jacques-Bernard, Montréal, B.Sc.A. (mécanique-électricité), I.C., avec distinction. Médaille d'or de l'Association des Diplômés de Polytechnique.

Lemieux, Jacques-Raymond, Sherbrooke, Qué., B.Sc.A. (mécanique-électricité), I.C., avec distinction. Médaille de Bronze de l'Association des Diplômés de Polytechnique.

Grenier, Guy, Montréal, B.Sc.A. (travaux publics-bâtiments), I.C., avec distinction.

Olynyk, Alexandre, Montréal, B.Sc.A. (mécanique-électricité), I.C., avec distinction.

DEGRÉ DE MAÎTRE ÈS SCIENCES APPLIQUÉES

Hurtubise, Jacques-Edouard, Montréal, Qué.
Brunette, Charles-Edouard, Montréal, Qué.
Chadillon, François, Montréal, Qué.
Quintal, Robert, Montréal, Qué.

DEGRÉ DE BACHELIER ÈS SCIENCES APPLIQUÉES ET DIPLÔME D'INGÉNIEUR CIVIL

Provencher, Léo-Paul, Montréal (mécanique-électricité).
Baillargeon, Robert, Montréal (travaux publics-bâtiments).
Marcotte, Benoit, Montréal (mines-métallurgie).
Miron, Jacques, Joliette (mécanique-électricité).
Allaire, Lucien, Montréal (chimie industrielle).
Roy, Georges, Montréal (chimie industrielle).
Julien, Roger, Trois-Rivières, Qué. (travaux publics-bâtiments).
Boulva, Francis, Montréal (travaux publics-bâtiments.)
Clément, Albert, Montréal (aéronautique).
Mailhiot, Fernand, Montréal (travaux publics-bâtiments).
Caron, Lucien, Montréal (mécanique-électricité).
Ricard, Julien, Montréal (mécanique-électricité).
Béland, Jean, Outremont, Qué. (mécanique-électricité).
Glen, Louis-André, Montréal (travaux publics-bâtiments).
Courchesne, Armand, Montréal (mécanique-électricité).
Deslauriers, Edouard, Montréal (travaux publics-bâtiments).

Prud'Homme, André, Montréal (mécanique-électricité).
Langevin, Jean, Montréal (aéronautique).
Laurin, Léopold, Montréal (mécanique-électricité).
Poitras, Guy, Montréal (travaux publics-bâtiments).
Archambault, Jean-Jacques, Montréal (mécanique-électricité).
Leroux, Jean-Jacques, Lachine, Qué. (travaux publics-bâtiments).
Proulx, Jean-Noël, Montréal (travaux publics-bâtiments).
Lefebvre, Marcel, Montréal (mécanique-électricité).
Sicotte, Bernard, Montréal (travaux publics-bâtiments).
Brais, Pierre, Longueuil, Qué. (mécanique-électricité).
Monette, Albert, Pointe-aux-Trembles, Qué. (travaux publics-bâtiments).
Dumont, Lomer, Amos, Qué. (mines-métallurgie).
Berthiaume, Jos.-Alphonse, Contrecoeur, Qué. (travaux publics-bâtiments).
Ewart, Philippe, Verdun, Qué. (travaux publics-bâtiments).

UNIVERSITY OF TORONTO

HONOURS

Belford, Richard Bruce, Toronto, Ont., B.A.Sc. (Ci.); Honours in Civil Engineering.
Cartier, William Oliver, Toronto, Ont., B.A.Sc. (Elec.); Honours in Electrical Engineering.
Cline, Richard Carl, Toronto, Ont., B.A.Sc. (Mech.); Honours in Mechanical Engineering.
Dewhurst, James Buchanan, Port Nelson, Ont., B.A.Se. (Mech.); Honours in Meehanical Engineering.
Hershfield, Allan Abraham, Montreal, B.A.Se. (Mech.); Honours in Mechanical Engineering.
McRostie, Gordon Callander, Toronto, Ont., B.A.Sc. (Ci.); Honours in Civil Engineering.
Maughan, Ronald George, Toronto, Ont., B.A.Sc. (Ci.); Honours in Civil Engineering.

DEGREE OF BACHELOR OF APPLIED SCIENCE

Bradley, Whitney Lloyd, Thorold, Ont. (Ci.).
Caverly, David Sundell, Aylmer West, Ont. (Ci.).
Chappell, Douglas Stewart, Toronto, Ont. (Ci.).
Cherry, Harold John, North Bay, Ont. (Ci.).
Crawford, George Byron, Bowmanville, Ont. (Ci.).
Gladney, William Edward, Toronto, Ont. (Ci.).
Hannon, Matthew Stuart, Toronto, Ont. (Ci.).
McNiven, Hugh Donald, Montreal, (Ci.).
Martin, John Clayton, Toronto, Ont. (Ci.).
Moffatt, Allan Gray, Toronto, Ont. (Ci.).
Peckover, Frederick Lionel, Toronto, Ont. (Ci.).
Perkins, Douglas Harold, Toronto, Ont. (Ci.).
Rodman, Marvyn Floyd, Toronto, Ont. (Ci.).
Sanderson, David Reynolds, Toronto, Ont. (Ci.).
Sommerville, Lorne Williams, Swansea, Ont. (Ci.).
Tovell, Joseph Allister, Guelph, Ont. (Ci.).
Travers, Frederick John, Toronto, Ont. (Ci.).
Ward, John, Toronto, Ont. (Mech.).
Ward, John William, Toronto, Ont. (Ci.).

BACHELOR OF ARCHITECTURE

Kent, Stanley Roland, Toronto, Ont. (B.Arch.).

Personals

Relatives and friends of members in the active forces are invited to inform the Institute of news items, such as locations, promotions, transfers, etc., which would be of interest to other members of the Institute and which should be entered on the member's personal record kept at Headquarters. These would form a basis of personal items in the *Journal*.

ENGINEERS SHARE IN KING'S HONOURS

It will be a matter of interest to all members of the Institute to see the complete list of their fellow members who shared in the recent King's Honour List. There are in all six persons included in the lists printed in the newspapers which we have every reason to believe are complete.

The Institute joins with the other citizens of Canada in congratulating the following members for the honours which they have so well deserved.

COMPANION OF THE ORDER OF THE BATH (C.B.)

Major-General John P. Mackenzie, D.S.O., M.E.I.C., Vancouver, who has been recently appointed associate controller of construction in the Department of Munitions and Supply, Ottawa.
Air Vice-Marshal E. W. Stedman, O.B.E., M.E.I.C., Ottawa, director-general of air research in theRoyal Canadian Air Force.

COMMANDER OF THE ORDER OF THE BRITISH EMPIRE (C.B.E.)

Brigadier Noel Dudley Lambert, M.E.I.C., Ottawa, deputy quartermaster-general (engineering) Department of National Defence.
Air Vice-Marshal A. T. N. Cowley, M.E.I.C., Toronto, air officer, commanding No. 1 Training Command.

OFFICER OF THE ORDER OF THE BRITISH EMPIRE (O.B.E.)

Lieutenant-Colonel Hugh A. McKay, M.E.I.C., Ottawa, Ont., directorate of accommodation and fire prevention, National Defence Headquarters.

MEMBER OF THE ORDER OF THE BRITISH EMPIRE (M.B.E.)

Major Howard L. Hayman, M.E.I.C., London, Ont.

Lieutenant-General A. G. L. McNaughton, C.B., C.M.G., D.S.O., M.E.I.C., was granted the honorary degree of Doctor of Laws at the Convocation of the University of Saskatchewan last month for his eminent services in scientific research and military leadership.

News of the Personal Activities of members of the Institute

Robert Dorion, M.E.I.C., city manager at Shawinigan Falls, Que., is the newly elected chairman of the Saint Maurice Valley Branch of the Institute. Born at Quebec, he was educated at Ecole Polytechnique where he graduated in 1922, having served as a lieutenant in the last war with the Royal Canadian Engineers. He

Robert Dorion, M.E.I.C.

was employed with the Department of Roads of the province of Quebec for five years and in 1928 he became town engineer at Dolbeau, Que. In 1930 he was appointed city engineer at Lachine, Que., a position which he held until he was appointed to his present position in 1939.

C. R. Whittemore, M.E.I.C.

S. T. McCavour, M.E.I.C.

R. M. Doull, M.E.I.C.

C. R. Whittemore, M.E.I.C., has been recently elected chairman of the Peterborough Branch of the Institute. Mr. Whittemore is research metallurgist, Deloro Smelting and Refining Company Ltd., Deloro, and was awarded the Duggan Medal and Prize of the Institute for 1939, for his paper "Welded Steel Pipe for the City of Toronto Water Works Extension" and also was Plummer Medallist for the year 1935-36 for his paper entitled "The Metallurgy of Metallic Arc Welding of Mild Steel."

A. L. McPhail, M.E.I.C., superintendent of water works of St. Catharines, Ont., was appointed chairman at the annual meeting of the Canadian Section, American Water Works Association, held in April at Niagara Falls, Ont.

B. W. Pitfield, M.E.I.C., is the newly elected chairman of the Edmonton Branch of the Institute. Mr. Pitfield graduated in civil engineering from the University of Alberta in 1934, and immediately went with Canadian Industries Limited, as a draughtsman. In 1935 he joined the engineering staff of the Northwestern Utilities Limited in Edmonton and in 1939 he became assistant engineer.

J. L. Smith, M.E.I.C., who has been on loan to the Federal Aircraft Limited, Montreal, as aeronautical engineer, from the Department of Transport, Civil Aviation Branch, has been recalled to the Department and is now acting chief aeronautical engineer.

P. E. Radley, M.E.I.C., formerly works manager of Aluminum Company of Canada, Ltd., at Arvida, has recently been appointed manager of smelters division of the company at Montreal. This is a new position created to better co-ordinate the management of aluminum smelters of the company.

A. S. Donald, M.E.I.C., is the newly elected chairman of the Moncton Branch of the Institute. He is district airways engineer for the Department of Transport of Canada at Moncton.

R. A. Campbell, M.E.I.C., general manager, R. Melville Smith Company Ltd., at Chicago, Ill., has recently been transferred to the Toronto office where he retains his present title.

C. A. Hellstrom, M.E.I.C., formerly employed in the engineering department of Price Brothers and Company, Ltd., Kenogami, Que., has joined the staff of Brompton Pulp and Paper Company, Ltd., Montreal.

R. M. Doull, M.E.I.C., has recently been appointed general manager of The Canada Gunite Company Ltd., and the Preload Company of Canada, Ltd., Montreal. Mr. Doull has been in the employ of the Department of Munitions and Supply for the past three years, in charge of production for the naval shipbuilding programme in the province of Quebec.

S. T. McCavour, M.E.I.C., has been appointed the new chairman of the Lakehead Branch of the Institute. Upon his graduation from the University of New Brunswick in 1920 he became engaged in the pulp and paper industry. In 1929 he joined the Great Lakes Paper Company Limited, Fort William, as resident engineer, and in 1931 he was promoted to chief engineer and joint manager.

Alexander Wilson, M.E.I.C., who has been branch manager of the Saint John, N.B., office of the Canadian Comstock Company, Ltd., has been transferred to the Toronto office.

Sydney Hogg, M.E.I.C., has been appointed chief engineer and acting sales manager for Hamilton Bridge Western Ltd., Vancouver, B.C. Mr. Hogg was formerly with the Saint John Drydock and Shipbuilding Company, Ltd., Saint John, N.B., where he was superintendent of new ship construction.

Allan S. Holder, M.E.I.C., of Canadian Industries Ltd., has recently been transferred from Ajax, Ont., to Shawinigan Falls, Que., as engineering and power supervisor in the cellophane division.

C. J. Jeffreys, M.E.I.C., has resigned from his position as chief records engineer with Allied War Supplies Corporation, to join the firm of John Stadler, consulting engineer, Montreal, as field representative.

G. R. McLennan, M.E.I.C., formerly with Canadian Car Munitions Ltd., Cherrier, Que., is now engineer with the Metropolitan Electric Company, Ltd., Montreal.

A. C. Macnab, M.E.I.C., employed with Dominion Woollens & Worsteds Ltd., Hespeler, Ont., received the degree of mechanical engineer from the University of Toronto last month.

Colonel J. T. Wilson, M.E.I.C., who has been stationed at CMHQ, London, England, has returned to Canada and is now on the general staff, as director of operational research, Ottawa.

G. E. Booker, M.E.I.C., formerly with the Wartime Housing Limited, on loan to Gore and Storrie, consulting engineers of Toronto, is now employed as process engineer with John T. Hepburn Ltd., Toronto, Ont.

W. D. Bracken, M.E.I.C., is the newly elected chairman of the Niagara Peninsula Branch of the Institute. Mr. Bracken has been with the Canadian Niagara Power Company, Niagara Falls, since 1923 when he graduated from Queen's University in electrical engineering.

C. H. N. Connell, M.E.I.C., has recently retired from his position as district engineer of Canadian National Railways at North Bay, Ont., and will reside at Callander, Ont.

Clarence Rudeford Forsberg, M.E.I.C., received his Master of Science degree last month at the University of Saskatchewan.

E. R. Grange, M.E.I.C., who has been on loan to the R.C.A.F., for the past two and a half years, employed as executive assistant to the Deputy Minister for Air, has been granted indefinite leave of absence to return to his firm, Delamere and Williams Ltd., Toronto, where he occupies the position of vice-president.

Charles L. Bates, M.E.I.C., has recently retired from his position as chief engineer with the Pacific Great Eastern Railway, at Squamish, B.C. Mr. Bates first joined the company in 1904 as resident engineer on construction. He served in that organization as assistant division engineer in the construction department and in the engineering department on maintenance of way until 1915 when he was engaged in private practice until 1920. In 1921 he joined the Northwest Dredging Company of Vancouver as chief engineer and superintendent, remaining with that company until 1926. Since 1927 Mr. Bates has been with the Pacific Great Eastern Railway as maintenance of way engineer, becoming chief engineer in 1937.

G. J. T. Gunn, M.E.I.C., has recently joined the Creole Petroleum Corporation, and is stationed at Caripito, Venezuela, S.A., as assistant utilities foreman.

A. F. G. Cadenhead, M.E.I.C., formerly director of the plant research department of Shawinigan Chemicals Ltd., at Shawinigan Falls, Que., has been named director of the department of chemical development, a newly formed department, with headquarters at Shawinigan Falls, Que.

P. W. Blaylock, M.E.I.C., formerly development engineer of Shawinigan Chemicals Ltd., at Shawinigan Falls, Que., has been appointed assistant director of the new department of chemical development, with headquarters in Montreal.

W. E. Bown, M.E.I.C., formerly with British Empire Steel Corporation, Sydney, N.S., is now general manager of Canadian Tube and Steel Products, Limited, Montreal.

G. A. Campbell, M.E.I.C., received the degree of Master of Science in civil engineering from the University of New Brunswick at the encaenial excercise last May.

H. J. B. Richards, Jr.E.I.C., formerly in the process engineering department of Defence Industries Limited, Westmount Tool Works, has accepted the position of plant engineer with Chatco Steel Products Limited, Chatham, Ont.

Jules Mercier, Jr.E.I.C., of the Canadian General Electric Company, Toronto, has recently been transferred to the Quebec office of the company.

A/Lieut. (E) R.C.N.V.R., Robert W. Phillips, Jr.E.I.C., has been recently appointed officer in charge of fuel combustion and is stationed at Halifax, N.S. Lieut. Phillips was formerly sales and service engineer of the Bailey Meter Company, Montreal.

P/2 Lt. J. A. Merchant, S.E.I.C., formerly of Halifax, N.S., is now stationed at Petawawa, Ont.

Mid. (A) D. R. Brown, R.N.V.R., S.E.I.C., is now with the Royal Naval Fleet Air Arm overseas.

Wing-Comdr. A. Dean Nesbitt, R.C.A.F., D.F.C. and BAR, S.E.I.C., of Montreal, is in command of the first air unit that moved into France, upon the invasion of Normandy. He has been a member of the R.C.A.F. from the outbreak of war and was formerly one of the active members of the Montreal Light Aeroplane Club. He received the D.F.C. and Bar in 1941.

R. E. Stopps, S.E.I.C., has joined the Department of Transport, Ottawa, as assistant radio engineer, radio division. Mr. Stopps is a graduate of this year in electrical engineering from McGill University.

Major L. G. Symons, S.E.I.C., has been recently promoted from the rank of captain, R.C.E.M.E. He is a graduate in mechanical engineering of the University of Saskatchewan.

D. L. Mackinnon, S.E.I.C., received the degree of Master of Science in civil engineering from the University of New Brunswick last May. His thesis was written on the Construction of the Shipshaw Power Development with which he was connected when employed with the Foundation Company of Canada, Limited. Mr. Mackinnon is now in the R.C.A.F. completing his training as a pilot.

T. C. York, S.E.I.C., is at present employed as mechanical designer, with Research Enterprises Limited, Toronto. He was formerly tool designer with Murray, Jones and Company, Toronto, Ont.

Obituary

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Thomas Bilton Patterson, M.E.I.C., died in Ottawa on June 9, 1944. Born at London, Ont., on June 10, 1896, he received his education at McGill University, where he followed the engineering course from 1919 to 1922, later completing the course at the University of Saskatchewan where he obtained the degree of Bachelor of Science in 1929. In the interval he had been employed on construction work as resident engineer with the Foundation Company of Canada and from 1924 to 1928 with the Department of Highways of Saskatchewan. In 1929 he joined the Canadian National Railways at Saskatoon as resident engineer in the construction department. In the last few years Mr. Patterson had been engaged in construction work for various firms in Ontario.

For a few months in 1942 and 1943 he was assistant superintendent with the Foundation Company of Canada on the Shipshaw power development in Quebec. Last fall he joined the Department of National Defence (Navy) as mechanical engineer at Ottawa, a position which he occupied at the time of his death.

Mr. Patterson joined the Institute as a Student in 1921, transferring to Junior in 1926 and to Associate Member in 1929. He became a Member in 1940.

News of the Branches

Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

EDMONTON BRANCH

G. H. Milligan, affil.e.i.c. - *Secretary-Treasurer*

A meeting of the executive of the Edmonton Branch of the Institute was held for the purpose of meeting Mr. Fraser S. Keith, past general secretary of the Institute. The executive were Mr. Keith's guests at luncheon at the MacDonald Hotel.

Mr. Keith among other things, discussed the recent developments in connection with Order-in-Council P.C.-1003, and brought the executive up to date on recent developments in connection therewith. He brought out the urgency of the situation with respect to the necessity of concerted action by the various engineering groups in Canada.

Considerable discussion took place regarding Order-in-Council P.C.-1003, and it was agreed that approximately 100 copies of a paper entitled *Labor Relations Regulations and The Technical Profession* by E. P. Muntz, m.e.i.c., be mimeographed for distribution to members of the branch.

Mr. Keith's visit was very much enjoyed by all of the executive, and regret was expressed that more time was not available for further discussion with him.

HAMILTON BRANCH

W. E. Brown, m.e.i.c. - *Secretary-Treasurer*
L. C. Sentance, m.e.i.c. - *Branch News Editor*

On Monday, June 12, 1944, eighty-six members of the Institute from Hamilton and the surrounding district gathered at the Scottish Rite Club to honour at dinner the visiting president of the Institute, de Gaspé Beaubien, c.b.e.

The meeting was opened by H. A. Cooch, branch chairman, who officially welcomed the president to Hamilton. Hugh Lumsden introduced Mr. Beaubien to the assembly.

The president opened his talk by reference to the experiences of his trans-Canada trip. It had proven an enlightenment and an inspiration, he said, to meet engineers from all sections of the country and to exchange views on matters of import. Visits to universities and the discovery of the sober yet idealistic outlook of the engineering students, had been particularly encouraging.

In a world faced with many innovations, in both social and industrial realms, the engineer still remains the logical link between labour and management. The engineer, by virtue of his specialized training, is better equipped than any other profession to take a leading part in the future problems of industry, and development of the Dominion. Since the onset of the present conflict, the industrial development of Canada has been phenomenal, and much credit for this goes to the engineer. The National Research Council was singled out for praise in this respect.

The president spoke of the coming change, when production would no longer take precedence over cost; in the peace time economy, increased efficiency will be the order of the day. The engineer will therefore find himself unable to rest after his wartime labours; rather will his burdens and responsibilities increase.

At the conclusion of his talk, Mr. Beaubien was thanked by Alex Love.

The second speaker of the evening was introduced by Norman Eager; R. E. Heartz, assistant chief engineer of Shawinigan Engineering Company, and chairman of the Institute's Committee on Employment Conditions, outlined to the gathering the work of his committee.

The speaker traced the progress of labour legislation in the United States over a period of 20 years, culminating in the Wagner Act of 1935, and showed the manner in which American engineers had reacted to such legislation. The latest Canadian legislation, P.C.-1003, was dealt with in some detail. A study had revealed many ambiguities, the position of the engineer under the Act being very ill-defined.

Mr. Heartz urged the gathering to consider the matter carefully and to be definite in their decision. Three possibilities were open to the engineer: (a) Bargaining for the engineer by a trade union, under P.C.-1003; (b) Bargaining for the engineer by a specially constituted group of professional engineers under P.C.-1003; (c) Bargaining under a special order other than P.C.-1003, by engineers for engineers.

At the conclusion of the talk, it was unanimously decided to hold a special meeting in Hamilton for consideration of this important topic. W. J. W. Reid moved a vote of thanks to the speaker.

L. Austin Wright, general secretary, spoke at some length regarding the many attempts of the Institute to secure proper recognition for the engineer in the Armed Services; the majority of such efforts had unfortunately ended in failure. Dr. Wright was particularly critical of the set-up of the newly formed Royal Canadian Electrical and Mechanical Engineers. The pioneer British organization which had been so successful in the North African campaign had found it absolutely essential to have highly qualified engineers in all posts with the exception of 2nd lieutenants. The present set-up of the Canadian corps is such that only a very few junior posts are held by engineers, all responsible and administrative posts being held by non-engineers.

LAKEHEAD BRANCH

W. C. Byers, jr.e.i.c. - *Secretary-Treasurer*
R. B. Chandler, m.e.i.c. - *Branch News Editor*

A dinner meeting of the Lakehead Branch was held at the plant of the Port Arthur Shipbuilding Company Ltd. on May 10th.

The members and guests met in the cafeteria at the shipyards, where the Port Arthur Shipbuilding Co. served a complimentary and excellent dinner.

S. T. McCavour, vice-chairman, presided at the meeting.

The chairman announced that G. F. McDougall, manager of the shipyards, was unable to be present at the meeting.

O. M. Gunderson described the work of the aircraft department which is working on a sub-contract for the Canadian Car in the manufacture of the Curtis *Helldiver*.

H. Walton, gen. supt. of shipyard, thoroughly described the work of the shipyards and the various steps in the construction of the Algerine minesweepers.

Lieut.-Cmdr. Young, captain of the newly completed minesweeper *"Border Cities"*, described the taking over of the ship by the Navy and the trip down the Great Lakes to the Atlantic coast for active sea duty.

O. J. Koreen of the shipyard engineering staff, welcomed the Institute members and guests to the shipyards and started the tour of inspection.

H. G. O'Leary gave a vote of thanks to the shipyards staff and management for the complimentary dinner and the opportunity to visit the plant.

Following the dinner a conducted tour was made through the newly completed minesweeper, *"Border Cities"* and then through the aircraft department.

There were 60 members and guests present.

* * *

S. T. McCavour, chief engineer of the Great Lakes Paper Co., was elected chairman of the Lakehead Branch of the Institute, at the annual meeting held on June 16th at the Port Arthur Golf and Country Club. He succeeds R. B. Chandler, manager of utilities, Public Utilities Commission.

Guests in attendance were G. F. McDougall, manager of the Port Arthur Shipbuilding Company Ltd., and Lt.-Cmdr. Hugh S. C. Wilson, officer commanding *H.M.C.S. Griffon*, the Port Arthur Division, R.C.N.V.R., both of whom spoke briefly.

Reports were given by the following committee chairmen: S. E. Flook, programme; W. H. Small, finance; A. D. Norton, membership; W. C. Byers, secretary, and H. G. O'Leary, nominations.

Mr. Chandler thanked the executive and chairmen of committees for their co-operation during his year as chairman. The attendance at meetings, he said, had been exceptional.

Following the meeting, movies were shown by Fred Lovelady and OS N. Birmingham, R.C.N.V.R.

SAGUENAY BRANCH

A. T. Cairncross, M.E.I.C. - *Secretary-Treasurer*
J. T. Madill, Jr.E.I.C. - - *Branch News Editor*

On April 12th, R. A. H. Hayes, acting chief engineer, Aluminium Laboratories Ltd., Montreal, presented a paper entitled **Description of the Electrical Equipment at Shipshaw.** This paper was published in the April issue of the *Journal.*

* * *

At a meeting of the Saguenay Branch of the Institute held on May 10th, Dr. W. G. Gussow of the Aluminum Company of Canada, Limited, Shipshaw, presented a pager on the subject **The Broader Aspects of Geology with Particular Emphasis on the Effect of Water.** Dr. Gussow first reviewed the three main types of rock, igneous, sedimentary, and metamorphic, outlining their origin and characteristics, and went on to illustrate the effect of water on geological formations. The speaker, with numerous clear examples, outlined the many and varied results of the effects of evaporation, erosion, deposition, and carrying power of water. The effect of the glacial advances over the North American continent was noted. Some mention was made of the knowledge of the earth's interior which has been gathered by the seismograph. The speaker concluded with a brief description of some points of interest in the local geology.

After a very considerable number of questions from the members had been answered by the speaker, a vote of thanks was moved by Mr. Waite.

* * *

At a meeting held on March 1st, the members of the Saguenay Branch of the Institute were privileged to hear a paper entitled **The Engineering History of Shipshaw** by McNeely DuBose, vice-president, Aluminum Company of Canada, Limited. This paper was published in the April issue of the *Journal.*

On March 8th, A. Leuthold, chief engineer of the Swiss Electric Company of Canada, Limited, presented a very interesting and detailed paper on **The Combustion Gas Turbine.** Mr. Leuthold has had quite a few years field experience with Brown, Boveri & Company of Switzerland, and it was to the development work carried out by that company that he referred. The speaker discussed what he termed the continuous gas turbine. That is, the turbine in which combustion is continuous, and which finds application in the field of the supercharger, for both aircraft and diesel engines. The speaker outlined in some detail the principle of operation of the direct-drive type of supercharger used with diesel engines. It was pointed out that the increase in engine output may be from 45 to 60 per cent for a 2 to 3 per cent weight increase, or in other words, a 30 per cent greater power to weight ratio results, which is an important fact in marine and traction applications. For aircraft application the engine fuel and speed render the direct-drive type of supercharger unsatisfactory, and the exhaust gas turbo-blower type offers the best solution, the speaker explained. The operation of this type of supercharger was outlined in considerable detail.

The speaker then showed the type of turbine operation encountered with the Velox boiler. The advantages of the operating characteristics of this type installation were discussed and one very interesting point brought out was that, in a standby plant, from a cold condition, 10,000 kilowatts could be picked up in three and one half minutes and a full load in ten minutes. The speaker mentioned the use of the turbo-type supercharger in the field of the chemical industry, and in particular showed illustrations of its application in the oil refining industry and in blast furnace plants.

The final application of the principle of the gas turbine mentioned by Mr. Leuthold was in the field of electric power generation. Here it was pointed out that with the proper heat flow system including heat exchangers, thermal efficiencies of 23 per cent were obtainable to-day.

Following questions by the members, the meeting was adjourned with a very hearty vote of thanks to Mr. Leuthold.

SAINT MAURICE VALLEY BRANCH

A. Trudel, Jr.E.I.C. - *Secretary-Treasurer*

A dinner meeting was held in the Cascade Inn, on June 20, at 7.30 p.m., under the chairmanship of J. H. Fregeau, at which 76 persons attended, the guests of honour being E. B. Wardle, vice-president of the Institute and R. E. Heartz, councillor of the Montreal Branch.

Mr. Wardle addressed the meeting and was ably thanked by Prof. H. O. Keay.

Mr. Fregeau then called on Mr. Heartz to deliver a talk on **Collective Bargaining and the Engineer.** Mr. Heartz greatly impressed the gathering with his very interesting and instructive talk, and all the members left the meeting with a much clearer picture of the collective bargaining question.

The speaker was then thanked by H. K. Wyman, the incoming vice-chairman of the Branch.

The secretary-treasurer then read a short report on the activities of the Branch for the past year and pointed out the financial standing was approximately the same as the previous year, the balance in bank amounting to $98.43.

Mr. Fregeau then announced the new slate of officers for the coming year, resulting from the letter ballot sent out in February.

The new chairman, R. Dorion, then made a few remarks, after which, the meeting was adjourned.

Library Notes

Book notes, Additions to the Library of The Engineering Institute, Reviews of New Books and Publications

BOOK REVIEW

INTRODUCTION TO HEAT ENGINES

By E. A. Allcut, M.E.I.C., University of Toronto Press, Toronto, 1943. 6 x 9½ inches. 292 pages. Illustrated. $2.75.

Reviewed by C. M. MCKERGOW, M.E.I.C.*

The author aims in this work "to indicate how the same general scientific principles are applied to heat engines of all kinds." The specific intention was to avoid a detailed description of any complete engine or plant, but rather to illustrate various principles in the light of their application to various kinds of heat engines.

The book is divided roughly into three parts:

(a) The general thermodynamic principles of the relationship between heat and work, and the fundamentals of combustion.
(b) History of the development of heat engines.
(c) Practical examples of the design and testing of heat engines.

The author assumes that the student has a knowledge of physics and chemistry at least equivalent to that of University matriculation.

The author has shown clearly the relationship between the theory and practice of heat engines. The book would suit an elementary general course on heat engines for students entering all branches of engineering.

* *Professor of Mechanical Engineering, McGill University, Montreal.*

ADDITIONS TO THE LIBRARY

TECHNICAL BOOKS

Basic Mathematics for Engineers:
Paul G. Andres, Hugh J. Miser and Haim Reingold. N.Y., John Wiley and Sons, Inc., 1944. 5¾ x 8½ in. $4.00.

Jig and Fixture Practice:
H. C. Town. London, Paul Elek (Publishers) Ltd., 1944. 5¼ x 8 in. 10/6d. plus 1/6d. postage.

Dynamics of Time Study:
Ralph Presgrave. Toronto, University of Toronto Press, 1944. 6 x 9¼ in. $3.50.

Principles of Powder Metallurgy:
Franz Skaupy. Y.N., Philosophical Library, 1944. 6¼ x 9¼ in. $3.00.

Canadian Trade Index:
Annual issue of 1944. Toronto, Canadian Manufacturers' Association, 1944. 6½ x 10 in. $6.00.

Symposium on the Identification of Water-Formed Deposits, Scales and Corrosion Products by Physico-Chemical Methods:
American Society for Testing Materials, 260 S. Broad Street, Philadelphia, Pa. This 44 page booklet includes three technical papers, general discussion and an extensive introduction describing the use of physico-chemical methods in identifying water-formed deposit scales and corrosion products. The technical papers by outstanding authorities cover X-ray diffraction methods in the study of power-plant deposits—Diagnosis of water problems at Limbo station—Interpretation of analyses and problems encountered in water-deposits. Copies of this booklet can be obtained from the A.S.T.M. Headquarters at 65c. each.

Oxy-Acetylene Handbook:
Toronto, Dominion Oxygen Company Limited, 1943. 6¼ x 9½ in. $2.00 postpaid. This new manual covers the entire range of the oxy-acetylene process, giving clear, easy-to-follow instructions for handling all the common commercial metals, together with simple explanations of the fundamental principles of the various methods of depositing and controlling molten metal. Considerable space is devoted to an explanation of the operating principles of oxy-acetylene equipment and instructions for its care and maintenance.

PROCEEDINGS, TRANSACTIONS

American Society of Mechanical Engineers:
Transactions. Volume 65, 1943. N.Y., A.S.M.E., 1944.

American Institute of Electrical Engineers:
Transactions. Volume 62, 1943. N.Y., A.I.E.E., 1944.

Society for the Promotion of Engineering Education:
Proceedings. Volume 50, 1942. Pittsburgh, 1943.

REPORTS

American Standards Association—A55. 1—1944:
Administrative requirements for building codes. Sponsored by the American Municipal Association Building Officials' Conference of America, Inc., 1944. 35c. The purpose of this standard is to provide for a suitable form of organization for building departments, and for efficient administration of building code work. Building codes are aimed at securing the public safety, health and general welfare in so far as buildings and other construction are concerned and this standard should be particularly valuable to the average town and city which desires to establish an up-to-date system of enforcement.

U.S. Interregional Highways:
A report of the National Interregional Highway Committee outlining and recommending a national system of interregional highways, January 12, 1944. House Document No. 379.

Montreal Tramways Company:
A report on a subway plan for Montreal.

U.S. Bureau of Mines:
Bulletin No. 449; Development and use of certain flotation reagents—No. 453; Report submitted to the Trail smelter arbitral tribunal—No. 455; Anthractie mine fires; their behaviour and control—No. 457; Metal and nonmetal-mine accidents in the United States 1941 (excluding coal mines).

Electrochemical Society—Preprint:
No. 85-23; Electrochemistry in the post-war world.

Harvard University—Graduate School of Engineering—Publications:
No. 385; The frequencies of natural power oscillations in interconnected generating and distribution systems.—No. 386; The impedance of short, long and capacitively loaded antennas with a critical discussion of the antenna problem.—No. 387; Longitudinal mixing in aeration tanks.

Canada. Dept. of Mines and Resources—Lands, Parks and Forests Branch:
Mimeograph 101; Literature review of the utilization of lignin in plastics.

Polytechnic Institute of Brooklyn—Graduate Electrical Engineering Dept.:
Reprint No. 4; Principles of short wave radiation—No. 6; An analysis of R-F transmission lines—No. 8; The synchronization of oscilloscope sweep circuits—No. 9; Video amplifier L-F correction—No. 10; Transients in coupling circuits—No. 11; Ultimate bandwidths in high-gain multistage video amplifiers.

BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet all of these books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

AIRCRAFT ANALYTIC GEOMETRY, Applied to Engineering, Lofting and Tooling
By J. J. Apalategui and L. J. Adams. McGraw-Hill Book Co., New York and London, 1944. 285 pp., diagrs., charts, tables, 8½ x 5½ in., linen, $3.00.

The methods of plane and solid analytic geometry are applied to the solution of a certain class of problems that arise in the design, lofting, tooling and engineering of airplanes. There is also a treatment of conic sections as used in design and lofting. The approach is systematic and is based on the principles of plane and solid analytic geometry.

AIRCRAFT MECHANIC'S POCKET MANUAL
By J. A. Ashkouti. 3rd rev. ed. Pitman Publishing Corp., New York and Chicago, 1944. Illus., diagrs., charts, tables, 8 x 5 in., leather, $1.50.

The basic data needed by the aircraft mechanic are provided in this pocketbook, which is intended to meet day by day requirements. Standard parts and finishes, structural materials, layout, shop arithmetic, tools, fabricating processes, etc., are discussed.

AMERICAN MACHINISTS' HANDBOOK, Wartime Data Supplement

By F. H. Colvin and F. A. Stanley. McGraw-Hill Book Co., New York and London, 1944. 154 pp., diagrs., charts, tables, 6¾ x 4 in., paper, $1.00.

Many changes in materials and shop practice have come about as a result of war demands for increased production. This supplement shows changes that have been found advisable in various lines of work, and provides data that have proved helpful. The topics discussed are: Materials, Screw threads, Drilling, Grinding-wheel markings, Gearing, Forging, forming, punching, and welding in aircraft work, inspection and metal-cutting saws.

BASIC MATHEMATICS FOR ENGINEERS

By P. G. Andres, H. J. Miser and H. Reingold. John Wiley & Sons, New York; Chapman & Hall, London, 1944. 726 pp., diagrs. charts, tables, 8½ x 5½ in., cloth, $4.00.

Presents, in one volume, "the mathematics required for an intelligent pursuit of elementary engineering courses, and serves as preparation for a course in the calculus." It contains those topics from algebra, trigonometry and analytic geometry needed to meet these objectives. The text is suitable for home study, by students who have had two years of high school mathematics.

BASIC OPEN HEARTH STEELMAKING

By the Committee on Physical Chemistry of Steelmaking, Iron and Steel Division, A.I.M.E.; edited by the Staff of Alloys of Iron Research, F. T. Sisco, Consulting Editor; sponsored by the Seeley W. Mudd Memorial Fund. Published by the American Institute of Mining and Metallurgical Engineers, 29 West 39th St., New York, 1944. 632 pp., illus., diagrs., charts, tables, 9¼ x 6 in., cloth, $3.00 to non-members, $2.00 to A.I.M.E. members.

We have here, for the first time in English, a comprehensive account of the art and science of open-hearth steelmaking. The work is divided into two parts: Practice and Theory. In part one, such topics as basic open-hearth furnaces, refractories, raw materials, slag control, charging and melting, refining, finishing and deoxidation, molds and pouring, segregation and inclusions are discussed by a number of expert steelmakers. In section two, the thermochemistry of the open hearth, the physical chemistry of liquid steel and slags and the kinetics of the open hearth are similarly treated. The book will be indispensable to everyone engaged in the industry.

CALCULUS REFRESHER FOR TECHNICAL MEN

By A. A. Klaf. McGraw-Hill Book Co., Whittlesey House Division, New York, 1944. 431 pp., diagrs., tables, 8½ x 5 in., cloth, $3.00.

The basic concepts and methods of differential and integral calculus are presented by means of questions and answers in this book, which is intended especially for men who have studied the subject before and wish to review it rapidly. Typical examples are worked out and problems provided for the student. A section is devoted to practical applications of calculus to engineering.

CHEMICAL ENGINEERING NOMOGRAPHS

By D. S. Davis. McGraw-Hill Book Co., New York and London, 1944. 311 pp., charts, tables, 9 x 6 in., cloth, $3.50.

This reference tool for chemists and chemical engineers is intended to simplify and facilitate their calculations. About two hundred nomographs are presented, selected because of their practical usefulness. The charts are large enough to be read easily and are accompanied by material indicating their validity and application, and with directions for their use.

THE CONSTITUENTS OF WHEAT AND WHEAT PRODUCTS (American Chemical Society Monograph Series No. 96)

By C. H. Bailey. Reinhold Publishing Corp., New York, 1944. 332 pp., illus., diagrs., charts, tables, 9¼ x 6 in., cloth, $6.50.

In this monograph the author has attempted to present systematically the important facts and data relating to the substances present in wheat. In other words, it covers the descriptive biochemistry of wheat and wheat products. The treatise provides a thorough review of the subject, with references to original sources and subject and author indexes.

CONTROL OF ELECTRIC MOTORS

By P. B. Harwood. 2 ed. John Wiley & Sons, New York; Chapman & Hall, London, 1944. 479 pp., illus., diagrs., charts, tables, 8¾ x 5½ in., cloth, $5.00.

In this book the characteristics of various types of motors are described briefly, and the way in which these characteristics are used to control them are explained. The design, construction and operating characteristics of a number of controllers and control devices are discussed, and methods of combining these devices to secure a desired effect are described. New Material has been added in this edition on variable-voltage control and synchronous motor control, electronic control, etc.

CONVEYORS AND RELATED EQUIPMENT

By W. G. Hudson. John Wiley & Sons, New York; Chapman & Hall, London, 1944. 341 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $5.00.

The title hardly describes this book, for it is a description of materials-handling equipment of the present day, together with information on methods of storage and transport, and on crushing and screening equipment, car and ship unloading, weighing and coal handling. The applications and limitations of various types of equipment are discussed. Information as to capacities, costs, etc., is included, with descriptions of layouts. While not comprehensive the book includes the equipment most frequently used.

ELECTRICAL TECHNOLOGY AND THE PUBLIC INTEREST

By F. J. Kottke. American Council on Public Affairs, 2153 Florida Ave., Washington, D.C., 1944. 199 pp., tables, 9 x 6 in., paper, $2.50; cloth, $3.00.

This study of our national policy toward the development and application of inventions discusses the question of the extent to which leading concerns can or do control the electrical industry through ownership of patents on the most effective technological methods. The effects of the patent privilege, the part played by company research laboratories, and the matter of patent licensing are discussed at some length. The recommendations of the Temporary National Economic Committee are discussed.

FOUNDATIONS OF POTENTIAL THEORY

By O. D. Kellogg, published by The Murray Printing Company, distributed by Frederick Ungar Publishing Company, 105 East 24th St., New York, 1944 reprint, 384 pp., diagrs., tables, 9½ x 6 in., linen, $6.00.

This is a reprint of the treatise by the late Professor Kellogg which was published in Berlin in 1929, and which was based on his courses at Harvard University. The first quarter of the book treats the subject in a fairly elementary manner, with applications to gravitational theory, electrostatics, magnetostatics and the flow of heat. The remaining portion is more mathematical in character. The restrictions on the validity of the equations of Gauss and Stokes are examined, and the Dirichlet problem is investigated.

FUNDAMENTALS OF INDETERMINATE STRUCTURES

By F. L. Plummer. Pitman Publishing Corp., New York and Chicago, 1944. 231 pp., illus., diagrs., charts, tables, 9¼ x 6 in., linen, $4.00.

This book brings together in one volume all of the principal and special methods of structural analysis used by designers in dealing with the problems created by the "continuity" of structures. The opening chapters cover the basic problems and present a general method for the analysis of any statically indeterminate structure. Later chapters are devoted to special methods. The methods by the three-moment equation, by fixed and conjugate points, by slope deflection, moment distribution, column analogy, automatic design, the P.C.A. building frame, and by model analysis are presented.

GUIDE TO WELDABILITY OF STEELS

Published by Welding Research Council, American Welding Society, 33 West 39th St., New York, 1944. 89 pp., illus., diagrs., charts, tables, 9 x 6 in., paper, $1.00.

This book presents "a proposed system of determining the effect of welding procedure upon the ductility of the heated zone adjacent to the weld in plain carbon and alloy steels." The system calls for only two tests. With these and the data given in the book, the welding conditions necessary for the preservation of the desired ductility can be predicted.

INTERNAL COMBUSTION ENGINES—Analysis and Practice

By B. H. Jennings and E. F. Obert. International Textbook Co., Scranton, Pa., 1944. 471 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.50.

This text is designed to give students and engineers fundamental and factual knowledge of the broad field of internal combustion engines. Basic analyses are developed in detail for the many processes that occur in the engine, and illustrative applications are drawn from current literature and manufacturing practice.

INTRODUCTION TO ELECTRIC POWER SYSTEMS

By J. G. Tarboux. International Textbook Co., Scranton, Pa., 1944. 385 pp., diagrs., charts, tables, 8½ x 5¼ in., fabrikoid, $4.50.

Two general fields are covered in this volume, the theory and operation of power transmission systems under balanced steady-state conditions, and system characteristics under unbalanced or faulty operation. The introductory material on inductance and capacity is brief, assuming the student to be well grounded in these fundamentals. The object of the book is to prepare the student particularly for work in the operating departments.

PRELIMINARY NOTICE

of Applications for Admission and for Transfer

June 26th, 1944.

The By-laws provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described at the August meeting.

L. Austin Wright, General Secretary.

*The professional requirements are as follows:—

A Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science or engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainment or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

ALLEN—FRED LOUIS, of Westmount, Que. Born at North Creek, N.Y., 1896. Educ.: B.S., M.E., Clarkson College of Technology, 1918. With the Aluminum Co. of America as follows: 1919, asst. mech. engr., at Messina, N.Y., 1919-21, research work at Pittsburg, Pa.; 1921-23, sales engr., Goulds Mfg. Co.; 1923-24, engr., Sandusky Fdry. & Mach. Co.; 1925-26, engr., Degrass Paper Co.; 1926-28, engr., Tide Water & Stann Paper Co.; 1928-34, engr., Nfld. Power & Paper Co.; 1934-36, plant engr., N.B. International Paper Co., Dalhousie, N.B.; 1936-44, chief engr., and at present, mgr. of mfg., newsprint div'n., Canadian International Paper Co., Montreal.

References: R. L. Weldon, R. E. MacAffee, G. H. Midgley, A. H. Chisholm, C. H. Champion.

BROUILLET—IGNACE, of 3778 Vendome Ave., Montreal, Que., Born at L'Assomption, Que., April 30th, 1903. Educ.: B.A.Sc., C.E., Ecole Polytechnique; R.P.E. Que.; 1929-30, asst. to supt., sanitation dept., City of Montreal; 1930-36, designer, and 1936-40, chief designer, Baulne & Leonard; 1940 to date, consltg. engr., Brouillet & Carmel, and 1943 to date, professor of reinforced concrete, Ecole Polytechnique.

References: L. A. Duchastel, H. R. Montgomery, J. E. Bonaventure, J. E. Prevost, Leo. Galler, A. Circé.

CADARIO—HARRY PAUL, Major, of Ottawa, Ont. Born at Kenora, Ont., Dec. 21st, 1915. Educ.: B.Sc. (Elec.), Queen's University, 1938. 1934 (5 mos), mining in Pioneer Gold Mine; 1935-37 (summers), welder, fitter, electr'n., etc., Grenville Crushed Rock Co., Hawk Lake, Ont.; 1938-39, dfting., and 1939-41, asst. engr., Hydro-Electric Power Comm'n. of Ont.; 1941-42, military training, Lieut., O.M.E.; 1942-43, Capt., D.M.M., and 1943 to date, Major, T.S.O. II, D.M.E., N.D.H.Q. Technical Staff, Ottawa.

References: LeS. Brodie, M. Dillon, R. L. Franklin.

CARMEL—E. GUY, of 4053 Van Horne, Montreal. Born at Montreal, Jan. 14th, 1905. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1931; R.P.E. Que.; 1931-34, sales engr., Cdn. Tube & Steel Products; 1934-39, asst. director of works, Catholic School Commission of Montreal; 1940 to date, consltg. engr., Brouillet & Carmel, reinforced concrete designs, etc.

References: J. E. Bonaventure, L. A. Duchastel, J. E. Prevost, L. Trudel, H. R. Montgomery, A. Circé.

CLAWSON—WILLIAM KENNERLEY, Captain, R.C.E., of Toronto, Ont. Born at Toronto, Ont., June 6th, 1916. Educ.: B.A.Sc., Univ. of Toronto, 1940; 1937-39 (summers) various civil engrg. work as an engrg. student, including work with the Toronto Transportation Comm'n.; 1940 to date, with the Royal Cdn. Engrs. in Canada, Great Britain & Italy, and at present, Adjutant, H.Q., R.C.E., 1st Cdn. Corps Troops, C.M.F.

References: C. R. Young, W. S. Wilson, C. F. Morrison, W. B. Dunbar, R. F. Legget.

CROMWELL—A. ROSS, of 3649 Durocher St., Montreal, Que. Born at Cookshire, Que. Sept. 4, 1899. Educ.: B.Sc. (Civil), McGill Univ. 1924; R.P.E. Que. 1916-24 (summers), gen'l. constrn. work, houses, banks, roads, bridges, etc.; 1924-26, own business, contracting & bldg. reinforced concrete bridges, etc.; 1926-27, Kennedy Construction Co. Ltd., Montreal, i/c road constrn., etc.; 1927-34, contracting & bldg., surveying, etc. in Eastern Townships for Dudswell Lumber Co., Pejepscot Paper Co., V. H. Lusk, etc.; 1935 to date, pres., Laval Enterprises Co. Ltd., constrn., alternations & operation of theatres, and 1942 to date, regional representative (Montreal), Wartime Bureau of Technical Personnel, Dept. of Labour, Federal Government.

References: W. G. Hunt, G. H. Burdett, H. W. Lea, J. F. Wickenden, W. L. Cassels, I. S. Patterson, S. W. Gray.

DEWSON—JAMES FREDRICK, of 2733 Retallack St., Regina, Sask. Born at Colgate, Sask. Dec. 25th, 1918. Educ.: Regina College, 1943-44; I.C.S. course in mapping & surveying; 1938-39 (summers), rodman, P.F.R.A.; 1940-42, trigonometrical surveyor, 1st Corps Fld. Survey Coy., R.C.E.; 1942-43, instr'man on highway location & constrn. in Nfld.; 1944 to date, instr'man P.F.R.A., Dept. of Agriculture, Regina.

References: H. G. Riesen, J. I. Mutchler, G. L. MacKenzie, W. D. Gray, W. L. Foss.

HESSE—WILLIAM A., of 110 Woodward Ave., Sault Ste. Marie, Ont. Born at Merane, Germany, April 23rd, 1892. (Naturalized Canadian, 1934). Educ.: "Diplom Ingenieur," Royal School of Mines, Berlin, 1921; Qualified to practise as Economic Geologist at School of Mines, Freiberg, Germany, 1917; R.P.E. Ont.; 1918-19-20 (summers), experience as shiftboss, surveyor & exploration engr. at various mines in Germany & Norway; 1921-25, engr., i/c dept. of mining mach'y., dist. office, Chemnitz, for Siemens Schuckert Werke, Berlin; 1925-26, mgr., silver mine, Freiberg; 1926-28, owner & mgr., silver lead mine, Freiberg; 1925-28, on Administration Board of the Freiberg Mining Assoc., owning several hydro-electric power plants & powder factories; 1926-28, consltg. engr. to the State of Saxony re State's interest in tin mines at Altenberg; 1929-34, consltg. mining engr., Montreal; 1934-39, consltg. mining engr., Sault Ste. Marie; 1940, engr. i/c exploration, Deep Lake Gold Mines, Michipicoten; 1940 to date, exploration engr., Algoma Ore Properties, Ltd., Sault Ste. Marie. Ont.

References: C. Stenbol, A. M. Wilson, E. M. MacQuarrie, K. G. Ross, J. L Lang, G. W. MacLeod.

HOPPER—CHARLES HOUGHTON, of 79 First St., Kirkland Lake, Ont. Born at New York, N.Y., Oct. 8th, 1907. Educ.: B.A.Sc. & Research Fellowship, 1929, Mining Engr., 1943, Univ. of Toronto; R.P.E. Ont.; 1929, experience as rodman on H.E.P.C. survey, asst., Ontario Geological Survey, Party, field geologist & prospector, Dom. Explorers, Ltd.; 1930-33, dftsman., Dept. of Highways, Ont.; 1933-37, engr., geologist, dftsman., Ventures, Ltd., Toronto, preparing maps & estimates, examination of mining prospects in the field, supervis'n. of mapping, diamond drilling, etc.; 1937-42, chief engr. & geologist, Matachewan Consolidated Mines, Ltd. At present, consulting engr., Boyles Bros. Drilling Co. Ltd., Vancouver, B.C.

References: S. B. Wass, T. H. Hogg, O. Holden, D. Forgan.

INGRAHAM—GEORGE BARLOW, of 123 Wright St., Saint John, N.B. Born at Saint John, N.B., Feb. 23rd, 1905. Educ.: Partial course, Univ. of N.B., 1938; Certificate for course on The Design & Fabrication of Cemented Carbide Tools, Cdn. Gen'l. Elec. Co., Toronto; I.C.S. course in mech. engrg. & special maths. (not yet completed); 1926-30, marine engr., ap'ticeship, Union Foundry & Machine Works; 1931-36, marine machinist, alternately employed with Saint John Dry Dock & Halifax Shipyards, Ltd.; 1936-37, machinist, T. McAvity & Sons, Ltd.; 1937-38, toolmaker, Massey-Harris Co., Brantford, Ont.; 1938 to date, with T. McAvity & Sons, Ltd., Saint John, as inspr., asst. chief inspr. and for the last five years i/c product planning & tooling, including the design & fabrication of Cemented Tungsten Carbide Tools.

References: T. S. Moffat, G. G. Hare, H. A. Stephenson, D. A. Duffy.

KNIGHT—GEORGE FREDERICK, of Toronto, Ont. Born at Middleton, England, June 16th, 1902. Educ.: 1918-22, Manchester College of Technology and at the same time serving ap'ticeship with Wests Gas Improvement Co. Ltd., Manchester, England; Assoc. M.C.T. 1922; With Wests Gas Improvement Co.

Ltd., New York, as follows: 1923-27, dftsman. & engr., 1928-30, i/c all engrg. work covering design & detail of gas mfg. plants for utilities, selling, erection, etc., 1930-40, asst. mgr., 1940-42, gen'l. mgr.; 1942 to date, works engr., Consumers Gas Co. of Toronto, Ont.

References: C. D. Bailey, H. P. World, K. L. Dawson, W. H. M. Laughlin.

LAIDRICH—EDWARD, of Montreal. Born at Hankau, China, March 11th, 1903. (Naturalized Canadian in 1937). Educ.: Certificate, Ecole des Arts et Metiers, Geneva (3 years), 1924; "Ingenieur Mecanicien," Ecole Polytechnique Federale Suisse, Zurich, (4 years), 1929; R.P.E. Que.; 1930-33, designing engr., Montreal Water Works; 1938-40, engr. i/c Centremaque Gold Mine Ltd.; 1941-42, mech. engr., Dominion Magnesium Ltd., Ottawa, plant designing. At present, mech. engr., Dominion Rubber Co. Ltd., Montreal.

References: C. J. Desbaillets, R. Ford, J. F. Brett.

PORTER—CORNELIUS JAMES, of Hamilton, Ont. Born at Port Dover, Ont., Sept. 27th, 1885. Educ.: B.A.Sc., Univ. of Toronto, 1909. (Post-graduate work, 1910); 1910-12, dftsman., Mt. Hood Rly. & Power Co., Portland, Oregon; 1912-13, dftsman., Pacific Power & Light Co., Portland; 1913-17, dftsman., Texas Power & Light Co., Dallas, Texas; 1917-23, asst. supt. of substations, and 1923-30, constrn. engr., Dominion Power & Trans. Co., Hamilton; 1930 to date, electrical engr., Steel Co. of Canada, Hamilton, Ont.

References: H. A. Cooch, H. J. A. Chambers, C. H. Hutton, N. A. Eager W. G. Milne.

POSTIN—GEORGE DANIEL, of Moose Jaw, Sask. Born at Regina, Sask., Jan. 15th, 1912. Educ.: B.S. (Mech. Engrg.), Tri-State College, Indiana, 1938. 1938-41, asst. to mtce. & constrn. engr., Consumers' Co-operative Refineries, Ltd., Regina, surveying, dfting., layout work, supervis'n. of constrn., etc.; 1941-42, designing engr., Frost & Wood Co. Ltd., Smith's Falls, Ont., designing, gen'l. engrg. work, etc. With the British American Oil Co. Ltd., as follows: 1942-43, designing engr., Toronto, designing refinery equipment, work on process layouts, pumping units, etc.; 1943 to date, res. engr., Moose Jaw, Sask., i/c mtce. & constrn., responsible for engrg. work at Moose Jaw Refinery.

References: C. K. Buchbach, R. M. Henderson, A. W. E. Fawkes, F. E. Estlin, J. N. de Stein.

RUDGE—FREDERICK WILLIAM, Sergeant, R.C.A.F., of Tuft's Cove, N.S. Born at Woodstock, N.B., June 4th, 1910. Educ.: B.Sc. (Elec.), Univ. of N.B., 1933. 1928-30 (summers), rodman, chainman & clerk engr., C.P.R.; 1933-34, asst. professor physics, St. Francis Xavier Univ.; 1935-36, road inspr., and 1936-37, plant inspr., asphalt paving, Province of N.B.; 1938-39, supervising inspec'n. engr., Milton Hersey Co., for Province of N.B.; 1939-40, asphalt engr., Dept. of Transport, Calgary, Alta.; With the Milton Hersey Co. as follows: 1940-41, chief inspr., Ottawa Dist., 1941-43, chief inspr., for Aluminum Co. of Canada, Passe Dangereuse, Que.; At present, laboratory technician, paving dept., No. 8 Constrn. & Mtce. Unit, R.C.A.F., Tuft's Cove, N.S.

References: M. F. Macnaughton, W. E. Lumb, J. R. Scanlan, F. L. Lawton, W. J. Lawson.

SHIPLEY—KENNETH ROSSER, of Sarnia, Ont. Born at Denfield, Ont., March 19th, 1909. Educ.: B.A.Sc., Univ. of Toronto, 1935; 1929-30 (summer), rodman & dftsman., C.P.R., London; 1936, dftsman., British American Oil Co., Toronto; 1936-37, sales engr., Peacock Bros. Ltd., Toronto; 1937-41, dftsman., 1941-43, process engr., responsible for process design, etc., and 1943 to date, supervisor No. 2 Plant, i/c of all process units and allied equipment, Imperial Oil Limited, Sarnia, Ont.

References: C. E. Carson, G. L. Macpherson, J. W. MacDonald, C. P. Warkentin, R. W. Dunlop.

STOCKWELL—HENRY P., Jr., of 392 Holland Ave., Ottawa, Ont. Born at Stanstead, Que., July 26th, 1904. Educ.: B.Sc. (Chem. Engrg.), McGill Univ., 1924; R.P.E. Ont.; 1924-25, demonstrator in chemistry, McGill Univ., research in rubber chemistry; 1925-26, junior chemist, pulp & paper div'n., Canadian Pulp & Paper Assoc., research on chemistry of wood pulp; 1926-27, mill chemist, Masons, Ltd., Hawkesbury, Ont., plant control in fibreboard mill & research on sizing process for pulp products, etc.; 1927-31, asst. chem. engr., tech. dept., Price Bros. & Co. Ltd., Kenogami, Que., chemical & tech. control in newsprint & board mill; With the City of Ottawa as follows: 1932-43, chem. engr., water purification plant; 1943 (July to Sept.), water works dept., i/c purification & pumping, 1943-44 (May), acting asst. water works engr., and at present, asst. water works engr.

References: W. E. MacDonald, G. H. Ferguson, N. B. MacRostie, R. E. Hays, E. V. Buchanan, W. F. M. Bryce.

FOR TRANSFER FROM JUNIOR

GREEN—JOHN SCOTT, of 315 East 3rd Street, Wichita 2, Kansas, U.S.A. Born at Simcoe, Ont., April 29th, 1911; Educ.: B.A.Sc., Univ. of Toronto, 1933; 1930 (summer), American Can Co.; 1931-32 (summers), and 1933-34, with County of Haldimand; 1934-36, branch mgr., Dominion Stores; 1936-40, metallurgist, Wm. Jessop & Sons Ltd.; With the British Air Commission as follows: 1940-41, inspr. at Toronto, 1941, inspr. at Nashville, Tenn., 1941-43, resident inspr. at Intercontinent Aircraft Corpn., Miami, Florida, and 1943 to date, resident inspr., and at present acting technical officer, at Beech Aircraft Corpn., Wichita, Kansas. (Jr. 1941).

References: W. F. Campbell, E. A. Allcut, J. R. Cockburn, T. R. Loudon, R. W. Angus, C. R. Young, W. S. Wilson.

TRETHEWEY—GRAHAM D., of Woodfibre, B.C. Born at Spokane, Wash., U.S.A. Sept. 11th, 1915; Educ.: B.A.Sc. (Chem.), Univ. of B.C., 1937; 1938-41, asst. chemist, testing and research, 1941-44, asst. plant chemist, lab. mtce., research and plant investigation, and since May 1944, research chemical engr. i/c research, B.C. Pulp & Paper Co. Ltd., Woodfibre, B.C. (Jr. 1940).

References: W. A. Bain, A. D. Creer, V. Dolmage, J. N. Finlayson, A. Peebles.

FOR TRANSFER FROM STUDENT

BREEZE—JOHN ELLIS, of 21 Findlay Ave., Ottawa, Ont. Born at Vancouver, B.C., May 31st, 1916; Educ.: B.A.Sc., 1939, M.A.Sc., 1941, Univ. of B.C.; 1940 (summer), Dominion Sound Equipment Ltd., Vancouver; With the Radio Branch, National Research Council, Ottawa, as follows: 1940-42, junior research engr., 1942-43, project engr. i/c of design, and prototype constrn., preparation of specifications, and operational trials of special radio equipment for Canadian Army; 1943 (May-Dec.), project engr. i/c of a new project. Work involved coordination of all radio branch effort, incl. supervn. of work of 11 engrs. Dec. 1943, in addition to above, took over duties associated with section head of the Army Section, incl. supervn. of personnel and supervn. of work on 12 projects. July 1943, appointed junior asst. research engr. (St. 1939).

References: R. W. Boyle, H. J. MacLeod, C. A. Price, B. G. Ballard, D. S. Smith.

CAMPEAU—CHARLES EDOUARD, of 6715 St. Lawrence Blvd., Montreal, Que. Born at Montreal, April 24th, 1916. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1941. R.P.E. Que.; Summers—1937-38, with Les Ingenieurs Associes, Montreal, 1938-39, Mines Labs., Prov. of Quebec, 1939-41, Prov. Road Dept.; 1941-43, private practice, plans, evaluation and constrn.; 1941 to date, with the City of Montreal as follows: 1941-42, technical services (evaluation), 1942-43, aqueduct—concrete works, 1943 to date, engr. attached to the city planning dept., considering the traffic and other engineering problems. (St. 1940).

References: J. F. Brett, A. Cousineau, C. J. Desbaillets, L. Trudel, H. Labrecque, H. A. Gibeau.

ERICKSON—PETER O. M., of Toronto, Ont. Born at Weldon, Sask., March 19th, 1914; Educ.: B.Sc. (Mech.), Univ. of Sask., 1939; 1937 (summer), surveying, dfting, mapping, Duquesne Mines, Que.; 1939-40, instr'man. on survey party, P.F.R.A., also res. engr. on constrn.; 1940-41, with Ford Motor Co., Toronto and Windsor, constrn. layout, dfting., mtce. & production, supply assembly, mtce. & plant revision, etc.; 1941 to date, with the Sutton Horsley Co., Leaside, as follows: 1941-42, chief work-in-process inspr. 1942-43, assembly dept. mgr., 1943-44, production supt., and from Feb. 1944 to date, prod. supt. & prod. planning mgr. (St. 1939).

References: C. J. Mackenzie, I. M. Fraser, E. K. Phillips, N. B. Hutcheon, V. E. Thierman.

ST-LAURENT—AURELE, of 190 Whittaker St., Sudbury, Ont. Born at Ste. Luce, Co. Rimouski, Que., Nov. 6th, 1913: Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1943; 1941, concrete inspr., Quebec Streams Commn.; 1942, remelting dept., Aluminum Co. of Canada; 1943 to date, training in the smelter dept., International Nickel Co. of Canada, Copper Cliff, Ont. (St. 1941).

References: A. Circé, H. Gaudefroy, R. Boucher, E. MacKay.

SYMONS—LLOYD GEORGE, Major, R.C.E.M.E., of 1185 Seymour Ave., Montreal, Que. Born at Saskatoon, Sask., March 23rd, 1917; Educ.: B.Sc. (Mech.), Univ. of Sask., 1941; 1941-42, asst. mech. supt. (machine shop, power house, refrigeration), Swift Canadian Co., St. Boniface, Man.; March 1942 enlisted in R.C.O.C., Sept. 1942 (after completion of training), stationed at Westmount, Que., workshops, to Dec. 1943, officer i/c armament, machine shop & carpenter shop; Dec. 1943 to date, officer i/c R.C.E.M.E. workshops, Westmount, Que., responsible for all repair and mtce. to officer commanding the unit. (St. 1941).

References: N. B. Hutcheon, I. M. Fraser, R. A. Spencer, E. K. Phillips, O. K. Ross, W. E. Lovell.

FOR TRANSFER FROM AFFILIATE

ARMSTRONG—THOMAS CHAPMAN, of Port Arthur, Ont. Born at Kenora, Ont., Sept. 23rd, 1908; Educ.: I.C.S. Course in Civil Engrg. Corres. course with Canadian Institute of Science & Technology; 1930-31, Noranda Mines; With the Ontario Dept. of Highways as follows: 1931-36, divn. dftsman., 1936-42, res. engr. i/c constrn. contracts, 1942-43, works engr. & asst. to chief engr., 1943 to date, res. engr. (Affiliate 1940).

References: T. F. Francis, J. M. Fleming, F. C. Graham, R. B. Chandler, G. H. Burbidge, H. G. O'Leary.

LIBRARY NOTES *(Continued)*

MAGNESIUM, Its Production and Use

By E. V. Pannell. Pitman Publishing Corp., New York and Chicago, 1944. 137 pp., illus., diagrs., charts, tables, 9 x 5½ in., cloth, $4.00.

A practical treatise on magnesium from the engineering and industrial point of view. The methods of producing the metal are described briefly. Most of the book is devoted to the alloys, their heat treatment, casting and working, corrosion and protective methods, and their industrial application. The book is a useful addition to the literature on magnesium.

MR. TOMPKINS EXPLORES THE ATOM

By G. Gamow. The Macmillan Company, New York; The University Press, Cambridge, England, 1944. 97 pp., illus., diagrs., 8½ x 6½ in., cloth, $2.00.

In this admirable bit of scientific humor, Professor Gamow pursues the further adventures of the hero of "Mr. Tompkins Explores the Atom." Attendance upon a series of lectures on nuclear physics results in three strange dreams, in which Mr. Tompkins learns of Maxwell's Demon, adventures among the electrons with disastrous results, and learns the mysteries of the nucleus.

MILITARY MAPS AND AIR PHOTOGRAPHS, Their Use and Interpretation

By A. K. Lobeck and W. J. Tellington, with an introduction by J. K. Wright. McGraw-Hill Book Co., New York and London, 1944. 256 pp., illus., diagrs., charts, maps, tables, 11½ x 8½ in., cloth, $3.50.

The authors, a geologist and an army topographer, have aimed to supply a complete, yet simple, presentation of the fundamentals of map reading and map interpretation, including air photographs. Techniques and methods are described in detail. Especial attention is paid to the representation of topographic forms by contours, and a section is devoted to landscape types. Engineering students, as well as military men, will find the book useful.

MODERN WOOD ADHESIVES

By T. D. Perry. Pitman Publishing Corp., New York and Chicago, 1944. 208 pp., illus., diagrs., tables, 9¼ x 6 in., linen, $3.00.

This is an excellent reference book on the properties of glues and resin adhesives, and on their uses and on glue testing. The various glues and resins, the methods of comparing them, glue mixing and spreading equipment, the use of pressure and heat, impregnation, and glue testing are considered from a practical point of view. Each chapter has a useful bibliography.

Employment Service Bureau

NOTICE

Technical personnel should not reply to any of the advertisements for situations vacant unless—

1. They are registered with the Wartime Bureau of Technical Personnel.
2. Their services are available.

A person's services are considered available only if he is—

(a) unemployed;
(b) engaged in work other than of an engineering or scientific nature;
(c) has given notice as of a definite date; or
(d) has permission from his present employer to negotiate for work elsewhere while still in the service of that employer.

Applicants will help to expedite negotiations by stating in their application whether or not they have complied with the above regulations.

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.

SITUATIONS VACANT

MANAGER OR ASSISTANT MANAGER for building construction company in Quebec province; construction, sales and business ability desirable. Must be aggressive with pleasing personality and able to converse in French. Apply to Box No. 2779-V.

ENGINEERING SHOP SUPERINTENDENT wanted to keep up production and quality of output and handle labour under present conditions. Chance of advancement and good salary to right man. In replying give age, experience and references. Apply to Box No. 2780-V.

ENERGETIC ASSISTANT SALES MANAGER wanted by engineering company making power plant equipment. Chance of advancement and good salary to right man. In replying give age, experience and references. Apply to Box No. 2781-V.

MECHANICAL ENGINEER DRAUGHTSMAN wanted. See page 42 of the advertising section.

CIVIL OR MECHANICAL ENGINEER wanted. See page 46 of the advertising section.

DRAUGHTSMAN WANTED—Wire and cable manufacturers require an experienced mechanical engineering draughtsman for shop and equipment layout work. To a man with initiative and energy the position offers an interesting prospect and is permanent. Apply to Box 2791-V.

ELECTRICAL DESIGNER WANTED—Graduate engineer with two to four years' design and layout experience in electric power utility installations. Location, mid-west. In reply give full particulars of previous experience, tate salary expected, age, etc. Do not reply unless available under Order-in-Csouncil P.C. 246. Apply to Box No. 2792-V.

ELECTRICAL ENGINEER—We are not too large and we are not too small. You will not lose your identity because an opportunity awaits an electrical engineer with commercial vision and ingenuity who can design products for industrial, communication and power companies.

A knowledge of electro chemistry will be an advantage. The remuneration is way above the average, which will encourage the man who accepts the position to produce results. Tell us about what you have been doing, not what you have been earning and what you have on the ball for this position. There is only one person going to see your reply and he knows enough to keep his mouth shut.

Apply to Box No. 2793-V.

SITUATIONS WANTED

ELECTRICAL ENGINEER, graduate, 20 years' broad experience, desires responsible position with progressive company. Apply to Box No. 278-W.

CHEMICAL ENGINEERING GRADUATE '44 desires permanent employment. Keen, young, willing to accept any position with possibilities for the future. Apply to Box No. 2464-W.

MECHANICAL ENGINEER, Canadian graduate, age 36, married, with ten years of outstanding domestic and foreign experience in industrial engineering and management, seeks a responsible permanent position in this field with post-war opportunities. Accustomed to handling executive responsibilities and with a proven ability to secure the co-operation of others. Intimate knowledge of South America. Available at once. Apply to Box No. 2465-W.

Mechanical Engineer Wanted for ARVIDA

To supervise and direct mechanical maintenance of plant equipment.

APPLY TO BOX No. 2785-V

GRADUATE ELECTRICAL OR MECHANICAL ENGINEER WANTED

Wire and cable manufacturers require services of an electrical or mechanical engineer, preferably one having a few years experience in mechanical work. Interesting prospects for a man having initiative and energy. Do not apply unless your services are available under Order-in-Council PC-246, Part III (January 19, 1943) administered by the Bureau of Technical Personnel. Apply to Box No. 2795-V.

LIBRARY NOTES (*Continued*)

TABLES OF LAGRANGIAN INTERPOLATION COEFFICIENTS

Prepared by the Mathematical Tables Project, Work Projects Administration of the Federal Works Agency; conducted under the Sponsorship of the National Bureau of Standards. Published by Columbia University Press, New York, 1944. 392 pp., tables, 10¾ x 8 in., cloth, $5.00.

This volume extends the existing tables of Lagrangian interpolation coefficients in n-point polynomials for $n = 3, 4, \ldots, 11$ by giving the entries at smaller intervals of the argument and by making adequate provision for interpolation near the beginning and near the end of the table. All the coefficients of Everett's central difference formula as well as several other special types, are identical with certain Lagrangian coefficients given in this table. The main group consists of 8- to 10-place tables.

SYMPOSIUM ON THE IDENTIFICATION OF WATER-FORMED DEPOSITS, SCALES AND CORROSION PRODUCTS BY PHYSICO-CHEMICAL METHODS, presented at the Forty-Sixth Annual Meeting, American Society for Testing Materials, Pittsburgh, Pa., June 29, 1943

Published by American Society for Testing Materials, 260 South Broad St., Philadelphia, 1943. 44 pp., reprint from Proceedings, illus., diagrs., tables, 9 x 6 in., paper, 65c.

Three papers given at the 1943 annual meeting of the Society, the general discussion of the subject and an extensive introduction are presented in this pamphlet, which is reprinted from the Proceedings.

Industrial development — new products — changes in personnel — special events — trade literature

MANUFACTURING RIGHTS

Arrangements were recently completed by Canada Foundries & Forgings Ltd. with the Hilliard Corporation of Elmira, N.Y., and the firm of Gleeson & Leahey, Ottawa, whereby the complete assets of the latter plant were purchased by Canada Foundries & Forgings Limited, and all the manufacturing and servicing equipment for Hilco oil reclaimers transferred to the company's James Smart plant at Brockville, where a new oil filtration division is now operating under the direction of E. M. Leahey, formerly of Gleeson & Leahey.

OPENS SALES OFFICE

D. S. Pocock, sales manager of Canadian Raybestos Co. Ltd., has moved his headquarters from the main plant at Peterborough to 12 Richmond Street, East, Toronto.

AIR TOOLS

Bulletin No. 5100, 12 pages, issued by Canadian Ingersoll-Rand Co. Ltd., Montreal, provides complete descriptions and illustrations of a variety of pneumatic tools, designed for use in the fabrication of aircraft. The list includes drills, riveters, grinders, chippers, scalers, wrenches, hoists, etc. In addition, the bulletin contains numerous action shots of the tools being used on actual aircraft and other applications.

CENTRIFUGAL PUMPS

Bulletin 30-B, eight pages, prepared by The Smart-Turner Machine Co. Ltd., Hamilton, Ont., contains typical specifications covering the component parts of the "Smart-Turner" line of double suction centrifugal pumps, also size and capacity tables and dimensional drawings. The illustrations show the various types of units available together with their drives and typical installations in plants from coast to coast.

ELECTED PRESIDENT, C.M.A.

J. C. Macfarlane, K.C., a vice-president of Canadian General Electric Co. Ltd., was elected president of the Canadian Manufacturers Association at the annual meeting held recently in Toronto.

J. C. Macfarlane, K.C.

MOTORS & MOTOR CONTROL

Canadian General Electric Co. Ltd., Toronto, have just issued a 70-page illustrated book relating to electric motors and covers all phases of their application, installation and maintenance. Typical section headings include: Fundamental Steps to Take in Selecting Motors; Motor Application; Control Application; Motor Installation; Control Installation; Motor Maintenance and Control Maintenance. In addition there is a section of Useful Information, containing definitions relative to protection of machines, duty and service, rating and speed classification; also mounting assembly symbols, three easy ways to determine WR^2 and several extracts from the 1939 Canadian Electrical Code.

ELECTRICAL INSTRUMENTS

Norton Electrical Instrument Co., Manchester, Conn., have for distribution catalogue No. 16, 32 pages, which contains descriptions, illustrations and ranges of the company's line of ammeters, voltmeters and wattmeters comprising three different systems, viz., moving-coil, electro-magnetic and electro-dynamometer. Included also are switchboard and portable shunts, resistors and special electrical instruments. Several pages are devoted to full scale drawings of switchboard and portable instrument hand-drawn scales.

IMPEDANCE RELAYS

Bulletin A. 3, eight pages, issued by Cansfield Electrical Works Ltd., Toronto, begins with a statement of the purpose of the high-speed impedance relay and then gives a statement of the theory on which they are based. This is followed by descriptions of the construction, dimensions, characteristics, applications, etc., of the impedance relays which the bulletin is featuring. A diagram of a radial distribution system in which impedance protection is provided as well as tables of dimensions and ratings are included.

MAINTENANCE ARC WELDING

The James F. Lincoln Arc Welding Foundation have just published a 234-page book, bound in semi-flexible simulated leather, which comprises twenty-five of the most significant award papers in the Foundation's Industrial Progress Award programme, maintenance classification.

This compilation of the most outstanding maintenance studies in the group submitted, deals with the use of arc welding in reclaiming broken and worn parts and also gives details on the application of welding in the fabrication of replacements.

The contents of the book are arranged in twenty-five chapters, titles of a few of which will indicate the scope of subject matter treated. These are: Cement Plant; Ceramic Plant; Chemical Plant; Copper Plant; Fibre and Plastics Plant; Furniture Mfg. Plant; Gravel Plant; Saw Mill; Steel Mill; and application such as: Coke Oven Doors; Welded Blast Furnace Shell; Cracking Still Charging Pump; Drill Pipe of Integral-Joint Construction; Corrosion Control in Refinery Pressure Vessels, etc.

"Maintenance Arc Welding" is priced at 75 cents per copy postpaid anywhere in Canada. Copies may be secured by writing The James F. Lincoln Arc Welding Foundation, c/o Lincoln Electric Co. of Canada Ltd., Leaside, Toronto, 12, Ont.

WRAPPING & PROTECTIVE MATERIAL

Alexander Murray & Co. Ltd., Montreal, have prepared a four-page folder illustrating a few of the many industrial applications for a tough, durable and waterproof wrapping and protective material for goods in transit, in emergency storage and in regular storage. Among wrapped goods shown are machinery, sheet steel, automotive equipment, leather, rubber, cordage and wet clay.

ELECTRONIC METAL ANALYZER

Allen B. DuMont Laboratories Inc., represented in Canada by Cyclograph Services Ltd., Toronto, have issued an eight-page bulletin illustrating and describing an electronic instrument that accomplishes non-destructive tests and instantly checks castings for machinability, brittleness, toughness and metallic composition. It also checks both ferrous and non-ferrous metals for case depth, depth of carburization, amount of cold working, structure, heat treatment, wall thickness, plating or cladding, etc.

REJOINS DOMINION RUBBER

W. M. MacLean, former liaison officer between Canada and the United Kingdom and the office of the rubber director in Washington, has rejoined Dominion Rubber Co. Ltd., concluding his official connection with the Federal Government after an absence of fifteen months.

Mr. MacLean will undertake market research for raw chemicals to be manufactured by Naugatuck Chemicals division of Dominion Rubber, and will co-ordinate the activities of the research laboratories of the company at Guelph with the chemicals division at Elmira, Ont.

A graduate of Acadia University and the University of Western Ontario, Mr. MacLean first became connected with Dominion Rubber as a chemist in the general laboratories, Montreal, and for five years was engaged in sales work for the company in Montreal and Ottawa.

W. M. MacLean

(*Continued on page 36*)

THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 27 MONTREAL, AUGUST 1944 NUMBER 8

"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

★ ★ ★

PUBLISHED MONTHLY BY

THE ENGINEERING INSTITUTE OF CANADA

2050 MANSFIELD STREET - MONTREAL

Price 50 cents a copy, $3.00 a year: in Canada, British Possessions, United States and Mexico. $4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, $2.00 a year. —Entered at the Post Office, Montreal, as Second Class Matter.

CONTENTS

LOWERING GENERATOR ROTOR INTO THE STATOR AT SHIPSHAW . . . . . Cover

THE ENGINEERING PROFESSION TOMORROW 446
Robert E. Doherty, Hon. M.E.I.C.

DISCUSSION ON THE DESIGN OF THE SHIPSHAW POWER DEVELOPMENT 449

PLANNING NOW FOR POST-WAR CONSTRUCTION PROJECTS 459

THE MACHINING OF CANNON 460
Major E. G. Moffat

THE GANARASKA SURVEY 463
A. H. Richardson

FROM MONTH TO MONTH 470

PERSONALS 480

Obituaries 482

LIBRARY NOTES 483

PRELIMINARY NOTICE 485

EMPLOYMENT SERVICE 486

THE ENGINEERING INSTITUTE OF CANADA

MEMBERS OF COUNCIL - 1944

PRESIDENT

deGASPÉ BEAUBIEN, Montreal, Que.

PAST-PRESIDENTS

*C. J. MACKENZIE, Ottawa, Ont.
‡K. M. CAMERON, Ottawa, Ont.
†C. R. YOUNG, Toronto, Ont.

VICE-PRESIDENTS

*W. P. BRERETON, Winnipeg, Man.
†G. L. DICKSON, Moncton, N.B.
†J. M. FLEMING, Port Arthur, Ont.
*L. F. GRANT, Kingston, Ont.
*C. K. McLEOD, Montreal, Que.
†E. B. WARDLE, Grand'Mère, Que.

COUNCILLORS

*J. E. ARMSTRONG, Montreal, Que.
*H. E. BRANDON, Toronto, Ont.
†H. L. BRIGGS, Winnipeg, Man.
*A. E. CAMERON, Halifax, N.S.
‡R. S. EADIE, Montreal, Que.
*J. W. D. FARRELL, Regina, Sask.
†G. H. FERGUSON, Ottawa, Ont.
†E. V. GAGE, Montreal, Que.
†P. E. GAGNON, Quebec, Que.
*R. E. HEARTZ, Montreal, Que.
*A. JACKSON, Kingston, Ont.
†J. A. LALONDE, Montreal, Que.

†ALEX. LOVE, Hamilton, Ont.
‡P. A. LOVETT, Halifax, N.S.
A. M. MACGILLIVRAY, Antigonish Harbour, N.S.
*N. B. MACROSTIE, Ottawa, Ont.
†J. McMILLAN, Calgary, Alta.
*A. W. F. McQUEEN, Niagara Falls, Ont.
†E. B. MARTIN, Moncton, N.B.
*G. E. MEDLAR, Windsor, Ont.
†W. MELDRUM, Lethbridge, Alta.
*J. P. MOONEY, Saint John, N.B.
†A. S. G. MUSGRAVE, Oak Bay, B.C.
NELSON, Edmonton, Alta.

*H. G. O'LEARY, Fort William, Ont.
‡P. E. POITRAS, Montreal, Que.
†J. A. RUSSELL, Sydney, N.S.
*C. SCRYMGEOUR, Dartmouth, N.S.
†H. R. SILLS, Peterborough, Ont.
†C. STENBOL, Sault Ste. Marie, Ont.
*E. O. TURNER, Fredericton, N.B.
*J. A. VANCE, Woodstock, Ont.
*H. J. WARD, Shawinigan Falls, Que.
*J. W. WARD, Arvida, Que.
*C. E. WEBB, Vancouver, B.C.
†W. S. WILSON, Toronto, Ont.

*For 1944. †For 1944-45. ‡For 1944-45-46.

TREASURER

F. C. MECHIN, Montreal, Que.

GENERAL SECRETARY

L. AUSTIN WRIGHT, Montreal, Que.

SECRETARY-EMERITUS

R. J. DURLEY, Montreal, Que.

ASSISTANT GENERAL SECRETARY

LOUIS TRUDEL, Montreal, Que.

STANDING COMMITTEES

FINANCE
C. K. McLEOD, *Chairman*
J. E. ARMSTRONG
G. A. GAHERTY
F. C. MECHIN
R. M. CALVIN

LEGISLATION
P. E. POITRAS, *Chairman*
F. J. BLAIR
R. J. DURLEY

PAPERS
L. F. GRANT, *Chairman*

LIBRARY AND HOUSE
E. V. GAGE, *Chairman*
A. T. BONE
J. S. HEWSON
M. S. NELSON
G. V. RONEY

PUBLICATION
R. S. EADIE, *Chairman*
R. DeL. FRENCH, *Vice-Chairman*
R. C. FLITTON
J. A. OUIMET
C. A. PEACHEY

SPECIAL COMMITTEES

BOARD OF EXAMINERS
R. A. SPENCER, *Chairman*
I. M. FRASER
W. E. LOVELL
A. P. LINTON
H. R. MACKENZIE
E. K. PHILLIPS

GZOWSKI MEDAL
T. H. JENKINS, *Chairman*
E. G. M. CAPE
V. A. McKILLOP
W. H. POWELL
E. O. TURNER

DUGGAN MEDAL AND PRIZE
W. J. W. REID, *Chairman*
R. C. FLITTON
H. M. WHITE

PLUMMER MEDAL
P. E. GAGNON, *Chairman*

LEONARD MEDAL
F. V. SEIBERT, *Chairman*
A. E. MACRAE
D. H. McDOUGALL
G. W. WADDINGTON

JULIAN C. SMITH MEDAL
deGASPÉ BEAUBIEN, *Chairman*
C. J. MACKENZIE
C. R. YOUNG

MEMBERSHIP
J. G. HALL, *Chairman*
S. R. FROST
N. MacNICOL

PROFESSIONAL INTERESTS
J. B. CHALLIES, *Chairman*
J. E. ARMSTRONG, *Vice-Chairman*
G. A. GAHERTY,
A. SURVEYER
J. A. VANCE

STUDENTS' AND JUNIORS' PRIZES

H. N. Ruttan Prize—Western Provinces
W. P. BRERETON, *Chairman*
A. M. MACGILLIVRAY
C. E. WEBB

John Galbraith Prize—Province of Ontario
J. M. FLEMING, *Chairman*
H. E. BRANDON
A. W. F. McQUEEN

Phelps Johnson Prize—Province of Quebec (English)
C. K. McLEOD, *Chairman*
E. V. GAGE
R. E. HEARTZ

Ernest Marceau Prize—Province of Quebec (French)
E. B. WARDLE, *Chairman*
P. E. GAGNON
P. E. POITRAS

Martin Murphy Prize—Maritime Provinces
G. L. DICKSON, *Chairman*
J. P. MOONEY
C. SCRYMGEOUR

INTERNATIONAL RELATIONS
M. J. McHENRY, *Chairman*
E. A. ALLCUT
A. E. BERRY
C. P. EDWARDS
D. H. McDOUGALL
C. SCRYMGEOUR
L. E. WESTMAN

WESTERN WATER PROBLEMS
G. A. GAHERTY, *Chairman*
C. H. ATTWOOD
L. C. CHARLESWORTH
A. GRIFFIN
D. W. HAYS
G. N. HOUSTON
T. H. HOGG
C. J. MACKENZIE
H. J. McLEAN
F. H. PETERS
S. G. PORTER
P. M. SAUDER
J. M. WARDLE

THE YOUNG ENGINEER
H. F. BENNETT, *Chairman*
C. G. R. ARMSTRONG
J. BENOIT
J. B. deHART
RENE DUPUIS
J. N. FINLAYSON
R. F. LEGGET
A. E. FLYNN
R. DeL. FRENCH
A. JACKSON
G. R. LANGLEY
A. E. MACDONALD
H. W. McKIEL
D. A. R. McCANNEL

ENGINEERING FEATURES OF CIVIL DEFENCE
J. E. ARMSTRONG, *Chairman*
P. E. ADAMS
J. N. ANDERSON
S. R. BANKS
H. F. BENNETT
W. D. BRACKEN
W. P. BRERETON
J. M. DAVIDSON
R. S. EADIE
E. V. GAGE
G. A. GAHERTY
R. J. GIBB
A. GRAY
J. GRIEVE
J. L. LANG
R. F. LEGGET
I. P. MACNAB
J. A. McCRORY
H. J. McEWEN
C. B. MUIR
W. H. MUNRO
J. A. A. PICHÉ
G. MacL. PITTS
C. J. PORTER
M. G. SAUNDERS
W. O. SCOTT
T. G. TYRER
H. K. WYMAN

INDUSTRIAL RELATIONS
WILLS MACLACHLAN, *Chairman*
E. A. ALLCUT
J. P. BRIERLEY
J. C. CAMERON
E. R. COMPLIN
J. A. COOTE
RENÉ DUPUIS
T. W. EADIE
S. M. GOSSAGE
F. W. GRAY
E. G. HEWSON
I. F. McRAE
W. H. MUNRO
W. J. W. REID

DETERIORATION OF CONCRETE STRUCTURES
R. B. YOUNG, *Chairman*
E. VIENS, *Vice-Chairman*
G. P. F. BOESE
A. G. FLEMING
W. G. C. GLIDDON
J. A. McCRORY
C. J MACKENZIE
J. H. McKINNEY
R. M. SMITH

THE ENGINEERING INSTITUTE OF CANADA

OFFICERS OF BRANCHES

BORDER CITIES
Chairman, J. B. DOWLER
Vice-Chair., A. H. MacQUARRIE
Executive, G. W. LUSBY J. M. WYLLIE
J. F. G. BLOWEY
(Ex-Officio), G. E. MEDLAR
G. G. HENDERSON
Sec.-Treas., W. R. STICKNEY,
1614 Ontario Street,
Walkerville, Ont.

CALGARY
Chairman, H. B. LeBOURVEAU
Executive, J. V. ROGERS F. C. TEMPEST
P. F. PEELE J. LANGSTON
(Ex-Officio) J. McMILLAN
S. G. COULTIS
J. G. MacGREGOR
K. W. MITCHELL
Sec.-Treas., A. B. GEDDES,
4716 Elbow Drive,
Calgary, Alta.

CAPE BRETON
Chairman, M. F. COSSITT
Executive, M. R. CHAPPELL
J. R. MORRISON
(Ex-Officio), J. A. MACLEOD
J. A. RUSSELL
Sec.-Treas., S. G. NAISH
Peacock Brothers Ltd..
Moore Bldg., Sydney, N.S.

EDMONTON
Chairman, B. W. PITFIELD
Vice-Chair., J. W. JUDGE
Executive, H. W. TYE
I. F. MORRISON
J. D. A. MACDONALD
J. E. B. CRANSWICK
R. SCOTT
R. H. LINKE
(Ex-Officio), E. NELSON
C. W. CARRY
F. R. BURFIELD
Sec.-Treas., G. H. MILLIGAN
Calgary Power Company,
214 McLeod Bldg.,
Edmonton, Alta.

HALIFAX
Chairman, G. J. CURRIE
Executive, R. J. BETHUNE J. W. MARCH
J. E. CLARKE C. D. MARTIN
K. L. DAWSON L. E. MITCHELL
D. C. V. DUFF H. A. RIPLEY
J. H. M. JONES R. B. STEWART
(Ex-Officio), A. E. FLYNN A. E. CAMERON
C. SCRYMGEOUR
P. A. LOVETT
Sec.-Treas., S. W. GRAY,
Wartime Bureau of Technical
Personnel, 84 Hollis Street,
Halifax, N.S.

HAMILTON
Chairman, H. A. COOCH
Vice-Chair., NORMAN EAGER
Executive, C. H. HUTTON
H. J. A. CHAMBERS
R. J. G. SCHOFIELD
A. R. HANNAFORD
(Ex-Officio), ALEX. LOVE T. S. GLOVER
Sec.-Treas., W. E. BROWN,
91 Barnsdale Blvd.,
Hamilton, Ont.

KINGSTON
Chairman, S. D. LASH
Vice-Chair., J. R. CARTER
Executive, F. A. ATHEY C. E. CRAIG
J. D. CALVIN H. D. ROGERS
(Ex-Officio), L. F. GRANT
A. JACKSON
K. M. WINSLOW
Sec.-Treas., J. DOUGLAS LEE,
Queen's University,
Kingston, Ont.

LAKEHEAD
Chairman, S. T. McCAVOUR
Vice-Chair., W. C. BYERS
Executive, S. E. FLOOK
E. L. GOODALL
O. J. KOREEN
W. H. SMALL
A. D. NORTON
W. E. MACLENNAN
J. LUNDIE
S. C. WILCOX
(Ex-Officio), R. B. CHANDLER
J. M. FLEMING
H. G. O'LEARY
Sec.-Treas., J. I. CARMICHAEL
367 N. Syndicate Ave.,
Fort William, Ont.

LETHBRIDGE
Chairman: A. L. H. SOMERVILLE
Executive, J. M. CAMPBELL
A. G. DONALDSON
P. E. KIRKPATRICK
R. S. LAWRENCE
(Ex-Officio), W. MELDRUM
Sec.-Treas, T. O. NEUMANN
Dept. of Transport,
Post Office Building,
Lethbridge, Alta.

LONDON
Chairman, R. S. CHARLES
Vice-Chair., H. G. STEAD
Executive, E. B. ALLEN
F. C. BALL
H. F. BENNETT
V. A. McKILLOP
G. N. SCROGGIE
(Ex-Officio), T. L. McMANAMNA
J. A. VANCE
Sec.-Treas, A. L. FURANNA,
732 Wellington Street,
London, Ont.

MONCTON
Chairman, A. S. DONALD
Vice-Chair., H. W. HOLE
Executive, H. J. CRUDGE A. GORDON
T. H. DICKSON E. C. PERCY
E. R. EVANS G. E. SMITH
(Ex-Officio), G. L. DICKSON
J. A. GODFREY
E. B. MARTIN
Sec.-Treas., V. C. BLACKETT,
Engrg. Dept., C.N.R.,
Moncton, N.B.

MONTREAL
Chairman, C. C. LINDSAY
Vice-Chair., J. B. STIRLING
Executive, C. E. GÉLINAS J. BENOIT
K. G. CAMERON L. H. BURPEE
G. H. MIDGLEY
M. S. MACGILLIVRAY
(Ex-Officio), deGASPÉ BEAUBIEN
C. K. McLEOD
J. E. ARMSTRONG
R. S. EADIE J. A. LALONDE
E. V. GAGE P. E. POITRAS
R. E. HEARTZ
Sec.-Treas., L. A. DUCHASTEL,
40 Kelvin Avenue,
Outremont, Que.

NIAGARA PENINSULA
Chairman, W. D. BRACKEN
Vice-Chair., A. G. HERR
Executive, M. H. JONES
A. D. SMITH
H. E. BARNETT
J. W. BROOKS
W. D. BROWNLEE
P. E. BUSS L. J. RUSSELL
(Ex-Officio), A. W. F. McQUEEN
G. E. GRIFFITHS
J. H. INGS
2135 Culp Street,
Niagara Falls, Ont.

OTTAWA
Chairman, W. L. SAUNDERS
Executive, W. H. B. BEVAN
J. H. BYRNE
D. G. KILBURN
J. M. WARDLE
C. D. WIGHT
(Ex-Officio), K. M. CAMERON
G. H. FERGUSON
N. B. MacROSTIE
Sec.-Treas., A. A. SWINNERTON,
Dept. of Mines & Resources,
Ottawa, Ont.

PETERBOROUGH
Chairman, C. R. WHITTEMORE
Executive, R. L. DOBBIN
A. L. MALBY
F. R. POPE
A. J. GIRDWOOD
W. T. FANJOY
(Ex-Officio), A. R. JONES
H. R. SILLS
Sec.-Treas., E. WHITELEY,
611 Weller Street,
Peterborough, Ont.

QUEBEC
Life Hon. Chair., A. R. DÉCARY
Chairman, E. D. GRAY-DONALD
Vice-Chair., J. O. MARTINEAU
Executive, A. E. PARÉ
CHARLES LEMIEUX
Y. R. TASSÉ W. J. MANNING
L. MARTIN J. M. PAQUET
(Ex-Officio), P. E. GAGNON
RENÉ DUPUIS
P. MÉTHÉ
PAUL VINCENT
Sec.-Treas., GUSTAVE F. ST-JACQUES
Public Service Board of
the Province of Quebec,
Court House,
Quebec, Que.

SAGUENAY
Chairman: CHAS. MILLER
Vice-Chair., G. B. MOXON
Executive, J. FRISCH W. E. COOPER
F. T. BOUTILIER
(Ex-Officio), R. H. RIMMER J. W. WARD
ALEX. T. CAIRNCROSS
Sec.-Treas., ALEX. T. CAIRNCROSS
8-C Brittany Row,
Arvida, Que.

SAINT JOHN
Chairman, C. D. McALLISTER
Vice-Chair., J. M. LAMB
Executive, G. M. BROWN
W. J. LAWSON
H. A. STEPHENSON
R. M. RICHARDSON
(Ex-Officio), J. P. MOONEY
A. O. WOLFF
F. A. PATRIQUEN
E. O. TURNER
Sec.-Treas., L. O. CASS,
National Harbour Board.
P.O. Box 1393,
Saint John, N.B.

ST. MAURICE VALLEY
Chairman, R. DORION
Vice-Chair., H. K. WYMAN
Executive, G. B. BAXTER
A. G. JACQUES
A. W. PETERS
H. J. RACEY
M. EATON
W. E. A. McLEISH
W. H. HARVEY
J. JOYAL
E. E. WHEATLEY
(Ex-Officio), J. H. FREGEAU
H. J. WARD
E. B. WARDLE
Sec.-Treas., A. TRUDEL,
208-5th Avenue,
Shawinigan Falls, Que.

SASKATCHEWAN
Chairman, J. McD. PATTON
Vice-Chair., N. B. HUTCHEON
Executive, F. C. CHRISTIE
G. W. PARKINSON
W. B. RAMSAY
F. E. ESTLIN
E. K. PHILLIPS
J. I. STRONG
(Ex-Officio), J. W. D. FARRELL
Sec.-Treas., STEWART YOUNG,
P.O. Box 101, Regina, Sask.

SAULT STE. MARIE
Chairman, A. M. WILSON
Vice-Chair., G. W. McLEOD
Executive, G. W. HOLDER
C. O. MADDOCK
H. W. SUTCLIFFE
(Ex-Officio), N. C. COWIE
C. STENBOL
Sec.-Treas., T. F. RAHILLY,
174 Pim Street,
Sault Ste. Marie, Ont.

TORONTO
Chairman, S. R. FROST
Vice-Chair., C. F. MORRISON
Executive, C. D. CARRUTHERS
E. A. CROSS
D. G. GEIGER
A. H. HULL
R. F. LEGGET
J. F. McLAREN
(Ex-Officio), H. E. BRANDON
W. S. WILSON
C. R. YOUNG
W. H. M. LAUGHLIN
F. A. DAVIS
Sec.-Treas., S. H. deJONG,
Dept. of Civil Engineering,
University of Toronto,
Toronto, Ont.

VANCOUVER
Chairman, T. V. BERRY
Vice-Chair., A. PEEBLES
Executive, J. P. FRASER F. H. BALLOU
E. S. JONES R. C. PYBUS
G. W. ALLAN J. A. TAMES
(Ex-Officio), C. E. WEBB
W. N. KELLY
Sec.-Treas., P. B. STROYAN,
2099 Beach Avenue,
Vancouver, B.C.

VICTORIA
Chairman, H. L. SHERWOOD
Vice-Chair., A. L. FORD
Executive, P. B. HUGHES
C. M. TRIPP
S. R. WESTON
J. N. ANDERSON
(Ex-Officio), A. S. G. MUSGRAVE
KENNETH REID
Sec.-Treas., R. BOWERING,
41 Gorge Road West,
Victoria, B.C.

WINNIPEG
Chairman, T. H KIRBY
Vice-Chair., C. P. HALTALIN
Executive, B. B. HOGARTH N. M. HALL
R. A. SARA W. F. RIDDELL
E. V. CATON
(Ex-Officio), W. P. BRERETON
H. L. BRIGGS
J. T. DYMENT,
Sec.-Treas., T. E. STOREY,
55 Princess Street,
Winnipeg, Man.

THE ENGINEERING PROFESSION TOMORROW

A RENAISSANCE THROUGH PROFESSIONAL EDUCATION

ROBERT E. DOHERTY, HON. M.E.I.C.
President, Carnegie Institute of Technology, Pittsburgh, Pa.

Presidential address delivered at the Fifty-Second Annual Meeting of the Society for the Promotion of Engineering Education, Cincinnati, Ohio, U.S.A., June 23rd, 1944, and published through the courtesy of the Society.

The engineering profession tomorrow will be largely what engineering education today makes it. The policies of industry, government, and state boards of course will have their influence. Nevertheless, the character of the profession—the height of its purpose, the extent to which its members live up to its ideals, the nature of its standards—must rest fundamentally upon individual convictions, individual attitudes, individual intellectual power; and these qualities are largely molded in college. The form of the mold is determined by the teachers and administrative officers of engineering colleges. If the profession is to be brought to the level which America needs, and is to receive the recognition which it deserves, the educators must bring it there. This is a pointed responsibility that, in light of lessons of the war, weighs upon us as it has not weighed upon any previous generation; it is a challenge we must accept.

We Must Rise to a New Level

Among these lessons, at least two point directly at us. One is that engineers, along with members of other professions and American citizens generally, were altogether unprepared either by interest or understanding to cope with the fundamental issues that, during the last two decades, underlay the emerging global conflict. Indeed, right up to Pearl Harbor, we as a people were incredibly unaware of our actual plight. Once war was upon us, engineers arose magnificently to the technical job it imposed. However, they are contributing little to the clarification of muddled thinking about the foundations of peace. As citizens who have been privileged by society to receive higher education, they should be in position also to take a leading hand with others so privileged, in understanding and clarifying and determining action upon those political and social issues on which the future peace, freedom, and prosperity of the country depend.

The second lesson of the war is that the engineering profession found itself near complete paralysis when there was need for unified action on matters of common concern in connection with the war effort. As a member of the Engineers' Council for Professional Development for six years, during the last three of which I was chairman, I had first-hand experience in this matter. The problem was of course not new. The practical inability of the several branches of the profession to act in a common cause is traditional; merely, the fact that they could not effectively unite for common action in war indicates the depth of the malady. Their tradition of isolation is understandable in light of the history of the successive beginnings and independent growth of the several branches of the profession. But the world moves on; change is inevitable, even in the engineering profession. While I make no predictions as to the specific nature of the evolution of the profession, especially of its organization, I do venture to predict that there will be—must be—change in point of view. The engineering profession must rise to a new level. That is our lesson from the war.

The Means: Proper Engineering Education

Engineering education is the primary source from which this rise must spring, and the Society has taken steps to vitalize that source. One of the first official acts of your president last fall was the appointment of a Committee on Engineering Education after the War under the chairmanship of Dean Hammond. The spirit, purpose, and unanimity of view of this large, representative committee have been most gratifying, and a general session of this convention will be devoted to its report. I hope I may solicit your interest in this report and in doing something about it at once in your respective institutions. I regard as very great the importance of establishing a clearer picture of the profession and of the professionl man we are attempting to educate, and accordingly of the general requirements of his education. I know there can be little enthusiasm for the fundamental revision of engineering curricula recommended in the committee's report unless there is a new vision, comparable to that of the committee, of what a member of the engineering profession should be. I therefore venture to outline such a picture.

In the first place, I must raise the old question, What is the engineering profession ?

Need of Defining the Profession

Thought on this question is extremely confused. To mention one evidence, the E.C.P.D. Committee on Professional Recognition after some ten years of futile effort to establish criteria of recognition, gave up this direct line of attack and turned to the engineering colleges in the hope of developing in the new generation a reasonably clear professional purpose—a professional consciousness and like-mindedness—that the present generation of engineers does not have. Engineers are objective and clearheaded on their *work,* but when it comes to defining their field, their professional relationships, their specific educational programs, this distinguished quality seems to vanish!

The two primary reasons for the confusion need hardly be reiterated. The first is that engineering graduates have entered many fields beyond those directly related to their engineering studies—for example, general management in business and industry, commercial work, accounting, and so on *ad lib.* We are all familiar with the ill-advised view that since engineering training has made success possible in these fields, they should be regarded *as* engineering when pursued by engineers. I could recommend as a hobby of rich possibilities the collection of adjectives now associated with the word "engineering"! This loose thinking confuses what an engineering graduate *may do* with what engineering *is.*

The other primary reason for confusion is the no-man's land between professional and sub-professional activity. There is no line of demarcation. And the confusion, already bad enough, has been greatly increased during the war. A high-school graduate learns in an Engineering, Science, and Management War Training course how to carry out a specific routine of test or calculation, and *ipso facto* becomes an engineer!

What Engineering Is

Let us try to clarify some of this confusion. Are there any firm grounds on which we can stand in indicating what, fundamentally, distinguishes the engineering profession from others and from the body of non-professional technicians? I think there are, but before I undertake a suggestion, let me confess to one of our handicaps. A struggle which I have myself experienced and discerned in others is trying to think through this problem without being bedeviled by such questions as how one's ideas if adopted would affect membership in engineering societies, or engineering enrollment, or the importance of one's particular course. I believe, however, that we can be realistic about such practical matters and yet proceed with a clear purpose; I am certain that we should do so.

In beginning such procedure, we must draw some general boundary lines. I certainly would not lay undue emphasis upon a legalistic approach, but there are a few simple criteria for a professional group that are, I believe, essential for our purpose and also rather widely acceptable. They are as follows:

1. that its members shall have acquired an organized body of higher learning;
2. that they serve their clientele by the application of that learning;
3. that they control a system of professional education and strive continually for its improvement;
4. that they share a common purpose and method of service and a common code of conduct with respect to each other and to their clientele.

Then I would add a fifth:

5. that they serve their country by expert counsel in their field, by participating as civic leaders in community enterprises, and by forming intelligent judgments on political issues and then actively supporting them.

I believe these points are not inconsistent with the thoughtful pronouncements by President Wickenden[1] and Dr. Bush[2], who are engineers, by Abraham Flexner[3], a student of higher education, and more recently by Dr. Robert S. Lynd[4], professor of sociology at Columbia University—with all of which pronouncements I assume you are familiar.

To these five criteria for professions in general, we must add one that will identify the profession of engineering. I realize that at this point we enter highly controversial grounds. After studying numerous definitions in which attempts have been made, for one purpose or another, to bound the field of engineering, I would suggest the following modification as both essential and sufficient *for our purpose:*

> Engineering is the art, based primarily upon training in mathematics and the physical sciences, of utilizing economically the forces and materials of nature for the benefit of man.

This definition will be criticized as too narrow: it should include organizing and managing men, social responsibilities, etc. But remember: other people and other professions as well as engineers have responsibilities in these areas. We are not trying to state everything a member of the engineering profession may conceivably do; we are trying rather to suggest broadly those things that distinguish him from other professional men. For our purpose we need do no more, but if we are to get anywhere with our present task we must do at least that.

If we accept these six criteria for the engineering profession, we are in position to be more specific as to its differentiation from other professional and quasi-professional groups whose work touches or overlaps engineering.

What Engineering Is Not

Consider a few examples. Take the engineer, a member of the engineering profession, who manages a business or a large industrial enterprise at top level where the functions are *general* management, or who runs a bank or accounting firm. Is he practicing engineering? Is the lawyer who does the same things practicing law? I think we need not labor that question further. The engineer is still an engineer, the lawyer is still a lawyer, but neither is practicing his profession.

What, then, is he practicing? It may or may not be a profession. It is if it meets the criteria—a body of higher learning, a common purpose and method, a common code. For example, there is unquestionably an emerging profession of business and industrial administration, but it has not yet arrived. Indeed, its development seems far behind that of engineering. Meantime those professional people like lawyers and engineers whose fields and methods are related to some of the basic requirements of professional management have found satisfaction and success in these management fields. A professional engineer in such management is practicing a quasi-profession, but it is not engineering. Let me repeat: we must not confuse what an engineer happens to do, with what engineering is. This point has fundamental significance when we are considering engineering education. We should not, I venture to suggest, sacrifice essentials in engineering education for courses in general management and thus have neither fish nor fowl.

The engineer's particular qualification for management is his method—the engineering method. But the engineer has no monopoly on that method—the method of a carefully calculated plan based upon principle and fact. It comes near to being mere professional common sense. Certainly one finds scientists, physicians, and businessmen who use it. However, it deserves the name, because the engineer has demonstrated its power; he has *always* used it; he has become its symbol. And therefore wherever, as in management, such a straightforward, rational approach is effective, those engineers, who in their stride can learn the necessary new subject matters outside engineering, become successful.

However, there is a kind of management that *is* engineering. It is, obviously enough, the management of engineering operations, involving the engineering executive whose decisions rest upon the professional qualifications we have defined—decisions, in other words, that a lawyer or businessman is not competent to make. Included in such management is the supervision of industrial production. Passing judgment upon the specification, design, and cost of machine tools together with other aspects of a production plan, and controlling the flow of materials and products, certainly fall within the scope of engineering as we have defined it, just as does the making of such a plan. Engineering education should therefore recognize such management *as* engineering.

[1] "The Second Mile," *Engineering Journal*, pp. 111-114, March, 1941.
[2] "The Engineer and His Relations to Government," *Electrical Engineering*, pp. 928-936, August, 1937.
[3] *Universities*, Oxford Press, pp. 29-31, 1930.
[4] *The New York Times*, March 18, 1944.

The Sub-Professional Group

Turning from such distinctions at the professional level to the boundary between professional and sub-professional levels, we may, I think, draw this important line of demarcation by two ideas. One has already been mentioned: that the members of the profession must have acquired "an organized body of higher learning." This, I take it, means educational progress at least up to the level of the baccalaureate degree. The second idea is that the engineer's work is characterized largely by rational processes, whereas sub-professional work is characterized largely by rule-of-thumb methods. These distinctions are educationally most important.

All of these boundary lines and distinctions are intended to afford a basis for outlining an adequate picture of a member of our profession, and thus for outlining what his education should be.

The Engineer: A Cultured Man

In that picture I see an educated man who can take his place in the community among members of other learned professions; who has *mastered* the essential "body of higher learning" that underlies his profession including a live knowledge, sufficient for good citizenship, of the world in which he lives; who has learned to think critically and constructively in terms of that knowledge; who has mastered the engineering method; who has cultivated to the utmost his creative talents; who has a professional consciousness and lives by it; who has traveled The Second Mile; and who plays the part of a leader in civic affairs. That is the kind of man we should visualize when we are planning engineering education after the war.

Needless to say, one would scarcely hope to see all engineering graduates achieve such full stature any more than the medical profession can hope to see all of its members achieve top stature, but I am nevertheless proposing that engineering education should set as its main task the planning of programs whose purpose would be to cultivate such professional men and therefore such a profession. Those who would achieve something less than such a full stature would yet be professional men whose education had at least laid the right kind of foundation.

If we accept the picture here outlined, we are in position to indicate the primary requirements with respect to which any program in engineering education should be tested. In the first place, has the "body of higher learning" been clearly defined and does the program lead toward its mastery? Secondly, is the "engineering method" in its broad sense clearly formulated and its cultivation carefully planned for in all phases of the program? And finally, are there definite provisions for developing a "professional consciousness"? My purpose is certainly not to write the answers to these questions, for I believe they are appropriately answered in broad outline in the Report of Dean Hammond's Committee. I wish merely to indicate a few personal opinions regarding them.

Primary Educational Requirements

The stumbling block is the "body of higher learning." I wish that some wise providence might cleanse our souls when we sit as designers of educational programs. Why, if our purpose is the cultivation of an intellect, do we feel under such irresistible compulsion to clutter the student's mind with an impossible tonnage of inert, undigested subject matters? We tend to include everything to the limit only of the student's time and endurance, and certainly at the cost of unfortunate sacrifices in thorough understanding and in the art of constructive use of the knowledge he does acquire. I wish to submit a practical suggestion as to how subject matters may be intelligently limited.

It is to define specifically the *essential* body of technological learning underlying the branch of engineering concerned. As tests for defining it, I would suggest three criteria:

1. it should include the fundamental ideas, principles, and basic facts underlying the field and be limited largely to these and to materials involving their direct application;
2. it should be limited to what can be thoroughly understood;
3. it should be limited largely to what will be *used* later by the student in a *planned* curriculum, or in post-graduate or post-college study.

A similar procedure is of course also called for on the humanistic-social side.

Then I wish to submit a thought or two regarding the cultivation of method. This is educationally the crux. Intellectual power, not merely routine skills and memorized facts, is the primary end. Acquisition of subject matter without a cultivated intellectual method of applying it to practical situations is educational sterility. Such method and power are characterized by efficient intellectual approach, by the ability to relate ideas to situations. A few components are:

(a) resourcefulness in identifying relevant data, in distinguishing the important from the trivial;

(b) ability to analyze a practical situation in terms of principle and to draw rational inference;

(c) resourcefulness in inventing means to an end;

(d) capacity to distinguish between a verified generalization and a doctrine or policy, between fact and opinion;

(e) habit of thorough understanding;

(f) capacity for making value judgments;

(g) ability to organize thought, to relate ideas logically, and to express them well in writing or speech.

Planning the Educational Procedure

These qualities do not appear spontaneously; they must be cultivated. The colossal and tragic blunder in education today takes rise from the fallacious assumption that a mind crammed full of subject matter will automatically become a cultivated intellect. One sees at the low end of the scale in educational procedure an instructor pouring out words to passive students; at the high end, the students taking the active part under the guidance of an instructor who realizes that the student's business is to learn to understand and think and do according to a carefully constructed educational plan thoroughly understood by the instructor. Any curriculum or individual component of it that is planned without primary emphasis on the cultivation of powers and qualities mentioned above represents a vital sacrifice imposed upon the student in the interest—of what? I can think of only one thing: the outmoded educational tradition of yesterday.

Let me urge with all the force I can a shift in emphasis in educational planning from subject matter to intellectual method, from cramming to constructive thought, from the talking instructor to the active student. Let us plan to cultivate precious intellectual qualities and thus give the students what they have the right to receive.

In Summary

My purpose here has been to focus the attention upon our inescapable responsibility—the cultivation of a renaissance in the engineering profession. I have tried to show that the profession must rise to a new level, must become more closely knit, and that engineering education must bring it to this new estate. But this undertaking is hopeless unless we are much clearer on what should constitute the engineering profession, unless we have a correspondingly clearer picture of what the individual member of the profession should be and therefore of the kind of education that will produce him. We cannot develop such a profession and still continue to regard engineering as everything an engineer may do and to gloss over civic responsibilities. Hence I have suggested boundary lines for the profession, tried to establish a picture of the ideal professional engineer, and to outline his educational requirements.

The Report of the Committee on Engineering Education after the War points the way in education, and the cooperation of the Engineers' Council for Professional Development and the Society for the Promotion of Engineering Education committees according to a definite plan approved by both bodies affords the means for developing professional interest and understanding. Moreover, the E.C.P.D. Committee on Canons of Ethics is, after years of patient study, struggling toward a formulation acceptable to the whole profession. So the profession is trying to be reborn. I hope that we, as engineering educators, shall accept the opportunity now before us to take the lead in professional education, and lay the foundation for a genuine engineering profession that must, sooner or later, inevitably come, and that would contribute significantly to a prosperous and secure America.

Editor's Note:—A summary was published, on page 314 of the May *Journal*, of the conclusions of the report of the Committee on Engineering Education after the War, referred to in the above article. The report in full appears in the May issue of the *Journal of Engineering Education.*

DISCUSSION ON

THE DESIGN OF THE SHIPSHAW POWER DEVELOPMENT

A paper by H. G. Acres, M.E.I.C., presented at the Fifty-Eighth Annual General Professional Meeting of The Engineering Institute of Canada, on February 10th, 1944, and published in the April 1944 issue of *The Engineering Journal*.

Dr. Earl Blough[1]

The Shipshaw Background

In discussing Dr. Acres' paper I shall leave the engineering features to others and will confine my remarks to the background and circumstances under which the management and executive officers of Aluminium Limited made their decisions. At the time Aluminium Limited acquired the water rights on the Saguenay river, now known generally under the comprehensive name of Shipshaw, the aluminum industry was just beginning to emerge from a worldwide depression. In addition, there were the distant rumblings of war, the nature and consequences of which could not then be foreseen. With this situation in mind I will present to you a series of dates on which decisions were made and, in order to keep before you the world conditions at that time, I will quote headlines current in North American newspapers on or about those dates.

On January 1, 1938, Aluminium Limited purchased from the Alcoa Power Company through a subsidiary, the Aluminum Power Company, all the lands, water rights and other assets situated on the Saguenay river or contiguous to the Shipshaw river. The world situation as of that date was as follows:

> "New Dealers thunder against big business.
> Shantung invaded. Tokyo apologizes.
> Says President Roosevelt, in connection with new battleship building program, 'World events have caused me growing concern... In the world as a whole many nations are not only continuing but are enlarging their armament program... Facts are facts, and the United States must face them.
> Germans gibe at American failures. Says Baron von Neurath, 'The Reich is pleased with its foreign diplomacy.'
> Lord Halifax's visit to Germany fails to ease tension."

In the year 1937 we sold approximately 42,000 metric tons. As a measure or yardstick of the significance of the amount sold at that time, our capacity for producing today is 500,000 tons per annum. No one, in his wildest flight of fancy, could have foreseen the demands that were to be made on ourselves and the other producers in the immediate years to come. However, we had acquired the properties and, while we had no expectations for their development in the near future, we felt that we should have some concept as to what to do with the properties at some time in the future if we were ever called upon to develop them. No adequate study had been made as to location of powerhouse, canals, tailraces and other elements of the project.

On March 6, 1940, after a considerable discussion running over the preceding months, we employed Stone & Webster Engineering Corporation to make a study of the hydroelectric power properties on the Saguenay river. The study was to include the proper ultimate development of the water power available at the Chute-à-Caron project on the Saguenay river, from tidewater near the mouth of the Shipshaw river to tailwater of the Isle Maligne plant.

As of March 6, 1940, eight months after the European war had begun, the situation of the world, as envisaged in the headlines, was as follows:

> "Sumner Welles visits Europe. He finds Germany not ready for peace. Berlin uses his visit as an

[1]President, Aluminium Laboratories Limited; Vice-President, Aluminium Limited; Director, Aluminum Company of Canada, Limited.

occasion for putting forth Nazi hopes of victory over British. Berlin seeks to end rift with U.S.
Italy fumes at Britain.
French tighten war rules: food restrictions and labor adjustments."

On November 28, 1940, several months after the completion of the Stone & Webster report, world affairs had developed to the point where it seemed as though we should take a further step and proceed to design a project for partial installation on the basis of completion later. On that date, our company employed Dr. H. G. Acres to design a power plant, utilizing the waters of the Saguenay river and embodying, so far as practicable, the recommendations of Stone & Webster.

On November 28, 1940, the situation of the world, from the headlines of the newspapers, was as follows:

"The New Order expands: Hungary joins the Axis.
Rumania signs alliance with Axis.
The Luftwaffe over the Midlands and bombing Birmingham.
British defense needs dominate U.S. policy.
London thinks invasion still is chief threat.
R.A.F. bombs Duisburg-Ruhrort.
Hitler pushes effort to organize Europe.
Fear of Japanese felt by Filipinos.
U.S. defense program entering construction stage."

By May 15, 1941, it became apparent that work must start. At that time, in order to make maximum speed, an oral contract was entered into with the Foundation Company of Canada, Ltd., to begin work at the earliest possible moment.

On May 15, 1941, the headlines say:

"The British shot down 33 planes while hundreds of Nazi bombers batter London. Bombs wreck House of Commons, unroof Abbey, hit British Museum.
Luftwaffe over Liverpool.
Rhine cities, Berlin and Hamburg attacked by R.A.F.
Japanese, in new tone, talk of peace with China.
Japanese see U.S. blocking disposal of war with China."

Within two weeks, by June 1, 1941, the Foundation Company had begun the assembly of construction equipment. By that date,

"President Roosevelt proclaims an unlimited national emergency. U.S. Army and Navy heads for positive action.
German battleship *Bismarck* is sunk.
Nazis take Crete.
Singapore ready for attack."

On September 28, 1941, the construction equipment was assembled and the actual work of construction began. Then,

"The Nazi ring tightens around Leningrad and Kharkov.
Nazi victory seen by Vichy official.
R.A.F. batters Cologne and Amiens.
29 Italian ships sunk this month."

On October 14, 1941, the definitive contract was signed with the Foundation Company, at the time when,

"Nazis drive towards Moscow. Hitler goes all out to beat the Russians.
Hard facts restrain the Japanese. Common sense traits of the people are more in evidence."

On November 24, 1942, less than a year after Pearl Harbor, the first power unit was placed on load. The headlines read as follows:

"Laval indicts U.S., sees hope in Nazi victory.
Allied pincers close on North Africa.
Heavy R.A.F. raids on Italy.
Japanese routed at Guadalcanal.
Spain seems firm in her neutrality. Argentina gives signs of a change of heart."

On December 24, 1943, thirteen months after the first unit took its load, the twelfth and last power unit was placed on load. At that date the newspapers state:

"Continuous bombing of Hitler's Europe. Emphasis on reducing German industry in the Reich and in occupied countries.
U.S. and British fliers hit 'rocket gun' coast.
Allies take mountain in Italy.
The Appenine front.
Eisenhower appointed invasion commander."

Such, in brief, were conditions—both economic and political—that confronted our management from the time of the acquisition of the properties to the completion of the last power unit. The interval between January 1, 1938 and December 24, 1943, witnessed a development of the use of aircraft in warfare not only beyond the comprehension of the layman but even beyond the concept of military leaders. We are proud of the part we played in preparing to meet the conditions which faced our countries, and we have been able to do this only because we have always taken a long-time view of the industry—without, of course, pretending to predict what particular conditions, economic or political, would be met in the future. It has been our policy to prepare for any future needs or emergency with, developed and undeveloped, adequate reserves of ore and power.

When undertaking the construction of the Shipshaw project under the conditions that I have explained, the company set forth three basic conditions which must be met by our own people, by the engineers and by the contractors.

The first and dominant condition which had to be met was speed, speed, and more speed.

The second condition was that, insofar as materials were available—and they have been available—nothing must be sacrificed as to design or quality.

The third condition was that, in spite of speed and in the face of the difficulties of securing materials promptly, the whole project must be a credit to the engineering profession but also to the architectural profession. It is our opinion that all these conditions have been met, so that today the Shipshaw project stands as an excellent example of engineering attainment in the year 1943.

Walter Griesbach, M.E.I.C.[2]

POWERHOUSE CONSTRUCTION

The design of the Shipshaw power development was such that it presented no unusual construction difficulties, with the exception of the powerhouse substructure and other work in that immediate vicinity.

As explained by Dr. Acres, it was expedient to locate the control section at the centre of the powerhouse, and the problem was to complete that section and a unit adjacent to it, first; and at the same time to have all other work sufficiently advanced to provide for the flooding of the tailrace and the delivery of power from the first unit on November 20th, 1942.

A 70-ft. steel trestle, with a two-boom derrick

[2]Chief Engineer, The Foundation Company of Canada, Limited, Montreal.

traveller operating along the longitudinal centre line of the substructure, and 3 ft. above the generator room floor level, served the purpose. The trestle was provided at deck level with truck runways on either side, and the concrete was delivered at this level clear of all work being carried on at the lower levels.

Further details are included in the paper covering the construction of the Shipshaw power development, published in the April 1944 issue of *The Engineering Journal.*

F. L. Lawton, M.E.I.C.[3]

The engineering profession is greatly indebted to Dr. H. G. Acres for his masterly presentation of the design philosophy behind the Shipshaw power development. No doubt due to space limitations and Dr. Acres' own engaging modesty, he has neglected to mention several elements which would be most helpful in visualizing the overall picture.

While the make-up of the overburden at the site of the several dams has been described, virtually no indication of the nature of the ledge rock has been given. Could Dr. Acres not discuss this briefly?

I believe Dr. Acres might, with justification, have devoted some time to the design and removal of the tailrace plug which so greatly facilitated the excavation in the powerhouse and tailrace area, which was carried out to the extent of 98 per cent or more, in the dry.

Power Transmission Design

Some may have wondered why no mention was made by Dr. Acres of the step-up transformers, high-voltage circuit breakers and transmission lines. The explanation is these were designed and constructed by the Aluminum Company of Canada, Limited, as part of the Arvida aluminum works' expansion programme, it being the customary procedure in the aluminum industry to provide transmission facilities as part of the aluminum plant. Brief mention of these facilities will be helpful.

The unit system was adopted, each 13.2 kv. generator feeding a bank of three single-phase 30,000 kva. transformers, connected to its own 154 kv. transmission circuit, through a high-voltage breaker and disconnecting switch, the transmission circuits being carried in pairs on steel towers.

In connection with the closed ventilating system adopted for the generator units, it would be well to stress the effect of cleanliness on stator winding temperature rise, even in an area where the atmosphere is relatively clean, as in the Saguenay. A thin coating of oily dust can increase the temperature rise 8 to 10 deg. C., or decrease the capacity of each of the generators some 8,000 kva., for the same temperature rise, a total of about 100,000 kva. for the station.

J. A. McCrory, M.E.I.C.[4]

The record that was made in the design and construction of Shipshaw is one chapter, and a very important one, in the story of the Aluminum Company's race against time. At the outbreak of the war it was recognized that aluminum was probably the most urgently needed of the critical war materials. The steps that were taken to mobilize the power resources of the province of Quebec in order to supply the rapidly expanding plant at Arvida prior to the bringing into production of Shipshaw is another chapter in that interesting story which I hope will one day be written up in its entirety. Bits and pieces have appeared in various publications from time to time and when the whole account is co-ordinated it will, I think, constitute a record of accomplishment of which the engineers of Canada can well be proud.

Dr. Acres, in the brief acknowledgements at the end of his paper, very modestly omits any reference to the engineers who designed this development and co-ordinated its construction. To organize and carry out this part of the work in the limited time available and to arrive at so well balanced a design was an accomplishment no less outstanding than its actual construction. There could have been little time available for the consideration and reconsideration, the checking and double checking so dear to the hearts of many engineers.

Tunnels Superior to Penstocks

Of the many interesting details in connection with this design there are three that appeal to me particularly. First is the provision of tunnels instead of penstocks between the intakes and the powerhouse. The maintenance staff will, I imagine, if they ever think of the matter, always be thankful that steel was a critical material and that under a bombing attack tunnels would be less of a hazard than penstocks. Even where these factors need not be taken into consideration the advantages of tunnels over exposed penstocks in reduced maintenance charges and freedom from trouble due to extremes of temperature would offset the comparatively small differential of cost.

Welded Scroll-Cases and Connections

The second item that appeals to me is the provision of welded scroll-cases and their tunnel connections. It is difficult enough to make hydraulic structures water tight without introducing additional points of leakage in the seams of riveted scroll cases and connections which are to be buried in the concrete. A number of years ago we tried to overcome this difficulty by means of caulk welding but without success. Some of the light fillet welds at the seams cracked under the expansion and construction that took place before the water was turned in.

Water Cooling of Generators

The third point in the design that I particularly like is water cooling of the generators. The same considerations that Dr. Acres notes as leading to the decision to provide water cooling for the generators at Shipshaw led us in 1938 to adopt this method of cooling the generators at La Tuque* and we have been very well pleased with their operation. We also found, as he did, that the cost of housings and cooling coils was almost entirely offset by the elimination of other provisions for ventilation that would have had to be made in the powerhouse structure.

Cutting Back Turbine Blades

The reference that Dr. Acres makes in his paper to the improvement in the performance of two of the Shipshaw turbines by cutting back their blades is very interesting. I have known of similar attempts to improve the output of turbines having been made with less satisfactory results. It is particularly interesting to note that in the case of Unit No. 9, in which both the inlet and the outlet edges of the buckets were cut back, an improvement was obtained in efficiency as well as

[3]Assistant Chief Engineer, Aluminum Company of Canada, Limited, Montreal.

[4]Vice-president and chief engineer, Shawinigan Engineering Company, Montreal.

*See *Engineering Journal,* February 1941.

in the output at full gate. I would have expected that the increase in output would have been obtained at a sacrifice in efficiency.

Forrest Nagler[5]

Shipshaw: World's Largest Prime Mover Plant

The subject matter of the paper presented adheres distressingly to facts. I feel that Dr. Acres, in his modesty, overlooks a lot of colour, and I would like to add a few comparisons. I believe that Shipshaw is capable of being classified as the largest prime mover plant, either hydraulic or steam, in the world today. Boulder Dam alone, by taking into account the powerhouses on the two opposite sides of the river—in two different states, by the way—has a greater installed capacity. The two Boulder plants last year developed between five and six billion kilowatt-hours, and reached a peak output of 1,049,000 kw. Corresponding figures of the half-completed Shipshaw were over three billion kilowatt-hours and the entire installation can carry over 1,000,000 kw. In a normal year, Shipshaw is capable of over six billion kilowatt-hours. There are very few plants in the world which may boast units larger than those at Shipshaw. Boulder and Grand Coulee are outstanding in this respect, with units capable of delivering up to 150,000 hp., but under so much higher heads that the physical dimensions of the hydroelectric equipment are smaller than those of Shipshaw. All these units have steel shafts about 40 in. dia. —quite a sizable steel sawlog. Incidentally, some multiple steam units go up to 200,000 capacity. We recently started a single unit for Commonwealth in Chicago of 150,000 kw. capacity.

[5]Formerly, during the period of Shipshaw construction, chief engineer, Canadian Allis-Chalmers, Limited, Toronto, now chief mechanical engineer, Allis-Chalmers Mfg. Co., Milwaukee, U.S.A.

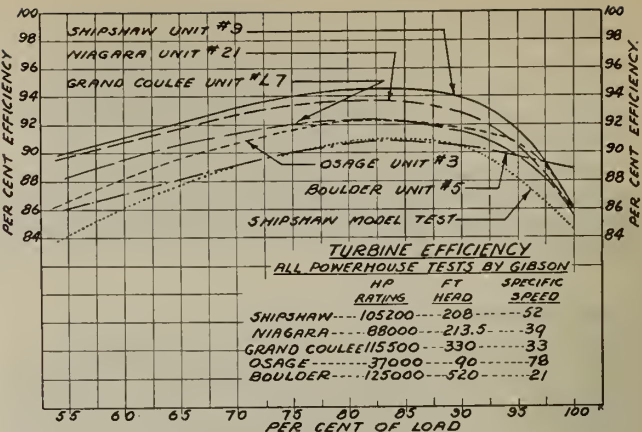


Fig. 1—Comparison of efficiency test results on various turbines.

—PROGRESS RECORD—

100,000.H.P. CAN. ALLIS-CHALMERS HYD. TURBINES. {208 FOOT HEAD; 16'-0 CASING INLET DIA.; 202" GUIDE VANE BOLT CIRCLE.}

—FOR—

ALUMINUM CO. OF CANADA. SHIPSHAW. QUE:

ITEM.	APPX. NO OF MEN.	UNIT NUMBER 7	8	10	9	5	6	4	3
DISCHARGE RING & DRAFT TUBE RECEIVED		ON HAND JULY.5-1942	ON HAND JULY.5.1942	SEP.2.1942	OCT.23.1942	JAN. 1943	MAR.16.1943	MAR.27.1943	APL.7.1943
SPEED RING "		"	AUG.2	SEPT. 26	NOV.27	FEB.24	MAR.20	JUNE 7	JULY 13
SPIRAL CASING "		"	AUG.2	SEPT. 27	1ST CARLOAD DEC.11 LAST CAR 2 WKS LATER	MAR.15	APL.1	MAY. 24	JULY 21
DISCHARGE RING & DRAFT TUBE ERECTION STARTED	10	JULY 17	JULY 28	SEPT. 3	OCT 23	APL. 8	APL.10	APL. 6	MAY. 12
SPEED RING ERECTION STARTED	12	JULY 23	AUG 3	SEPT. 27	NOV. 27	APL. 14	APL. 19	JUNE 7	JULY 13
CASING ERECTION "	12	JULY 24	AUG 5	SEPT. 28	DEC.11	APL.15	APL.20	JUNE 9	JULY. 23
CASING FITTING "	12	JULY 24	AUG 14	SEPT. 28	DEC.11	APL. 16	APL. 21	JUNE 9	JULY. 23
CASING WELDING "	22	JULY. 27	AUG 14	SEPT. 29	DEC.11	APL.16	MAY. 5	JUNE 10	JULY 23
WELD TESTING & INSPECTION	2	JULY. 27 SEPT. 16	AUG. 14 SEPT. 22	SEPT. 29 NOV. 4	DEC. 11.1942 JAN.27.1943	APL.16 MAY. 14	MAY. 5 JUNE.1	JUNE 10 JULY. 12	JULY. 23 AUG. 21
SPEED RING WELDING STARTED / COMPLETE	16	AUG. 11 / AUG. 14	AUG 29 / SEPT. 1	OCT. 18 / OCT. 21	JAN. 6 / JAN. 10	MAY. 1 / MAY.3	MAY. 14 / MAY. 16	JUNE 22 / JUNE.24	AUG.4 / AUG. 6
CONCRETE POUR STARTED	5 DAYS 5 NIGHTS	AUG. 19	SEPT.5	OCT. 27	JAN. 18	MAY.7	MAY. 21	JULY. 5	AUG.12
GOVERNOR & GOV: PIPE INSTALLATION STRT'D / CMPL'D	12	OCT. 9 / OCT. 22	OCT. 24 / NOV. 16	DEC.3.1942 / JAN.31.1943	FEB. 2 / MAR. 18	MAY 31 / JULY 6	JUNE 26 / AUG 26	JULY 26 / OCT. 15	AUG.30 / NOV. 13
TURBINE ERECTION STARTED / COMPLETED	12	SEPT. 24 / NOV. 3	NOV. 3 / NOV. 24	JAN. 13 / JAN. 31	MAR 1 / MAR 23	JUNE 11 / JULY. 9	AUG. 10 / AUG. 26	OCT. 9 / OCT. 27	NOV. 6 / NOV. 18
UNIT STARTED		1.27. A.M NOV. 23-42	10.15 P.M NOV.25-42	10.30. A.M FEB 1-43	9.15 A M MAR.25-43	1.40 P.M JULY. 14-43	2.40 P.M AUG.31-43	8.07 P.M OCT. 29-43	2.49 P.M NOV. 21-43
DAYS WORKED		90	74	73	90	68	78	75	72
WELDING ROD USED. LBS PER MAN HR.		4050.lbs 1.34	3700 1.45	4390 1.18	4864 1.51	3145 1.77	3195 1.76	3205 1.94	3350 1.77
WELDING. MAN HOURS		3006	2551	3754	3208	1770	1798	1652	1883
						← THIN PLATES →			

Fig. 2—Field erecting and welding schedule on eight turbine units.

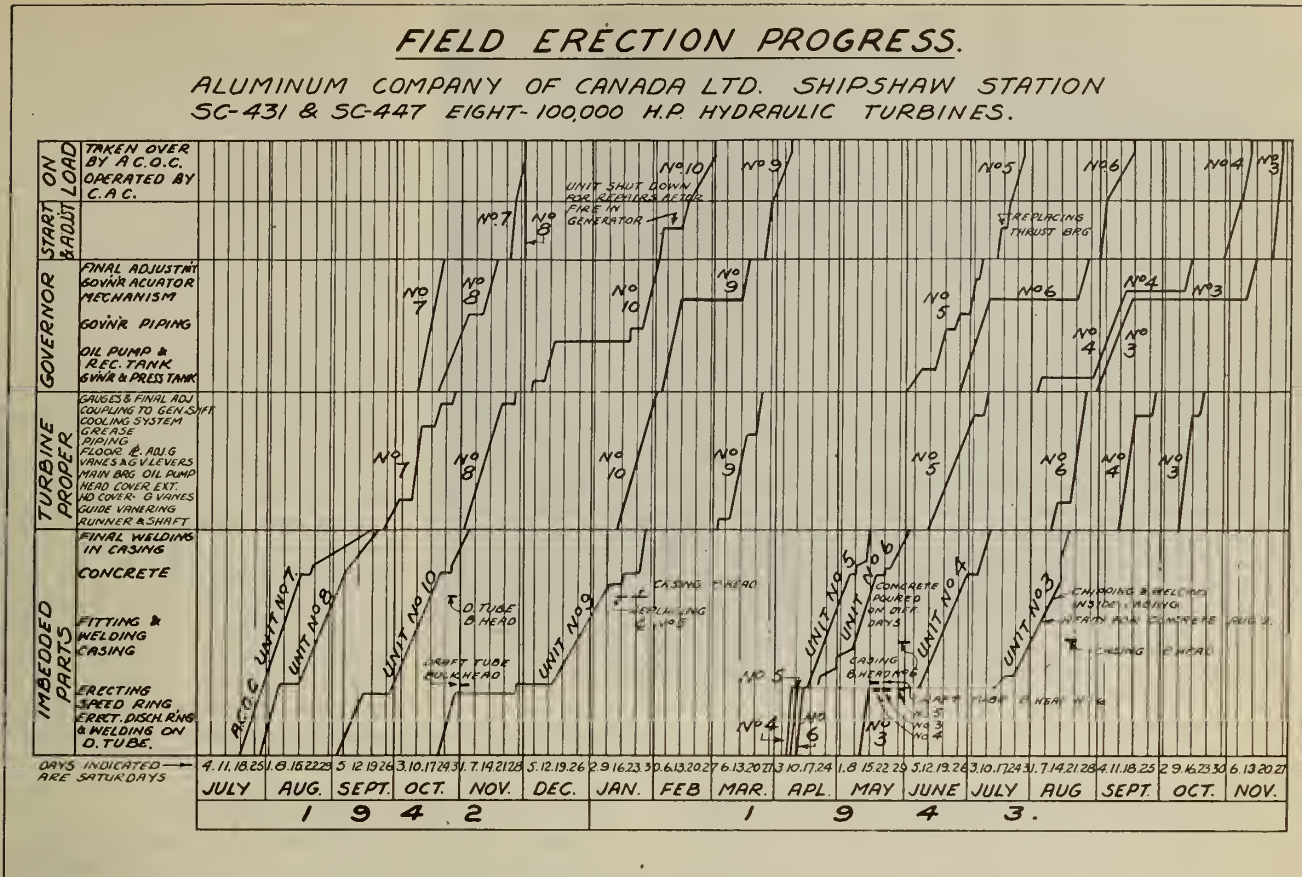


Fig. 3—Chart showing the field erection progress on the turbines.

Water Wheel Efficiency

The Shipshaw conditions are practically ideal for maximum water wheel efficiency. The tests show what we believe to be the highest efficiency ever measured on a major hydro plant. Figure 1 represents an interesting comparison of many of the largest modern units. All have been tested by the same method, the Gibson test. The Niagara unit, which for long was the most powerful in the world, was developed for maximum efficiency over twenty years ago under the utmost incentive, both in dollars and competitive pressure. It reached a maximum efficiency of 93.7. Shipshaw, of almost exactly the same head, and nearly the same capacity, reaches 94.5. This is a fair measure of a twenty-year progress. Hydraulic turbines for higher and for lower heads show uniformly less efficiency. Boulder and Grand Coulee are the flatter or lower speed types of runners for higher heads; and Osage is brought in to show a higher speed type for lower heads, such perhaps as will ultimately suit the St. Lawrence development.

The dotted curve at the bottom of Fig. 1 shows the remarkable parallelism between results obtained on a small 14-in., 100 hp. test runner under about 100 ft. head as a basis for predicting performance with as big a step-up as is involved in going to 100,000 hp.

Field Welding of Turbine Casings

Dr. Acres emphasizes deservedly the extent to which welding was utilized in fabricating the turbine casings. This has been the most complete application of this method to turbine casings and has shown amazing benefits to rapid field construction and smooth casing outlines. Figure 2 shows a complete field erecting and welding schedule on the eight Allis-Chalmers units. Significantly, the entire casing assembly and welding ranged from two to four weeks, and averaged about three. All welding was done under extensometer and test-bar control. The former controlled locked-up stresses and eliminated stress-relieving by controlled peening. The latter was dominated largely by impact testing of sections cut daily from the actual welds of every man. A general requirement of 30 ft. lb. (Charpy) was demanded. I know of no other field welding job that ever met such stringent requirements. Deposited weight of weld rods ranged between one and two pounds per man per hour total elapsed time.

Figure 3 shows graphically the progress of the different portions of the hydraulic turbine erection. The rapidity and uniformity obtained on such large construction is a splendid tribute to the team work of the entire organization. The welded construction of casings is shown in Fig. 4 and Dr. Acres' Fig. 10, which illustrates the flush type of joint obtainable with welding. The resulting benefit to smooth flow is reflected in the high efficiency performance.

Turbine Runner

The runner, which is probably the very heart of the entire development, is shown in Fig. 5. Originally designed for the specific speed of about 47, its capacity, as outlined by Dr. Acres, was raised by every means possible to provide quickly a maximum output for aluminum production under war demands. This modification has not resulted in any difficulty from the standpoint of efficiency, vibration, or general regulation. Slight traces of pitting have been noticed in units that have been running wide open over a year, but it is not of such magnitude as to give any concern or that would not be invited in a normal commercial plant to achieve saving by higher generator speed.

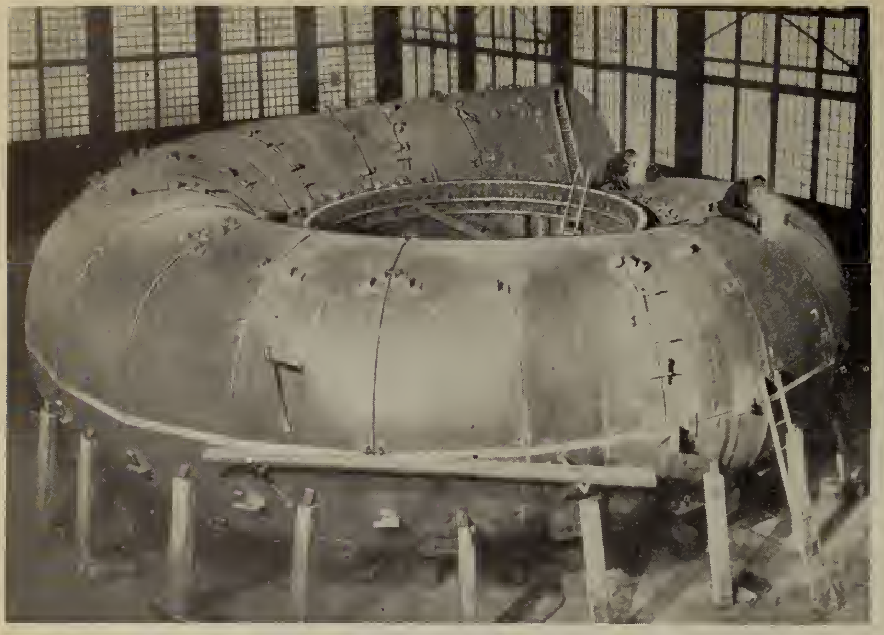


Fig. 4—Shop erection view of all-welded plate steel spiral casing for 90,000 hp. hydraulic turbine.

J. F. Roberts, M.E.I.C.[6]

Design of Water Passages

As the manufacturers of the water wheel equipment which has shown such a high efficiency under the Gibson tests, naturally we are proud of the record, but in justice to Dr. Acres and his staff we feel that part of the credit for the excellent efficiency performance is due to the design of the water passages leading to the wheel. An examination of the setting shows that the penstock supplying the wheel is practically horizontal and without bends or curves for a long distance upstream from the spiral casing. The only possible source of disturbances to the water flowing to the turbine is in the Y-pipe and the vertical bend upstream of the Y-pipe, and these are sufficiently far away so that any possible disturbance is ironed out before it enters the turbine proper. Our experience indicates that such an intake adds greatly not only to the maximum efficiency performance of the wheel but also contributes greatly to the freedom from vibration and disturbances which sometimes occur in turbines. It is gratifying that in the Shipshaw turbines there appears to be no critical loads or gate openings where disturbances or rough operation might make it desirable to avoid operating.

Draft Tube

A second feature which contributes to the excellent performance of the turbines both as to efficiency, quietness and smoothness of operation is the draft tube. These draft tubes are of the square-heeled elbow type which our company has long advocated and on which we have had particularly good success. It differs materially from the long radius elbow draft tube now used so extensively by other manufacturers and which is similar to that advocated by the European designers. This particular type of square-heeled elbow draft tube was used with success at Grand Falls, New Brunswick, Outarde Rapids and Abitibi Canyon as well as many other large and moderate size Canadian installations. The Shipshaw draft tubes have a vertical length from the centreline of the distributor to the bottom of the draft tube of 44 ft. 6 in. which with a runner discharge diameter of 13 ft. 8 in. gives a length ratio of 3.26 times the runner discharge diameter. The horizontal length of the draft tube from the centreline of the unit to the downstream wall of the powerhouse is 49 ft., giving a length: diameter ratio of 3.6. The free width of the draft tube including one central pier is 47 ft. 0 in., giving a width ratio of 3.44 times the runner discharge diameter. These ratios are liberal but the performance speaks for the desirability of such liberal ratios. If it were possible to use such ratios in plants having large Kaplan type turbines we feel that improved results could be obtained with the Kaplan turbines, but with large diameter Kaplan turbines necessarily set several feet below tailwater the excavation costs usually run so high that some sacrifice in performance must be made in order to bring the overall installation within economical limits.

Tests on Model Runner

On page 232 of his paper, Dr. Acres shows in tabular form the efficiency and horsepower output of Units 8, 9, and 10, Unit 8 having the original runner as designed without modification. A 14-in. model of this runner tested in our experimental laboratory under a head of 120 ft. showed a maximum efficiency of 92.4 percent. According to the Moody formula correcting only for the diameter ratios and neglecting the head ratio, this model should show an improvement of 3.5 per cent when stepped up from a 14-in. diameter to a 163-in. diameter. The horsepower of the model was 5 per cent above the guaranteed maximum output of 85,000 hp. or 89,200 hp., and allowing even a 2 per cent increase in discharge opening to allow for casting variations on the larger unit, a strictly homologous runner would have developed only 91,000 hp. Actually, Unit 8 delivered 96,600 hp. or an increase of about 6 per cent above the model test. This would indicate that the field installation would show from 2½ to 3 per cent higher than the model test, or approximately 94.8 to 95 per cent. As pointed out by Dr. Acres, it was impossible to check the piezometer locations and the length and diameter of the penstock on Unit 8 by field measurements before the Gibson tests were run. Therefore it is possible that the 92½ per cent based on computed volumes and areas may be too low and a value of between 94 and 95 per cent may result when accurate measurements are made. This would check more closely with the Moody formula increase and with our expectations based on a 6 per cent power increase of the field installation over the model. Our conclusions based on our model tests would indicate that Unit 8 should show comparable results with Units 10 and 9, both of which showed over 94.4 per cent.

Specific Speed of Turbines

The specific speed of the turbine as covered by the original contract at a rating of 85,000 hp. under 208 ft. head and 128½ rpm. is 47.5. This specific speed com-

[6]Manager, Hydraulic Department, Allis-Chalmers Mfg. Co., Milwaukee, Wis. Formerly, hydraulic engineer, Power Corporation of Canada, Montreal.

pares favourably with conservative practice during the last ten years. Unit 10 with an output of 101,360 hp. actually shows a specific speed of 52, and Unit 9 with an outputof 105,160 hp. shows a specific speed of 53. These latter values are well above any previous experience curves for plants operating at around 200 ft. head. The Outarde development placed in operation in 1938 operating under a rated head of 208 ft. has a specific speed of 42.7 or five points below that of the Shipshaw turbines and ten points below the actual capacity of theincreasedShisphawturbines. The original turbines installed at Chute-à-Caron under a head of 165 ft. had a specific speed of 56.5 or only three points above the actual specific speed of the increased Shipshaw turbines for 43 ft. lower head.

Fig. 5—Lowering the turbine runner into place.

The centreline of the Shipshaw turbines is set at Elevation 39.0 and the throat of the runner is at Elevation 37.5 or 6½ ft. above normal tailwater at Elevation 31. This gives a σ value of 0.1275 which is normal for a turbine of this specific speed at this head. Under these conditions when developing 85,000 hp. the vertical discharge velocity from the runner would be about 29.5 ft. per second average, corresponding to a velocity head of 13.8 ft. When developing 105,160 hp. the discharge velocity would be increased to 35.5 ft. per sec. and the velocity head in the discharged water increases from 13.8 to 19.6 ft. of head, or an increase of almost 6 ft. in the velocity head in the water when discharging from the runner. In order to maintain the original margin of safety for pitting and cavitation the increased capacity runner should therefore be set about 6 ft. lower than the original runner developing its rated capacity of 85,000 hp. This is in line with accepted practice which requires higher specific speed runners to be set closer to tailwater, they naturally having a higher σ value. Actually, of course, all the units are set at the same elevation and therefore the vacuum on the increased capacity runners when operating wide open is about 6 ft. greater than originally planned. Naturally this cuts down the margin of safety and under these conditions some cavitation and pitting on the runner is to be expected. The entire freedom from serious vibration and cavitation noises even at the greatly overloaded conditions indicates, however, that this cavitation will not be serious and it is expected that after the urgent demand for power is over, the units will be operated the greater part of the year at their normal or best efficiency rating instead of at full gate. This of course will further decrease the velocity through the runner and will materially reduce the pitting and cavitation.

All-Welded Spiral Casings

To our knowledge, the Shipshaw development is the first installation to go into service where the spiral casings are of the all-welded construction. At the Shipshaw plant, all of the plates in the spiral casing were field welded both to each other and to the cast steel speed ring sections. No stress relieving or annealing was done. Our company has two other installations in operation where the casings were shop welded to the speed rings and then the entire casing and speed ring were stress relieved before shipment to the field. Two of these units rated 103,000 hp. at 330 ft. head are in operation at the Bureau of Reclamation's Grand Coulee dam on the Columbia river in the State of Washington. The field joints on these casings were held together with riveted buttstrap joints but all the shop joints were of the welded construction similar to the Shipshaw units. Welded casings were also used on the four casings for the 50,000 hp. units installed in the Pit River No. 5 plant of the Pacific Gas and Electric Company near Redding, California. These casings of considerably smaller diameter were made in two parts only and the joints were provided with welded steel flanges drilled for field bolting so that the field work on those casings consisted only of bolting these two halves together just as though they had been steel castings. It is gratifying to note that, at the Shipshaw installation, no trouble has occurred to date with the field welding, and it is anticipated that many future plants will be built using the field welded construction.

Comparable with the Shipshaw turbines, our company is now building some 91,500 hp., 330-ft. head welded steel casings for the Fontana dam of the Tennessee Valley Authority to be located on the Little Tennessee river in North Carolina. These casings will have the plates shop welded to the speed ring joints but the five major field joints are to be field welded after which the entire casing is to be subjected to a hydrostatic pressure test under 371 lb. per sq. in. before the concrete is poured around it. The original intention was to field test the first Shipshaw casings, but field tests were omitted because of the lack of time and because an examination and tests on the field welding indicated that such tests were not necessary. Experience has confirmed the soundness of this decision.

H. R. Sills, M.E.I.C.[7]

In offering this discussion of Dr. Acres' paper, in particular reference to the generators, I propose to confine my remarks to a few of the novel features of the design that were incorporated in these generators;

[7]Assistant A. C. Engineer, Canadian General Electric Company, Peterborough, Ont.

Fig. 6—Nearly completed generator with some of the hatch covers lifted off to work in the interior of the machine

a generator has the same basic advantages as a square design of any house or building; it can be made of standard structural shapes and flat sheet; the operations are those of shearing, bending and welding; the fitting is relatively easy and adjustable (the use of flashings, and clamp type joints eliminated 80 per cent of the bolts with their attendant fitting). The field erection proved to be as quick and easy as the shop assembly, which was very welcome as there was no time for fussing.

As the design was being worked out (in the Canadian General Electric machines) it appeared possible to incorporate provisions for rapid and easy access to the electrical parts of the machine which, in most enclosed machines, are rather difficult to get at. The top of the housing is divided into nine squares. The centre one supports the exciter; the others are removable; one section next to the gallery contains the stairway to the thrust bearing deck and the platform to the exciters; the remainder are hatch covers that drop into the troughs in the edge of the openings and can be lifted out without any unfastening, completely exposing the operating parts of the interior (Fig. 6). The removal of the corner hatches uncover the surface coolers which can be cleaned by removing their top head covers in position or serviced by unbolting them from their opening in the housing and lifting them out. Steel ladders are provided in the vertical air ducts in the corners from the hydraulic floor to the top of the generator frame, the inside of the machine is painted a light cream and illuminated so that it is possible to climb up into the top of the machine at any time, whether the machine is running or not, and see what is going on. It is not necessary to remove the top hatches for this.

namely, the square housing, the ventilating system, and the provisions for rapid inspection and repair.

Square Housing for Generators

The square housing was used because it provided the best solution of several vexing problems, not that its appearance was widely acclaimed, which would hardly be the truth. In order to meet the erection schedule, the order for the generators was divided between the Canadian General Electric Company and the Canadian Westinghouse Company; the machines to be delivered alternately as fast as the foundations could be provided for them. As the outward appearance had to be alike, and as the mechanical structure and proportions of the generators offered by the two manufacturers were beyond compromise, the simplest solution was to cover them all in with a similar housing that would be adaptable to either design. The square housing proposed in the GE design was used as the basis, as it was largely supported on the floor and required only four support points on the generator. A common level and location for these supports could be set up, together with the distance across the flats of the housing, and the general machine design proceeded with, inside these limits, independent of the housing details.

The virtue of the square housing was that, on the whole, it seemed to provide the best solution of the powerhouse problems, and, incidentally, appeared to be the easiest to build and erect; moreover it required the minimum of steel which was rather critical at that time. The powerhouse problem was to take care of 150,000 to 200,000 cu. ft. per min. of cooling air per machine with the machines at 54 ft. centres; to arrange to exhaust it out of the powerhouse or recirculate it as the season demanded; and to provide room for the necessary station auxiliaries. The square housing and the closed ventilating system took care of it with a 36 ft. square housing covering a 33 ft. diameter machine. I understand that the saving in eliminating a station air duct system went a long way in paying for the enclosing housing and coolers.

From the manufacturing angle, a square housing for

Ventilating System for Generators

In order to provide the utmost in accessibility no shrouding was used over the winding end connections to enclose the fans, thus the top and bottom ends of winding and the inter-polar spaces are open at all times for inspection. The ventilation system used in order to do this is, I believe, novel in this type of machine. Instead of cooling the machine by the customary way by mounting fans on the end of the rotor to blow air into the space between the poles and so out through the stator ducts, the greater part of the cooling air is supplied to the stator ducts through ducts in the rim of the rotor feeding the interpolar space and then directly into the stator ducts. In this way the air entering the stator ducts is at the same temperature throughout the core and so the temperature throughout the core and coils is very uniform; the average temperature and the maximum temperature nearly coincide. Scoop type fans are provided at the ends of the rotor to ventilate the ends of the winding and to prevent recirculation of the air (see cover picture). The volume of cooling air was 50 per cent more than the quantity required to limit the temperature rise of the air to the desired value of 18 deg. C. Moreover all this air passed out through the stator ducts, none of it around the end windings. The kilowatts power required to force this volume of air through the stator duct resistance (approximately five inches of water), is comparable to that listed in the handbooks for a spiral cased fan against a similar head. Thus, while the actual efficiency in circulating this volume of air is higher than we have been able to attain heretofore, the amount is excessive. On a temperature basis, the machines are capable of 30 per cent more than their rating though not on the basis of their mechanical and excitation characteristics. So, while the low temperature rise of less than 40 deg. C. promises almost infinite life of the windings it would appear to be an uneconomical margin; however, it is pleasant to have a problem of surplus ventilation and too cool operation; it can be readily rectified. It seems probable that this efficiency can be largely attributed to the flow in the high velocity part of the cooling circuit being almost entirely radial and that, by means of special slot wedges, the kinetic energy of the air, in the form of velocity, is maintained in that form and is directed, with minimum turbulence, from the rotor to the stator ducts. At the moment there is not enough data to do more than generalize, but it is interesting to note that the stator ducts and duct entrances were scoured clean after a year of operation under conditions that deposited nearly a barrel of dirt in the inside of the rotor rim. If it should prove that this method of ventilation does have self-scouring characteristics with regard to the ventilating ducts it will be a valuable contribution toward maintaining constant temperature rises in machines over a considerably longer operating period.

Provision for Inspection and Repairs

To provide a means for more rapid replacement of stator coils than the customary one of dismantling the generator and removing the rotor, the field coils and poles were designed so that they could be readily disconnected at the top; the pole keys pulled out by the crane, and the rotor poles lifted out by the same means (Fig. 7). The stator coil or coils are removed by heating an adjacent span of coils electrically to soften the insulation, removing the slot wedges, and pulling the span out into the gap left by the withdrawn poles and then lifting out the damaged coil or coils (Fig. 8). The new coils are installed by reversing this process. With the protection usually afforded to the modern generator by means of split phase relaying and high speed removal from the line and quick extinction of the excitation in combination with the relatively incombustible nature

Fig. 7—Interior of the generator showing how a pole may be removed after the hatch covers are lifted off.

Fig. 8—Interior of the generator showing the replacement of a stator coil.

of modern Class "B" insulation, it was anticipated that the majority of such failures as might occur in the machines would be limited in extent. It came to pass that a coil did fail, and the working time required to make the replacement was approximately 56 hours. It also confirmed the prediction that the damage would be limited; it did not extend beyond that due to the arc itself, and the flames from the gases generated by the heat of the arc went out of their own accord, without the use of extinguishers, shortly after the arc was killed.

No. 9 Durite Babbitt for Thrust Bearing

Of timely interest may be the fact that one of the thrust bearings is babbitted with No. 9 Durite, an arsenical lead base babbitt containing only about one per cent tin. The operating charactertistics are indistinguishable from the others having the standard 8.3 per cent tin base babbitt. The co-operation of the Aluminium Laboratories in assisting in making this full scale test of the characteristics of this alternative babbitt is gratefully acknowledged. It substantiates the experience already obtained on a smaller thrust bearing, and in general application of this babbitt in journal bearings.

The Author

Closing Remarks

The invitation to Dr. Blough to open this discussion was nothing short of an inspiration.

Shipshaw was a great project, and great events led inevitably to its consummation. Dr. Blough has devised an original and striking means of accentuating this fact, and his chronological summary of headline events since 1938 creates a background that imparts colour and substance to a subject which would, otherwise, have been circumscribed by the usual technical limitations.

Mr. Griesbach has chosen, for his brief comment, a single feature of the construction programme which was outstanding in its contribution to construction speed, and to a sequence of operations which ensured a comparatively smooth flow of construction procedure in the critical powerhouse area.

This trestle, which Mr. Griesbach himself devised, made it possible to proceed simultaneously with the excavation work in the powerhouse area and the tunnels, and the open hatchways and run-arounds on the elevated floor made it possible, later, to place substructure concrete simultaneously with the installation of the main units in the previously completed portions of the substructure.

The substance of Mr. Lawton's discussion can be answered in a general way by reference to the prefatory note and to the final paragraph in the paper, as published.

As explained, space limitations made it necessary to carefully select the elements of design which, in combination, would cover the scheme as a whole in reasonably intelligent perspective, and leave the amplification of these elements to be covered by subsequent papers.

For instance, Mr. Griesbach's paper on the construction features of Shipshaw covers in detail the procedure relative to the removal of the tailrace plug, and a paper now in course of preparation will cover not only the hydraulic design of the tailrace, but the hydraulic design of the scheme as a whole. The same statement applies to the electrical features mentioned by Mr. Lawton.

The discussions of Messrs. Nagler, Roberts, Sills and McCrory comprise an impressive combination, representing as they do, in natural sequence, the expert authority of the turbine designer, the generator designer, and the large-scale engineer-operator. To properly appreciate these discussions, they should be read as a single document, because they constitute, as a group, a more valuable contribution to current technical literature on hydroelectric power development than the original paper, and the author is honoured in having instigated them.

The relationship between these four discussions is illustrated by reference to the four points brought out by Mr. McCrory; namely—tunnels, as compared with exposed penstocks; welding of scroll-cases, penstocks and tunnel liners; water-cooling of generators; and turbine performance.

For instance, Mr. McCrory's preference for a tunnel instead of steel penstock water connections, from the standpoint of operation and maintenance, is supplemented by Mr. Roberts' statement that the tunnel design contributed appreciably to the efficient performance of the turbines, as evidenced by the official tests.

Again, Mr. McCrory's discussion of the advantages of welded scroll-cases and penstocks from the standpoint of the operating engineer is supplemented in a most interesting way by Mr. Nagler's and Mr. Roberts' discussion of the advantages of welding from the viewpoint of economics and turbine efficiency.

And again, Mr. McCrory's emphatic endorsement of re-circulated water-cooling for large generators is supplemented and amplified by Mr. Sills' valuable discussion.

Finally, in the matter of turbine performance, the rather surprising results of the efficiency tests, as alluded to by Mr. McCrory, are discussed at length by both Mr. Nagler and Mr. Roberts.

As to the welding procedure, Mr. Roberts mentioned that no stress-relieving was done at Shipshaw in the ordinary sense of that term. Mr. Nagler mentions, however, that in lieu of stress-relieving by the normal process of heat application, the alternative of unusually close laboratory control and the similarly closely controlled supervision of peening have given satisfactory results.

As to turbine performance, essential factual evidence is lacking in connection with two items only; the first being the lack of check measurements of the penstock and piezometer locations of No. 8 unit, and the second being the lack of evidence to the incidence and progress of pitting. The measurements on No. 8 unit can be obtained at some convenient time and the test results corrected, if necessary, but authentic evidence relative to pitting will be forthcoming only with lapse of time. As related to this latter condition the record of the original units placed in operation in the winter of 1942-43 do not constitute a fair criterion, because they operated continuously at full-gate; whereas under normal operating conditions, relative to available water supply, their gate opening at the point of best efficiency will not be that which is necessary to provide the normal rating of 85,000 hp., and their susceptibility to pitting should be associated with this operating condition.

From the background of his own personal experience, Mr. McCrory fully appreciates, and has been kind enough to express his realization of the anxiety and strain to which the designing staff of H. G. Acres & Company had been subjected in the process of producing working plans which almost literally had to be delivered to the job to-night in order to be available for construction next morning. As a matter of fact, a number of elevations and assembled cross-section drawings were not completed for months after the plant commenced commercial operation.

PLANNING NOW FOR POST-WAR CONSTRUCTION PROJECTS

A Brief Presented by The Engineering Institute of Canada to the House of Commons Committee on Reconstruction.

NOTE—Early in 1943, K. M. Cameron, then the president of the Institute, appointed a committee under the chairmanship of Warren C. Miller of St. Thomas, Ont., to study the post-war problems as related to engineers. This committee, with representatives right across Canada, examined the problem from many angles to see what the Institute could best do to help.

Eventually, it was decided that already enough proposals had been made to Parliament so that the urgent need was not more proposals but rather emphasis on the need of doing something about some of them.

The committee prepared the following brief which, after acceptance by Council, was submitted to Mr. J. G. Turgeon, M.P., chairman of the House of Commons Committee on Reconstruction. Readers will note that it is very short, concise and to the point. It is much more difficult to prepare a short report than a long one, and the chairman deserves just credit for this excellent example of brevity and logic, supported by clear argument and emphasis.—Ed.

This brief is submitted on behalf of The Engineering Institute of Canada, an organization incorporated by the Dominion of Canada many years ago and composed of professional engineers of all kinds, civil, mechanical, electrical, chemical, mining, metallurgical, etc., in all fields of activity, industrial, public service, and consulting. It operates twenty-five branches from coast to coast and provides a sound cross-section of the opinions and views of professional engineers throughout the Dominion.

It is generally recognized that when the present hostilities conclude, a great volume of private and public construction projects will be required to provide employment for demobilized service men and industrial workers, during the transition from war to peace economy. It has been suggested that approximately five hundred million dollars might be required for the first post-war year. On the assumption that for every $5.00 spent on construction, $2.00 will go to "on site" workers and $3.00 to those in factory, forest, mine, transportation, and office, and assuming the average normal earnings and hours employed per year, a programme of this magnitude would provide work for over 150,000 "on site" workers alone, as well as for over 225,000 others.

We appreciate that no programme of construction projects can by itself restore balance to the national economy. Such a programme, however, can be a powerful factor provided it forms part of a comprehensive scheme comprising as well monetary and taxation measures designed to stimulate industry and expand private enterprise. It is inconceivable that in the publicly financed part there should be a return of the methods of the early thirties when to meet the sudden demand for employment, hurriedly initiated and consequently ill considered projects were undertaken. These projects from their very nature brought little or no return in the form of worthwhile service to the community and were to a small extent or not at all, self-liquidating. It is also essential that effective use should be made of modern and economical construction methods in carrying out the programme. The need therefore is not merely for a number of construction projects but for a programme of well selected, well considered and well planned works, both private and public.

In determining the merits of any particular project, consideration must be given to its technical and economic aspects. This is the particular field of the engineer. No works programme with a large volume of employment can spring into being overnight. Some time period is required for the completion of essential engineering work that must be done before excavation can start and industry move. Surveys must be made, sub-surface exploration carried out, the merits of various alternative schemes studied, and preliminary plans and estimates prepared before a report and recommendations can be submitted. This is the minimum amount of preliminary engineering necessary for any project.

The Engineering Institute believes that this preliminary work should be commenced at once. A number of engineers are now available with the completion of large war construction works. The cost will not be excessive and will be saved many times over by economies in the final cost made possible by careful study. In short, such early planning is a necessary expenditure if the projects are to be wisely chosen and effectively engineered. Some help and leadership will be necessary in carrying out this preliminary work and the Dominion Government is best able to supply it. Under the present taxing structure it is difficult for municipal and provincial governments to finance, in their entirety, their necessary expenditures now. Some form of grants in aid or advances from a crown company especially constituted for that purpose might be worked out for public bodies, while in the case of private corporations, such expenditures might be facilitated if the various taxing agencies concerned would give them appropriate consideration.

The Engineering Institute of Canada believes that what is planned now will, in a large measure, determine what will happen in the immediate post-war period. What we have suggested, is, we believe, vital to the successful bridging of the gap between war and normal peace economy.

The Engineering Institute of Canada therefore submits that:—

1. A properly studied programme of construction projects should be made available for the immediate post-war period to assist in the restoration of the national economy to a normal basis and that every encouragement should be given to preparation for a period of expansion and change in the immediate post-war years involving construction projects by both private and public organizations.

2. Appropriate measures should be taken now to insure that these projects are advanced as closely to the state of actual construction as is right and possible under war conditions so that there will be no delay in providing the required employment when and where required. These projects, both private and public, should have the benefit of sound engineering study and analysis before adoption and these engineering studies should be commenced now.

3. Appropriate measures should be taken by the Dominion Government to facilitate and finance these studies in the case of public projects and to facilitate them in the case of those to be carried out under private auspices.

All of which is respectfully submitted.

The Engineering Institute of Canada.

Warren C. Miller, M.E.I.C.,
Chairman of Committee on Post-War Problems.

June 2, 1944.

THE MACHINING OF CANNON

MAJOR E. G. MOFFAT
Assistant Works Manager, Watervliet Arsenal, Ordnance Department, Watervliet, N.Y., U.S.A.

Paper presented at a joint meeting of The American Society of Mechanical Engineers and The Engineering Institute of Canada, at Toronto, Ont., on September 30th, 1943

While the machining of cannon is not unlike other heavy precision manufacturing, many problems do exist which are unique in this type of work. For instance, in the finish boring of a 16 in. gun, a hole sixteen inches in diameter with an excellent finish must be bored to a depth of more than 65 ft., with a minimum of runout and bore reduction. Equipment and methods now in use enable us to perform this operation producing a bore with a mirrorlike finish, a runout not to exceed seven thousandths in the total length, and with a tool wear or reduction in diameter of less than one thousandth of an inch.

In attempting to describe any problem as broad as this, in a limited time, it becomes necessary to divide the analysis into several of its major aspects, and to consider these briefly, and then to devote such other time as is available to the particular points in this process on which additional information is desired. I shall therefore outline the processes generally used in the five major divisions of gun manufacture which are: turning, boring, honing, rifling and hobbing. These processes are more or less similar regardless of the caliber of cannon involved, or whether or not the gun is of a built-up structure assembled by shrinkage, or whether it is of monobloc construction.

With the advent of high physical strength alloys, in recent years the trend in gun construction has shifted away from the fabricated structure toward the one piece design which, while simplifying and shortening manufacturing procedures, does demand changes in manufacturing equipment and methods because of the difference in machinability of high physical strength stock. The material used in gun construction consists chiefly of steel forgings or centrifugal castings usually machined first to about one-quarter to one-half inch of finished rough dimensions, and properly heat treated or coldworked to produce the desired physical properties. Yield strengths of from 65,000 to 80,000 lb. per sq. in. are required of tube material for guns which are to be coldworked. Guns manufactured of high physical strength material will have yield points in the order of 90,000 to 110,000 lb. per sq. in., and those made of super strength alloys will have yield strengths of 130,000 to 150,000 lb. per sq. in. Corresponding changes in hardness and other physical properties, of course, follow.

Turning

The external turning of cannon is accomplished usually on heavy engine lathes of the type generally used in commercial industry. The forgings as received are sawed to length, leaving about two inches over and above finished length, and, before setting up for external operations, are telltaled. The process of telltaling is merely a matter of exploring the rough bore in relation to the external dimensions in order that the forging may be chucked in such a way that both the internal and external surfaces will clean up in final machining. Telltaling is usually done by means of a pivoted exploring bar and indicator, and records of the location of the rough bore are taken at every lineal foot of the tube, and the final setting arrived at, which will permit clean up. Having arrived at the proper setting, spots are turned for the steady rest and the tube is spot bored at each end to accommodate expanding plug centers, which are used to mount the tube during its external turning. The external surfaces of the tube are then rough machined to the final contour. Standard methods are used incorporating the use of carbide turning tools which permit cutting at from 250 to 500 ft. per min., with an average feed of 0.025 in. per revolution, the depth of cut being from 0.10 to 0.25 in. On the extremely large cannon, limitations of mass prevent operations at these high speeds and this turning is done usually at from 10 to 30 ft. per min., and high speed or high carbon steel turning tools are employed.

Throughout the external turning, the tube is supported in steady rests which are equipped with antifriction roller bearing jaws, and the revolving centers used in the tailstock are also equipped with antifriction bearings. The tubes are rough machined to within approximately 0.20 in. of finish dimensions, this allowance being left to provide for runout that may occur in the machining of the bore.

Boring

Machines for boring of deep holes for cannon tubes, essentially consist of heavy duty engine lathes, in which the tail stock has been replaced by a supported boring bar, together with feed mechanism to advance it into the bore. The present trend is to use hollow spindle lathes which are much better adapted to high speed carbide boring operations than the older style boring lathes. The work is supported by antifriction roller steady rests as in external machining.

The forging is mounted in the boring lathe and centered up in the chuck, until it is mounted as telltaled so that the entire bore will clean up. The actual boring is accomplished by means of a packed reamer or bit. This reamer consists of a cast steel frame which is slightly smaller than the diameter being bored, and, at the front end, is equipped with devices in which are mounted two carbide-tipped or high speed steel cutters. Coolant tubes built into the body of the reamer conduct coolant from the hollow boring bar, under pressure past the cutters, thus flushing the chips out ahead of the cut. The reamer body is built up using either babbitt or oil-impregnated maplewood packings which are later machined concentric with the cutters. The function of this packing is to secure permanent alignment throughout the boring operations. In actual use, the woods or packing of a wood packed reamer are turned 0.010 to 0.015 in. larger than the diameter which will be bored by the cutter and hence, after the reamer has once been started in a pilot bore, uniform pressure from the compression of the wood fibers would hold the reamer to a true axial bore. Due to the limitations of friction and wear on the wood, it is not practical, in high speed boring, to use wood packing on reamers larger than 37 mm., and, for these applications, reamers built up with babbitt packing are used. Since babbitt is relatively noncompressible, these are sized only about 0.002 in. larger than the pilot bore and hence it is to be expected that slightly more drift will be experienced during high speed babbitt-packed reaming than with the low speed wood-packed reaming. Modifications of babbitt-packed reamers, using wood strips or wood inserts to take compression, have likewise been used on high speed reamers. Thus, deep hole boring is accomplished by means of accurately boring a pilot counterbore, which is on the true axis that is to be maintained, and if a packed reamer which accurately fits that bore is used, the deep hole can be bored with a minimum of runout. It is obviously necessary that throughout the boring operation, a given reamer must hold up and cut to its true size for the entirety of its course. Common practice on rough boring of large guns is to ream in half way and then to reverse the tube, reaming in half way from the opposite end in order that the runout will not be so great. However, on the finish bore, a single reamer traverses the full length of the tube. Pack reaming is done with cutting speed of about 180 ft. per min. and a feed of approximately 0.015 in. per revolution, the depth of cut varying with the application and becoming smaller on the final cuts. Approximately 0.008 to 0.010 in. is left in the bore for finishing operations by honing.

Honing bore of 8-inch Howitzer.

After the bore is complete, the powder chamber is bored using conventional boring methods, and is then machined to its finished profile by means of formed tool packed reamers. A pilot on the front of the reamer, which fits the bore just completed, is used to assist in preventing drift of the powder chamber reamer.

Honing

The technique of honing cannon bores was developed with a twofold purpose, namely, to improve the finish and thus lessen the responsibility of the reamer maker for producing a high finish, and second, as a more easily controlled method of bringing the bore to final size. This honing is accomplished in the conventional manner using hydraulically controlled stones moving in a rotating and reciprocating manner, thus producing a cross-hatch of cutting lines which yields a very fine finish. Throughout the honing process, the heat is conducted away from the stones and the tube, and the metal removed is washed away by a flow of cutting lubricant which is introduced under pressure through the opposite end of the tube. The honing machines used are of conventional design having the tube supported rigidly by steady rests. The machines have a stroke sufficient to pass through the entire length of the tube. The honing head is constructed of a hollow steel body, arranged with forward and rear pilots of serrated construction, with the stones arranged axially in staggered positions around the circumference. The stone holders are adjusted by means of expanding cones which, while controlled hydraulically, have a manual adjustment. Stones and holders are held to the expanders by means of helical spring bands. The head is driven through a flexible driver that permits the head to center itself in the bore. Finish is controlled by using different grades of stones, varying stone pressures and speeds.

Finish Boring Where Honing Impracticable

Because of limitations of equipment, the large caliber guns are not honed, and hence greater emphasis must be put into the final reaming operations. To secure the desired finish of the bore, finish boring is done at slow speeds, about 7 ft. per min., using a conventional packed reamer with two special bits. The finish bore is made in one cut, each bit removing approximately 0.050 in. of stock. The finishing bits, made of high carbon steel, are rectangular in shape measuring about 6 by 3 by 1 in. The cutting edge which has a total length of about 4 in. is divided into three zones, the breakdown, the approach and the sizing. The first or breakdown zone is approximately one inch long and is ground at an angle of 4 deg. and is used to break into the surface being cut. The second or approach zone is approximately three-quarters of an inch long and is ground at an angle of 2 deg. and is used to complete the cut to its full depth. The third or sizing zone, which is used to bring the cut to finish size, is approximately two and one-quarter inches long and is ground cylindrically. These three zones blend together to form one cutting edge. The cutting edge is lipped for its full length, using a three-quarter inch wheel, maximum depth of lip being one-sixteenth inch, with no land permitted. The cutting face of the bit is relieved by hollow grinding with a 14 in. wheel to give proper clearance and to facilitate stoning of the cutting edge.

Rifling

While, in every case, the rifling of cannon is accomplished by the broaching method, the details of the process will vary depending upon the size of the cannon. On the larger guns, the rifling is accomplished by pushing through the tube a rifling head which has a group of form cutters properly located to form the rifling grooves. The twist or pitch of the rifling is controlled by rotating the rifling head, as it progresses through the tube, by means of a key riding in a groove machined in the rifling bar and which carries the proper developed form of the rifling. On cannon having a non-uniform twist of rifling, the broaching is done in a special rifling machine on which the rotation of the head is accomplished by a rail adjusted to the developed form of the rifling and which, by means of gearing, rotates the head as it travels through the tube. At the end of a stroke, the cutters are retracted, and the head is moved back through the tube, after which the cutters are reset for

Grinding cradle surface on 8-inch Howitzer.

the following cut, and the process repeated. In this method of rifling, approximately one-third or one-half of the grooves are cut at one time, after which the head is indexed to broach the remaining grooves. On the smaller caliber cannon, i.e., 240mm. and under, the broaching of the rifling is accomplished on similar machines. However, a set of rifling broach cutters is used instead of a rifling head. The broaching head is constructed of a steel body with a cast iron sleeve acting as a guide. The forward end has a hardened steel pilot on which the broaching cutters are centered and keyed in place, so that proper alignment between the various steps of the broaching will be maintained. A set of rifling broaches may consist of from 15 to 35 cutters, each ground so that the full profile of the rifling groove is progressively attained with uniformly distributed depths of cuts. In this type of broach, all the teeth are cutting at one time, and the number of the broaches in a set will depend upon the depth and form of the rifling. The cutters are graduated in size so as to have an individual cut of approximately 0.002 in., the broaching being accomplished at an average speed of about 8 ft. per min., the speed varying with the size of the gun. On the smaller guns, having straight walled rifling, all the broaching cutters are designed to cut the full width of the groove. However, on the larger guns, especially those having tapered side rifling grooves, the first group of cutters parts the stock to the full depth of the groove after which the groove is widened and given the proper form.

Hobbing

The last major operation in the manufacture of cannon is the hobbing of the breech threads. It is assumed that, in finish turning, the breech surface has been turned to form the proper major diameter of this thread. The breech threads are made in several different methods, but the one in most common use at this time is that of using the thread milling machine. In this operation, the tube is chucked in the hollow spindle chuck, and the threads generated by means of a thread form hob. The spindle is geared to rotate at slow speed which acts to feed the work into the hob, and the carriage is arranged with a spindle which drives the hob at the desired speed, coordinated with a traverse, which in turn is synchronized with the work spindle, so that a thread is produced. Long hobs are spiral gashed and have staggered cutting edges to eliminate chatter and to improve the finish attained. The complete thread is made in from two to four cuts, depending upon the size of the gun. The job is operated at a speed of about 40 ft. per min. while cutting, during which time the work spindle will rotate one complete revolution, thus completing the thread for its full length. Climb milling is used, producing a better finish.

Secondary Operations

The remaining operations on the tube are minor in nature and include relieving the thread termination, sectoring the thread if the gun is of that construction, and milling extractor pockets, etc. Subsequent operations include careful inspection of each square inch of the bore and external surfaces, searching for defects in the metal, and in checking every controlled dimension.

We have covered the basic processes normally used in gun manufacture. Modifications to these have been, and are constantly being, developed. The extent to which modifications are introduced depends greatly upon the volume in which a given gun is being manufactured. For instance, in external turning, high production of certain guns has caused to be developed the use of multiple cutting tools, the feeds of which are controlled by templates so that the external profile of a gun is turned in one operation. Powder chambering is likewise done either by template controlled boring, or by template controlled internal grinding with a formed wheel, which finishes the powder chamber by the grinding method, rather than reaming, as outlined previously.

THE GANARASKA SURVEY

A. H. RICHARDSON

Chairman, Interdepartmental Committee on Conservation and Rehabilitation, Department of Lands and Forests, Toronto, Ont.

An article based on a paper delivered before the Toronto Branch of The Engineering Institute of Canada, on November 19th 1943

Deterioration of soil, due in a large measure to the removal of forest cover, has given rise to serious problems in many parts of Canada. In fact it is not sufficiently realized by our people how urgent the task of soil conservation really is. If the Ganaraska area in southern Ontario, which was settled in 1793, be taken as representing one of the older areas of Canada, then the picture is far from hopeful. Twenty years ago it was estimated that there were 8,500 sq. mi. of land in southern Ontario which was marginal or submarginal with respect to agriculture, and at the present rate at which remedial measures are being applied, it will take approximately 800 years to deal with the problem. It would be trite to say that such conditions are not improved by wishful thinking, but such an attitude is not much better than the one of "anxious inertia," which describes the present status of the conservation problem in southern Ontario.

Conservation is a term which at present at least is much overworked, therefore it would be appropriate at this point to state what is envisaged by the use of the term in this article as it is applied particularly to southern Ontario.

The renewable natural resources of any country, such as soil, including erosion and silting; water, including desiccation, floods, swamps and stream pollution; forest cover, both natural woodland and areas to be planted; wild-life and recreational facilities, form a delicately balanced system in which all parts are interdependent and therefore cannot be successfully treated piecemeal. The improving and rebuilding of such basic natural resources and their maximum use, not only for the immediate future but for succeeding generations, is the chief objective of the conservation programme. It was with this in mind that a group, later to be known as the Guelph Conference, came into being and urged the Dominion and Ontario Governments to take immediate action in the rebuilding of the country's renewable natural resources, by the use of post-war employment.

The Guelph Conference included in its personnel municipal officers, naturalists, hunters, fishermen, war veterans, foresters, agriculturists, biologists and teachers, and was a representative cross-section of the citizens of the province. Subsequently, representation was made to the Dominion Advisory Committee on Reconstruction and the Prime Minister of Ontario, with the result that the two governments agreed to collaborate in a sample or type survey. For this purpose the Ganaraska area was chosen because it presents most of the factors under consideration, in a comparatively small drainage basin. It is approximately 103 sq. mi. in area (65,911 acres) in Durham and Northumberland counties, and takes its name from the river which drains the area and empties into Lake Ontario at the town of Port Hope.

Settlement

Settlement commenced at the mouth of the Ganaraska as early as 1793 (the same year as the founding of the City of Toronto by Governor Simcoe) and therefore it may be considered one of the oldest settled parts of the province. In early times, before the coming of the white man, different Indian tribes had congregated at the mouth of the river, attracted by the wildlife, particularly beaver and fresh water salmon, which were so plentiful there. One of these villages was called Ganaraské, from which the river takes its present name, and "probably means," according to J. N. B. Hewitt, eminent authority on the Iroquois language, "at the spawning place." Later a fur trading post was established by Peter Smyth at this point, and, for many years, after, the river and the settlement were known as Smith's Creek. Settlement, however, soon fanned out from the lake and it was not long before several rural communities sprang into being, in what is now the good agricultural part of the watershed.

From 1837 to 1881, the population increased rapidly and during this period the rural communities, as well as Port Hope, reached a high mark which has not since been equalled. After 1881, due to the near exhaustion of timber and the fact that much of the land in the north was of poor agricultural quality, young people commenced to migrate from the area, with the result that the population (1861-1941) decreased one-half for the townships of Clarke and Hope, and several communities disappeared altogether, while those remaining are only skeletons of their former selves.

Forest Products

Throughout the history of the watershed, the forest has formed a "back-drop" for the whole area in its commercial and community life. Commencing with the export of masts for the Royal Navy, and squared timber for the British market, the products ran the gamut of all those and more with which we are familiar today. Lumber, chiefly pine, stood at the top of the list, reaching its maximum export in 1879 when fifty million feet was shipped from the harbour at Port Hope. Handmade shingle-makers, and later shingle mills, produced roofing for the homes in the area and for export. Cooperage for whiskey kegs and fish packages was carried on extensively. Fuel in great quantities was cut for the woodburning engines on the railway, and large quantities of other material were used for building plank roads, fencing and railway ties. Timber also was responsible for many small industries in the villages, around which the community life centred. These manufactured tools, utensils, furniture, vehicles, and building material of all kinds. The settlers also used the byproducts of the forest, such as maple syrup, tanbark and potash, for their own needs and for export in limited quantities.

Water

In all these industries, the river supplied the necessary power. As early as 1795, the first mill was built by Elias Smith and Jonathan Walton near the mouth of the river, and as settlement advanced northward, the area became dotted with dams and mill-ponds, until by 1861 thirty-six mills were in operation. Most of these were built as saw-mills, a few were grist-mills which supplied the settlers with flour and chop, a few were woollen-mills, and often two or more were combined, As the timber reached the state of near exhaustion.

and the population commenced to decline, many of the mills were abandoned, or in some cases were burned and not rebuilt, so that, today, mills on the river are few and far between—only eight being in operation for different purposes.

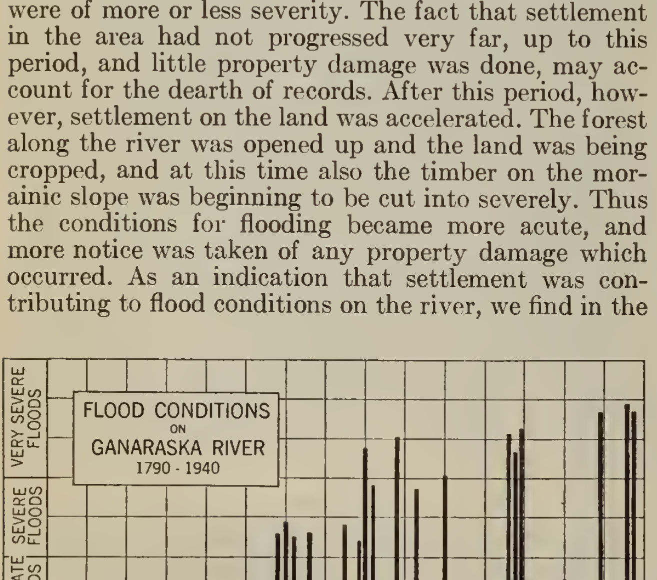
Early in the life of the settlement it was soon evident that a river of the character of the Ganaraska could cause destruction to, as well as assist in, community life. Since the middle of the last century the good people of Port Hope and the settlements lying immediately to the north have been visited periodically by disastrous floods. Each spring, and in fact following a few days' heavy rain, the fear of flood is uppermost in the minds of the townspeople.

When severe floods do occur, they always cause serious damage to property and to merchants' stocks in the business section of the town. During the flood of 1929, such damage was estimated at $250,000. The same year, the dam at Canton required repairs in excess of $20,000. Damage in other years was in proportion to the severity of the flood.

In securing information on floods on the river, no effort has been spared in searching out all available records which might have a bearing on this subject. The source for this material includes personal diaries, gazetteers, newspapers, meteorological reports, as well as conversations with people who experienced the floods.

The first flood of which there is any record occurred prior to 1813, as it is recorded that the log bridge on Walton street was washed out. Also, it is said that this freshet changed the course of the river, which previously was much wider at this point than at present, and to have disturbed the gravel bed which then existed, exposing the shale rock which is so evident at the present time. The record of this early freshet shows that sometimes, even when a countryside is covered with forest, floods do occur.

Unfortunately, no records of floods, from 1813 to 1848, had been found, although it is reasonable to assume that these occurred from time to time, and were of more or less severity. The fact that settlement in the area had not progressed very far, up to this period, and little property damage was done, may account for the dearth of records. After this period, however, settlement on the land was accelerated. The forest along the river was opened up and the land was being cropped, and at this time also the timber on the morainic slope was beginning to be cut into severely. Thus the conditions for flooding became more acute, and more notice was taken of any property damage which occurred. As an indication that settlement was contributing to flood conditions on the river, we find in the diary of Sarah Hill, who lived on the Duck Pond Branch, the first mention of muddy waters during a spring overflow about 1877, indicating, no doubt, that water was coming from cultivated land.



(Courtesy Canadian Geographical Society)

Fig. 1—Flood chart.

About this time, also, many dams were built on the river. Most of these were for local mill operation and impounded small areas of water. Such ponds would have had an ameliorating effect on small floods and at such times would have retarded the scouring and erosive effect of the river by checking its speed. They, no doubt, also improved summer flow in the river. However, considering the total acre-feet of all the mill ponds, it is doubtful that they would control the river to any great extent in times of severe flood. On the other hand, it is just possible that under certain circumstances the presence of so many dams and ponds on the river might have increased flood conditions lower down the river. These dams were all privately owned, and it is most likely that when the river commenced to rise, each mill owner, fearful that his dam might be washed out, would lift the logs in the dam, with the result that the volume of water going down the river would be increased.

In the town of Port Hope it is well known, too, that flood conditions have been aggravated due to the volume of ice coming down the river and forming a jam in the channel, or at some of the obstructions which occur along its course, within the town limits.

Space will not permit of reference to the forty different years, from 1813 to 1937, in which records of floods of varying severity have been given. The accompanying diagram, Fig. 1, describes graphically the frequency and severity of floods for which information has been obtained. Actually there is no scientific basis for severity as the quantity of water coming down the river has not been measured at any time. Reports are based largely on property damage and personal observation, and therefore allowance should be made for the personal judgment and volubility of the chronicler. However, from these records it is clear that floods did vary in severity; therefore, commencing with this known fact, an attempt has been made, based on an examination of the several reports, to group floods into four more or less arbitrary classifications, namely: very severe floods, severe floods, moderate floods, and sharp freshets.

The most serious damages resulting from extreme floods on the river, as already indicated, have been principally to properties in or near the town of Port Hope. In 1937, this municipality secured reports on flooding from two firms of consulting engineers, namely H. G. Acres and Company, and James, Proctor and Redfern. Both these reports emphasize the necessity of engineering works within the town limits, which consist chiefly of excavating in the channel of the river, a new spillway under the Canadian National Railway tracks, improvements to dams, and a new bridge at Walton street, at a total cost of $130,000. These works, or modifications of them, are decidedly necessary considering the flood situation as it is today. However, flooding within the town limits has a much wider significance.

The seriousness of the situation is not so much the fact that floods periodically occur in Port Hope, but rather that the beneficial effects of a great deal of this water are lost to agriculture, as it relentlessly and persistently carries away the topsoil of the land, thus lowering the purchasing power of the farmers and affecting the economy of the whole area. In other words, the silt which annually goes down the Ganaraska river is not just so much mud being dumped into Lake Ontario,

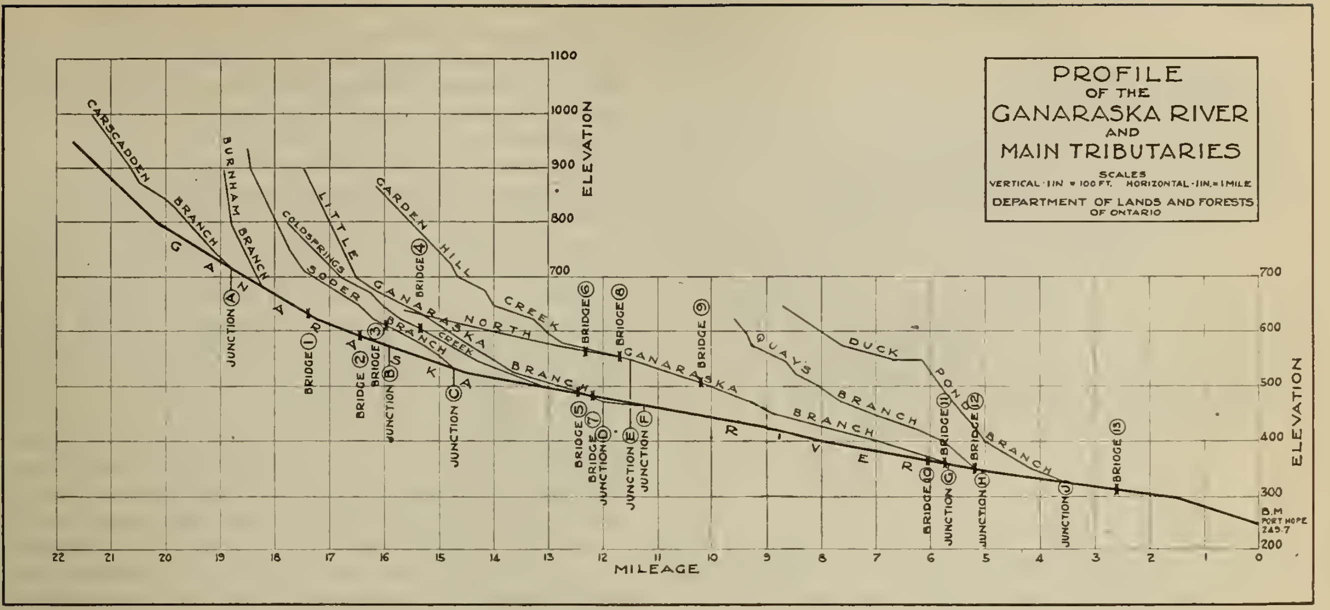


Fig. 2—River profile.

but is "the department stores, the banks, and the shops" of the town of Port Hope being wasted away. Furthermore, it is not beyond the realm of possibility that in two or three generations this town and others similarly situated may become ghost towns, unless steps are taken soon to control flooding, topsoil washing, and forest denudation.

Where a river such as the Ganaraska floods periodically, as indicated in the preceding paragraphs, it is obvious that silting also becomes a serious problem. While soil erosion is related specifically to the individual farm and it is here that in the aggregate most damage is done, nevertheless where farm land is related to a river system, such as the Ganaraska, with many of the fields sloping down to creeks which in turn feed the main river, the quantity of silting becomes serious. Early in the history of the watershed, reference is made to the river becoming muddy and this condition has increased in recent years. Today in the spring, or after a heavy rainfall, the Ganaraska is perceptibly muddy.

The amount of silt which is transported in this way, even by a small river, is enormous. One river which is comparable to the Ganaraska is the West Humber, above the village of Thistleton, with a drainage area of approximately 100 sq. mi. On March 17, 1942, when the river was in flood, Professor A. F. Coventry took measurements of the flow and the load of silt being carried down. At eleven o'clock in the morning the flow was 4,000 cu. ft. per sec. (earlier in the day it had been higher). If this rate of flow had continued for twelve hours, one-half of all the water that fell on the watershed would have been in Lake Ontario. The estimated amount of sediment was 2,400 tons an hour, a large part of which undoubtedly was topsoil from the surrounding farm land. Furthermore, the river at this point is liable to cease flowing entirely in summer.

The quantity of sediment coming down the Ganaraska has not been measured, nor has the composition of the sediment been analyzed, but considering the relation of agricultural land to the river, and by examining aerial photographs of the area taken in early spring, it is evident that an enormous amount of good topsoil, as well as other material, is carried down the river to the harbour each year. In reporting on this, C. C. Jeffrey, Senior Assistant Engineer of the Department of Public Works, Canada at Toronto, states as follows: "The materials dredged at Port Hope in 1936 consisted of sand; gravel; stones, which obviously came down the river; and debris of all kinds, such as an automobile chassis, stumps, logs, oil drums, tires and trees . . . Generally speaking, the materials dredged in the east slip and outer harbour are dark, being silt and clay mixed with sand. The materials dredged in the lake approach are mostly sand and gravel, light in colour. The amount of top-soil contained in this silting can only be estimated."

Dredging was first carried out in the Port Hope harbour in 1875. The records of that year do not reveal the necessity for this dredging, except that it was done to provide sufficient draught to facilitate navigation within the harbour. It is reasonable to expect, however, that with progress of land clearing on the lower part of the watershed, even by 1875 a certain amount of soil was coming down the river, particularly at flood periods, and silting up the harbour.

Maintenance dredging in the harbour has been carried on almost every year since then, and during the last eleven years for which accurate data is available, 226,813 cu. yd. of sand and silt have been dredged from the harbour; an average of 20,619 cu. yd. per year. It is of interest to note, in comparing the amount of dredging for these eleven years with the flood years, that the largest amount, namely 32,111 cu. yd., was taken out in 1936—the year of one of the severe floods. Regarding the work done in this year, Mr. Jeffery continues as follows: "I personally superintended dredging operations at Port Hope in 1936 when, in the early spring, the river caused considerable flood damage in the business section of the town, and large cakes of ice were carried on to the main street. The harbour shoaled up to a greater extent than usual; for instance, a bar was formed across the channel at the entrance to the harbour, having minimum draught of 8 ft.; this was due to an evergreen tree having been washed down the river and lodged at this point, indicating that silting from the river caused the shoaling of the harbour from the river mouth out to this point, amounting to 24,000 cu. yd. approximately, or 75 percent of the dredging. The other 25 percent of the dredging carried out was in the lake approach and might reasonably have come from the lake." "I am, therefore, of the opinion that it is safe to say that 75

Fig. 3—Map showing forest conditions.

percent of the maintenance dredging carried out by Port Hope is necessitated by silting from the river."

Wildlife

Wildlife of many kinds was plentiful when settlement first began. Fresh water salmon and sturgeon were abundant, as were also speckled trout on the smaller branches of the river. Grouse, hares, muskrats, raccoons, wolves, deer and bears were found in abundance before the white man came, and for some years later. Passenger pigeons darkened the sky on their migrating flights and roosts were located on the sandy ridges. Today, most of the wildlife, certainly in abundance, has disappeared. Even speckled trout, grouse, and hares are greatly depleted.

Agriculture

Agriculture in the pioneer period was largely a type of subsistence farming. In a country where the land was covered with timber it was difficult for the settlers to make a choice of soils, and no doubt the procedure was to accept any land as long as it was close to the lake. The growing of wheat for flour was the chief concern of the early settlers, as, before 1800, Simcoe states that "The product of the earth which forms the staple of Upper Canada must be wheat"; consequently land was valued in relation to its ability to grow wheat. That this was not a true guide is known full well today, because many areas on which it is reported large yields of wheat were produced, are now blow sand. The explanation is that, following the cutting of the virgin forest, the natural "forest manure" which had accumulater over hundreds of years provided the necessary plant food to produce crops.

The inadequate preparation of the soil for seeding by primitive methods, and no knowledge of the modern methods of rotation, as well as the lack of fertilizers, soon gave rise to the idea that the soils were exhausted. This was particularly true of the sandy soils, and after a few years of cultivation the pioneers recognized the limitations of this class of soil, especially in the northern part of the watershed, which accounts for the abandonment of much of this land in later years. Referring to this part of the watershed, John Squair, writing many years later, states that "These areas (the ridge and Iroquois beach line) ought never to have been cleared of trees. If they had been kept as forest they would have yielded their yearly crop of wood, which today would be very valuable."

Later on, with the raising of cattle and the recognition of the potentialities of the heavier soils farther south, a marked improvement in soil fertility was brought about.

Agriculture on the watershed today is of the mixed general type. To the south of the area, in the district of Port Hope, Welcome, Dale and Canton, the majority of farmers practise dairying and the area is included in the Toronto milk shed. Many farmers are also interested in apples and canning crops, especially tomatoes, peas and corn, and there are canning factories at Port Hope, Cobourg, and Peterborough. In this district, also, clover seed is another cash crop and some have done exceptionally well with Alsike clover seed.

As one proceeds farther north to Perrytown, Garden Hill and Campbellcroft, more general farming is practised, with the majority of farmers keeping dual-purpose cattle, with a few being milked and the rest allowed to raise their calves. Some of this district, particularly west of Perrytown and east and north of Campbellcroft, is quite suited to growing potatoes and a few growers produce several acres of certified seed each year, with others growing a limited acreage for commercial purposes.

In the Osaca district the land is suitable for tobacco growing. During the past four or five years, about 2,000 acres of this land have been taken over by the Durham Tobacco Plantations, and for the past two years about 200 acres of excellent tobacco have been grown. A few private individuals also have purchased tobacco farms in this area. In the Kendal district, where the land is rolling, general farming is practised.

Surveys

Before a comprehensive programme of remedial measures can be recommended for such an area, a number of carefully planned and carefully executed studies must be carried out. This was the case with the Ganaraska. In fact, the Ganaraska survey was not, strictly speaking, a single survey but a group of surveys which, while separate units, fitted together when completed and formed a mosaic of land use from which the remedial measures necessary were reduced.

Soil Survey

Basic to any land use study is a soil survey, the purpose of which is to establish an inventory of the soil resources. The soils are studied, classified, mapped, and described by men specially trained in the science. They are examined in depth as well as on the surface, and such factors as texture, stoniness, colour, structure, are noted. The topography, drainage, natural vegetation, crops grown, and the amount of erosion, if any, are also noted and correlated.

The most important contribution of the soil survey, from an employment standpoint, was the finding that at the north of the watershed, where most of the tributaries of the river take their rise, is an area of 20,000 acres of marginal and submarginal land which for the most part should be withdrawn from agriculture and formed into a protection forest.

Soil Erosion Survey

Soil erosion of farm land in some parts of Ontario has reached serious proportions. Nowhere, perhaps, is this better exemplified than on certain parts of the Ganaraska watershed. While it was not possible to carry out an intensive soil erosion survey of the whole area, a representative section of 20,000 acres was covered, which is indicative of this type of soil deterioration in any similar area. Such a survey includes the study of soils, soil history, topography, drainage, climate, vegetation, and types of agriculture being carried on. Its greatest concern is the study of the amount of sheet erosion, gully erosion, etc., on the slopes of different classes or percentages, and recommendations for its control. The Ganaraska soil erosion survey showed that if erosion on farm land particularly, is allowed to go on unchecked, further reductions in crop yields, and increased land abandonment may be expected.

AGRICULTURAL ECONOMICS SURVEY

On the 20,000 acres of marginal and submarginal land indicated by the soil survey are several families carrying on farming, with varying degrees of success. To secure a picture of the economic conditions of these families, an agricultural economic survey was carried out. This included the study of such items as crops grown, income, capitalization, assessment, productivity of the land, buildings, social relations, etc. This survey indicated that the average level of living of most of the families in this area is low, and for a good many of the individual farms the level is so low that insufficient necessities are obtained, and almost nothing in the way of advancement goods and recreation, which are considered as part of the Canadian level of living.

LAND USE AND RESOURCES

This survey covered the whole watershed, and while it recorded in a superficial way such items as soil and slope, the main purpose of the survey was to appraise and record such items as woodland, plantable land, forest plantations, streams, springs, ponds, flooded land, kettle areas, old dam-sites, buildings, fences, open grown trees, road conditions, and wildlife. In recording such data, each acre of each lot of the whole watershed was examined on foot. From this survey the gross land areas were found to be occupied as follows: Crop land 51 per cent, woodland 23 per cent, plantable land 19 per cent, eroded land 3 per cent, forest plantations 2.5 per cent, towns 1.5 per cent.

HYDROGRAPHIC AND HYDRAULIC SURVEY

Time nor funds did not permit of making a complete hydrographic survey of the river and its tributaries. However, the river and all its tributaries were carefully checked on each lot as to position and condition of flow at the time of the year the survey was carried out, and this made it possible to map the river fairly accurately. Also a profile of the river was drawn, based on contours from the military map, and elevations at bridges and other points indicated. Levels at these points were checked from established bench marks in the area.

Similarly, very little was done in the field of hyrdaulics as no gauging stations have ever been established on the river. However, many of the old dam-sites were examined for water storage, and three suitable areas, providing 17,500 acre-ft., were located. This was done by the use of aerial photographs, contour lines, and checking on the ground with a level. The cost of the necessary dams, which would be largely of earth construction, was estimated.

VEGETATION

In so far as time would permit, a survey of the vegetation was carried out. Emphasis in this was placed on tree growth, and all species of trees found on the watershed, as well as their frequency, were recorded. This survey also included a list of other woody plants, and the most important herbaceous plants found during the summer months. Observations were also made on grass-land.

FOREST INSECTS

The whole watershed was examined for the presence and movement of forest insects, particularly those which are capable of causing damage to important timber trees, or which interfere with the establishing of new plantations. All such insects were listed, and recommendations for their control set down.

TREE DISEASES

Similarly, tree diseases in the area were listed, and special recommendations were made to cover those which are interfering at the present time with the health of the stand, and those which should be controlled in the event of carrying out further extensions to the forest.

FISH

The main river and its tributaries were examined for the presence of fish of different species, and recommendations were made for the improvement of the streams for increasing the fish population.

In all the above surveys the Interdepartmental Committee of the Ontario Government, which was charged with planning and carrying out the Ganaraska Survey, had the fullest co-operation of the best authorities in the respective subjects considered. These included the Soils Division of the Ontario Agricultural College; the Experimental Farms, Ottawa; the Economic Division of the Dominion Department of Agriculture; the Hydro-Electric Power Commission of Ontario; the Department of Botany, University of Toronto; the Dominion Department of Entomology; the Ontario Department of Lands and Forests; the Ontario Department of Game and Fisheries; and the Department of Zoology, University of Toronto.

Conservation Measures Recommended

The most important remedial measure recommended on the Ganaraska is the establishing of a 20,000 acre forest on the marginal and submarginal land indicated by the surveys at the extreme north of the area. This forest would serve as a protection forest. The idle land would be planted with suitable trees, the existing wood-

Fig. 4—Short bridges, buildings, and the outcropping of the bedrock in the channel aggravate flood conditions in the town of Port Hope—Walton street bridge.

Fig. 5—Red pine plantation, thirty years of age, at Saint Williams, Ont. Such plantations not only provide healthful outdoor work, but also valuable returns for the future.

land would be improved and planted, and areas which might still be used for agriculture would remain as such, but become an integral part of the forest property. The badly eroded gullies would be repaired with small check dams, and the steep hillside would be reclothed with trees and shrubs.

The main river and tributaries, throughout the whole watershed are fairly well protected with woodland. As an added protection these should be insured against clean-cutting and should be improved and planted, where necessary. On the other hand, there are small stretches of the river which have no protective forest fringe, which should be replanted where the sites are suitable. Where such areas consist of farm land from which there is excessive run-off and top washing, these should be examined by an agricultural engineer, and where the slope is sufficient to warrant it, be brought under improved agricultural methods such as contour plowing and strip cropping. Where the terrain becomes steep and unsuitable for mixed farm crops, permanent pastures should be established, and lately, the hills should be put back into forest.

Also, throughout the whole watershed, exclusive of the proposed forest and river protection area, there are areas of poor land on private farms. Owners should be further encouraged to reforest these, under existing Government aid, and where areas are too large for individual management, the municipalities should take the responsibility of planting and carrying out other remedial measures.

The preservation and care of privately owned woodlots throughout the area is the concern of the individual owner. On the Ganaraska, many of these are run down due to grazing—the survey showing that 75 per cent of the woodlots are subject to this—and haphazard cutting. In some areas, clean-cutting is the usual practice, and the custom of selling acre lots for fuel, by auction, is carried on. The result is that such cutting of natural woodland, as times goes on, may easily defeat the purpose of many public-spirited owners who are carrying on a systematic, though small, programme of reforestation. It is urged that all land owners be educated in the management of their woodlots, so that they may envisage the larger purpose of conservation, and that a system of controlled cutting of woodlots be inaugurated. In this way the water-holding and soil-binding qualities of these areas, especially where they are of strategic value from the standpoint of conservation, would be retained. This would not mean that trees could not be cut, but rather that cutting would be done under supervision, so that the fundamental value of the forest would not be impaired.

Another important remedial measure, which is proposed partly for the reduction of floods in the town of in the Port Hope, partly for the increasing of summer flow river, and also for the purpose of putting more moisture into the soil, is the establishing of storage basins, and agricultural and wildlife ponds. Many small ponds could be made by rebuilding some of the old dams on the watershed. These, however, must be considered only as agricultural or wildlife ponds, and would have no important bearing on flooding. To take care of flooding, one or more of the storage areas already mentioned, with the necessary dams, would have to be built.

The upper part of the watershed lends itself well for recreational purposes because of its topography, river system, and wooded areas. Several such centres could be established, particularly on the high parts of the moraine, in some of the well-preserved woodlots, and particularly around storage basins recommended for flood control and wildlife purposes.

As the whole area originally was predominantly white pine, it would be feasible to replant certain parts of it with this species. Before this could be done, however, assurance would have to be given that the area would be made reasonably free from the white pine blister rust, and this would mean the eradication of the alternate host of the disease, namely the botanical family ribes (gooseberries and currants), over much of the area.

The other remedial measures would include restocking streams with fish; forest insect surveys; gathering maple syrup; planting of permanent snow fences on highways; roadside planting; the collection of tree seed; nursery practice; and miscellaneous works such as building bridges, culverts, telephone lines, fire towers, camp fireplaces and trails, restoring springs, building forest foot trails, removing old buildings, protecting stream banks, harvesting ice, and erecting historical monuments.

As indicated in the first part of this article, one of the chief reasons for this study was to estimate the amount of employment which could be provided by the rehabilitation of an area of this kind. The survey shows that, on the Ganaraska watershed, work can be provided amounting to 2,136,511 man-hours, or sufficient for 600 men for 18 months, or, leaving out the three winter months when such work is impracticable, sufficient work for two years.

In considering this figure, however, it should be remembered that the Ganaraska represents only a small area of southern Ontario which requires such treatment. If this amount is multiplied say twenty times, it would not include all the needy areas of the province, let alone those which are included in the other provinces of the Dominion where similar work should be done.

Future Returns

In conclusion, such a programme as outlined for the Ganaraska should not be classed with many other works programmes which are indicated for the utilization of post-war employment, because projects concerned with the renewable natural resources of the country over a long term of years will yield returns which are self-liquidating.

Such returns may be divided into three groups. The first group includes those values which can be gauged accurately in dollars and cents, such as saw-logs, fuelwood, hydro poles, and Christmas trees, from both natural woodland and forest plantations.

Records are on file of woodlots yielding $35.00 an acre in saw-logs and fuelwood from improvement thinnings, in which only the overmature, defective and suppressed trees were taken out. In such work the conservation value of the area is retained and it is expected that such woodlots will be ready for further thinning in about fifteen years, and at similar intervals in perpetuity.

Similarly, forest plantations have a definite potential value. By and large, forest plantations of pine produce better and more trees to the acre than natural stands of the same age. The red pine (pinus resinosa), shown in Fig. 5, is a good example of reforestation on light land in southern Ontario. This plantation is now (1943) thirty years old. Many of the trees are over fifty feet in height and the average diameter (D.B.H.) is 6.9 in. By measurement, this stand now contains 8,325 F.B.M. per acre. In addition, several cords of wood have been taken out over the years from thinnings. At sixty years of age it is estimated that this stand will yield at least 30,000 F.B.M. per acre, which at $20.00 a thousand on the stump would be worth $600.00 per acre. To this should be added cordwood and a few saw-logs and poles from thinnings during the ensuing thirty-year period.

Fig. 6 — Abandoned road, creek, erosion (sheet, wind and gully), woodland, and farmstead on the upper Ganaraska.

If, on the other hand, all suitable trees in such a plantation are used for hydro poles, the yield would be greater. It is estimated that in another thirty years this plantation will yield 150 such poles 30 ft. long, and 150 poles 50 ft. long, per acre, which at current prices would be worth $4.50 and $10.00 each. or a total of $2,175.00 per acre.

Also, Christmas trees from forest plantations are a crop which has come on the market in recent years. However, where these are grown for clean-cutting, that is, the removal of all trees from the area after seven or ten years, such practice is not in the best interest of conservation where such factors as soil erosion, stream protection, etc., are involved. On the other hand, most plantations will yield a small percentage of trees per acre after seven years, without interfering with the conservation value of the stand.

An example of such a thinning is the Boy Scout Coronation Tract in Simcoe county. In 1937, the County of Simcoe purchased 82 acres of non-agricultural land, as a part of its county forest, on the Thornton-Baxter road, at a cost of $410.00. The area was planted the same year with 82,000 red and Scotch pine, by a group of 120 boy scouts camped at the village of Angus over the 24th of May weekend. As the work was done gratis by the boys, the cost of planting was insignificant and involved only supervision and trucking by the regular staff of the Department of Lands and Forests. In the late fall of 1943, 7,500 Scotch pine averaging 6 ft. in height were cut from this area as an improvement thinning, and sold for Christmas trees for thirty cents each, or a total of $2,250.00.

Such returns, as indicated from the foregoing examples, should go a long way in providing for the self-liquidation of a conservation programme such as is recommended for the Ganaraska watershed.

The second group of returns includes a number of values which are tangible but impossible to measure statistically. These are: increased ground water, which would raise the water table of the area, improve wells and springs, and increase the fertility of the land; the retarding of erosion on crop land, with the resulting increase in crop production; and the impounding of water, which would improve summer flow and ameliorate flooding. Such values would reflect themselves in a general improvement of agricultural conditions.

The third group includes a number of values which are intangible but nevertheless important, such as roadside planting, the beautification of the landscape by improved forest conditions, increased wildlife, and recreational facilities such as boating, swimming, fishing, and winter sports. The initial work connected with carrying out such changes and facilities would have a therapeutic value for returned men who might require the solace of the out-of-doors for bruised bodies and minds. And on through the years, the use of such areas by the people of our province, both young and old, would yield returns in spiritual values, the effect of which would be immeasurable.

Editor's Note—*The complete Ganaraska Report will be released for distribution during the present summer and may be obtained from the Dominion Advisory Committee on Reconstruction, Ottawa, or the Department of Lands and Forests, Toronto.*

From Month to Month

News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

THE PRESIDENT CALLS ON THE MASTER-GENERAL OF THE ORDNANCE

Shortly after the publication in the June *Journal* of the editorial on the Royal Canadian Electrical and Mechanical Engineers, and the presentation to the Minister of National Defence of the resolution of Council on the same subject, the president received a communication from the Master-General of the Ordnance, Major-General J. V. Young, stating that the Institute's protests indicated a lack of "a complete knowledge of the situation and the related problems," and inviting him to call at N.D.H.Q. so that "we can have a complete and frank discussion of the matter."

The president accepted the invitation and on July 25th, with Vice-President Lt.-Col. L. F. Grant of Kingston, and the general secretary, called upon the M.G.O. Others at the interview were Brigadier W. Mavor, Deputy M.G.O. and Colonel R. L. Franklin, M.E.I.C., Officer Administering R.C.E.M.E. and Director of Mechanical Engineering.

General Young outlined the personnel setup of the establishment for R.C.E.M.E. as compared to R.E. M.E., submitting figures to show that in R.C.E.M.E. at home and overseas the percentage of non-engineers was somewhat less than in the British organization. This is contrary to figures in the Institute's possession which indicate that the proportion of non-engineers in the Canadian Corps is twice as great as in R.E.M.E. There is some difficulty in making precise comparisons as the overseas figures which have been included in the computions of the M.G.O. are not available to the public either by R.E.M.E. or R.C.E.M.E. As far as home establishment is concerned the figures are attainable either through press releases or by personal observation, and it is in this classification that the Institute feels it is best qualified to comment. After all, the home establishment is the basis for overseas supply, and if only a small number of engineers are taken on here, only a small number are given the training and experience for overseas. The Institute's figures indicate that less than 38 per cent of the officer personnel at home is made up of professional engineers.

Promotion from the Ranks

The M.G.O. explained that Corps policy permitted the advancement to commissioned rank and technical officer appointments of selected tradesmen from the Other Rank personnel of the Corps. He further explained a certain portion of the work of the Corps, although comparatively small, calls for staff experience in other than engineering, such as regimental duties, accounting, clerical and personnel record work.

It is agreed that, when examining the overall picture, consideration must be given to those who by merit have risen from the ranks, but this does not explain the original appointment of so many non-professional people to higher commissions who did not rise from the ranks.

The figures for the total establishment in Canada and the number of professional persons holding commissions in it, both in Ottawa and in the districts, were shown to the president. It is true that the proportion of professional officers was higher than had been indicated by the figures supplied to the Institute Headquarters by members in the Corps and in the press. Apparently one of the conditions that has contributed to give the appearance of a low percentage of professional engineers is that in such cities as Montreal and Toronto the number of engineers holding commissions is very small, i.e., one only in each establishment out of eight or ten appointments. Apparently the greater numbers are at the west and east coasts, with by far the largest number being attached to Headquarters at Ottawa.

Scarcity is Controlling Factor

The most important thought expressed to the Institute officers was that the reason there were not more engineers in the Corps was that more engineers were not available, which is not difficult to understand in view of the treatment of engineers in the Ordnance Corps, the predecessor of R.C.E.M.E. It was stated that engineers who had the qualifications would be given an appointment without hesitation, and that there were still a number of openings available right now for such persons. This was a great surprise and the president expressed the opinion that engineers did not know of these openings. He was advised that the Wartime Bureau of Technical Personnel was recognized as the official source of engineering candidates and, as the Institute is one of the sponsors of the Bureau, it was considered that it need not be approached separately on the matter. In reply the president stated he was confident that had such information been given to the Institute as well as to the Bureau many additional candidates could have been found. He pointed out that his appearance before every branch of the Institute and every university at which engineering was taught gave him unusual opportunities to disseminate such information.

The delegation gathered the impression that Headquarters of the Corps was prepared to fill practically all present openings in the establishment with suitably qualified engineers as they could be found. As the *Journal* had pointed out frequently, it is no part of Institute policy to hamper government agencies in the prosecution of their duties. The Institute has no motive for criticism other than a desire to see conditions improved in the national interest. If conditions upon which attention has been focussed recently are due solely to a shortage of engineers, the Institute is prepared to be as zealous in an endeavour to find the necessary persons as it has been to criticize the earlier appointments.

Opportunities for Engineers

Perhaps the mention of openings awaiting engineers will arouse an interest across Canada. The R.C.E.M.E. is one of the few services that can give a commission immediately to a qualified person, without him first becoming a cadet. This should make it an especially attractive service for engineers. If a substantial number of engineers are added to the present enrolment it will make a big difference in the professional appearance of the corps, and, what is more important, in the professional attainments as well, providing they get the share of senior appointments justified by their qualifications and attainments.

The *Journal* expresses the hope that members will interest themselves in these openings. If engineers want this to be an engineers' corps in fact as well as in title, let them seek these appointments. The Institute's delegation to the M.G.O. was advised definitely that such was the desire of the senior administrative officers.

It will be a matter of some gratification to engineers to know that the administrators of R.C.E.M.E. agree "that the majority of officer appointments in R.C.E.M.E. should be suitably qualified engineers," and that the present situation will be improved just as soon as qualified persons are available. As an earnest of this policy it can be stated that of a large number of personnel now enrolled at officer training quarters every candidate but one is a university graduate in engineering.

Wide Interest Displayed

This discussion with the Department of National Defence has been followed with great interest by many members, not a few of whom have given material encouragement to continue. For a time it was planned to print some of tbe letters, as a meams of driving home the arguments, but it is hoped that the objective has been reached without resorting to such strong methods. The word "strong" is not overstating the case, as many bitter words have been written to Headquarters by persons in the field who have actually experienced the conditions of which they made complaint. It is everyone's wish that the causes for complaint have now been removed.

THE FUTURE OF THE PROFESSION

Elsewhere in this *Journal* is printed the presidential address of Robert E. Doherty, HON.M.E.I.C., delivered at the recent annual meeting of the Society for the Promotion of Engineering Education. The *Journal* recommends that this be read by every member. Although it was written for a United States audience, it is equally applicable to Canada, and probably in any part of the world.

Dr. Doherty believes that "The engineering profession must rise to a new level" and "Engineering education is the primary source from which this rise must spring." He believes that better results would follow if less time were spent on considering the material which is to be taught and more time on the methods by which it is taught. "I wish that some wise providence might cleanse our souls when we sit as designers of educational programs. Why, if our purpose is the cultivation of an intellect, do we feel under such irresistible compulsion to clutter students' minds with an impossible tonnage of inert, undigested subject matter?"

The address gives a neat and satisfying definition of the profession and a clear expression of what engineering is and is not. It says many things that have needed saying, and it places the responsibility for this "cultivation of a renaissance" in the engineering profession squarely on the shoulders of the engineers..

Dr. Doherty, as president of the Carnegie Institute of Technology, retiring president of the Society for the Promotion of Engineering Education, and past chairman of the Engineers' Council for Professional Development, and a successful electrical engineer, is in a unique position to know what he is talking about.

COLLECTIVE BARGAINING

At the moment of writing, it is impossible to say what the answer to the collective bargaining problem is going to be, but if the volume of interest and thought shown by individuals and groups right across the country has any significance, the answer should be ready shortly. There is no doubt that this is the most stirring topic that has ever been before the profession—stirring and disturbing. One result is that opinions in the form of briefs and memoranda are being expressed by many organizations, and mass opinion is being sought through the medium of questionnaires.

Thirteen different briefs have been received at Headquarters with thirteen different questionnaires. It is interesting to see the variance in observations, interpretations and recommendations. They can't all be right, and it must be a bit bewildering to those who belong to more than one organization to read the contradictions in the explanatory documents that are sent to clarify the issue and to aid in reaching a sound decision. However, it may be that this cross fire will only stimulate their thinking so that eventually they will have a genuine understanding of the problem and its complexities. Let us hope so!

The next river to cross is the discovery of a basis of approach to the Wartime Labour Relations Board that will be acceptable to all organizations. Unfortunately, the questionnaires are so different that a comparison of the majority of opinion of one society with that of another will be difficult, if not impossible. It would have been helpful if the same questions had been asked on all questionnaires.

If it is decided that the present ruling of the Board should be appealed before the period for such an appeal expires, it is clearly evident that a common policy must be determined which can be supported by a common front. If the final decisions of the societies are as far apart as the briefs and questionnaires, there will be great need for a Moses with the character of Solomon to lead us out of our confusion, but a common front must be established and maintained at all costs.

It is reasonable to believe that the interests of all members of the profession are similar, regardless of the organization to which they belong. It is the interests of the members that should dictate the policy of the organization, hence it should not be impossible to find a basis acceptable to all, but preliminary discussions indicate that the task will not be as easy as it sounds.

Most of the Institute questionnaires have been returned and the answers indicate a definite trend, but there can be no announcement until the committee has examined the results and prepared a statement. Many meetings of branches have been held, at several of which the committee was represented. The Montreal Branch meeting was quite outstanding in that two hundred and fifty members attended, and a very wide discussion took place. Many young engineers were in the audience but many more came from the senior groups. In all the conversations and discussions over the last several weeks, it has been interesting to observe that senior engineers are unanimous in the recommendation that something should be done for the economic welfare of the younger members of the profession. This is an encouraging sign.

The next meeting of the fourteen organizations has been arranged for August 15th, in Ottawa.

TOWN PLANNING

This subject is becoming of more and more importance, not only as a means of providing post war employment, but as a part of the better living that is looked for by most people after the war. From time to time the Institute receives enquiries for town planning engineers to act as consultants and for permanent full time employment, but the number experienced and available in this field is extremely limited. The Institute would like to promote an increased interest in the subject among its members, and the Journal would welcome papers from engineers that would add to the total of technical information available, and that would aid in arousing the required interest.

All the signs are that Canada is going to do a lot of town planning for the post war period. Rumours indicate that governments will take a prominent part in this, perhaps both lending money and carrying out work. It has been suggested many times that money should be loaned only to those communities that have their plans well prepared in advance. This should establish a great need for persons who know something about planning. It is to be hoped that enough Canadian engineers will be found that it will not be necessary to borrow from the United States.

This is a field in which the architect and the engineer can combine to produce the best results. Members will be interested to know that the Royal Architectural Institute of Canada and the Engineering Institute have been holding conversations to explore the possibilities of cooperative thinking that may result in an increased public support for planning and an increased interest on the part of architects and engineers.

Officers of the Engineering Institute have also interviewed government officials in order to make available to them the support and assistance of the organization in carrying out the expansive programmes which it is believed they are working on. It is likely that some very interesting developments of particular interest to engineers will be announced before long, after which plans of professional societies and of individuals can be more easily formulated.

The following paragraphs are taken from a letter received from a member who has experience in the town planning field. They are repeated here because they draw attention to some of the misunderstandings of the subject, and some of the complexities:

"Too many people have too little knowledge of town planning. Some imagine it to be a matter of beautification, 'town planting'; others think of it as a form of building control. Few would consider it to be a specialized field of civil engineering.

"There are, of course, town planners and town planners. The man on the street who says that something should be done about it is a planner of sorts—he advocates town planning. The person who insists that there be control of the location of nuisances or that there be an adequate system of street transportation or a well distributed scheme of municipal play grounds, is also a town planner—a piece-meal town planner. But the professional planner is the person with the ability to visualize a community as a unit and plan all phases of its orderly development. If the several abilities of the statistician, the surveyor, the architect, the lawyer, the transport, highway and other types of civil engineering, not forgetting the designing engineer, could be developed in one person, we could then say 'Behold the ideal of the professional town planner."

"What, then, is town planning ? Some have likened its operation to pressure brought to bear on a stick of sealing wax. Suddenly applied, with force, the stick will break and must be remoulded. This is the kind of town planning required for slum clearance—demolition and reconstruction according to a preconceived plan. On the other hand, by a process of constantly applied moderate pressure, the stick may be altered in form. This, perhaps, best illustrates the type of town planning most needed in a rapidly growing country such as ours, namely, a long term policy of physical development in each community, tied down to the extent that future public works shall be in conformity with that policy or plan; and protected by adequate zoning. The services of the statistician are necessary to compile present and estimate future population concentration, and the designing engineer to interpret the nature of the facilities required for that population."

POST-WAR EMPLOYMENT FOR TECHNICAL PERSONNEL AND THE W.B.T.P.

On July 24th the presidents of the three societies sponsoring the Wartime Bureau of Technical Personnel, interviewed the Minister of Labour, with the object of discussing with him the possible services that might be rendered to technical persons turning to civil occupations either from the armed services, or from war industry, and also the prospect of maintaining on a long-term or permanent basis, a service for the professional worker similar to that now rendered by the Bureau.

The delegation recommended that the Bureau be authorized to start a survey now that will gather additional necessary information, particularly about men in the active services, and that will permit an analysis of all data so that a better appraisal of qualifications and needs can be made. This would be in the nature of a stock taking of personnel and qualifications, particularly of those for whom it may be necessary to find new employment upon the cessation of hostilities. Such information could be of great use to government, industry and universities as a basis for that part of their post-war planning.

The second point related to a possible service to technical personnel in the post-war period. It was recommended that a separate service and organization be retained. The delegation quoted a resolution which had been passed at a meeting of the Advisory Board of the Bureau, held on July 20th, which reads as follows:

"The Advisory Board of the Wartime Bureau of Technical Personnel is firmly of the opinion that, in the best interests of the national economy, all govenrment services to be established for post-war employment should recognize the special needs of special groups of workers and certain types of employers and to that end, in particular reference to engineers and science workers, should continue a service along the lines already established by the Department through the Wartime Bureau of Technical Personnel.

"The reasons for such services are many, and will be apparent to employees and employers alike who are familiar with the conditions surrounding this type of employment, as exemplified in the recent report of the Hankey Committee on Higher Appointments prepared for the Minister of Labour and National Service of Great Britain, which report the Board recommends be given most careful study and consideration."

The Hankey report referred to makes recommendations to the British Ministry of Labour that are almost identical with those made by the delegation. This is a source of gratification as Lord Hankey is one of the most competent persons in the Empire to report on such subjects.

It may be some time before the Minister is able to make any announcement, but in the meantime technical persons throughout Canada will be interested to know that such proposals have been made and are being considered.

The presidents making up the delegation were:—The Canadian Institute of Mining & Metallurgy, Allan MacKay, the Chemical Institute of Canada, L. E. Westman, and The Engineering Institute of Canada, deGaspé Beaubien.

THE CASE OF ARCHITECTS vs. ENGINEERS

Many members of the Institute have been enquiring as to the outcome of the suit taken by the Province of Quebec Association of Architects against a Montreal engineer, for having designed an industrial building. The last word received by the *Journal* is that the case has been postponed again, this time to October.

It is with regret that we have to comment that, so far, no effort seems to have been made by the Association to settle the issue professionally. It seems hard to believe that any great number of members of the Association support this impending public exhibition but there are no signs that anyone is doing anything to stop it.

The president of the Institute has made an advance towards the development of open discussion between the professions, but the response has not been encouraging. Apparently nothing short of a court hearing will satisfy the appellants. The engineers, on the other hand, are confident of the court's decision, but still feel it should not be necessary to go that far to settle a dispute between two professions. It is not professional!

CHEMISTS PROCEED WITH COORDINATION

The Institute has just received a copy of a report made by the Interim Board of Directors of the Chemical Institute of Canada to the members of the Interim Council and the executive of local groups. This report outlines the steps which have been taken since the annual meeting in Toronto towards the consolidation of the three chemical organizations.

Mr. L. E. Westman, M.E.I.C., has been made Chairman of the Interim Board, with P. E. Gagnon, M.E.I.C., Honorary Treasurer and R. R. McLaughlin, M.E.I.C., Honorary Secretary. Portfolios have been assigned to certain directors as indicated in the following tabulation:

Director of Business	Dr. H. R. L. Streight
Director of Information	Dr. R. V. V. Nicholls
Director of Conferences	W. E. Pomeroy
Director of Professional Affairs	Dr. L. Lortie
Director of External Relations	L. E. Westman

Dr. Streight is setting up a Membership Committee with representatives from all local groups. Dr. Nicholls is organizing subject divisions, and hopes shortly to be able to announce the establishment of a news letter or a journal for the membership.

Mr. Pomeroy has a committee working on a draft of the constitution and by-laws of the new Institute, and Dr. Lortie, who is the Institute's representative on the joint committee considering collective bargaining, reports that the paper which he delivered at the annual meeting on this subject has been reprinted and distributed to the combined memberships. It is planned to obtain an expression of opinion from the membership on this question.

Already there has been some discussion as to the location of next year's conference, but there are as yet no details ready to be announced.

The new Institute is endeavouring to secure a full time Secretary-Manager. Several applications have been received, but it is not likely that any decision will be made before the next meeting of the Board, which is scheduled for Aug. 10th in Ottawa.

WASHINGTON LETTER

Lack of Preparedness for Peace

Within the last week, the Normandy break through, the resignation of the Japanese Cabinet, the continued successes on the Russian front, and the apparent revolt in the German High Command, have all been encouraging signs. For the second time in a year, there is a surge of optimism which this time, however, is tempered by experience and by a number of conditioning factors. Nevertheless, there is a feeling prevalent here that, while there may be some cause for alarm in the fact that war production is lagging somewhat behind expectations, there is even more cause for alarm in the fact that there is also a serious lag in plans for reconversion. The word reconversion is used in its widest sense to include problems of demobilization, conversion of industry, disposal of surpluses, contract termination, and a number of other problems, all of which are the subject of much discussion and investigation. For instance, S 1730 before the Senate is entitled "A bill to create an Office of Demobilization, establish general policies for the operation of that office, provide for the settlement of claims arising on termination of war contracts, provide for the disposal of surplus Government property, and for other purposes." A most interesting report on hearings on this bill before the Committee of Military Affairs was published recently. There are committees in both the Senate and the House on Post-War and Economic Policy and Planning. Both have submitted interesting reports within the last month. The War Department has recently issued an interesting, readable and semi-graphic pamphlet setting out the whole problem of contract termination. As has been previously recorded, of course, authorities have already been created for dealing with the disposal of surpluses and problems of demobilization. The Chamber of Commerce and the CID continue to publish results of their studies. In spite of all this, however, specific and definitive action is still lacking and legislation is needed in many phases. The plea which Mr. Bernard Baruch addressed to Director of War Mobilization Byrnes some months ago is still true—"We think we should inform you that while much has been done in carrying out the programme recommended by us and approved by you, on some matters of importance, administrative or legislative action is still lacking . . . For the good of all of us, but mostly for the sake of our soldiers and sailors, let us hurry, hurry, hurry not only in winning the war but in being ready for the peace. Delays jeopardize both these objectives. . . . Further delays and inaction can only make our readiness ever more distant and will turn the adventure in prosperity that lies within our grasp into an adventure in adversity." The magnitude of the conversion problem in this country, of course, is very great. The United States has practically doubled its normal average productive capacity and considerably more than half its present production is directly or indirectly being produced for war purposes. Not only will it be necessary to convert from war production to civilian production but it will be extremely difficult to maintain full employment which all authorities agree will be necessary if a collapse is to be avoided. In the words of the recent Senate report mentioned above—"Employment of 8 to 10 million more people than have ever before been employed in America and absorbtion thereafter of approximately three-quarters of a million people annually into labor forces must be America's goal. It presents a challenge almost as grave as the challenge of war." This, of course, means more than have ever been employed in normal civilian production. The same report concludes with the observation that so many important matters in this field await Congressional action that "the very destiny of the Nation may depend upon wise and prompt decisions in respect to them" and the Report suggests "that no extended Congressional recess should be considered."

International Monetary Controls

Transcending local problems are the discussions taking place on international trade and international monetary control. Both are closely inter-related. The question of international monetary control has been deemed to be the more fundamental problem and is being tackled first. The conference at Bretton Woods is being held as this is written. It is too early to comment on its progress although the problems being faced are extremely difficult and it would be unwise to be too optimistic with respect to the result of this first "full-dress" conference on so contentious a subject. The two main propositions under discussion at Bretton Woods are the establishment of a monetary fund and the establishment of a bank for reconstruction and development, both under international control. The monetary fund, to which all United and Associated Nations would subscribe, is to amount to about eight billion dollars. The fund will be administered to the end of achieving the following objectives: the provision of machinery for consultation on international monetary problems, the extension and balanced growth of international trade, the making available of funds to correct maladjustments in trade and the balance of payments, the promotion of exchange stability, the facilitating of multilateral payment facilities, and the reduction of the degree of disequilibrium in the international balance of payments. The establishment of a bank for reconstruction and development should be of considerable interest to engineers in that its purpose is to assist in the reconstruction and development of all member countries by co-operating with private financial agencies and by the actual provision of capital. Another of the purposes of the bank is to use its good offices and capital to facilitate the rapid and smooth transition from war to peace by increasing the flow of international investments. It is anticipated that the authorized capital of the bank should be equivalent to about ten billion dollars. One of the things which interested me in reading the Treasury Reports on the subject was the suggestion that the bank should establish a technical staff which would be competent to make careful studies of the merits of international projects and programmes. It is hoped that the next letter may be able to report on the progress which has been made at the Bretton Woods Conference.

International Trade

On the general question of international trade, the Advisory Committee on Economics of the Carnegie Endowment has just published an interesting short report on "World Trade and Employment" which sets out in quite terse and interesting form the fundamentals which are involved. Also worth attention is a report of the Federation of British Industries entitled "International Trade Policies." There is a considerable cleavage of opinion between the United States and the United Kingdom in respect to some of the overall policies of international trade. Anyone interested in this subject should read the writings of Mr. Eric Johnson, chairman of the American Chamber of Commerce, for an American view point, and they could not do better than to read the excellent series of articles on international trade which ran for some months in the *London Economist*, commencing in January of this year.

Advances in the Chemical Field

These letters have commented on the advances in the medical sciences brought about by the pressures and necessities of war. Equally spectacular are some of the advances being made in the fight against insects, pests and, with the growing importance of food, against plant infestations. Because of critical shortages recently, I have been working with technical officers in the Department of Agriculture and the War Food Administration and getting at least a glimpse into some of the exciting developments. I have been learning to pronounce impossible looking words and to speak knowingly about anthelmintics. In the early days of the Combined Raw Materials Board, one of the first materials to come under our attention for rigid control was pyrethrium, which was required for insecticide purposes. The spectacular new DDT—dichloro-diphenyl-trichloroethane—which in a few days removed the dread menace of typhus from devastated Italian cities, made its debut in a recent *Readers Digest* article. The aerosol technique, involving the use of the highly volatile freon, will revolutionize peacetime practices when it can be adopted to civilian purposes. The manufacturers of face cream, beauty lotions and perfumes have also gone to war, particularly in aid of jungle fighters. Who knows what added virtues their products may possess in the post-war world!

"The Word and the Fact"

In all the talk of peace settlements, post-war trade, reconstruction, currency control, etc., there appears to be more attention to facts that to principles. After the last war, Wilsonian principles appeared to carry the day but national and selfish interests intervened. If we start out this time with our eyes fixed on the facts of our own national interests—perhaps principles will be better served. But I fear not. This war is being fought for principles which are common to all men. An effective peace cannot be one of arrangement and of the nice balancing of the selfish interests of those in the best bargaining position. Mr. Archibald MacLeish has an excellent article in the July *Atlantic* entitled "The Word and the Fact." It should be widely read. In one place he says: "To talk of liberty without declaring, with the precise and revolutionary ardor of those to whom the talk of liberty comes naturally, what liberty we mean to have, and for what purpose, is to trade upon the nobility of men long dead, and, worse, to spill and waste the virtue of the word they left us. Freedom, liberty, democrary, equality, are revolutionary words. They are revolutionary words always, and whenever used. They cannot be employed to arouse men's minds to fight defensive wars for the protection of the status quo or the preservation of a Society 'the way it was' without destroying their vitality and meaning."

E. R. Jacobsen, M.E.I.C.

July 21, 1944.

PRESIDENTIAL VISIT TO HAMILTON BRANCH

Above—Head table with Chairman H. A. Cooch *at right*, then the president, Vice-Chairman Norman Eager, Hugh Lumsden, J. Porter.

Upper right—Right to left: E. M. Coles, T. S. Glover, L. F. A. Mitchell, C. A. Ernst.

Right—Head table *right to left*: H. J. A. Chambers, Alex. Love, General Secretary, J. Porter, R. E. Heartz, H. A. Cooch.

THE PRESIDENT AT THE BORDER CITIES

I. R. Tait of Montreal chats with H. L. Johnston and C. G. Walton.

Above: Left to right, T. H. Jenkins, J. A. Vance, President Beaubien, A. H. MacQuarrie, H. F. Bennett steering the ship, W. R. Stickney, Jack Alton, C. G. R. Armstrong.

Right: The head table, R. E. Heartz, G. G. Henderson, President Beaubien, Chairman J. B. Dowler.

PRESIDENTIAL TOUR OF ONTARIO BRANCHES

During the month of June the president, accompanied by R. E. Heartz, Montreal councillor, and the general secretary, visited five of the Ontario branches. All meetings were well attended even though it was during the summer season, and the president was greatly encouraged by the signs of activity exhibited in every branch.

The first meeting was held at Hamilton on the 12th. During the afternoon the party visited the plant of the Steel Company of Canada where they had an opportunity to see the new installations and the great expansion made necessary in order to meet the demands of the war programme.

In the evening a dinner meeting was held at the Scottish Rites Hall under the chairmanship of H. A. Cooch, the branch chairman. Unfortunately, Mr. Cooch had to leave the meeting before it was completed, at which time the chair was taken over by Mr. Norman Eager, the vice-chairman of the branch. The meeting taxed the capacity of the hall, and was a successful event from every point of view.

The president and his party went from Hamilton to London, stopping off at Woodstock for lunch on Tuesday, the 11th. They were met at the train by Councillor Vance and after a drive through the country and different parts of the city, met several of the local engineers and executives of the city at a luncheon arranged by Mr. Vance. It was a very pleasant occasion, and gave the president an opportunity to meet several persons who were unable to attend the meetings at Hamilton or London. After the luncheon a visit was made to two of the local industries before proceeding to London.

At London the meeting took the form of a dinner at the Hunt Club, under the chairmanship of R. S. Charles, chairman of the branch. Dinner was held on the veranda and the group adjourned to the lounge for the meeting during the course of the evening.

The president's party with the addition of Councillor Vance and Mr. Harry Bennett motored on Wednesday from London to Windsor, where they made an extensive inspection of activities at the plant of the Canadian Bridge Company. This inspection included a trial run on one of the new sea-going tugs, and lunch in the staff dining room of the company.

In the evening, dinner was held in the ball-room of the Prince Edward Hotel with J. B. Dowler, chairman of the branch, presiding.

On Thursday morning the party left by rail for Niagara Falls, where they had a very pleasant luncheon with the executive of the branch on the veranda of the Refrectory. After luncheon a meeting was held with the executive, at which many activities of the Institute were reviewed.

In the evening dinner was held at the Refrectory in a very beautiful setting of flowers and plants which had been arranged by the park's officials. This added much to the pleasure of the occasion. The meeting opened under the chairmanship of G. E. Griffiths, but, during the course of the evening after the election of new officers, the chair was taken over by the new chairman, W. D. Bracken. A pleasant feature of this meeting was the presentation by the branch to the retiring chairman of a gold badge of the Institute. This ceremony was conducted on behalf of the branch by the president.

On Friday the party motored from Niagara Falls to Queenston and took the boat from Queenston to Toronto.

The Toronto Branch had arranged a dinner for members and their wives at the Royal Canadian Yacht Club, which, in the unavoidable absence of the chairman, was presided over by Dean C. R. Young. This occasion was quite distinguished by reason of the number of

PRESIDENT BEAUBIEN AT NIAGARA FALLS

Above—Head table *right to left:* the President, Chairman G. E. Griffiths, C. G. Cline, Past-President A. J. Grant, R. E. Heartz, H. G. Acres, Secretary-Treasurer J. H. Ings, P. Buss in the background.

Above—Left to right: T. A. Barnett, J. I. Gram, A. S. Jannati, L. L. Gisborne.

Left—The president presents retiring Chairman Griffiths with the Institute badge.

PRESIDENT AND MADAME BEAUBIEN AT TORONTO

Above—Head table _left to right:_ Past-President Cameron, Mrs. Gaby, the president, Past-President Young, Mme Beaubien and, not shown in the picture, Past-President Gaby and R. E. Heartz.

Above—"Monty" Laughlin spins one for Mr. and Mrs. Frank Flett.

Above—Here we have A. V. Sanderson, Mrs. W. S. Wilson, Prof. and Mrs. T. R. Loudon with G. P. Wilbur in foreground.

Below—Special guests were Mr. and Mrs. W. H. Hewitt (secretary A.S.M.E. for Ontario) followed by Miss M. Mackenzie, Prof. J. R. Cockburn, Prof. and Mrs. W. D. Dunbar.

Left— From right to left: Mr. and Mrs. T. Dembie, Mr. and Mrs. R. Hewitt.

---

past-presidents who were at the head table. These included Messrs. Gaby, Young and Cameron.

On Saturday morning a regional meeting of Council was held in the Royal York Hotel which, according to the usual Toronto traditions, was extremely well attended. The meeting lasted all day and did not adjourn until after five P.M.

This brief account is not intended in any way to supersede the reports which regularly come from the branches for meetings of this kind. These will appear in a subsequent issue of the *Journal* as they are received.

COMING MEETINGS

Canadian Good Roads Association—Inter-provincial conference of highway ministers, their deputies, engineers, and other department officials of the provincial governments, September 26-27th, 1944, Cornwallis Inn, Kentville, N.S. Secretary: Mr. G. A. McNamee, New Birks Building, Montreal, Que. Attendance will be restricted to those mentioned above.

Canadian Institute on Sewage and Sanitation—Annual Convention, Royal York Hotel, Toronto, November 2-3, 1944. Secretary: Dr. A. E. Berry, Ontario Department of Health, Toronto, Ont.

LONDON RECEIVES THE PRESIDENT

Above—From right to left: Chairman R. S. Charles (back), the president, E. V. Buchanan, Harry Bennett, G. H. Edgecombe.

Right—The chairman opens the meeting.

E. V. Buchanan thanks the speaker with Warren Miller behind him and James Vance in the foreground.

Left to right: James A. Vance, V. A. McKillop, E. F. Carson, W. C. Miller, G. H. Edgecombe.

Right to left: Secretary-Treasurer A. L. Furanna, Vice-Chairman H. G. Stead, J. W. Demcoe, Capt. E. B. Allen, F. A. Bell, R. W. Garrett, K. Armstrong, Col. I. Leonard.

CAN YOU READ RUSSIAN?

A member in the Montreal Branch area has suggested that it might be profitable if a group speaking Russian could gather together at convenient times to study the engineering and scientific literature that has come recently from that country.

In addition to the engineering material there must be a lot of other good material coming from Russia. For instance, the reports from the various commissions headed by scientists that are following the victorious Russian armies to investigate German crimes in the formerly occupied territories, must be very revealing in their own language. Even the brief reports in English that come to this country stagger the imagination.

The *Journal* is pleased to bring this to the attention of the members. If those who may be interested will so advise Headquarters, an effort will be made to get something underway.

CORRESPONDENCE

Post-War Planning Paper

The Editor,

The Engineering Journal, Montreal.

An engineer is well aware that a bridge may look alright on blueprint but will collapse if built on faulty ground.

Unfortunately the whole structure of the paper in question is built up on the generally accepted but faulty foundation of "prosperity through full employment" and accordingly must fail in its intended purpose.

My Social-Economic Engineering Research, as presented in my lectures in 1937, 1939, and 1942, before the Montreal E.I.C. Branch, proves conclusively that, ever since the power and machine age, "prosperity" and "full employment" have become contradictory terms.

Prosperity never involves only the availability of "plenty of material things," but invariably it implies also the "ease" with which such material things can be attained.

Hence "part employment" of a nation's manhood becomes the natural adjunct to prosperity in our new era where machine-power and not man-power has become the actual national producing force.

The problems discussed in the three parts of the paper are therefore not those for which the authors tried to find an answer, but instead they are as follows:

Part 1: What is the post-war problem?

Answer: It is decidedly not the problem of full employment as is assumed by the authors but instead the problem of how to assure an income to all, irrespective of whether still needed to perform a nation's economic duties or whether having become superfluous.

My answer is a Mutual Retirement Insurance Scheme, retiring the elder at their attained net income level when those younger become capable of producing the whole of a nation's needs.

Part 2: What can industry do about it?

Answer: Nothing to alleviate the condition, simply because industry's function is to "produce" and "produce evermore efficiently," that is, with everless manpower, the effect thus being directly the opposite to full employment.

Industry's basic trend is therefore not to re-employ manpower but to get rid of all the superfluous manpower.

What industry can and must do therefore, if it is to save free enterprise is, that it broadcasts this fact about its basic purpose and joins in the verifying and propagating of the simple solution for our social-economic ills as established by the writer's research. Only by helping to fix the blame and place it where it belongs, can industry possibly exonerate itself from the present faulty accusations.

Part 3: What can the Government do about it?

Answer: Everything! It is the Government which alone can restore economic and social stability by bringing our social mechanism up to date to meet the new requirements of industrial society. The simple two measures needing correction are:

1. Age control to split the nation's manhood into economically active and inactive manhood, so that the economic system, including industry, can freely rid itself of all superfluous manpower.

(2) A regulatory instead of a punitive tax system which will assure a healthy yearly circulation of the total money flow to avoid stagnating money.

The answer to (1) is a mutual social retirement insurance scheme with retirement at the attained income level when no longer needed.

The answer to (2) is a tax system based on individual income only. Consumers taxes, including business taxes, should be discarded entirely, while the individual income tax in its main purpose would become the taxpayer's premium on his own retirement insurance policy.

* Readers interested in studying the proofs of Mr. Ackerman's contentions can secure from the author at a nominal cost, copies of the pamphlet, "Industrial Democracy and Its Survival" or the leaflet, "Will our Fallacious Viewpoint on Unemployment Destroy Us?"

These are the simple remedies which alone can save Democracy and bring peace and prosperity to a war torn world.*

Unless everybody, including the engineer, joins in this crusade and helps verify and propagate these simple but vital facts, it will be impossible to forestall a post-war catastrophe of unprecedented magnitude with one-quarter to one-third of an industrial nation's manhood becoming unemployed and accordingly destitute. This is more than any nation can possibly bear.

P. Ackerman, m.e.i.c.

Note: In the paper Post-War Planning, the authors suggest as a basis from which to start reasoning that "we may assume that full employment exists in Canada when approximately 53% of her population fourteen years and over in age is employed during summer months and slightly less in winter months." This is quite different from the interpretation put on the words "full employment by Mr. Ackerman.—(*Editor*).

The General Secretary,
The Engineering Institute of Canada,
Dear Sir:

In the summary of discussion on post-war planning which appears in *The Engineering Journal* for June, 1944, on page 364 near the end of the paragraph (following my name) there is given a figure of four million for the estimate of total employed population in Canada. I believe this is an error since the paper which was discussed used a figure of 4,860,000 for total employed population at January, 1947, and in commenting on this figure I believe I stated that about 4,900,000 seemed to me to be of the right order of magnitude.

Perhaps it is a small point to bring up but I should not like anyone to get the idea that I considered unemployment of the order of 900,000 normal in Canada.

Yours very truly,
(*Signed*) Eric G. Adams, m.e.i.c.,
Chief, Statistics and Research Section,
Foreign Exchange Control Board.

Note—The figure of 4,000,000 used in the *Journal* was taken from the verbatim and is apparently a stenographic error. We are glad to have Mr. Adams' correction. *Ed.*

Letter From England

Cardiff, Wales, England, 26th June, 1944.

L. Austin Wright, Esq.,
The Engineering Institute of Canada.

Dear Sir:

I wish to let you know how deeply we appreciate the kindness of the Institute to we members in Great Britain. We are all the more grateful as it is so difficult to export money from this country. I have received the *Journal* fairly regularly; I think I have only missed two issues, and this can no doubt be put down to enemy action. I follow closely all the articles in the *Journal* and find them not only of great interest, but often of considerable use, and my colleagues in this country consider it to be one of the best engineering journals they have read.

I would point out that I have settled at the above address after considerable knocking about since I lost my home, and would you please be good enough to address all correspondence there in future.

Yours very truly,
C. H. Oakes, m.e.i.c.

Canada's Future in Test Tubes

The *Journal* is pleased to publish the following letter, as one means of acquainting a large group of Canadians with this good work. The author is well qualified to write on such a topic as he is head of the Department of Physics at Queen's University and is president of the Royal Society of Canada. Members desiring copies should write direct to the Canadian Institute of International Affairs, 230 Bloor St. W. Toronto.—*Editor.*

The Secretary, July 7, 1944
Engineering Institute of Canada,
2050 Mansfield Street, Montreal, P.Q.

Dear Sir:

We are enclosing herewith a copy of "Canada's Future in Test Tubes ?" by J. K. Robertson. This pamphlet is a recent issue in the **Behind the Headline Series,** which we publish in co-operation with the Canadian Association for Adult Education.

The Canadian Institute of International Affairs according to its constitution is "an unofficial and non-political body," and is strictly non-profit-making. Its purpose is to make available information about international affairs and Canadian political, economic and social problems. All proceeds from sales are turned back into the funds of the Research and Public Education Committees to make more publications.

As the specialized nature of this pamphlet limits its popular appeal, we are trying to find groups particularly interested in science and its application in national life, who may find this pamphlet useful in study groups or for individual reading.

Single copies of "Canada's Future in Test Tubes ?" sell for ten cents; in bloc orders of ten to a thousand copies the price is seven cents the copy.

We would be very grateful if your Institute could co-operate with us in distributing this pamphlet. Any suggestions that may occur to you will be very welcome.

Yours sincerely,

(*Signed*) (Mrs.) Jeanie C. Bishop,
Publications Secretary.

Personals

Relatives and friends of members in the active forces are invited to inform the Institute of news items, such as locations, promotions, transfers, etc., which would be of interest to other members of the Institute and which should be entered on the member's personal record kept at Headquarters. These would form a basis of personal items in the *Journal*.

News of the Personal Activities of members of the Institute

Lt.-Col. C. A. Scott, E.D., M.E.I.C., who, from the winter of 1939 to the end of 1942 acted as overseas commissioner for the Canadian Red Cross Society with headquarters in London, and since his return to Canada has been national director of field services of the Society, has been appointed commissioner of the Red Cross for British Columbia, with headquarters at Vancouver, B.C.

P. R. Sandwell, M.E.I.C., is now engaged by the Ontario Paper Company at Thorold, Ont., as development engineer. He had been with Dominion Engineering Works, Montreal, since his return from Australia a few months ago.

E. A. Ryan, M.E.I.C., consulting engineer of Montreal, has recently been appointed member of the Quebec Public Service Board, replacing J. W. McCammon, M.E.I.C., now on the Quebec Hydro-Electric Commission.

Douglas S. Laidlaw, M.E.I.C., who was formerly employed with Defence Industries Limited, Montreal, has now joined the Canadian Car and Foundry Company aircraft division, Fort William, as assistant plant engineer.

Roy W. Emery, M.E.I.C., has recently joined the staff of the Marathon Paper Mills of Canada, Limited, Toronto, as designing engineer. He was formerly employed in the same capacity with H. G. Acres and Company, Niagara Falls, Ont.

Lawrence H. Burpee, M.E.I.C., who was formerly with the Montreal Light Heat and Power Company, has recently returned to The Foundation Company of Canada, Limited, Montreal, where he was employed at one time.

John R. W. Ambrose, M.E.I.C., superintendent and chief engineer of the Toronto Terminals Railway Company at the Toronto Union Station, has recently retired, after 35 years service. He has been in railroading for the past 47 years. He joined the Institute in 1912 as a Member.

T. A. Lindsay, M.E.I.C.

T. A. Lindsay, M.E.I.C., has been appointed general manager of Automatic Electric (Canada) Limited. He was educated at the University of Manitoba and after some experience in mining and electrical construction work, he joined the staff of the Phillips Electrical Works Limited and later transferred to Automatic Electric (Canada) Limited, having been in turn manager of that company's Regina, Edmonton and Ottawa offices.

A. M. Macgillivray, M.E.I.C., retired a few months ago from his position of district engineer with the Canadian National Railways at Saskatoon, Sask., after over 40 years service with the railways. He has returned to Antigonish, N.S., where he was born and educated, and where he worked in the early years of his career. During his stay in Saskatoon, Mr. Macgillivray took a leading part in engineering societies' activities and was chairman of the Saskatchewan

Branch of the Institute, president of the Association of Professional Engineers of Saskatchewan and was representative of that Association on the Dominion Council of Professional Engineers. Mr. Macgillivray is at present a councillor of the Institute.

J. B. Hayes, M.E.I.C., manager of the Nova Scotia Light and Power Company, Halifax, was elected president of the Canadian Electrical Association, at the recent annual meeting. He was also elected to the executive committee of the Canadian Transit Association, which recently held a meeting in Quebec City.

E. V. Caton, M.E.I.C., chief engineer and manager of production, Winnipeg Electric Company, has been elected vice-president of the Canadian Electrical Association.

E. D. Gray-Donald, M.E.I.C., chief engineer of the Quebec Power Company was elected vice-president of the Canadian Transit Association, at the recent meeting held in Quebec.

Acton Burrows, Affil.E.I.C., president of Acton Burrows Company, publishers, has been appointed honourary president of the Canadian Transit Association.

W. G. Murrin, M.E.I.C., has been elected member of the honourary advisory council of the Canadian Transit Association. Mr. Murrin is president of the British Columbia Electric Railway Company, Limited.

Arthur Duperron, M.E.I.C., formerly president of the Canadian Transit Association, has been appointed to the executive committee. He is assistant general manager of the Montreal Tramways Company.

D. E. Blair, M.E.I.C., vice-president and general manager of the Montreal Tramways Company, has been elected member of the executive committee of the Canadian Transit Association.

Grant R. Jack, M.E.I.C., former commissioner of works of East York Township, Ont., has been appointed to the post of city engineer of St. Johns, Newfoundland. He started his new duties on July 1st. Mr. Jack was a member of the executive of the Toronto Branch of the Institute in 1941.

John S. Galbraith, M.E.I.C., civil engineer of Toronto, has been appointed director of the Community Planning Division of the National Housing Administration at Ottawa. An engineer of wide experience in town planning, Mr. Galbraith was appointed "for the purpose of assisting in the development of better public understanding of the principles of community planning and promoting the adoption of such planning by Canadian municipalities."

Mr. Galbraith was one of the engineers who made the plans for what was known at that time as the model city of Mount Royal in 1919. He has also made plans for other towns in Canada, having travelled extensively in both Canada and the United States in studying town planning Mr. Galbraith is widely known in this field.

A. E. K. Bunnell, M.E.I.C., formerly director of utilities under the service administrator, Wartime Prices and Trade Board, has been retained as consultant on community planning for the Ontario Department of Planning and Development. He will continue as director of the Toronto City Planning Board.

P. M. Sauder, M.E.I.C.

P. M. Sauder, M.E.I.C., has been appointed to represent the Association of Professional Engineers of Alberta on council of the Institute pursuant to the coming into effect of the by-law granting such representation to provincial professional associations having co-operative agreements with the Institute.

Dr. L. Austin Wright, M.E.I.C., general secretary of the Institute, has recently been appointed member of the Board of Governors of Sir George Williams College, Montreal.

Ralph C. Flitton, M.E.I.C., of Canadian Vickers Limited, Montreal, has been appointed a member of the enlarged Montreal Protestant Central School Board which, as from July 1st, has taken control of the finances of the protestant schools in the metropolitan area. He was nominated chairman of the Board's Building Committee. Mr. Flitton is a member of the Publication Committee of the Institute.

A. E. Cameron, M.E.I.C., Deputy Minister of Public Works and Mines for the Province of Nova Scotia, was elected president of the Nova Scotia Mining Society, at the annual meeting held last month at Kentville. Mr. Cameron is a councillor of the Institute representing the Nova Scotia Association of Professional Engineers.

Wing-Cmdr. J. L. Gray, M.E.I.C., formerly with the Western Air Command, Royal Canadian Air Force, Vancouver, is now stationed at Air Force Headquarters, Ottawa.

M. J. McHenry, M.E.I.C., director of sales promotions, Hydro-Electric Power Commission of Ontario, has been elected a director of the American Institute of Electrical Engineers, New York, N.Y. He is chairman of the Engineering Institute's Committee on International Relations.

G. L. McGee, M.E.I.C., formerly with the Department of Transport, civil aviation branch, Ottawa, has recently accepted the position of Chief of the Building Supplies Division, Soldier Settlement and Veterans' Land Act.

F. E. M. Thrupp, M.E.I.C., has recently received an appointment as Director of Industrial Rehabilitation for the Balkan Mission, in the United Nations Relief and Rehabilitation Administration. He is at present located at Cairo, Egypt. Lately, Mr. Thrupp had been located in Washington as supply officer with the British Ministry of Supply Mission. Before the war he was manager for Canada and Newfoundland of the Buell Combustion Company, Limited, of London, England.

Oliver A. Barwick, M.E.I.C., M.R.A.I.C., has resumed practice as architect. In the May issue of the *Journal*, Mr. Barwick was represented as being with Robert A. Rankin and Company, industrial engineers, whereas such is the case that he is engaged by this firm, for special work, only for occasional periods.

W. E. Weatherbie, M.E.I.C., of Aluminum Company of Canada, Limited, has been transferred from Shawinigan Falls, Que., to Shipshaw.

Major Jacques Dery, Jr.E.I.C., has recently been promoted from the rank of captain. He was formerly with the Department of Public Works, as a junior engineer at Montreal. Major Dery is with the 2nd Survey Regiment, Royal Canadian Artillery in England.

A. Trudel, Jr.E.I.C., is the new secretary-treasurer, of the Saint Maurice Valley Branch of the Institute. Mr. Trudel is in the engineering department of Shawinigan Chemicals Limited, Shawinigan Falls, Que.

G. O. Sanders, Jr.E.I.C., formerly with Naval Ordnance for the British Admiralty, as assistant inspector, stationed at Providence, R.I., U.S.A., has now joined the staff of Massey-Harris Company Limited, Verity Works, Brantford, Ont.

Alan H. Meldrum, Jr.E.I.C., who was on the staff of the Algoma Steel Corporation, Sault Ste. Marie, Ont., is now employed by the British American Oil Company, Ltd., at Clarkson, Ont.

Armand Courchesne, S.E.I.C., is now employed with the Consolidated Paper Corporation, Limited, Grand'-Mère, Que.

G. B. Batanoff, S.E.I.C., formerly with the Canadian General Electric Company, Peterborough, Ont., has been transferred to the engineering department, industrial heating section, Davenport Works, Toronto.

Herbert F. Coupe, S.E.I.C., is now with the Jamaica Bauxites Limited, Jamaica, B.W.I. He was formerly with the Aluminum Company of Canada, Limited, Arvida, Que.

Obituary

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Eugene Walker Dimock Cummings, M.E.I.C., died on July 3, 1944, at the Colchester County Hospital, N.S. Born at Truro, N.S., in 1881, he received his education at McGill University graduating in electrical engineering.

Mr. Cummings spent several years in Mexico. In 1908 he was the electrical engineer for Dos Estrellas Mining Company, Mexico; 1911, electrical engineer with Guanajuato Power & Electric Company; 1913, electrical and mechanical engineer with Real del Monte Company and in 1915 he was electrical and mechanical engineer with LaLucha Mining Company. After having had several attacks of malaria, he returned to his native province and settled in Truro where he carried on a consulting practice.

Mr. Cummings joined the Institute as a Member in 1940.

Alfred Hedley Morgan died suddenly in Montreal on July 5, 1944. Born at Usk, Monmouthshire, England, on November 4, 1869, he received his education in Montreal. From 1884 to 1889 he was an apprenticed machinist, Montreal. In 1889 he was employed in the tool department of the Singer Manufacturing Company until 1892 when he became employed with Pillow Hersey Manufacturing Company, Montreal, being head of one of the departments. In 1895 he was a partner in the firm of Kerr & Morgan, manufacturing engineers, Montreal, remaining in this position until 1900. In 1901 he joined the firm of E. Leonard & Sons Ltd., London, Ont., as superintendent and later became vice-president of the company. During the last war and this one he was in charge of the munitions plant operated by the company.

Mr. Morgan became a Member of the Institute in 1922.

Harry Alton Wilson, M.E.I.C., died suddenly at his work in Rochester, N.Y., on June 14, 1944. Born at Glenora, Ont., on April 17, 1890, he received his education at the University of Toronto, graduating in mechanical and electrical engineering in 1911. For a number of years he was engineer for the J. C. Wilson Company, Glenora, Ont. During the first world war he was engineer and manager in charge of the J. C. Wilson Company's munitions factory at Belleville, Ont., and was subsequently appointed equipment engineer for the North East Electric Company, at Rochester, N.Y.

In 1923, he joined Canadian Fairbanks-Morse Company, Montreal, as chief engineer and was employed in this capacity until 1935 when he established himself as technical representative in Canada of several United States firms manufacturing mechanical equipment. At the beginning of the present war, he joined Canadian Car Munitions Limited, Montreal, later being appointed plant engineer at Cherrier, Que. On account of ill health he had to relinquish that position and went to the United States where for the past few months he had been employed with the Consolidated Machine Tool Corporation, at Rochester, N.Y.

At one time Mr. Wilson was connected with the McLean Publishing Company as technical editor in Montreal.

Mr. Wilson joined the Institute as an Associate Member in 1932, transferring to Member in 1938.

Wing-Commander D. S. Jacobs, D.F.C., S.E.I.C.

Wing-Commander David Sinclair Jacobs, D.F.C., S.E.I.C., officer commanding the Goose Squadron of the Canadian bomber group overseas who had been reported missing after operations over enemy territory on May 23, has now been reported dead. Born at Winnipeg, Man., on April 30, 1915, he received his education at McGill University, Montreal, where he graduated in 1937 in civil engineering. He did post-graduate work in Paris, France, for a year and, returning to Canada, joined the Canadian Liquid Air Company Toronto. He enlisted soon after the war broke out, and after training in Winnipeg and Toronto, he received his wings at Camp Borden in 1940. He was an instructor in Calgary and took advance training at Trenton before going overseas in March 1942.

He was with Canadian squadrons in England for over two years and participated in the first 1,000-plane raid on Essen as well as other operational sweeps.

On one occasion, as his plane was returning from a raid on Osnabruck, he was attacked by a German night-fighter. The rear-gunner was killed, the hydraulic system ruined and a tire shot away, but Wing-Cmdr. Jacobs shook off his pursuer by means of violent evasive tactics and brought his craft back to base to make a belly landing. For this service, he was awarded the Distinguished Flying Cross in 1943.

Last December, he was promoted to wing commander and appointed officer commanding of a Lancaster bomber squadron. He was within a few trips of completing his second tour of operations when he was reported missing.

Wing-Commander Jacobs joined the Institute as a Student in 1937. He was the son of L. C. Jacobs, M.E.I.C., director of the Defence Projects Construction Branch in the Department of Munitions and Supply.

Library Notes

Book notes, Additions to the Library of The Engineering Institute, Reviews of New Books and Publications

CANADIAN ENGINEERING STANDARDS ASSOCIATION

Canadian Electrical Code C22.1-1939:
Consideration is now being given to a general revision of the Canadian Electrical Code, Part 1, preparatory to the publishing of a fifth edition. Sub-committees have been organized to review the various sections of the code and are now actively engaged in the work of revision. Any and all proposals for revision will be welcome and should be submitted without delay to the Canadian Engineering Standards Association, Ottawa, in order that fullest consideration may be given well in advance of the closing date for receipt of proposals, which is October 1, 1944.

ADDITIONS TO THE LIBRARY

TECHNICAL BOOKS

Industrial Electronic Control:
W. D. Cockrell. N.Y., McGraw-Hill Book Co., 1944. 5¼ x 8½ in. $2.50.

Reinforced Concrete Water Towers, Bunkers, Silos and Gantries:
W. S. Gray. 2nd ed. London, Concrete Publications Ltd., 1944. 6½ x 9¾ in. 10s. 7d.

Rockets:
Willy Ley. Toronto, MacMillan Co. of Canada, 1944. 5¾ x 8½ in. $4.50.

Engineering Materials Annual 1944:
Edited by H. H. Jackson. London, Paul Elek (Publishers) Ltd., 1944. 5¼ x 8¼ in. 8s. 6d.

Engineering Production Annual 1944:
Edited by H. H. Jackson. London, Paul Elek (Publishers) Ltd., 1944. 5¼ x 8¼ in. 8s. 6d.

Apprenticeship for a Skilled Trade:
F. Twyman. London, Charles Griffin and Co. Ltd., 1944. 5½ x 8½ in. 5s.

TRANSACTIONS, PROCEEDINGS

American Society for Testing Materials:
Proceedings of the forty-sixth annual meeting held at Pittsburgh, June 28-July 1, 1943. Volume 43.

American Society for Testing Materials:
Index to A.S.T.M. standards including tentative standards, December 1943.

Canadian Institute of Mining and Metallurgy:
Transactions including those of the Mining Society of Nova Scotia for the year 1943. Volume 56.

The Institution of Water Engineers:
Transactions volume 58, 1943. London, The Institution, 1944.

Prov. of Quebec. Bureau of Statistics:
Statistical year book 1942-1943.

REPORTS

Quebec Streams Commission:
Twenty-ninth and thirtieth annual reports for the years 1940, 1941.

National Harbours Board:
Annual report for the calendar year 1943.

Nova Scotia: Board of Commissioners of Public Utilities:
Report for the year ended December 31, 1943.

Canada: Department of Labour:
Thirty-second annual report on labour organization in Canada for the calendar year 1942.

Canada: Dominion Water and Power Bureau:
Water resources paper No. 85; Surface water supply of Canada. St. Lawrence and southern Hudson Bay drainage Ontario and Quebec for climatic years 1937-38 and 1938-39.

Alberta: Department of Lands and Mines:
Annual report for the fiscal year ended March 31, 1943.

U.S.—Bureau of Mines:
Suggested procedure for conducting first-aid mine rescue contests.

U.S.—Bureau of Mines—Technical Papers:
No. 657; Dilution of stack effluents.—No. 661; Electrical devices applied to metallurgical research.

U.S.—Bureau of Mines—Miners' Circular:
No. 44; Construction, care and use of permissible flame safety lamps.

Purdue University—Engineering Bulletin:
Research Series; No. 91—Research and extension activities for the sessions of 1942-1943. No. 92—Solution of vibration problems by use of electrical models.

University of Illinois—Engineering Experiment Station:
Bulletin No. 350; Fatigue strength of fillet-weld and plug-weld connections in steel structural members.—No. 351; Temperature drop in ducts for forced-air heating systems.—Reprint Series No. 28; Tenth progress report of the joint investigation of fissures in railroad rails.—No. 29; Second progress report of the investigation of shelly spots in railroad rails.—No. 30; Second progress report of the investigation of fatigue failures in rail joint bars.—No. 31; Principles of heat treating steel.

University of California—Engineering Publications:
Vol. 5 No. 3; Transient heat conduction in hollow cylinders after sudden change of inner-surface temperature.

Electrochemical Society—Preprints:
No. 85-19; The extraction of indium from lead-tin bullion.—No. 85-21; Review of patents on electrolytic methods for making powdered metals.—No. 85-22; The early days of nickel-tungsten powder metallurgy.

British Standards Institution:

British Standard No. 308—1943; Engineering drawing office practice. The recommendations for standard practice commence with sizes and typical layouts of drawing sheets and the planning, numbering and referencing of series of drawings. Recommended scales, types of line, methods of projection, lettering, dimensioning and sectioning are set down followed by standard methods of indicating machining symbols, surface finish, screw threads, bolts, nuts, rivets and welds. Notes on structural steelwork, a list of abbreviations for drawings and directions for the preparation of graphs complete the numbered clauses. This revised edition supersedes B.S. 308-1927 and is priced at 3s. 6d.

British Standard No. 986—1944; Concrete railway sleepers. This specification provides data for the design and manufacture of both ordinary reinforced concrete and pre-stressed concrete sleepers. It incorporates up-to-date information collected from experiments and from experience with previous designs of sleepers. The type of pre-stressed concrete sleeper which is covered by this specification is that in which the steel is stretched in a straight length and where anchorage of the steel is by bond alone without mechanical aid. Information available to date is insufficient to justify provision for any other method of pre-stressing.

BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet all of these books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

COMPOSITE AIRCRAFT MANUFACTURE AND INSPECTION

By L. C. Michelon and R. J. Devereaux. Harper & Brothers, New York and London, 1944. 547 pp., illus., diagrs., charts, tables, 11 x 8 in., cloth, $6.00.

The aim in this book is to describe the manufacture and inspection of composite aircraft. It covers the basic materials used, metals, wood, plastics and fabrics, and the Army-Navy aeronautical specifications covering them. It discusses the processes by which they are fabricated into finished structures and presents the methods and instruments used in inspecting them. The book is fully illustrated and covers the subject comprehensively.

EXPERIMENTAL STRESS ANALYSIS

Proceedings of the Society for Experimental Stress Analysis, Vol. 1, No. 2, held at Hotel Pennsylvania, New York, Dec. 2, 3, 4, 1943. Addison-Wesley Press, Kendall Square Bldg., Cambridge 42, Mass., 1944. 132 pp., illus., diagrs., charts, tables, 11¼ x 8½ in., cloth, $4.00.

The Society, which is a reorganization of the former Eastern Photoelasticity Conference, presents its second publication. Fifteen papers are included, dealing with methods of stress measurement and stress analysis in heavy machinery, aircraft and other structures. The volume also includes synopsis of the papers contributed by the Applied Mechanics Division of the American Society of Mechanical Engineers to the joint meeting in December, 1943, at which these papers were presented.

HEATING, VENTILATING, AIR CONDITIONING GUIDE 1944

American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York. 1,168 pp.; Roll of Membership 104 pp., illus., diagrs., charts, tables, 9 x 6 in., fabrikoid, $5.00.

The new edition of this reference book follows the pattern of previous ones. It has, however, been thoroughly revised and many new data added, to bring it up to date. A new chapter, on marine heating and ventilation, has been added. The new edition maintains the position as a practical guide to the best practice in its field.

INDEX FOSSILS OF NORTH AMERICA

By H. W. Shimer and R. R. Shrock; a publication of the Technology Press, Massachusetts Institute of Technology; John Wiley & Sons, New York; Chapman & Hall, London, 1944. 837 pp., illus., tables, 11 x 7½ in., cloth, $20.00.

This is a revision of Grabau and Shimer's "North American Index Fossils" and, like that work, is a treatise on "those fossils best adapted for the determination of geologic horizons." The work now describes and figures about 7,500 species. Over 300 plates are included, showing about 9,400 illustrations. There are select bibliographies for the larger divisions. The investigator of stratigraphic paleontology will find the book indispensable.

MANUAL OF FIREMANSHIP, Pt. 2, Appliances

Great Britain. Home Office (Fire Service Department). Publ. by His Majesty's Stationery Office, London, 1944. 186 pp., illus., diagrs., charts, tables, 8½ x 5½ in., paper, 2s. 6d. (obtainable from British Information Services, 30 Rockefeller Plaza, New York, 75c.).

The Manual of Firemanship, issued by the Fire Service Department of the British Home Office, is a comprehensive survey of firefighting and fire prevention. The present section discusses appliances, including pumps and their operation, ladders of all types for firefighting and rescue work, and such special appliances as hose carriers, foam equipment, smoke exhausters, mobile kitchens, etc.

Ostwald-Luther HAND—und HILFSBUCH zur AUSFÜHRUNG PHYSIKO—CHEMISCHER MESSUNGEN

Edited by C. Drucker. 5th new ed. Dover Publications, 31 East 27th St., New York, 1943. 986 pp., illus., diagrs., charts, tables, 9 x 6 in., fabrikoid, $4.95.

For nearly fifty years this manual of physico-chemical measurements has been widely known as one of the best handbooks of its kind. The present publication is a reproduction of the latest (fifth) German edition. The publishers have added a translation of the table of contents and a glossary of technical terms used in the book which American users will find helpful. The price is about one-fourth that of the German edition.

PRINCIPLES OF POWDER METALLURGY

By F. Skaupy. Philosophical Library, 15 East 40th St., New York, 1944. 80 pp., illus., diagrs., charts, tables, 9¼ x 6 in., cloth, $3.00.

This is a translation of a German book that was published in 1930. It describes briefly the production and properties of metal powders and the methods of production of powdered metal parts, as developed at that time.

AMMUNITION, its History, Development and Use, 1600 to 1943—.22 BB Cap to 20 mm. Shell.

By M. M. Johnson, Jr. and C. T. Haven. William Morrow and Co., New York, 1943. 374 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $5.00.

The development of ammunition is traced from the beginning of the paper musket cartridge to the forms used to-day. It covers both early and modern pistol and revolver cartridges and all foreign and American sporting cartridges, and discusses the larger type of fixed ammunition now being used in anti-aircraft and anti-tank cannon. Much information is included on defects in cartridges, stoppages, ballistics, etc.

(The) FLIGHT TESTING OF PRODUCTION AIRCRAFT

By J. A. C. Warren. Sir Isaac Pitman & Sons, London; Pitman Publishing Corp., New York, 1943. 131 pp., illus., diagrs., charts, tables, 9 x 5½ in., cloth, $3.00.

This manual presents the principles and purposes of the flight testing of production aircraft. The general faults that are likely to occur are described, and methods to be adopted in finding their causes are indicated.

FUNDAMENTALS OF TELEPHONY

By A. L. Albert. McGraw-Hill Book Co., New York and London, 1943. 374 pp., illus., diagrs., charts, maps, tables, 8½ x 5½ in., cloth, $3.25.

This is an elementary text on wire telephony only, intended for beginning students and telephone workers, rather than for trained engineers.

PUBLIC RURAL ELECTRIFICATION

By F. W. Muller. American Council on Public Affairs, 2153 Florida Ave., Washington, D.C., 1944. 183 pp., tables, 9 x 6 in., paper, $2.50; cloth, $3.00.

This is a report on the development and present status of rural electrification in this country, with some attention to future possibilities. The functions, organization and general character of the Rural Electrification Administration and of local co-operative systems are discussed, as well as their relationships in regard to control and planning.

QUESTIONS AND ANSWERS FOR MARINE ENGINEERS, Auxiliaries—Application of Steam and Heat in Producing Power—Powering, Fuel Economy, Propulsion, Propellers and Shafting

Compiled by H. C. Dinger. Marine Engineering and Shipping Review, New York, 1944. 330 pp., diagrs., tables, 8¼ x 5 in., paper, $2.00.

This book gives practical answers to problems that confront marine engineers. The operation and maintenance of pumps, condensers and other auxiliary machinery, the application of steam and heat in producing power, and powering, propulsion, propellers and shafting are the subjects covered.

PRELIMINARY NOTICE

of Applications for Admission and for Transfer

June 26th, 1944.

The By-laws provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described at the September meeting.

L. Austin Wright, General Secretary.

*The professional requirements are as follows:—

A Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science or engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainment or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

CARLYLE—DAVID GORDON, Lieut., of Vancouver, B.C. Born at Lethbridge, Alta., Oct. 13th, 1919. Educ.: B.A.Sc. (Mech.), Univ. of B.C., 1943; 1935-36, refrigeration mtce. (dairying); 1936-37, refrig'n. design, install'n., etc., for Frank Knowles, M.E., also training in dfting., mach. shop, welding and elect'l. work, Vancouver Tech. School; 1939-40, mach. shop work, Britannia Mining & Smelting Co.; 1942 (May to Sept.), preliminary E.M.E. training in Canada with the C.A.; 1943, enlisted in R.C.O.C. as E.M.E. (4th class), and at present, O.C., No. 63, L.A.D., R.C.O.C., Canadian Army Overseas.

References: J. N. Finlayson, H. J. MacLeod.

COCK—CECIL JAMES, Capt., R.C.E., of 4022 Quesnelle Drive, Vancouver, B.C. Born at Phoenix, B.C., Oct. 15th, 1900. Educ.: B.A.Sc. (Chem.), Univ. of B.C., 1923; 1924-42, instructor, chemistry, physics, maths., etc., Magee High School, Vancouver; 1942-44, Training Officer and 2nd-in-Command, 6th (Reserve) Field Coy., R.C.E.

References: T. V. Berry, W. O. Scott, W. H. Powell, J. R. Grant, J. McHugh.

DOUGLAS—ROBERT BELL, of 4809 Grosvenor Ave., Westmount, Que. Born at Bisbee, Arizona, Feb. 9th, 1914. Educ.: B.Sc., 1936, M.Sc., 1938, Mass. Inst. of Technology; with the Canadian Car & Foundry Co. Ltd., Montreal, as follows: In the aeronautical div'n., 1938-39, asst. to designing engr., 1939-40, produc'n. engr., and in the propeller div'n., 1940-42, asst. supt., 1942-43, supt., and 1943 to date, works mgr.

References: L. McCoy, A. T. Hurter, J. B. Francis, J. M. Robertson, C. Craig, A. Ferrier, N. M. Campbell.

FIFE—THOMAS, of 1320 Rockland Ave., Victoria, B.C. Born at Gateshead, England, Jan. 21st, 1901. Educ.: 1924 and 1928, South Shields Marine School; First Class Board of Trade Certificate, London (as Chief Engr.); 1917-22, ap'tceship as marine engr., R. & W. Hawthorn Leslie & Co., Newcastle-on-Tyne. With Furness Withy & Co. as follows: 1922-28, junior engr., 1928-30, second engr., S. S. British Prince, 1930-36, chief engr., turbo elec. vessel, "Monarch of Bermuda"; 1936-40, asst. engr., Bermuda Elec. Light, Power & Traction Co.; with the R.C.N. as follows: 1940-41, Lieut. (E) i/c mach., H.M.C.S. "Restigouche"; 1941-43, Lieut.-Cmdr. (E), N.S. Headqtrs., asst. to Director of Ship Repairs, and at present, Acting Cmdr., (E), O.C., Mech. Training Establishment, West Coast.

References: G. A. Browne, A. C. M. Davy, J. Middleton, J. S. Cooper, A. D. M. Curry, W. S. Morrison, R. K. Odell.

GIBBS—MAXWELL, of 1927 West 6th St., Los Angeles, California. Born at New York, Dec. 4th, 1892. Educ.: B.Sc. (Civil Engrg.), Cooper Union Inst. of Technology, New York, 1914; R.P.E. of the State of New York; Assoc. Member, A.S.C.E., 1943; Member, A.S.M.E., 1944; Member, American Soc. of Military Engrs.; 1914-16, asst. engr. on constrn. of sections of 7th Ave. subway, New York; 1916-17, engr. and steel concrete designer, Burchartz Engrg. Co., New York; 1917-19, engr. of constrn., Brooklyn Navy Yard, New York; 1919-20, engr. and designer of steel concrete structures, Truscon Steel Co., New York; 1920-21, chief engr., New York office, National Concrete Metal Forms Corp'n. of Newark, N.J.; 1921-24, engr. and cost estimator of New York subway constrn. incl. repair yards for subway trains, D. C. Serber Co., New York; 1925-29, in business as engrs. and contractors under the name of Gibbs-Rice Co., New York; 1929-32, in business as engr. and contractor under the name of Maxwell Gibbs Corp'n., New York; 1933-41, consultant and prof. engr. and cost accountant, licensed by the State of New Yrok; 1941-42, assoc. mech. and structl. engr. with dept. of plant operation and gen. estimator with military div'n., U.S. Engineers, Honolulu; at present, engr., plant layout dept., North American Aviation Co., Los Angeles, California.

References: T. Barbato (Member, A.S.C.E.), S. B. Arison (Assoc. Member, A.S.C.E.), M. J. Joseph (R.P.E. of New York State), A. J. Linsky (R.P.E. of New York State), I. Warshaw (R.P.E. of New York State).

GORDON—ARTHUR I. E., of 578 West 23rd Ave., Vancouver, B.C. Born at Ferguson, B.C., April 13th, 1904. Educ.: B.A.Sc. (Civil), 1927, and B.A.Sc. (Geol. Eng.), 1935, Univ. of B.C.; 1920-25 (summers), survey asst., Hydrographic Survey of Canada; 1926-27 (summer), instru'mn., Geodetic Survey of Canada; 1927, transitman, Greater Vancouver Water Dist.; 1928, transitman, C.P.R. Co., Vancouver Div'n., on yards, mtce. and constrn., also engr on location and constrn. of Klondyke River Power Diversion for Yukon Consldt. Gold Corp'n.; 1929, dftsman., timekeeper, Dominion Bridge Co., Vancouver; 1929-35, asst. engr., Vancouver & Dist. Joint Sewerage & Drainage Bd., instru'mn. on constrn. of shaft, tunnel, etc., outfall sections of English Bay interceptor sewer, designing and res. engr. on various trunk sewer projects; 1935-37, asst. engr., Premier Gold Mining Co., office engr., mine surveyor, etc.; 1937-38, asst. engr., Britannia Mining & Smelting Co. (Copper mine); 1938 to date, with City Engineer's office, Vancouver, dft'ng, field work and research, design of sewerage systems, etc.

References: C. Brakenridge, R. Rome, W. H. Powell, T. V. Berry, J. M. Begg.

HAHN—HERMAN GUSTAV, of Viauville, Montreal, Que. Born at Belle Plaine, Sask., July 11th, 1916. Educ.: B.A. (Geol.), Univ. of Sask., 1939, B.Sc. (Mining Eng.), Queen's Univ., 1941. 1938-39-40 (summers), miner's helper, Sheep Creek, B.C., and South Porcupine, Ont.; 1941-43, chemist and lab. foreman, D.I.L., Nobel, Ont.; 1943, industrial radiography in welding inspec'n., and at present, industrial radiographer (qualified by R.C.A.F.), and technical supervisor, engrg. div'n., Canadian Vickers Ltd., Maisonneuve, Montreal.

References: G. Agar, R. K. Thoman, R. C. Flitton, P. F. Stokes, R. M. Calvin.

HOLLYHOCK—WALTER STANLEY, of "Langley", Dorney Grove, Weybridge, Surrey, England. Born at London, England, July 12th, 1898. Educ.: 1919-22, London University; Assoc. Fellow 1939, Royal Aero. Society, London, England; 1913-15, indentured apprenticeship in mech. engrg., not completed owing to service with H.M. Forces; with Hawker Aircraft Ltd., Kingston-on-Thames, England, as follows: 1922-25, aircraft dftsman., 1925-29, designing dftsman., section leader, 1929-31, roll and die (aircraft) designer, 1931-37 designer i/c foreign contracts (aircraft), 1937-40, asst. chief dftsman. (Air Ministry contracts), and 1940 to date, chief dftsman.

References: S. Camm (F.R.Ae.S.), R. H. Chaplin (A.F.R.Ae.S.), L. R. E. Appleton (A.F.R.Ae.S.), F. H. M. Lloyd (A.F.R.Ae.S.), R. C. B. Hendy (A.F.R.Ae.S.), T. E. Davies (A.R.Ae.S.), J. R. Cotton (A.R.Ae.S.).

MACDONALD—GEORGE EDWARD SCOTT, of 1950 St. Luke St., Montreal, Que. Born at Sedley, Sask., March 2nd, 1907. Educ.: B.Sc. (Elec.), Milwaukee School of Engrg., Milwaukee, 1933; 1924-28, serviceman, Radio Supply Co. Ltd., Edmonton, also amateur radio bldg.; 1930-31, asst. lab. instructor, Milwaukee School of Engrg. (part time work); 1936-38, studio engr., CFRN, Edmonton, i/c equipm't., mtce., constrn., etc.; 1938-40, station engr., CFAC, Calgary, assisted in re-design and re-bldg. of part of IKW transmitter; 1940-42, chief radio engr., mtce. and install'n. of aircraft radio equipm't., and 1942-44, radio supt., No. 2 Air Observer School, Edmonton. At present, radio development engr., "Systems" div'n., Northern Electric Co., Montreal.

References: J. W. Porteous, A. Sandilands, J. J. H. Miller.

Employment Service Bureau

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.

NOTICE

Technical personnel should not reply to any of the advertisements for situations vacant unless—

1. **They are registered with the Wartime Bureau of Technical Personnel.**
2. **Their services are available.**

A person's services are considered available only if he is—

(a) unemployed;
(b) engaged in work other than of an engineering or scientific nature;
(c) has given notice as of a definite date; or
(d) has permission from his present employer to negotiate for work elsewhere while still in the service of that employer.

Applicants will help to expedite negotiations by stating in their application whether or not they have complied with the above regulations.

SITUATIONS VACANT

CIVIL OR MECHANICAL ENGINEER wanted. See page 59 of the advertising section.

DRAUGHTSMAN WANTED—Wire and cable manufacturers require an experienced mechanical engineering draughtsman for shop and equipment layout work. To a man with initiative and energy the position offers an interesting prospect and is permanent. Apply to Box 2791-V.

ELECTRICAL DESIGNER WANTED—Graduate engineer with two to four years' design and layout experience in electric power utility installations. Location, mid-west. In reply give full particulars of previous experience, tate salary expected, age, etc. Do not reply unless available under Order-in-Csouncil P.C. 246. Apply to Box No. 2792-V.

ELECTRICAL ENGINEER—We are not too large and we are not too small. You will not lose your identity because an opportunity awaits an electrical engineer with commercial vision and ingenuity who can design products for industrial, communication and power companies.

A knowledge of electro chemistry will be an advantage. The remuneration is way above the average, which will encourage the man who accepts the position to produce results. Tell us about what you have been doing, not what you have been earning and what you have on the ball for this position. There is only one person going to see your reply and he knows enough to keep his mouth shut.

Apply to Box No. 2793-V.

SITUATIONS WANTED

ELECTRICAL ENGINEER, graduate, 20 years' broad experience, desires responsible position with progressive company. Apply to Box No. 278-W.

GRADUATE ELECTRICAL ENGINEER with over fifteen years experience in design, construction, operation and maintenance of electrical installations in industrial plants. Available on short notice. Registered with W.B.T.P. Apply to Box No. 1718-W.

M.E.I.C., UNIVERSITY GRADUATE with manufacturing experience, mechanical and chemical processes, design and supervision, seeks temporary or part-time employment. Apply to Box No. 1878-W.

CHEMICAL ENGINEERING GRADUATE '44 desires permanent employment. Keen, young, willing to accept any position with possibilities for the future. Apply to Box No. 2464-W.

MECHANICAL ENGINEER, Canadian graduate, age 36, married, with ten years of outstanding domestic and foreign experience in industrial engineering and management, seeks a responsible permanent position in this field with post-war opportunities. Accustomed to handling executive responsibilities and with a proven ability to secure the co-operation of others. Intimate knowledge of South America. Available at once. Apply to Box No. 2465-W.

Junior Civil Engineer or Surveyor

REQUIRED FOR JAMAICA

Apply to Box No. 2805-V

PRELIMINARY NOTICE *(Continued)*

McPHERSON—JOSEPH EDWARD, Major, R.C.E., of 354 Campbell St., Winnipeg, Man. Born at Cochrane, Alta., April 18th, 1894. Educ.: 1910-15, Western Canada College; with the Dept. of Public Works, Alta., as follows: 1926-28, rodman, 1929, instru'mn., 1930-31, junior engr., i/c gravel surfacing contract, 1935-37, instru'mn., i/c detached party, 1938, instru'mn., i/c office, design, highway projects, etc., 1939-41, junior engr., i/c location, constrn., etc.; 1941, qualified Lieut., A 6 Advanced Training Centre, R.C.E., Dundurn, Sask.; 1941, Works Officer (Lieut.), and 1942-44, Dist. Fire Prevention Officer (Major), Military Dist. No. 10, Winnipeg, Man., superv'n. of bldgs., struct'l. alterations, design and control of safety measures, etc.

References: T. H. Kirby, J. N. McLean, W. D. Hurst, J. Veitch, F. S. Adamson.

NAGY—ALEXANDER JOSEPH, of 446 Hurontario St., Collingwood, Ont. Born at Yarbo, Sask., May 28th, 1910. Educ.: Diploma in Mech. Engrg., Technological Inst. of Great Britain, Toronto (3-yr. correspondence course); 1926-30, ap'tceship, Mr. James Smart, Hazel Cliffe, Sask.; 1930-34, in business for self, Esterhazy, Sask.; 1934-35, asst. foreman, Foullard Implement Exchange, St. Lazare, Man.; 1935-37, mech. supt., i/c shop, Yorkton Implement Exchange; 1938-40, gen'l. mtce., Brunner Mond, Amherstburg, Ont.; 1940-42, engrg. dept., Canadian Bridge Co., Ojibway, Ont., toolage for Universal Carriers (4 mos.), and foreman on final assembly (18 mos.); 1942-43, asst. supt., Massey Harris Co., Brantford, gun mounting and tool proving (Mosquitoes); 1943-44 (March), mech. supt., Acme Machine Shop, London. At present, toolroom foreman, Clyde Aircraft, Mfg. Co., Collingwood, Ont.

References: F. J. Pollock, W. M. Mitchell, A. H. MacQuarrie.

RANGE—GEORGE NEIL, S/Sgt., R.C.E., of 628½ Notre Dame Ave., Winnipeg, Man. Born at Copenhagen, Denmark, April 22nd, 1899. Educ.: B.Sc. (Arch. Eng.), The Royal Technical College, Denmark, 1921; 1921-24, military engr., Royal Danish Army; 1924-27, T. A. Burrows Lumber Co. Ltd.; Bowsman River, Man., bldg. dams, roads, scaling and grading lumber, etc.; 1927-30, engr., W. K. Bearisto, plumbing and heating contraetor, Winnipeg; 1930-32, lumber grader and checker, T. A. Burrows Lumber Co. Ltd.; 1932-41, farming at Bowsman River, Man. (own dairy farm), and also (summers), road inspr., Rural Municipality of Swan River; 1941-44, Military Foreman of Works, No. 10 Coy., E.S.&W., R.C.E. and at present, Military Foreman of Works and Asst. to Capt. S. L. Thompson, R.C.E. Works Officer, M.D. No. 10, Fort Osborne Barracks, Winnipeg.

References: J. N. McLean, E. C. Cowan, C. B. Jackson, E. W. R. Butler, R. H. Robinson.

ZACHARIAS—EDWARD RONALD, of Welland, Ont. Born at Herbert Sask., Feb. 19th, 1914. Educ.: B.Eng. (Civil), Univ. of Sask., 1935; 1935 (summer), geological survey of ground water resources in southern Sask. and Alta., Dept. of Mines and Resources; 1936-37, time study engr., Jos. Stokes Rubber Co., Welland, Ont.; 1937-38, time study and estimating, Massey Harris Co., Toronto; with Jos. Stokes Rubber Co., Welland, as follows: 1938-42, planning and produc'n. engr., 1942 to date, factory produc'n. engr., mfg. of plastic, hard and soft rubber—mainly for automotive trade and for the D.M.& S.

References: C. J. Mackenzie, A. Tubby, E. K. Phillips, C. Neufeld, H. O. Peeling, L. C. Sentance.

THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 27 | MONTREAL, SEPTEMBER 1944 | NUMBER 9

"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

★ ★ ★

PUBLISHED MONTHLY BY

THE ENGINEERING INSTITUTE OF CANADA

2050 MANSFIELD STREET - MONTREAL

Price 50 cents a copy, $3.00 a year: in Canada, British Possessions, United States and Mexico. $4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, $2.00 a year. —Entered at the Post Office, Montreal, as Second Class Matter.

CONTENTS

THE "SEXTON"—A 25-pdr. full-tracked, self-propelled mount, manufactured in Canada (N.F.B. Photo) . . . . . Cover

THE COMBUSTION GAS TURBINE 488
Armin K. Lenthold, M.E.I.C.

DEFENCE PROJECTS IN NORTHWEST CANADA 498

THE INTERCEPTING SEWER SYSTEM IN QUEBEC CITY . . 503
J. G. Chenevert, M.E.I.C.

THE BAILEY BRIDGE 513
Colonel E. C. Thorne, M.E.I.C.

FROM MONTH TO MONTH 514

PERSONALS 522
Obituaries 523

NEWS OF THE BRANCHES 525

LIBRARY NOTES 527

PRELIMINARY NOTICE 529

EMPLOYMENT PAGE 530

THE COMBUSTION GAS TURBINE

Basic principle, various applications and prospects for the future

ARMIN K. LEUTHOLD, M.E.I.C.
Chief Engineer, Swiss Electric Company of Canada, Montreal, Que.

Summary of paper delivered before the Saguenay Branch of the Engineering Institute of Canada, at Arvida, Que., on March 8th, 1944.

In principle, there are two types of gas turbines namely, the constant volume turbine, called the explosion gas turbine in which combustion takes place intermittently by explosion in a closed chamber with a substantial rise in pressure and the so-called continuous combustion gas turbine where continuous combustion takes place, the pressure of which depends on and varies with the load.

As the explosion gas turbine is outside the scope of this present paper, only the most important developments of the combustion gas turbine are further discussed, a great part of which has been contributed by Brown Boveri & Company (Switzerland).

Preliminary Steps

One of the very earliest (about 1915) practical applications of a gas turbine was in connection with supercharging of Diesel engines. In order to make use of the last portion of the expansion of the gases in an ordinary four-stroke Diesel engine, which the unsupercharged engine is throwing away, the exhaust gases are used to actuate an exhaust gas turbine, which drives a supercharging blower. The compressed air supplied by the blower increases considerably the weight of the available air for combustion, scavenges the residual gases of the compression spaces and cools all parts of the combustion chamber, by which means the power output of the engine can be considerably increased. By supercharging, the Diesel engine output can be increased on an average 50 to 60 per cent or even more, the specific fuel consumption is improved and considerable space saving is possible because—due to the very small weight increase by the supercharger—an approximate 30 per cent greater power-weight ratio is obtained.

Fig. 1—Brown Boveri exhaust gas turbo-blower for charging aeroplane engines.

The gas turbine driven supercharger, Fig. 1, has also been applied with great success during the last few years on aircraft engines in order to obtain a higher engine output in relatively high altitudes.

An important step forward in the design of the gas turbine and compressor was achieved (around 1930-32) when a gas turbine driven compressor was applied in connection with the Velox steam generator, Fig. 2, which is a boiler of very high efficiency (93 to 95 per cent) with combustion under pressure and forced circulation. There are in operation over 75 Velox steam generator plants, totaling an output of over five and a half million pounds of steam per hour, of which a number of plants have more than 40,000 operating hours to their credit. The pressure produced by the compressor is partly applied to maintain high gas velocities in the heat-transmitting parts of the Velox boiler to obtain high rates of heat transfer, and partly to drive the gas turbine. In order to obtain a very high boiler efficiency, it was necessary that the exhaust gas turbine could develop all the power required for the compressor and therefore much effort was given to designing a compressor and gas turbine of very high efficiency.

This has been attained by developing a four to five stage reaction turbine and a ten to twelve, or even more, stage axial compressor, designed according to the latest research in the field of aerodynamics. This first achievement of a relatively high overall efficiency of the gas turbine driven compressor set enabled that, in addition to the energy required for full load of the compressor, even excessive power could be made available which opened a wide field for many interesting applications of the gas turbine for power generation, traction, propulsion, etc.

Basic Principle of the Combustion Gas Turbine

The simplest form of a combustion turbine power generating plant is illustrated in Fig. 3. Air drawn from the surrounding atmosphere is compressed in the axial compressor (a) to approximately 30 to 60 lb. per sq. in. and forced into the combustion chamber (b). Part of the air enters through the air nozzle (d) where it is mixed with the fuel which enters through the burner nozzle (c), while the remaining part of the air is forced through the annular space (e) between the burner jacket and the wall of the combustion chamber. This latter part of air cools the burner jacket and enters finally into the combustion chamber (b) where it mixes with the combustion gas leaving the burner jacket and reduces the temperature of this gas to a value which is admissible for the gas turbine blades (f). In this simplest form of gas turbine, the gas passes through the turbine and goes straight to the chimney without utilizing the heat contained in the exhaust gas. The speed of the gas turbine is governed by controlling the fuel oil supply through the burner nozzle and also by means of the by-pass valve (h) which acts as a relief valve. The generator (i) is coupled, over a

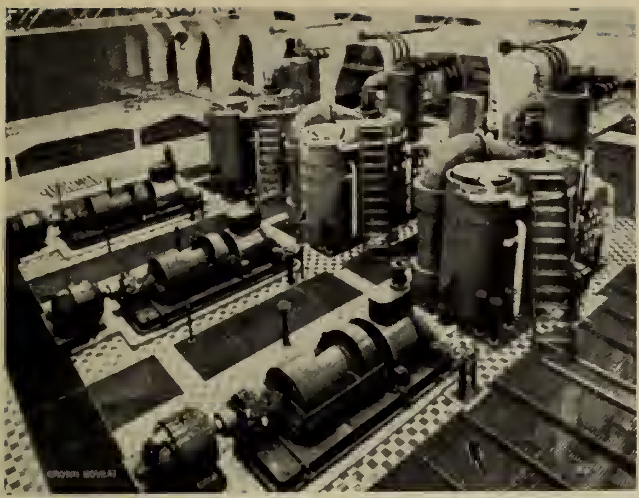


Fig. 2—Three Velox steam generators each for 34.5t/h of steam, with gas turbine driven compressor erected in front of each boiler, at Haifa power plant.

reduction gear, to the shaft of the compressor and a small starting motor (k) is applied for starting up the compressor to such a speed that it can deliver the quantity of combustion air which is required for igniting the combustion chamber. The fuel oil and lubricating pumps are shown as further auxiliaries.

Such a gas turbine power plant seems to be extremely simple in comparison to a steam power plant where a boiler with such auxiliaries as: feed water pump, water treatment plant, condenser with circulating water, air-extraction and condensate pump and water supply system, are necessary. With the gas turbine applied in this simplest form without preheater, a thermal efficiency at the coupling of the turbine of 17 to 18 per cent can be expected for net outputs of 2000 to 8000 kw. assuming an overall compressor and turbine efficiency of 74 to 75 per cent and a gas turbine inlet temperature of 1000 deg. F. Before high pressures were introduced in steam power plants, 18 per cent was considered a satisfactory efficiency for such a size of steam turbine plant and only by introducing, in modern steam power plants, high pressures and temperatures and applying regenerative heating of condensate, air preheating, etc., was it possible to attain—for such outputs—a coupling efficiency as high as 25 per cent.

Entropy-Diagram of the Gas Turbine Cycle

In order to show how the efficiency of a gas turbine plant can be further improved to very appreciable values, the gas turbine cycle is explained further with the help of the entropy diagram as illustrated in Fig. 4. While for an exact calculation, the gas changes (during the cycle) in quantity and composition will have to be considered, we assume, for the sake of simplicity, a constant specific heat at constant pressure (c_p) and an invariable gas constant.

If the compressor draws in air of atmospheric pressure $(p_1) = 1$ Kg/cm^2. abs. at a temperature of 20°C. which is equal to an absolute temperature $T = 293°$, the cycle begins at point (A). Assuming as a first approximation that the cycle would be without losses, i.e. a compressor and gas turbine of 100 per cent efficiency, then compression would take place adiabatically up to pressure (p_2) and reaches point (B) and the work $AB \times c_p$ expressed in heat units is expended. If we permit a gas temperature of 550°C. (1022°F.) for the gas turbine, which corresponds to $T = 823°$, sufficient heat is introduced to the combustion chamber, at constant pressure (p_2), to reach point (C), the corresponding quantity of heat is $\triangle t_{z_0} \times c_p$. The mechanical output due to adiabatic expansion in the turbine is represented by $CD \times c_p$. The available useful output (with an electrical efficiency ηel) accordingly becomes:

$$L_{n_0} = (CD - AB) \times c_p \times \eta el = A'D \times c_p \times \eta el$$

and the thermal plant efficiency amounts to:

$$\eta t_0 = \frac{A'D}{\triangle t z_0} \times \eta el$$

i.e., with increasing temperature, the useful output increases because the latter is represented by a difference (CD—AB) which is obtained from the divergence of the constant pressure lines (p_1) and (p_2).

In the above, we assumed the cycle without losses, but actually the compression takes place with an efficiency η_v and therefore ends in B′ instead of B, the work expended being $AB/\eta_v \times c_p$. Likewise the expansion actually takes place with an efficiency η_g and therefore ends in D′ instead of D, the actual output liberated in the turbine being $CD \times \eta_g \times c_p$ and therefore the actual effective useful output becomes:

$$L_{n_1} = \left(CD \times \eta g - \frac{AB}{\eta v}\right) \times c_p \times \eta el = \triangle t_{n_1} \times c_p \times \eta el.$$

As in this case, only an amount of fuel corresponding to the quantity of heat $c_p \times \triangle t_{z_1}$ is required, the effective thermal plant efficiency amounts to:

$$\eta t_1 = \frac{\triangle t_{n_1}}{\triangle t_{z_1}} \times \eta el$$

By a similar reflection to the above, the entropy diagram shows how the useful output would be increased if the temperature before the gas turbine were to be increased. If, for example, a temperature of 777°C. (1430°F.) would be admissible for the gas turbine, which corresponds to point (E), that is $T = 1050°$, a quantity of heat $\triangle t_{z_2} \times c_p$ would have to be introduced to the combustion chamber. Assuming still a compression from p_1 to p_2, the work of compression (AB′) remains unaltered, while the mechanical output due to expansion (EF′) in the turbine is increased and therefore the effective useful output becomes increased to:

$$L_{n_2} = \triangle t_{n_2} \times c_p \times \eta el$$

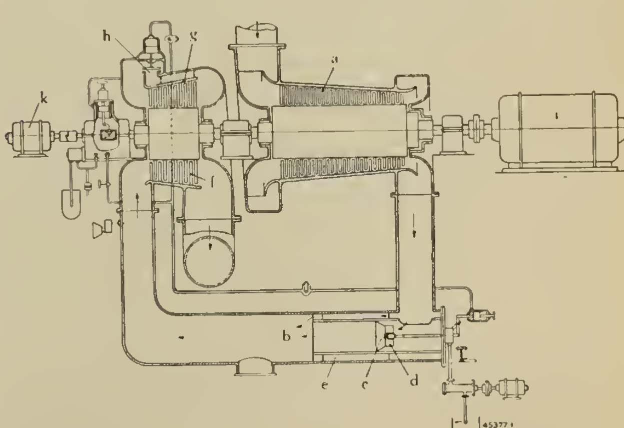


Fig. 3—Diagram of the simplest form of a combustion turbine plant for oil fuel with a reaction type gas turbine and an axial compressor.

a. Axial compressor
b. Combustion chamber
c. Burner nozzle
d. Air nozzle
e. Cooling air ring
f. Gas turbine blades
g. Gas turbine
h. Relief valve
i. Generator
k. Starting motor

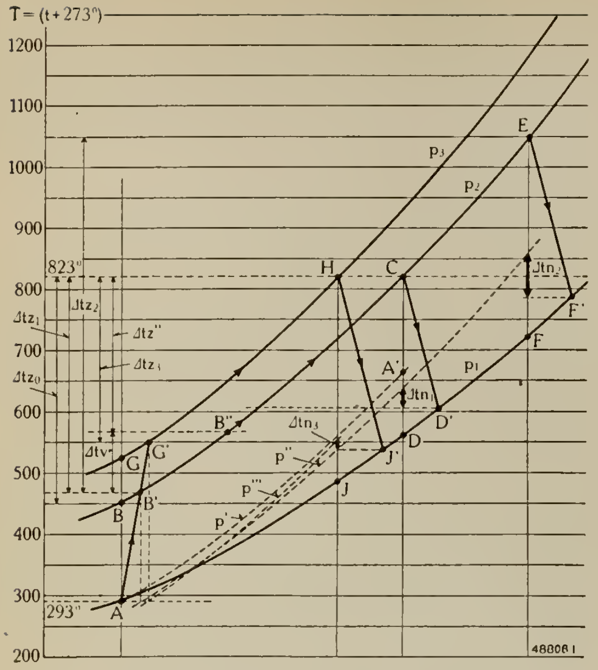


Fig. 4—Entropy diagram for a gas-turbine plant.

And the thermal efficiency of the plant is:

$$\eta t_2 = \frac{\Delta t_{n_2}}{\Delta t_{z_2}} \times \eta el.$$

From the entropy diagram can also be easily seen how the conditions change if the compression is carried out to a higher pressure (p_3) instead of a pressure of (p_2) only. The state at the outlet of the compressor corresponds to point (G′), and assuming a maximum admissible temperature of $T = 823°$, we can only introduce the heat $\Delta t_{z_3} \times c_p$ to the combustion chamber. The outlet from the combustion chamber corresponds to point (H) and the expansion ends at point (J′). In spite of the fact that the divergence of the constant pressure lines (p_1) and (p_3) is greater than that of (p_1) and (p_2), the useful output: $L_{n_3} = \Delta t_{n_3} \times c_p \times \eta el$ is very small because the expansion line (HJ′) is closer to the compression line (AG′) than is the expansion line (CD′) which corresponds to a lower pressure (p_2). If, on the other hand, we consider the limiting case where the heat is introduced along the constant pressure line (p_1), with no compression at all, there are only the losses left and the useful output is negative. We can clearly conclude, from the above, that there is a certain pressure (p_2) for which the useful output reaches a maximum.

When designing the first gas turbine plant, it was found that this range of (p_2/p_1) for maximum useful output was approximately 4, considering a maximum admissible absolute temperature $T = 823°$ respectively a gas inlet temperature of 550°C. (or 1022°F) and therefore for the constant-pressure gas turbine, a combustion chamber pressure of approximately 60 lb. per sq. in. was chosen.

A higher efficiency than shown above can be obtained if the exhaust gases which leave the turbine at a comparatively high temperature (D′) will be passed through an air preheater which is connected between compressor and combustion chamber. In this case, the air which enters the cycle AB′CD′ has already a temperature of B″, due to the heat $\Delta t_v \times c_p$, which was recovered and therefore only the heat $\Delta t_{z''} \times c_p$ has to be supplied by the fuel; but, otherwise, everything remains the same. The thermal efficiency of the plant therefore increases to:

$$\eta t = \frac{\Delta t_{n_1}}{\Delta t_{z''}} \times \eta el$$

The size of the preheater is limited to the extent that it should not cause an excessive pressure drop as otherwise this may nullify the increase in efficiency.

Improvements of the Gas Turbine Cycle

From the above, we can therefore summarize that the thermal efficiency of a gas turbine plant can be increased by: improving the efficiency of turbine and compressor, choosing the best suitable pressure ratio in relation to the gas cycle at given gas turbine inlet temperature, applying air preheater to utilize the heat in the exhaust gases, and increasing the gas turbine inlet temperature if the heat-resisting material can be further improved.

How much the thermal efficiency of a gas turbine unit can be increased by the above mentioned improvements can best be seen from the efficiency curves of Figs. 5.A, B, C. In Fig. 5A is shown the efficiency at coupling of a 2000 kw. combustion turbine with different sizes of air preheaters in relation to various pressure ratios of compression, assuming a gas turbine inlet temperature of 1000 deg. F. and that a single-cylinder gas turbine is applied. It can be noted that the maximum efficiency is obtained at different pressure ratios with various sizes of heat exchangers, which shows how important it is to design the air preheater as a unit together with the particular compressor. The maximum efficiency can be improved from 16 per cent up to approximately 25 per cent when increasing the air preheater surface from 0 to 30,000 sq. ft.

This efficiency can be further improved, as illustrated in Fig. 5B, if the gas turbine is divided into several cylinders for reheating the gas between the cylinders to the initial temperature which is naturally limited by the cost of the plant and the corresponding pressure drop. With this arrangement, the maximum efficiency at the coupling of a 2000 kw. combustion turbine can be improved from 19 to approximately 28 per cent when increasing the air preheater surface from 0 to 30,000 sq. ft., also assuming a gas turbine inlet temperature of 1000 deg. F.

If, in the future, a heat-resisting material for the blading should be available which allows a gas turbine inlet temperature of 1200 deg. F., as shown in Fig. 5C, the efficiency at the coupling of a two-cylinder 2000 kw. combustion turbine could be increased from 24 to 33 per cent if the surface of the air preheater is increased from 0 to 30,000 sq. ft. A temperature as high as 1200 deg. F. may be possible in the near future judging from experiences with a number of Diesel engine supercharging units which have been in operation for a considerable time at a temperature approaching this value.

If the gas turbine is divided into two turbines: one driving the compressor only and one driving the generator, the efficiency can be further improved particularly at partial load because the compressor can always be operated at the most suitable speed for the compressor independently of the speed of the turbine supplying useful power.

From the above it can be concluded that an application of doubleshaft arrangement with reheating of the gas between the turbines to the initial temperature, by an additional combustion chamber, and applying the

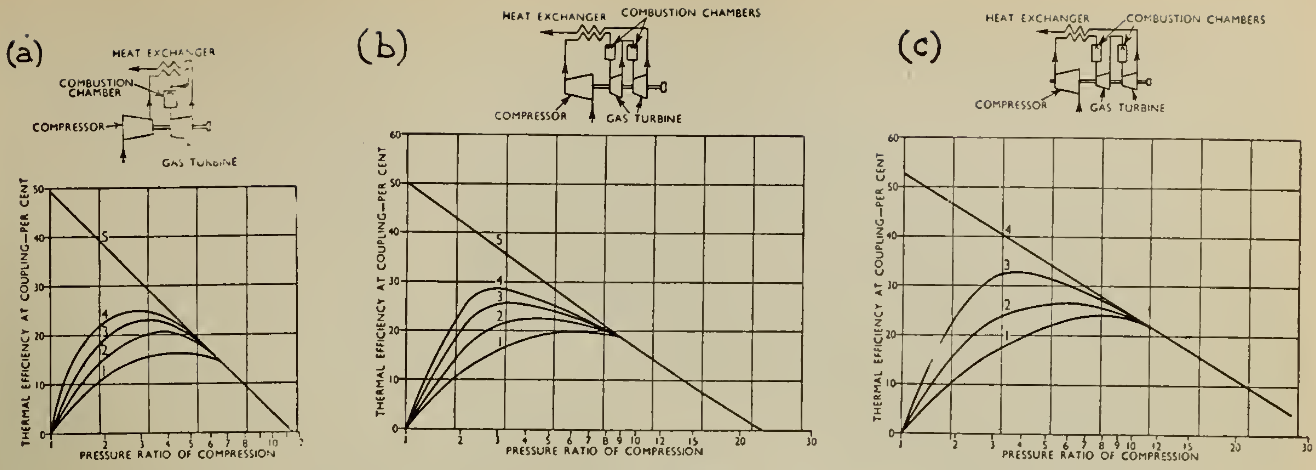


Fig. 5—Efficiency at coupling of 2000 kw. combustion turbine.

(a) With temperature of 1000°F. at the turbine inlet, and air preheating by exhaust gases with different sizes of preheater. Surface of heat exchanger for 2000 kw.:

Curve 1..........	0 sq. ft.
Curve 2..........	5,000 sq. ft.
Curve 3..........	15,000 sq. ft.
Curve 4..........	30,000 sq. ft.
Curve 5..........	sq. ft. (theoretical)

Temperature before turbine, 1000°F.; temperature of intake air, 68°F.; compression without cooling.

(b) With temperature of 1000°F. at the turbine inlet, and air preheating by exhaust gases with different sizes of preheater, and reheating of the gases to the initial temperature between two stages.

Surface of heat exchanger for 2000 kw.:

Curve 1,..................	0 sq. ft.
Curve 2..................	5,000 sq. ft.
Curve 3..................	15,000 sq. ft.
Curve 4..................	30,000 sq. ft.
Curve 5..................	— sq. ft. (theoretical)

Temperature before turbine, 1000°F.; temperature of intake air, 68°F.; compression without cooling. Turbine efficiency, 86 per cent; compressor efficiency, 83 per cent.

(c) Temperature 1200° F. at turbine inlet; preheating of the air by exhaust gases with different sizes of preheaters; reheating of the gases to the initial temperature between two stages.

Surface of heat exchanger for 2000 kw.:

Curve 1..................	0 sq. ft.
Curve 2..................	5,000 sq. ft.
Curve 3..................	30,000 sq. ft.
Curve 4..................	— sq. ft. (theoretical)

Temperature before turbine, 1200°F.; temperature of intake air, 68°F.; turbine efficiency, 86 per cent; compressor efficiency, 83 per cent.

best suited air preheater surface and pressure ratio, will enable to obtain a very satisfactory efficiency over a large range of load which can compete with the efficiency of any steam or Diesel engine plant of similar output.

Design of Gas Turbine and Compressor

In order to achieve a high overall efficiency of turbine and compressor, a four to five stage reaction turbine and an axial compressor of ten to twelve and of even higher stages, have been developed taking into account the results of the latest research in the field of aerodynamics. Such sets to-day have reached an overall efficiency of turbine and compressor of 74 to 75 per cent.

The design of a modern gas-turbine driven axial compressor unit is shown in Fig. 6. The gas turbine—to the left—has a horizontally split casing of molybdenum cast steel which contains grooves into which are mounted the stationary nickel-chromium steel blades. The rotor consists of a drum of forged steel with five rows of reaction turbine blades of special heat-resisting stainless steel. The rotor is carried by two pressure oil lubricated bearings and suitable arrangements are provided to ensure that free expansion can take place when the turbine is heated. At both sides of the rotor where the shaft traverses the casing, labyrinth glands are provided. The compressor—to the right—is rigidly coupled to the gas turbine and consists of a cast iron casing, also horizontally split, with suitable grooves in which are fitted the steel guide blades. The rotor consists of a forged steel drum carrying about 17, or more, rows of blades, which are fixed by means of T-feet similar to that adopted for steam turbines. The axial thrust, due to the rotating blading of the compressor, is practically compensated by that of the gas turbine; where the shaft traverses the casing, labyrinth glands are provided which consist of very fine strips of rustless metal caulked into suitable grooves in the rotor. The rotor is carried by means of two pressure oil lubricated bearings. Both the gas turbine and the compressor are mounted on a common base-plate.

Various Applications of the Combustion Gas Turbine

Charging Unit for Chemical Processes

The gas turbine driven compressor set, Fig. 7, which was first introduced in 1937 by Brown Boveri on the Houdry Oil Refinery process at the Sun Oil Company, Philadelphia. may be looked upon as the forerunner of the gas turbine as applied later on in its simplest form for power generation and traction.

In principle the circuit is as follows:

Air at atmospheric pressure is compressed in an axial blower, from where it enters an air heater and reaches finally the chemical process with the desired pressure and temperature. The hot gases, recovered from the chemical process, enter the gas turbine where they are expanded to atmospheric pressure by which means the necessary power is produced to drive the compressor and also to generate excess power. The gas turbine inlet and the axial blower discharge are bridged by a starting combustion chamber which is only in operation during the starting of the charging set. By a relatively small starting motor, the axial blower can be started up to approximately 10–20 per cent of its normal speed at which the blower supplies enough air that the starting combustion chamber can be ignited and its hot gases will finally bring up the charging set to full speed. After the charging set is started up, the compressor and the gas turbine will be connected to the chemical process and the starting combustion chamber will be disconnected.

The charging set consists of an axial compressor of an input of 4400 kw. and a gas turbine which produces an output of 5300 kw. by the gases at 930 deg. F. recovered from the chemical process. The synchronous generator, which produces an excess power of about 900 kw., is coupled through a reduction gear to the compressor shaft and the starting motor is located to the extreme right. An air-cooled starting combustion chamber, which is not visible in Fig. 7, is heated up by oil flame and is located above the gas turbine and the compressor. The very excellent operation results of

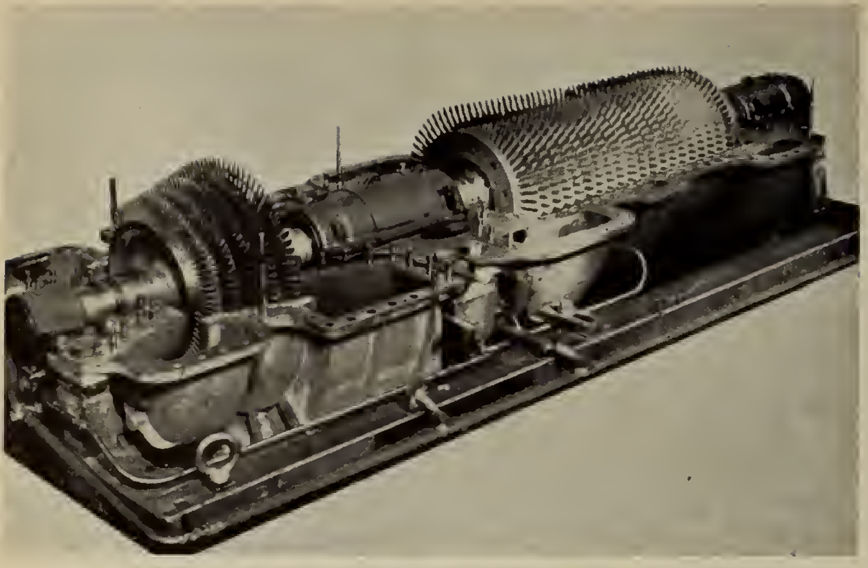


Fig. 6—Brown Boveri gas turbine axial compressor unit with top casing removed.

combustion air. The combustion gas passes the gas turbine (2) and finally escapes through the heat exchanger (8) to atmosphere. The gas turbine is coupled directly to the compressor while the auxiliary gas blower and starting motor are connected over a reduction gear to the blower shaft.

Already two similar installations were carried out in blast furnace plants, giving very satisfactory operation. Such a unit designed, for example, for an air flow of 100,000 cu. ft. per min., of which 35,000 cu. ft. per min. is extracted at a pressure of approximately 17 lb. per sq. in. gauge for blast air, while the remaining air, extracted at somewhat higher pressure, is applied as combustion air, would require a space of approximately 32 ft. long and 13 ft. wide, which undoubtedly would mean considerable space saving compared to that required by boiler with steam turbine-driven centrifugal blower as generally installed at present. Also the efficiency of such an arrangement would be substantially higher.

Other very interesting combinations are possible—as, for example, where the air supply for the blast furnace and its heating are combined with the operation of the combustion turbine by using the same compressor and, also, a common combustion chamber for both purposes. Such a combination becomes particularly interesting when the air heaters are fired under pressure which enables reducing their dimensions considerably. There is no doubt that the gas turbine blower unit, due to its unparalleled simplicity, is very suitable for blast furnace plants; in comparison with an ordinary gas engine, it has the advantage of considerably lower first costs, while in comparison with a steam plant, its simplicity is striking because no boiler, condenser plant, water treatment plant and water supply are necessary.

this first installation have led to a rapid increase of such applications so that to-day, in America, over thirty such gas turbine supercharging plants for chemical process are installed. Most of the earlier ones were built and supplied by Brown Boveri while the later ones were built by Allis-Chalmers. Most of these units are designed for a total air quantity of either 23,000 or 40,000 cu. ft. per min. but this is by no means the limit for which such units are available.

To-day, with all the extensive experience gained from a large number of similar units, it is possible to build gas turbines and axial blowers for much higher capacities. The adiabatic efficiency of the gas turbine measured on such charging sets is approximately 86 per cent; that of the axial blower 85.5 per cent, which results in an overall efficiency of the complete set of approximately 73.5 per cent at full load. With such a high overall efficiency of the charging set, an application of this principle would even be economical if the gas turbine only covered the requirements of the blower. In case the gases leaving the gas turbine should be further utilized in a low-pressure heat exchanger, the thermal economy of such a plant could even be further increased.

GAS TURBINE DRIVEN CHARGING UNIT IN BLAST FURNACE PLANTS

Arrangements similar to those mentioned above will also work out very favorably in blast furnace plants, especially for the purpose of blast generation and blast heating. The available furnace gas can be utilized as fuel for the combustion chamber, while the air supply for the blast furnace and its heating can be combined with a gas-turbine-driven blower unit.

An example of such an application is illustrated in Fig. 8. Both the blast and combustion air are drawn in from atmosphere by the compressor (3) which delivers, from an intermediate stage, the blast air at somewhat lower pressure than the combustion air. This arrangement ensures a large, very stable, operating range for the compressor. The combustion air passes through a preheater (8) to the combustion chamber (1), where it is used partly for the combustion and partly for cooling the burner jacket and the combustion gases. The blast furnace gas, which is used as fuel for the combustion chamber, is compressed by means of a small auxiliary blower (6) to the same pressure as the

First Combustion Gas Turbine for Power Generation

In 1939, Brown Boveri put the first combustion gas turbine, ever built for direct power generation, into operation. This, which appeared unthinkable only a short time ago, was realized successfully due to the improvement of the compressor efficiency on the one hand and the improvement of heat-resisting material on the other. The axial compressor, which was developed in connection with the Velox boiler, improved the gas turbine cycle about 65 per cent compared to the best centrifugal type compressor and a further 18 per cent improvement was rendered possible by the increase in temperature due to better heat-resisting steel.

The design principle and layout of this gas turbine unit are similar to that shown in Fig. 3. The compact design of this unit was obtained by placing the air-cooled combustion chamber above the axial compressor and gas turbine. Air of atmospheric pressure is compressed in an axial compressor to a pressure of approximately 50–60 lb. per sq. in. Part of this compressed air is supplied into the air-cooled burner jacket where the temperature reaches approximately 2500 to 3000 deg. F., the remaining air is used for cooling the burner jacket and finally mixes with the gas, after combustion is completed, in order to reduce the gas temperature to an admissible value of approximately 1000 deg. F. at the turbine inlet. The gas turbine is provided with multiple-stage reaction blading and its rotor consists of two shaft ends, each forged in one piece with the end disc, and of an intermediate unbored disc of constant strength section welded at its periphery to the two outer discs, the same construction as has been applied very successfully on steam turbines for many years past. The design and construction of the gas turbine and compressor are similar to those described in connection with Fig. 6.

Load and governing tests were carried out under the supervision of Dr. Stodola, an engineer of world-wide prominence and former professor at the Swiss Federal Institute of Technology, with the assistance of the Swiss Association of Steam Boiler Proprietors, the test laboratory staff of the Swiss Association of Electrical Engineers and the Fuels Department of the Swiss Federal Material Testing Laboratories. These associations carried out the power measurements and determined the calorific value of the fuel.

This test data and the efficiency values are given in Table I.

From these readings it can be seen that the inlet temperature at full load, 4000 kw., was approximately 1000 deg. F. and with the compressor efficiency of 84.6 per cent and the turbine efficiency of 88.4 per cent, an overall efficiency of the complete turbo set of 74.8 per cent was obtained, from which resulted a thermal efficiency at the generator coupling of 18.04 per cent at full load or 17.38 per cent at the generator terminals.

For the guaranteed conditions, namely an air temperature of 68 deg. F., and a speed of 3000 r.p.m., the

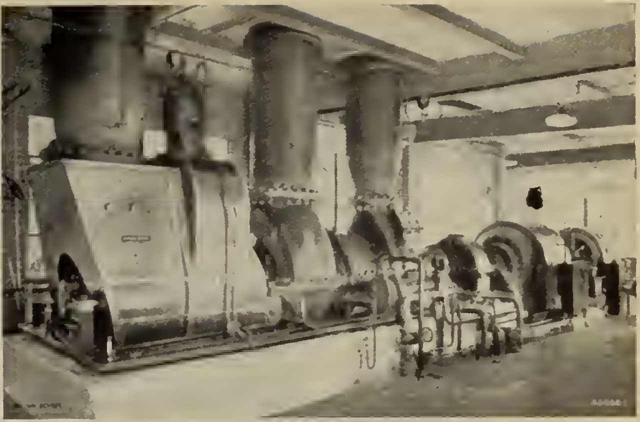


Fig. 7—Gas turbine supercharging plant for the Houdry oil refining process at Marcus Hook, Philadelphia.

fuel consumption, based on fuel having a net calorific value of 18,000 B.t.u. per lb., amounts to 1,090 lb. per kwh. at full load and 1,210 lb. per kwh. at ¾ load, which is approximately 4 to 5 per cent better than guaranteed.

Load changes, from full-load to no-load and vice versa, were carried out at which the amount of fuel was regulated directly by the governor. At these extreme load changes, a momentary speed increase of 5.8 per cent after 22 seconds and a permanent speed increase of 2.5 per cent after 1 min. and 48 seconds were noticed—respectively, a momentary speed drop of 5 per cent after 33 seconds and a permanent speed drop of 2.65 per cent after 1 min. and 45 seconds. During these operations, no smoke was visible at the

Table I

GENERAL			
Test number	1	2	3
Duration, min	15	60	30
Barometric pressure, mm. Hg	732.7	732.7	732.7
Speed, r.p.m.	3020	3020	3030
Net calorific value of fuel oil, Btu/lb	18257	18257	18257
EFFICIENCY			
Terminal output of generator, kw	0	4021	3057
Power at generator coupling, kw	0	4184.3	3193.8
Fuel quantity, lb. per hr	1812	4338	3649
Specific fuel consumption, lb/kwh	....	1.078	1.193
Thermal efficiency at terminals, %	....	17.38	15.67
Thermal efficiency at coupling, %	....	18.04	16.37
For inlet air temperature of 68 F., the above efficiency values correspond			
to a speed, rpm	....	3000	3000
to a terminal output, kw	....	4000	3026
to a turbine inlet temperature, F	615	998.5	890.5
COMPRESSOR			
Temp. at compressor inlet, F	73.6	77.4	78.6
Temp. at compressor outlet, F	357.6	396.8	393.0
Abs. pressure at compressor inlet, lb/sq. in	14.056	14.056	14.056
Abs. pressure, compressor outlet, lb./sq. in	53.72	61.69	60.26
Pressure ratio	3.82	4.38	4.28
Weight of air, lb. per hr	496436	491264	498347
Adiabatic power, kw	8650	9710	9660
Efficiency (less bearing friction, etc.), %	84.4	84.6	84.9
Coupling output, kw	10250	11480	11380
GAS TURBINE			
Temp. at turbine inlet figured from fuel, F	627	1025	917
Temp. after gas turbine, F	325	532	487
Abs. pressure at gas turbine inlet, lb./sq. in	52.8	60.77	59.31
Abs. pressure, gas turbine outlet, lb./sq. in	14.21	14.22	14.215
Pressure ratio	3.7	4.25	4.15
Gas weight, lb. per hr	498248	495602	501996
Adiabatic power, kw	12000	17725	16460
Coupling output, kw	10250	15664.3	14573.8
Efficiency from power, %	85.4	88.4	88.4
OVER-ALL EFFICIENCY OF THE TURBO-SET			
Tot. eff. = Comp. eff. + turb. eff., %	72.1	74.8	75.0

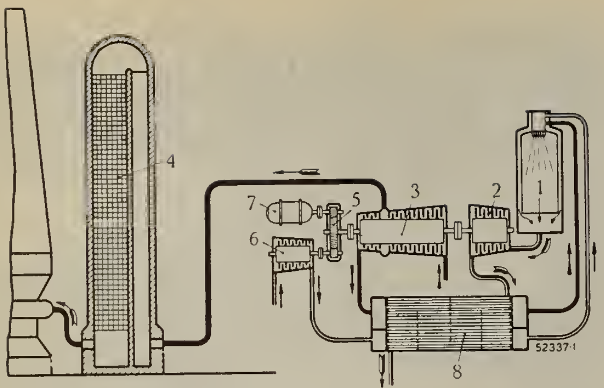


Fig. 8—Gas turbine driven blast-furnace blower in blast-furnace plant.

1. Combustion chamber
2. Gas turbine
3. Compressor
4. Cowper stove or steel blast heater
5. Reduction gear
6. Auxiliary gas blower
7. Starting motor
8. Heat exchanger

stack outlet which is a sign that perfect combustion was maintained throughout these tests.

The total efficiency of 17.38 per cent at the terminals of the generator could naturally be considerably further increased by applying an air preheater and dividing the turbine into two units: one for driving the compressor and one for driving the generator, which also would allow reheating of the gases in an intermediate combustion chamber. However, in this particular case of an emergency standby power plant, the employment of such means was deliberately refrained from in order to retain the extraordinary simplicity of the plant and to allow low capital cost, which is of great importance for such a plant operating only in case of emergency.

This gas turbine emergency power plant is installed in a bomb-proof tunnel. The overall dimensions of this underground installation are only 60 by 17 ft. and 26 ft. high, which are sufficient to also install—besides the gas turbine, compressor, combustion chamber, generator, starting motor and exciter,—the control board and a small Diesel driven alternator which, in the event of a complete failure of power, supplies the auxiliary power for the starting motor of the gas turbine. In the basement, ample space is provided for a fuel storage tank, of considerable size, and the fuel pump. Two fans are applied for ventilating the complete installation and a small crane facilitates the erection and the inspection of the gas turbine unit. The inside of this bombproof, rapid starting, gas turbine power plant is shown in Fig. 9. This picture shows perfectly how relatively little space is required for the complete 4000 kw. gas turbine unit due to the simple arrangement of the compressor, turbine and combustion chamber. As no cooling water is required, such a plant can be located anywhere most suitable which is of special importance to meet power requirements of key industries in time of war.

Also, if an installation in this simplest form of gas turbine power unit, where preheater and many other means (which would further improve the efficiency) have not been applied, cannot yet compete with a modern steam plant for base load purposes, it deserves serious consideration as a standby and peak load plant on account of its simple design and low capital cost, its light weight and small space requirements, which mean an inexpensive foundation and building which can be located right at the point of consumption as no water supply is required.

First Gas Turbine Locomotive

About the same time as Brown Boveri completed the first gas turbine power plant, they also undertook to build the first gas turbine locomotive for the Swiss Federal Railways. In spite of the fact that the outbreak of this war delayed its completion considerably, this gas turbine locomotive successfully went into service in the fall of 1941.

The layout of this gas turbine locomotive is illustrated in Fig. 10. On a common bedplate (G) are erected: the gas turbine (B), the axial compressor (C), the reduction gear (E) with the power generator (F). The combustion chamber (A) is erected to the left of the gas turbine, while the air preheater (D) is erected above the gas turbine set. The latter is connected to the compressor by an air pipe (8) with several expansion joints (9) which allow for different expansions of the air heater and gas turbine set. In regard to the principle of operation, which is similar to the gas turbine for power generation, it will be sufficient to recall briefly the following: The compressed air, which is preheated in an air heater, enters the combustion chamber partly as combustion air through the air nozzle ring (1) and partly as cooling air through the slits (2). The fuel enters through the injection nozzle (3). The cooling air enters into chamber (4) and reduces the combustion gas temperature to the admissible gas turbine inlet temperature. This gas expands in the gas turbine and passes afterwards through the air heater where finally it escapes through slits (6) in the locomotive roof to atmosphere.

For practical and technical reasons, the electrical transmission—as developed and successfully applied in many cases with Diesel electric units—was applied with this first gas turbine locomotive. Therefore, only the gas turbine set was a new feature while the generator, motors and switchgear could be adopted from the Diesel electric locomotive without modification. Electric transmission was also preferred because such equipment had already proved very satisfactory for larger outputs while hydraulic or mechanical transmission was not yet fully developed for larger outputs and therefore its application would have introduced uncertainties, which could have affected the success of this first gas turbine locomotive. Furthermore, the gas turbine which drives the generator through gearing can

Fig. 9—First 4,000 kw. gas turbine power unit installed in bomb-proof standby power plant at Neuchatel, Switzerland.

always be operated at the most suitable speed for the compressor and therefore the engine gives a relatively high efficiency at all speeds and loads and there will be no reverse turbine or corresponding reversing gear necessary which would otherwise be required in addition to the standard turbine if mechanical transmission is applied. The whole gas turbine generator set is mounted on a common frame which contains, at the same time, reservoirs for fuel oil and lubricating oil.

Extensive tests were carried out on the test bed with the completely assembled set and it was found that the test data closely agreed with the calculated values. A thermal efficiency between 14 and 18 per cent is obtained at half to full load of the unit, with a gas turbine inlet temperature varying between 940 to 1060 deg. F.

The efficiency of a steam locomotive is only of the order of approximately 8 to 12 per cent, allowing for improvements made in the last few years, while with a gas turbine locomotive with electrical or mechanical transmission at least an efficiency of approximately 14 to 18 per cent can be expected. This efficiency does not allow for competition with the Diesel engine but the difference between the fuel consumption of the two machines (Diesel and gas turbine units) is, in many cases, fully compensated by the difference in the costs of Diesel oil and gas turbine fuel oil. Furthermore, quite often the possibility of getting more power from a given size of locomotive is of more importance than the efficiency. In this case, the gas turbine deserves due consideration, because approximately twice the output can be installed in a gas turbine locomotive than is possible in a corresponding Diesel locomotive.

A large number of test runs were carried out which proved the successful performance achieved with this first gas turbine locomotive. In this connection, the following data is of interest: the guaranteed continuous output of the power unit measured at the generator coupling is 2200 hp. at a turbine speed of 5200 and a generator speed of 812 r.p.m. The maximum speed of the locomotive is 70 miles per hour. The fuel consumption at full-load is about one pound per hp.-hour at the wheel rim, i.e., it amounts to about 2000 lb. of fuel per hour with 2000 hp. at the wheel rim. As this locomotive has also to be used on branch lines, an effective weight, with fuel tanks full, of only 92 tons (respectively 16 tons per driving axle) was permitted. The following figures resulted from the acceleration tests with a 321-ton train:

At a grade of	0% (level)	—an acceleration of	0.500 mph per sec.
" "	1.2%	— " "	0.385 " " "
" "	1.8%	— " "	0.276 " " "
" "	2.6%	— " "	0.186 " " "

These figures were even better than those guaranteed.

The regulation of the power developed by the gas turbine locomotive with electrical transmission is effected by regulating the field of the generator by means of a servo-field regulator, which is operated by an oil pressure governing system. The control system also comprises a number of safety devices which prevent overspeeding of the set in case of a broken connection, protect the blading from harm due to excessive temperature, shut-off the fuel should the governing oil pressure fall below a certain minimum, or the flame in the combustion chamber should suddenly go out, etc.

The complete unit can be very easily fitted in the locomotive by taking off the removable roof as shown in Fig. 11.

The economic prospects of the gas turbine locomotive are as follows:

If the traffic density is great, electrification receives first consideration especially in larger cities, otherwise

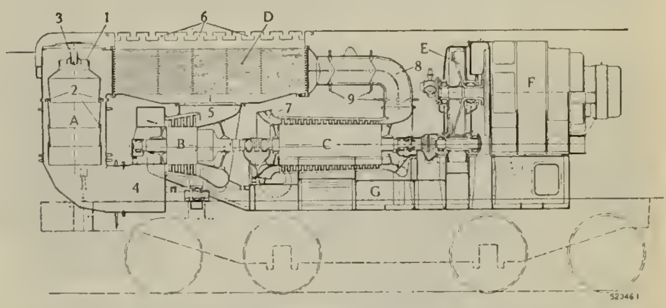


Fig. 10—Layout of the gas-turbine set of the locomotive.

A. Combustion chamber
B. Gas turbine
C. Compressor
D. Air heater
E. Gear
F. Generator
G. Bedplate of unit.

either a steam, Diesel electric or gas turbine electric locomotive may be applied. It is therefore of interest to mention a few figures from a comparison between steam, Diesel-electric and gas turbine-electric locomotives. The data for steam and Diesel electric units are taken from a paper presented before the American Society of Mechanical Engineers by Mr. E. E. Chapman giving an interesting comparison of steam and Diesel-electric locomotives, in the light of modern American experience.* To these figures, the corresponding data for a gas turbine locomotive were added, based on careful estimates and operating experiences as far as they were available. From the comparison between the steam, Diesel electric and gas turbine-electric locomotives resulted the figures in Table II.

To the above characteristics, the following comments seem appropriate. The cost of the gas turbine locomotive is assumed on quantity production similar to steam and Diesel locomotives. In the given steam locomotive efficiency, the steam turbo locomotive is not included as this type has not been adopted to any extent. If supercharged four-cycle Diesel engines are applied, the efficiency would be still higher than mentioned above. The equality of fuel cost for gas turbine and Diesel locomotives applies only to oil producing countries and countries where the cost of fuel oil is about one-half that of Diesel oil. The lubricating cost of the gas turbine is negligible, while for the Diesel engine, it amounts to a very high percentage of the fuel cost. The lubrication requirements of the wheel axles are not included, but they are, of course, the

*"Operation of Steam vs Diesel-Electric Locomotive," by E. E. Chapman, *Mechanical Engineering*, June 1941.

Table II

	Steam	*Diesel*	*Gas Turbine*
Approximate costs/hp. in American funds	35	87	65
Efficiency at draw-bar, %	6 to 8	26 to 28	15 to 16
Fuel cost, %	100	50 to 75	50 to 75
Lubrication costs per cent of fuel cost	10	20 to 30	1
Water costs per cent of fuel cost	10	small	nil
Mileage per year	180,000	250,000	250,000
Maintenance	Lower	High	Least
Approximate life in years	30	15 to 20	30
Power braking	None	Full power	Full power

same as those of the other locomotives. For the gas turbine locomotive, no water at all is required because for the small starting auxiliary Diesel, an air-cooled auxiliary Diesel engine can be applied. Since the gas turbine locomotive possesses no reciprocating parts, the time out for repairs and maintenance should be the smallest of the three. The operating temperature range has been chosen at 850 to 1100 deg. F. For this range of temperature, experiences with a large number of exhaust gas turbines on Velox boilers and combustion turbines for oil refining process have shown that there is practically no wear of the blading even after several years of operation. Also the greatest degree of security

Fig. 11—Fitting of the complete gas-turbine in the locomotive.

is ensured for the combustion chamber, due to the air cooling, the air of which is supplied by the same compressor as the combustion air, which means that the cooling air can never fail whilst combustion is going on.

The gas turbine locomotive can be applied for power braking whilst coasting downhill. If the fuel oil supply is reduced to such an extent that the flame just continues to burn, the motors are converted to generators by suitably exciting the fields and delivering their power to the main generator which, in this case, is operating as a motor driving the compressor and turbine. By opening, at the same time, the blow-off valve, which normally is actuated only by overspeed governor, the greater part of the air delivered by the compressor will escape to atmosphere, while enough air enters the combustion chamber to keep the burner alight with a small flame. In this manner, without requiring any additional apparatus, the full motor power can be applied for braking.

While at present the gas turbine locomotive is not as yet a serious competitor for the Diesel locomotive, it must be remembered that the gas turbine locomotive is the youngest member of the great locomotive family and therefore has its whole development period before it, of which much may still be expected. The gas turbine locomotive should be suitable for express service over long distances especially in countries where water is scarce and where there is a considerable difference in the cost of Diesel oil as against ordinary fuel oil. Further improvements in the efficiency of turbine and compressor and in the heat-resisting material, allowing for higher operating temperature, will bring the gas turbine into closer competition with the Diesel electric locomotive.

Combustion Gas Turbine for Ship Propulsion

There is no doubt that another very promising field for the application of the gas turbine will be found in the propulsion on ships. Even if today competition with modern geared steam turbine plants cannot yet be contemplated, the application of 2000 to 4000 hp. combustion gas turbines, instead of reciprocating engines, on oil fired ships deserves closer attention especially when considering that thermal efficiencies of 22 to 24 per cent can already be obtained with the simplest form of a gas turbine if an air preheater is applied.

In case of warships, which mostly are driven by steam turbines and where the drive is a compromise, since the top speed entails outputs ten, or even more, times that required at normal cruising speed, their steam turbine plant efficiency at full speed is only approximately 14 to 18 per cent, which is a value that can be obtained with a combustion gas turbine even without preheater. There is, therefore, good reason why the gas turbine will be applied in the near future on such ships in view of the fact that the average fuel consumption over the whole speed range would be about equal to the average of a steam drive and taking into account the distinct advantages achieved by the gas turbine such as the great simplification due to the omission of the boiler with its feed water evaporating plant and condensing plant, the rapidity with which the gas turbine plant can be brought into service and the very flexible and fast regulation, etc., all of which are of great importance for ship propulsion.

The advantages offered by the combustion turbine propulsion of ships, compared to other types, in regard to weight can best be judged from Table III which shows comparison of different forms of propulsion for a 10,000 ton freight ship, of 6200 shp. with a speed of 16 knots.

The above shows that a considerable saving in weight can be achieved, over all other forms of drive, by the gas turbine drive which was based on two-stage compression and combustion. Also in regard to space, even when compared to a modern high-pressure watertube boiler plant, there is a considerable saving in space.

From the above, it can be deduced that the propulsion of ships by means of combustion turbines is—today—able to compete with regard to economy with other existing forms of propulsion and its simplicity and flexibility in starting and regulation will secure a rapid increase of such applications in the near future.

Combustion Gas Turbine in the Field of Aeronautics

Up to the present, petrol engines have been applied on most aircraft. The engine capacity has been steadily increased by increasing the number of cylinders and by applying exhaust gas turbine-driven compressor for supercharging the engine. By this means, engines of a capacity as high as 2400 hp. have been developed and,

Table III

	Total weight of machinery	*Specific weight kg/shp.*	*Fuel consumption kg/shp. hr.*
Scotch type boiler-turbine plant	590 tons	95	0.4
La Mont boiler-turbine plant	237 "	38.2	0.31
Diesel, double-acting, two-stroke compressorless plant	530 "	85.5	0.177
Gas turbine plant	90 "	14.5	0.29

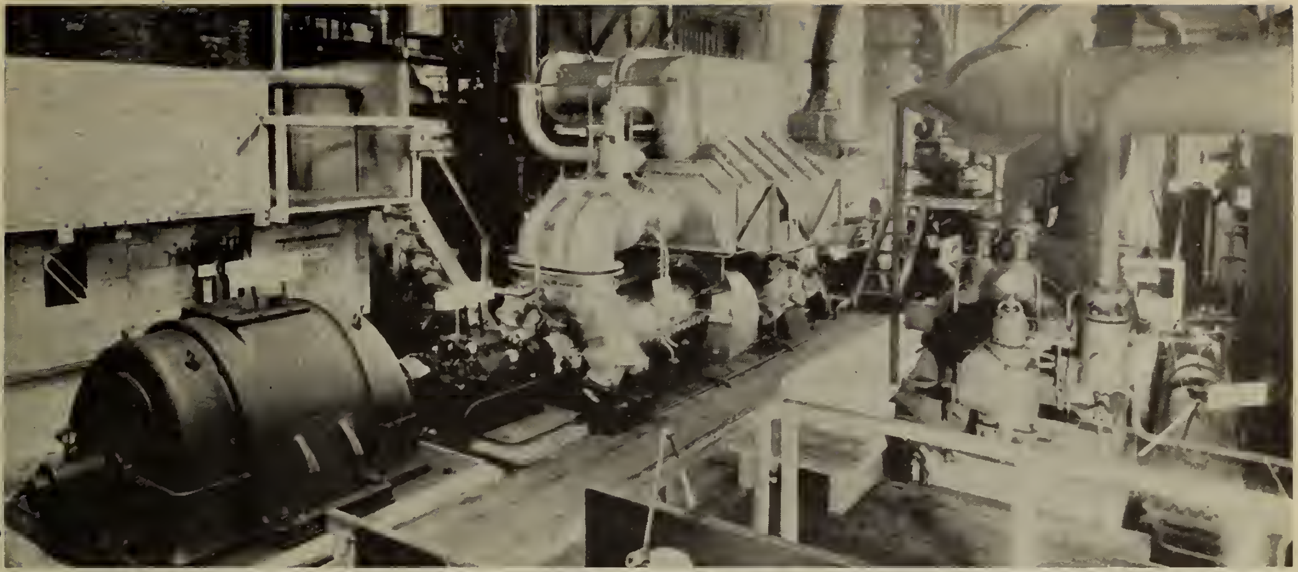


Fig. 12—Experimental 1500 kw. pulverized coal-fired combustion gas turbine with heat exchanger (to the left) and coal-fired Velox boiler with gas turbine driven supercharging set (to the right) on Brown Boveri test floor in Switzerland.

if required, probably engines of 3000 hp. and even higher, could be designed with eighteen cylinders or more. There is no doubt that such large units will be extremely complicated and will also probably require special means of servicing them in flight. Therefore, there is a good possibility that for huge power outputs, as required for extremely large aircraft for long-range overseas service or for ultra-high speeds and stratosphere flight, the gas turbine may be adapted as a power unit for either air screw or jet propulsion system, as an alternative to the reciprocating engine.

For jet propulsion, a large compressor is required for delivering a great quantity of air of high velocity while for propulsion with airscrew, the compressor has only to deliver a quantity of air sufficient for the combustion of the fuel, but in both cases the essential components of the power plant are similar, as they consist of an air compressor, a combustion chamber and a gas turbine.

The type of aircraft propulsion which will finally be adopted depends to a large extent on such governing factors as speed, altitude, range, size of air-field for take-off, etc. While for aircraft flying at very great altitude with high speed, the jet propulsion probably will be preferred, for aircraft of moderate speed and flying at lower altitudes, the turbine-driven airscrew may well be chosen.

There is also conceivable an application combining jet and airscrew propulsion where the airscrew is driven by a gas turbine power set while the exhaust from the gas turbine is utilized as an auxiliary propulsive jet. There are today many, very optimistic, speculations in this field—however, the future will, undoubtedly, reveal the suitability and limitation of these particular applications.

A Glimpse into the Future

Much attention is given, in further research on gas turbines, to applying pulverized coal instead of fuel oil (Fig. 12). Before pulverized coal can be used many new problems have to be solved as, for example, the elimination of ashes and slag, which may affect the operation of the turbine. A portion of this refuse can be eliminated in the combustion chamber, the remaining part must be removed in a special centrifugal separator in order to prevent it from entering the turbine, which is very difficult as this elimination must take place under high pressure and temperature. There has also to be overcome the problem of the erosion of the blading which can be noticed after longer running tests, etc. In spite of these many difficulties to be solved, tests have given promising results and therefore further efforts will be made to render the gas turbine also capable of burning pulverized coal because, if this problem is solved, the future of the gas turbine for locomotives and many other applications will be very great indeed.

In Fig. 12 to the right is shown the experimental installation of a coal-fired Velox boiler with a gas turbine-driven supercharging set which has been in operation for quite a few years and has given valuable experience for solving the various new problems of applying pulverized coal instead of oil fuel. Furthermore, referring to the considerable efficiency improvement by a higher temperature at the gas turbine inlet, this can be achieved by improving the present heat-resisting material to a higher creep strength or when some means is devised for protecting the blading of the material now used against the effects of higher temperatures. There is hope that, in the near future, a temperature of 1200 deg. F. can be safely applied, which would raise the cycle efficiency from 18 to 23 per cent and bring the cycle efficiency for a two-cylinder, 2000 kw. gas turbine, with intermediate reheating and an air preheater of 3000 sq. ft. surface, as high as 33 per cent.

When we consider furthermore that every improvement of one per cent in the efficiency of the turbine or compressor, due to improvements in the blade shape, will increase the overall efficiency of the unit approximately 4 per cent, we can clearly see that the gas turbine has many promising possibilities in the near future which will attract engineers of power plants and industries.

This paper can convey only to a certain extent the present state and future of the combustion turbine but it may serve to show that the subject is a very promising one, full of interesting possibilities. The gas turbine, naturally, is not the answer to every power problem but, undoubtedly, there is a big future in store for many applications in the field of supercharging, power generation, traction, ship propulsion, aeronautics, etc., where the gas turbine will be ideally suited.

DEFENCE PROJECTS IN NORTHWEST CANADA

1940-1944

A great system of airways and highways in Northwest Canada has been built as an important part of the joint war effort of the United States and Canada. The result has been the completion, in record time, of the Northwest airway from Edmonton to Fairbanks, the Alaska highway connecting the same points, the various subsidiary air, road, and water transportation routes which were needed, the necessary communication facilities, the development of an important new source of oil fuel supply.

In all this work, cooperation and mutual assistance have marked the relations between the already active Canadian organizations and the United States Army and Air Transport authorities. When the latter swung into action in December, 1941, an airway with good airports and radio ranges at 200-mile intervals all the way from Edmonton to the Alaska boundary was already available. It had in fact been used for some months before that date by many U.S. aircraft. Thus, essentials for their activities in the Canadian northwest were ready when needed by the United States authorities and particularly when the threatened Japanese attack on Alaska necessitated great and immediate additions to the original programme.

The Northwest Staging Route

The well deserved publicity which the construction of the Alaska military highway has received has rather tended to divert attention from the Canadian achievements in connection with airways in northwest Canada. The air route from Edmonton to Whitehorse and the Alaska boundary forms a major part of one of the great world-airways. It is important that the Canadian public should realize that this Edmonton-to-Whitehorse section was established, equipped, and mainly constructed by Canadian engineers and contractors.

In 1935, anxious to develop mail service in northern Canada, the Canadian government authorized a survey of alternative routes through Canada to the Yukon and Alaska. The report left no doubt that the best course to follow was east of the main chain of the Rocky mountains, via Fort Nelson and Lower Post. When this route had been checked, with its possible connections to Prince George and Vancouver, an airmail service, weekly, was established in 1937 between Edmonton and Whitehorse.

An airway survey was authorized in 1939 with instructions to locate and prepare detailed contour plans for aerodrome sites at Grande Prairie, Fort St. John, Fort Nelson, Watson Lake and Whitehorse. The plans were to provide for landing strips 3,000 by 500 ft., all suitable for extension, and radio range stations.

At the outbreak of war, measures were taken to hurry the completion of the route. This action enabled Canada to offer to the United States, when that country entered the war in December 1941, the free use of an airway to Alaska removed from the Pacific coast, relatively free from the danger of enemy attack, and connecting with established air and ground communication networks at Edmonton and Vancouver.

This is a staff article based on reports and releases supplied by various government departments at Ottawa. (*Ed.*)

The airway was of great assistance in the location and building of the Alaska military highway. On the other hand, the building of the highway has greatly facilitated the completion of the airway and its maintenance.

The Canada-United States Permanent Joint Board on Defence, meeting in Victoria, British Columbia, on November 13, 1940, recommended to their respective governments that the air route from Edmonton to Fairbanks, Alaska, be developed on the basis of the plans already prepared by the Canadian government. A month later, funds were released for the project, the Canadian government undertaking the plan at its sole expense.

To do the work at Fort Nelson and Watson Lake, supplies and equipment for both had to be taken for hundreds of miles through difficult country.

In the winter of 1941, Canadian engineers built a construction road from Fort St. John to Fort Nelson, a distance of 240 miles through bush, muskeg, across large rivers and ravines, and transported some 1,500 tons of supplies and equipment into the Fort Nelson site. The Alaska highway, started a year later, roughly parallels this route. The engineers' and contractors' organizations were flown into the Fort Nelson site, landing on the frozen Nelson river early in February of that year. Bulldozers broke through the bush, blazed trails across ravines and frozen rivers and established a tote road over which tractor-drawn trains of sleighs could be hauled. The road was then trimmed up and rolled to provide a frozen snow surface over which tracks could operate. Camps were established at which supplies and gasoline were cached for the use of the trucks and transport crews. This same trail was used in the winter of 1942 to ship in another 3,000 tons of supplies, and 300,000 gals. of aviation gasoline brought in at the request of the U.S. Army Air Corps.

To carry out the programme at Watson Lake, supplies and equipment had to be assembled and shipped from Vancouver. The route followed was by steamer up the British Columbia coast to Wrangel, thence by stern wheelers and barges up the tortuous Stikine river to Telegraph Creek in northern British Columbia. Here the freight was transferred to trucks and hauled over 72 miles of trail to the Dease river. The freight was then handled by tunnel boats and barges down the Dease river, a distance of 185 miles, to Lower Post on the Liard river. A road was built from Lower Post—20 miles —to the Watson Lake site. A total distance of over 1,000 miles was involved. The tunnel boats and barges, used on the Dease, were constructed at Vancouver in February and March 1941, knocked down and shipped to Dease Landing, where they were reassembled. Due to the frozen river, freight movements could not get under way until May. The first lot of equipment reached the airport site on July 22nd, and the first plane landed on a completed gravel runway on August 30th, which is not a bad record for Canadian engineering enterprise and ingenuity. Later in 1941, U.S. Army planes flew over the route taking pictures for aerial maps. The Canadian government had ground survey parties establishing geodetic landmarks to tie in these aerial photographs. By the beginning of September 1941, however, seven months after final authority had been given, the airway from Edmonton to Whitehorse was usable by daylight in fine weather. By the end of 1941, radio range stations were in operation at 200-mile intervals from Edmonton to the Alaska boundary.

Five main airports have been built along this route since 1941. These are located at Grande Prairie and Fort St. John in the Peace River country, Fort Nelson at the north-eastern corner of British Columbia, Watson Lake and Whitehorse—both in the Yukon Territory. Five additional intermediate airports were constructed in 1942 and 1943 along this route, at Beaton River, Smith River, Teslin, Aishihik and Snag. The latter two are located between Whitehorse and the Alaska boundary.

The Canadian forces started work on the five main airports early in 1942, and the preliminary development was completed by the fall of that year. The preliminary development consisted of usable runways 4,000 ft. long, radio range stations, transmitter buildings, powerhouses, administration buildings, staff quarters and equipment sheds. All this is necessary before an airport is available for air traffic. That is to say, the route was open for traffic before the United States entered the war or work had commenced on the Alaska highway.

In 1942, the runways were lengthened to over 5,000 ft. (6,000 ft. at Fort St. John and Whitehorse), and surfaced with asphalt. Work was started on the five intermediate fields in 1942.

It was then seen that war traffic would necessitate great additions to the original programme. Accordingly, an immense amount of construction work, enlarging airports, improving facilities, furnishing living accommodation and other buildings, was carried out by the Canadian government in 1942 and 1943. This was largely to meet United States needs.

Map of northwestern Canada

Construction work on the intermediate fields at Snag, Aishihik, Teslin, Smith River and Beaton River was pushed with energy during 1942 and 1943 as access became possible.

On July 12, 1943, the Canadian government, having virtually completed the Canadian programme of construction at the main fields, closed out its contracts and withdrew its construction forces. The United States government then undertook still further work to meet the increasing volume of its air traffic. This included the construction of the satellite field at Namao, about seven miles north of Edmonton, the contract for which was let to a Canadian company.

In September 1942, control of the aerodromes was transferred from the Department of Transport to the Royal Canadian Air Force, which now operates the chain from the Northwest Staging Route headquarters in Edmonton. The Department of Transport provides meteorological services, operates and maintains the radio range stations, and temporarily services communications facilities. Department engineers for coordinating any new work with that already done by Canada are also retained at each aerodrome along the route. Control towers are staffed by the R.C.A.F., which is responsible for maintenance and repair work at all aerodromes, including snow removal. The R.C.A.F. is solely responsible for security.

In 1943, agreements were made to permit American engineers and contractors to complete certain extensions at all fields, except Edmonton where Canadian contractors worked under U.S. direction.

This has now been changed. Any further permanent work will be carried out by Canadian engineers and contractors—and at the expense of Canada. Such additional work includes strengthening the original runways to carry four-engined aircraft weighing 135,000 lb.

In brief, the Northwest staging route is Canadian property, under Canadian ownership and management. It was built and developed by Canada in co-operation with the United States, who undertook certain additions and other installations. The total expenditure authorized from Canadian funds has been $25,000,000.

The Alaska Military Highway

The Alaska military highway, practically completed in November 1943, one month ahead of schedule, has now been developed so as to be capable of handling heavy vehicular traffic with little interruption. Seasonal

Tractor train on Fort St. John-Fort Nelson construction road.

thaws and flood conditions still present maintenance problems.

Of a total of some 700 bridges, varying from a few feet to 2,100 ft. at the Peace River crossing, only 14 temporary structures remained at the end of 1943 to be replaced by permanent installations.

The section of the highway in Canada, 1,257 miles from Dawson Creek to the Alaskan boundary, passes through mountain and muskeg for more than half this distance until it completes the crossing of the Rockies a few miles west of Fort Nelson. At one point it rises to an altitude of 4,350 ft. In such country, hairpin turns and steep hills are unavoidable, but banking and grading, nowhere exceeding 10 per cent, have eliminated the worst of the hazards.

North of Fort St. John, the width of the road is 26 ft. from shoulder to shoulder with a wider strip from Fort St. John to Dawson Creek. The roadbed, except where muskeg or other conditions required a variation, averages 12 in. of rock or coarse gravel surfaced for the most part with fine gravel or crushed stone.

The United States government undertook to maintain the highway until six months after the termination of the present war. At the conclusion of the war the section of the highway which lies in Canada will become in all respects an integral part of the Canadian system, on the understanding that there shall at no time be imposed any discriminatory conditions in relation to the use of the road as between civilian traffic of the two countries.

By agreement between the two governments, the construction of a cutoff road between Haines, Alaska, and a point on the highway 108 miles northwest of Whitehorse, was authorized as an integral part of the Alaska military highway.

A joint Canada-United States Traffic Control Board was set up on June 9, 1943, to deal with applications and issue permits for travel on the Alaska military highway, at present confined to official business.

Two pipelines supplement the Canadian section of the highway project. The first of these runs northwest from Whitehorse and the second runs from Carcross to Watson Lake. Both lines, fed from Skagway, are now operating.

Flight strips along the Alaska military highway have been constructed by United States authorities. These will be used only for contact flying, using the highway as a guide and providing facilities for the rapid movement of construction and maintenance personnel and equipment, as well as safe landing areas along the highway.

The Canol Project

The Norman Wells oilfield is located on the Mackenzie river about 100 miles south of the Arctic circle. The first well was drilled there in 1920 and oil found in commercial quantities. In 1940, four wells were producing and a refinery was providing gasoline and fuel oil for local needs.

Early in 1942, the United States government, faced with the necessity of obtaining without the danger of enemy interruption an assured fuel supply in Alaska and Northwest Canada, proposed a project to make available greatly increased production from the Norman Wells field. After negotiations between the United States government and the Canadian government an agreement on this development was reached in June 1942.

Construction work proceeded through 1942 and 1943. Forty wells have been completed in the Norman field by the Imperial Oil Company, Limited, under contract with the United States Government. Of these, 33 found oil. The pipeline from Norman Wells to Whitehorse and the refinery at Whitehouse were completed this year.

At the beginning of 1943, the United States government expressed the view that it was vitally necessary to discover additional sources of petroleum in Northwest Canada and Alaska apart from the Norman Wells field. In order to prevent the possibility of intervention by anyone whose interest was not identical with that of the Canadian or United States governments, the regulations then effective were expanded to include all the Yukon Territory and the western part of the District of Mackenzie.

While the original Canol plan was designed to solve the problem of oil supply for Alaska and the Yukon if enemy action should interrupt tanker movement up the coast, the United States government had the more immediate problem of establishing the quickest possible supply line under existing conditions to supplement tank car movement over the highway. In August 1942, the Canadian government agreed to the building of a pipeline from Skagway, Alaska, 110 miles to Whitehorse, passing through British Columbia. Permission was also given to construct installations for storage and loading at Prince Rupert, British Columbia, from which point oil was to be moved by barge to Skagway through the inside passage. The pipeline from Skagway to Whitehorse has been operating for some time.

White Pass and Yukon Railway

The White Pass and Yukon Railway, with its termini at Skagway and Whitehorse, was constructed before the turn of the century and was owned and operated in British Columbia by the British Columbia-Yukon Railway Company and in the Yukon by the British Yukon Railway Company. The operation of its 110 miles of 36-in. track presents many difficulties, particularly during the winter months. In pre-war days, no attempt was made to keep the railway operating on schedule during the winter. For the construction of defence projects in the Northwest, however, the railway was a vital supply line and, in 1942, was leased to the United States government by the companies involved.

Under military personnel and with greatly increased rolling stock the railway was operated throughout the winter of 1942-43, one of the most severe on record. Monthly tonnage moved is nearly three times the amount moved in any one season in pre-war days.

National Film Board photo

A section of Canol pipeline under construction over a Yukon lake.

The Mackenzie River Water Route

The purpose of the Mackenzie River water route, an adjunct of the over-all Canol project, was to develop and utilize facilities for the transportation of freight and supplies between Waterways, Alberta, and Norman Wells, in the Northwest Territories. The route follows the general line of passage that has been the main transportation and communication artery of the Mackenzie River district since the days of the fur trade. It starts at the railhead at Waterways, some 270 miles north of Edmonton, thence via the Athabaska river to the westernmost end of Lake Athabaska, thence by the Slave river and westward across Great Slave lake to Fort Providence, and finally down the Mackenzie river to Norman Wells, a total distance of about 1,170 miles. The single break in the continuity of this water route for heavy traffic is at the portage on the Slave river between Fitzgerald and Fort Smith, a distance of 16 miles.

The average time required for the return trip from Waterways to Norman Wells, assuming no unforeseen happenings, is 30 days. The route is navigable for about 125 days during the year, from approximately mid-June to mid-October, during which time Great Slave lake is ice-free. In the event of an early freeze-up the route may be used as far as Fort Smith and the winter road used from that point to Norman Wells. During the 1943 summer season approximately 40,000 tons of freight were shipped from Waterways.

The Mackenzie River Air Route

Canadian bush pilots have long used the air route following the general course of the Mackenzie river northward as far as Aklavik with seaplanes and skiplanes, but far greater payloads were required for the carriage of Canol freight to augment shipments over the Mackenzie River water route, which has very definite limitations. Twin-engined transport aircraft were decided upon as the most suitable carriers and landing facilities were provided at McMurray, Embarras, Fort Smith, Fort Resolution, Hay River, Fort Providence, Mills Lake, Fort Simpson, Wrigley, Norman Wells, Camp Canol, Peace River, Metis and Upper Hay River Post. A cut-off route running between Peace River, Alberta, and Mills Lake in the Northwest Territories, used mainly during the winter months, is included in the scheme.

Construction commenced May 15, 1942, and was carried out by United States Army personnel or their contractors. With the exception of the fields at McMurray and Peace River, where expansion of existing facilities was sufficient, the fields and landing strips are new construction.

Meteorological Services

A closely integrated network of weather observation posts and forecast stations has been established throughout the Canadian Northwest by both Canadian and United States agencies. The main groups engaged in this field are the Department of Transport, the Royal Canadian Corps of Signals, and the United States Army Weather Service. Close co-operation is maintained among them.

Forecast centres are maintained at Edmonton and Whitehorse to supply 24-hour service to aircraft over the Northwest staging route and the Mackenzie River air route, and the forecast centres at Vancouver provides summaries to aircraft flying via Prince George and Fort St. John. The United States Army Air Force provides its own service and briefs its own pilots in Canada.

Telephone and Telegraph Facilities

Telephone and telegraph lines, built by the United States government, with a capacity of six voice and thirteen teletype communications, are now in operation between Edmonton and Fairbanks, Alaska, a total distance of 1,993 wire miles. The lines follow the general direction and route of the Alaska military highway, with right-of-way arrangements secured as part of the highway scheme. Poles to carry the wire strands, ranging up to 80 ft. in height, were cut on the spot.

A telephone line has been strung along the 110 miles of pipeline involved in the supplementary Canol project and a line is being strung along the main Canol pipeline from Norman Wells to Whitehorse.

Aquisition of Property

It is the policy of the Canadian government to acquire and thereafter make available to the United States for wartime use all properties required by the latter in the Northwest area. The Department of Mines and Resources is responsible for acquiring properties located in the Northwest Territories, Yukon Territory, Dawson Creek area, Fitzgerald area, and those sections connected with the right of way for the Alaska military highway. The Department of Transport is responsible for the acquisition of property in all other cases. It has been arranged by consultation between the two governments that applications for lands required in construction or for other purposes be submitted to the office of the Special Commissioner for Defence Projects in Northwest Canada, at Edmonton.

The Post-War Disposition of Projects

The governments of Canada and the United States have given approval to a general formula for the post-war disposition of defence projects, installations and facilities for which no specific provisions have previously been made, set forth in a recommendation of the Permanent Joint Board on Defence. The general formula provides for the following:

(a) the relinquishment to Canada, within one year after the cessation of hostilities, of all immovable defence installations built or provided in Canada by the United States;

(b) the removal from Canada, or the offering for sale to Canada or to the appropriate province, within one year after the cessation of hostilities and on the basis of the valuation determined by a board of two or three appraisers, of all movable defence installations provided in Canada by the United States;

(c) in the event that neither the Canadian government nor the appropriate provincial government exercises option to purchase the movable defence installations under (b) above, the facility under consideration shall be offered for sale in the open market, any sale to be subject to the approval of both governments;

(d) in the event of no sale being concluded under (b) and (c) above, the disposition of such facility shall be referred to the Permanent Joint Board on Defence or to such other agency as the two governments may designate.

Provision is also made whereby all of the foregoing principles shall apply reciprocally to any defence installations or projects which may be built in the United States by Canada, and are not to be interpreted as being prejudicial to any agreements between the two governments in regard to the post-war use of any of these projects, installations and facilities.

Costs

The figures in Table I showing the costs met by each government are based on a report presented by the Prime Minister to the House of Commons in August.

Table I

	U.S. Expenditures (U.S. dollars) (April 24, 1944)		Canadian Expenditures (Canadian dollars)
	Total	Of permanent value	Expended to March 31, 1944
Northwest staging route	$37,320,226	$31,311,196	$14,535,071
Flight strips along Alaska Highway	3,262,687	3,262,687	
Mackenzie-Athabaska route	1,264,150	1,264,150	
Telephone Line, Edmonton to Alaska Boundary	9,342,208	9,342,208	
Grand Total	$51,189,271	$45,180,241	$14,535,071

Additional construction work undertaken by Canada in 1944 on the Northwest staging route at the request of the United States is estimated to cost $5,161,000 in Canadian funds.

THE INTERCEPTING SEWER SYSTEM IN QUEBEC CITY

J. G. CHENEVERT, M.E.I.C.
Partner, Arthur Surveyer and Company, Consulting Engineers, Montreal, Que.

Paper presented before the Montreal Branch of The Engineering Institute of Canada on March 23rd, 1944.

The problem of intercepting sewers had been under discussion for many years when, in 1937, the City of Quebec appointed a special Drainage Commission to make a complete study of the sewerage system of the city and to prepare a report on the most economical procedure to improve the sanitary conditions of the St. Charles river. The commission was composed of Edouard Hamel, chief engineer of the City of Quebec, A. B. Normandin, M.E.I.C., chief engineer of the Hydraulic Department of the Province of Quebec and the author's partner, Dr. Arthur Surveyer, M.E.I.C., consulting engineer of Montreal as chairman. Ludger Gagnon, M.E.I.C., assistant chief engineer of the City of Quebec acted as secretary.

The execution of the intercepting sewer system as recommended by the Drainage Commission was started in 1939 and 1940.

The preparation of plans and specifications for the lower section of the intercepting sewer, including the main pumping station and outfall sewer was entrusted to the engineering firm of Arthur Surveyer and Company, Montreal, by the Department of Public Works of Canada of which K. M. Cameron, M.E.I.C., is chief engineer. Our firm was also entrusted with the complete supervision of the lower section of the intercepting sewer system which has now been built. The author was in charge of the general design and supervision, and J. M. Begg, M.E.I.C., and Gérard Lajoie, M.E.I.C., were successively our resident engineers in Quebec.

The work of which we had the supervision was executed under contracts, but the remainder of the intercepting sewer system has been mostly constructed by day labour under the supervision of the City of Quebec engineering department.

Up to date, about two-thirds of the complete system of intercepting sewers recommended has been constructed. The portion which has been left to be built as post-war work consists mainly of the sewage pumping stations, the siphon crossings under the St. Charles river, a number of regulators and the main outfall sewer into the St. Lawrence river.

Expose of the Situation

Although the city of Quebec is located along the shore of the St. Lawrence, almost all the sewage from its 140,000 inhabitants was discharged into the St. Charles river, which divides the territory of the city into two sections. (See Fig. 1). A certain amount of sewage was also discharged into the Lairet river which flows into the St. Charles.

The flow of these rivers is practically nil during dry weather periods and, therefore, insufficient to provide adequate dilution of the sewage waters. These conditions were further aggravated due to the fact that the St. Charles is an estuary affected by the tidal range of the St. Lawrence river. As a result, very noticeable septic action took place along these rivers, creating unbearable sanitary conditions within the boundaries of the city.

Actually, due to the topography of the territory and to the tidal range of the St. Charles and St. Lawrence rivers, the problem involved many special features. Gravity discharge could not always be resorted to, and automatic regulators, inverted siphons and sewage pumping stations had to be used in many instances.

The intercepting sewer system had to comply with the requirements and regulations of the Federal Government, of the Quebec Harbour Board, and of the Province of Quebec Board of Health.

Studies

In preparing the scheme, the following items required consideration:

1. Estimate of the probable future population of the city of Quebec, based on the increase of population from 1880 to 1937.

2. Calculation of the present and future domestic sewage water flow.

3. Study of rainfall intensity in the city of Quebec according to the statistical data of Quebec Observatory from 1914 to 1937, and preparation of rainfall curve according to concentration periods.

4. Calculation of the drainage basin of each existing outlet to be intercepted by the proposed intercepting sewers.

5. Estimate of the present and future density of population for each drainage basin.

6. Computation of the sanitary and storm water flow discharged by each outlet and of the maximum probable concentration of sewage water at different points of the proposed intercepting sewers.

7. Selection of the most economical type of conduits to be used for the different schemes studied.

8. Study of the results of the chemical and bacteriological analyses made of the water samples taken in St. Charles river, the estuary and the St. Lawrence river.

9. Experiments with different types of floats to determine the best location for the proposed main outfall sewer.

10. Layout and profiles of the different proposed intercepting sewers.

11. Determination of the capacity of the pumping stations required together with the electric power demand.

12. Estimate of the construction and operating costs of the proposed intercepting sewer system.

13. Study and inspection of sewage pumping stations in Boston, Lynn Harbour, Beverly, Salem and Gloucester, with reference to efficiency and results obtained from these plants.

City of Quebec Territory

Although the difference of elevation between the higher and lower levels of the city, called "haute-ville" and "basse-ville," is about 300 ft., their drainage towards the St. Lawrence river is practically impossible due to irregularities of topography. The large proportion of the population which lives along the shores of the St. Charles river increases the difficulties of the problem. As the tide fluctuations of the St. Lawrence river at Quebec vary, in general, between 13 and 20 ft., continuous drainage of the lower sections of the city could not be obtained without providing for pumping during rising tide periods.

Fig. 1—Plan of city of Quebec showing existing sewer outfalls.

The territory tributary to the intercepting sewer system within the boundaries of the city comprises an area of 4,924 acres, of which 2,625 acres are located along the south shore of the St. Charles and 2,299 acres along the north shore. Any proposed system should have enough capacity to drain also the territory of the municipality of Quebec West which comprises an area of about 1,100 acres, together with a part of the territory of the municipalities of Sillery, Ste. Foy, and Charlesbourg, which later will probably have to be drained by the City of Quebec sewerage system.

St. Charles River

The St. Charles river rises about 25 miles north-west of the city. Its drainage basin is about 225 sq. mi., and it has much to do with the public health and sanitation of the city. For instance the city takes its domestic water supply from the upper reach of the St. Charles river, at Château d'Eau, and its sewage water is discharged into the lower section of the same river. During dry weather periods, its flow, upstream of the water intake, is reduced to about 50 to 75 cu. ft. per sec. On the other hand, the domestic water consumption of the city reaches 35 to 38 million gallons per day or about 65 to 71 cu. ft. per sec. Thus, at low stage, there is practically no water available for sewage dilution.

Dilution of Sewage Water

The sanitary authorities of Canada as well as of the United States agree that a flow of at least 8 cu. ft. per sec. per thousand of population is required to dilute sewage water in a satisfactory manner. Whenever that flow is less than 2 cu. ft. per sec., very insanitary conditions will result, and the municipality is generally compelled to treat its sewage before discharge into a water course.

A flow of at least 1,100 cu. ft. per sec. would therefore be required to dilute the present sewage of the city of Quebec, whilst the flow of the St. Charles river is practically nil during the low stage periods. Fortunately, the flow of the St. Lawrence river at Quebec is about 300,000 cu. ft. per sec. at low water. It is obvious that this water volume is more than sufficient to dilute properly all the sewage water of the city of Quebec.

The problem was therefore to find the most rational and economical method of intercepting the domestic sewage water discharging along the St. Charles and Lairet rivers, and discharging it into the St. Lawrence at the most appropriate point in order to prevent the pollution of the St. Charles and Lairet rivers.

Existing Sewerage System

The existing sewerage system of the city and adjacent territory is subdivided naturally into three main sewer districts as shown in Fig. 1. These are

(a) District of Quebec South
(b) District of Limoilou
(c) District of Quebec West

The district of Quebec South is by far the most important. It comprises the section of the city bounded on the north by the St. Charles river and on the south by the St. Lawrence river. The district of Limoilou comprises the portion of the city north of the St. Charles river which is known as Limoilou. The district of Quebec West includes the municipality of Quebec West and is located along the north shore of the St. Charles river west of Limoilou.

In these districts, the sewers are all of the combined type, i.e. the domestic sewage and the storm water are carried in the same pipes. They have been built piecemeal as the city grew and lead by the shortest routes towards the lower parts of their respective drainage basins.

As a result, there are today about forty sewer outlets scattered along the St. Charles river and the Lairet river. A portion of the existing system is very old and some of its conduits are too small for the territory to be drained.

The location and drainage basins of these outlets are shown in Fig. 1.

District of Quebec South

The district of Quebec South covers an area of 2,625 acres, and comprises fifteen parishes. Its population is about 109,000.

It is to be noted that the densities of population differ greatly in the various parishes. From a density of 7 persons per acre in the parish of Très Saint-Sacrement, the figure rises to 165 persons per acre in the parish of St-Sauveur, which is the most thickly populated of the city. The average density of population for the district is about 42 persons per acre.

The sewer outlets of Quebec South District range in size from 12 in. diameter to 5 ft. 6 in. by 5 ft. 6 in. and serve a drainage area of 2,015 acres.

Actually, out of the total population of the city, 78 per cent live in the district of Quebec South, and 1,675 acres or about 64 per cent of the total area of the city is drained directly into the St. Charles river by 24 outlets scattered along the shore between Bell road and Samson bridge. An additional area of 340 acres was drained by two other outlets into the old stone sewer on St. Andrew street discharging into the St. Lawrence river at Pointe à Carcy. This territory includes a portion of the higher level of the city, particularly the parishes of Notre Dame de Quebec, St. Coeur de Marie, and a section of St. Jean Baptiste. The parish of Notre-Dame de la Garde is the only parish in this district which discharges all its sewage directly into the St. Lawrence river.

That such a large proportion of this district is drained into the St. Charles river is due to the peculiar topography of the territory. The ground level rises abruptly some three hundred feet near the north shore of the St. Lawrence river and slopes gradually towards the valley of the St. Charles river, where the elevation in some places is but a few feet above the level of maximum high tide. It was therefore proper and economical for the sewers to follow the natural slope of the ground down to the St. Charles river.

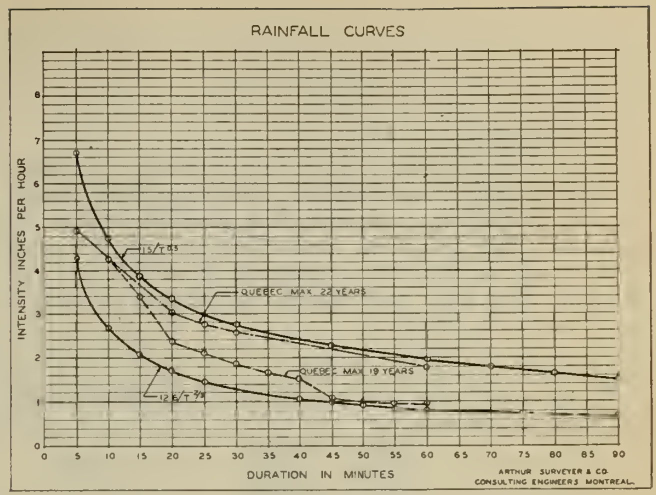


Fig. 2—Rainfall curves for city of Quebec.

Districts of Limoilou and Quebec West

Similar computations had to be made for the districts of Limoilou and Quebec West. For instance out of a total area of 2,299 acres in the district of Limoilou, the sewage water of a territory of 1,059 acres is drained into the St. Charles river by 12 outlets scattered along the north shore of the St. Charles river and of the Lairet river which is tributary to St. Charles.

Although the municipality of Quebec West is independent of the City of Quebec, all its territory, an area of 1,129 acres, must be drained into the St. Charles river. Any project of improvement must therefore include its sewerage problem. While the area of Quebec West is some 23 per cent of the total area of the City of Quebec, its population is only two per cent of the total population of the city.

Actual Flow of the Different Outlets

The actual sewage water and storm water flows have been computed for each outlet based on the drainage area, the population and other pertinent factors. The domestic water consumption in Quebec is very high and therefore the calculations of the domestic sewage flow have been checked by gauging each of the present outlets. The drainage basin boundaries have been dertermined in order to estimate the present and probable future flow at different points of the proposed intercepting sewers. A series of special gaugings was also made to determine the water seepage in the sewer conduits for that portion of the system which was very old and submerged at high tide. These tests have shown so much tidal infiltration that many of these conduits will have to be rebuilt or repaired in order to reduce the operating cost of the main sewage pumping stations.

The actual domestic sewage flow observed for each of the three districts which discharge into the St. Charles river or in the stone sewer of St. Andrew street (outlets No. 23 and 24) is as follows:

Outlet No.		Average actual flow
1 to 24	District of Quebec South....	31.07 c.f.s.
27 to 35	District of Limoilou........	5.92 c.f.s.
25 & 26	District of Quebec West.....	1.20 c.f.s.
	Total.................	38.19 c.f.s.

General Basis of Design of New Intercepting Sewer System

Period of Design

It was considered that, from an economical point of view, the sewerage system should have sufficient capacity for the requirements of the maximum probable population for about the next thirty years. All the calculations for the intercepting sewers, regulators and pumping stations have therefore been based on the conditions expected to exist in 1970.

TRIBUTARY AREA IN 1970

In assuming the area which will probably contribute sewage in 1970, consideration was given to all known factors, recognizing, however, that possible changes in economic and industrial conditions as well as other factors may modify the boundaries of the area to be drained. This may well include certain areas outside the present city limits.

POPULATION IN 1970

The growth of the city population from 1901 to 1936 has been as follows:

1901— 68,840
1911— 78,710
1921— 95,193
1931—130,594
1936—138,890

With these data as a guide, it was estimated that the population of the city of Quebec will reach about 232,000 inhabitants in 1970, and the total population of Quebec and suburbs about 254,000.

Out of this population, about 52,000 inhabitants are likely to live in the territories discharging directly into the St. Lawrence river. Thus the sewage water from a future population of about 202,000 inhabitants should be carried by the proposed intercepting sewer system.

DOMESTIC SEWAGE FLOW

After a study of the statistics and of the gaugings of the sewage which is now being discharged into the St. Charles river, we have adopted, as a basis for design, an average flow of 150 gal. per head per day. For the intercepting sewers design, the maximum domestic sewage flow was taken as three times the average future flow.

This factor has been used in order to provide sufficient dilution of the domestic sewage by storm water before the automatic regulators and storm water outlets begin to discharge directly into the St. Charles river.

STORM WATER FLOW

At points where the existing sewerage system was submerged by the rising tide it was necessary for the interceptors to collect not only the domestic sewage but also the storm water of these lower sections, which will have to be handled by pumping.

The estimate of storm water flow has been based on the so-called rational method, using a rainfall curve plotted from actual records without attempting to express it by an equation. (See Fig. 2). This rainfall curve shows, in dotted lines, the maximum rain intensity registered by the Quebec Observatory for 19 and 22-year periods, between 1914 and 1936. The 22-year frequency curve was used in the present case.

The lower curve gives the rainfall intensities which were generally used in Montreal up to 1939 and represents intensities which would be equalled, or exceeded, on the average once in 2 or 3 years. It is understood that, in the future, a higher intensity curve will be used in Montreal. It is interesting to note that the 22-year rainfall curve in Quebec is very close to the upper curve which represents intensities which are liable to be equalled or exceeded once in 15 years in New England and New York districts.

In general, the frequency curve to be adopted depends largely upon economic conditions, and the extent to which it is necessary and financially practicable to avoid occasional surcharging of the sewers and possible damage from flooding. The relative positions of the rainfall curves of different frequencies also influence the choice; thus, if the curve of 15-year frequency lies but little below the 25-year curve, there will be little saving in cost by adopting the former, and it may be better to adopt the 25-year than the 15-year curve as the basis of design. Very likely, a rainfall curve of 15-year frequency will be adopted more often than any other in the future whenever possible.

The storm water flow depends on the rate of rainfall or intensity, the area drained and the degree of imperviousness of the surface.

To determine the total storm water flow the well-known formula was used, in which

$$Q = CiA$$

where Q = total flow in cu. ft. per sec.
i = intensity of rainfall in inches per hour
A = area in acres
C = coefficient of run-off

It may be noted that intensity in inches per hour equals the intensity in cu. ft. per sec. per acre.

The run-off coefficient used with the maximum intensity for each drainage basin was the result of a special analysis for each particular case. The coefficient used was varied according to the density of population, the nature and topography of the ground, and the type of construction in the section considered or, in other words, according to the degree of imperviousness of the surface.

In general, the coefficient of run-off varies about as follows:

For most densely built-up portions of a district.........................0.70 to 0.90
For adjoining well built-up portions...0.50 to 0.70
For residential portions with detached houses.........................0.25 to 0.50
For suburban portions with few buildings..........................0.10 to 0.25

The run-off coefficients used have been checked to a certain extent by the gaugings made on the flow of the outlets during storms of known intensity.

Further, the intensity of rainfall to be used in any specific case is that intensity at which all parts of the contributing area, as far as the farthest point, would add increments to the total flow. In other words, the maximum flow will occur for that duration of storm which will enable the rain from the most distant point of the contributing area to reach the point under discussion. This time of concentration is made up of two phases: (a) inlet time, or the time taken for the water to flow over the ground to the inlet basins; (b) flow time, the time taken to flow through the sewers from the most distant inlet to the point in question.

HYDRAULICS OF COLLECTORS

In computing the sizes of the new intercepting sewers, Kutter's formula has generally been used. The following coefficients of roughness were applied according to the nature and conditions of the conduits:

For new concrete sewer......$n = 0.012$ to 0.013
For existing sewers.........$n = 0.013$ to 0.015
For the old stone sewer......$n = 0.017$
All sewers were assumed to flow full.

As the new intercepting sewers will have to carry the sewage water from a combined system, slopes were adopted which, in general, give velocities of not less than 2.5 ft. per sec. for the present average domestic sewage flow.

Fig. 3—Plan of city showing proposed intercepting sewers.

FLOAT TESTS

A series of tests was made by means of floats to determine the most appropriate location for the main outfall sewer. The direction and the velocity of the currents have been plotted, together with the probable course of floating particles discharged at different distances from the shore during a complete cycle of the tide. These tests have shown that it would not be necessary to extend the main outlet very far into the St. Lawrence, also that all domestic sewage discharged at Pointe à Carcy in line with St. Andrew street would be quickly diluted, and that there is no reason to fear that, at rising tide, any floating material will be diverted into the estuary of the St. Charles river.

CHEMICAL AND BACTERIOLOGICAL ANALYSIS

A series of chemical and bacteriological analyses were made on water samples taken in the St. Charles and St. Lawrence rivers, at different places, and at regular intervals during a number of complete cycles of the tide, in order to determine the degree of pollution caused by the present discharge of sewage water. These tests have clearly shown the insanitary conditions existing along the St. Charles river.

Extent of the Intercepting Sewers Project

An intercepting sewer system for a city of the importance of Quebec requires so large a capital expenditure that only the most economical possible scheme should be adopted. The present outlets discharge all sanitary sewage and storm water into the St. Charles river. But to build intercepting sewers and sewage pumping stations of sufficient capacity to discharge this total volume into the St. Lawrence river would involve a prohibitive construction cost.

To reduce such expenditure and operating cost to a minimum, it is necessary to limit the amount of water intercepted at each outlet as much as possible while still obtaining the necessary improvement of sanitary conditions. To do this, while retaining a moderate size for the intercepting sewers, a control chamber or automatic regulator was provided at each existing outlet. With these regulators, all domestic sewage water will be automatically diverted into the collectors, and the storm water surplus discharged direct into the St. Charles river.

During heavy rain storms, the volume of water carried by a combined sewerage system is very important. The maximum storm water flow may be 100 to 120 times as great as the domestic sewage flow. Health authorities, however, agree that it is permissible to discharge surplus storm water into a water course, without causing any nuisance, whenever the flow is more than three times the average dry weather flow.

Alternative Projects

In order to determine the most economical and appropriate layout for the system, a study was made of different locations for the intercepting sewers, together with methods available for the discharge of the sewage both by gravity and by pumping.

DISCHARGE BY GRAVITY

If it were possible to discharge all the sewage water by gravity into the St. Lawrence river, this method would naturally be the most economical; but in that case, the intercepting sewers in the lower section of each district would have to be built many feet below the average tide level in order to obtain sufficient slopes and minimum covering.

Consideration was given to the possibility of constructing storage reservoirs of sufficient capacity to collect all sanitary and storm water during rising tide periods, to be discharged later by gravity during the following low tide. We came to the conclusion that the cost of the works required would be very high and that the project would not be economical. Moreover, the maintenance of these storage reservoirs would be difficult and expensive and they might become a nuisance from a sanitary point of view.

Even with these reservoirs, pumping stations would still have been required for the districts of Limoilou and Quebec West in order to discharge into the main south shore intercepting sewer all the domestic sewage water coming from these two districts.

DISCHARGE BY PUMPING

For many reasons it was found necessary to be able to discharge the sewage water at any time. The most economical way of doing this would be to pump the sewage water into the St. Lawrence river and the storm water into either the St. Charles river or the St. Lawrence river.

To meet the requirements of the health authorities, as noted above, the pumping system must at least be large enough to deliver three times the average future dry weather flow. In an endeavour to reduce this capacity, we studied a system of reservoirs for storing storm water only. They were to be built near the St. Charles and the St. Lawrence rivers. During high tide periods, the surplus of storm water would be stored in them and discharged by gravity at the next ebb tide.

The conclusions reached during the course of this study can be summarized as follows:

(*a*) The construction of these storage reservoirs would not avoid the necessity of building pumping stations; it would only somewhat reduce their capacity.

(*b*) The saving in construction and operating cost of these pumping stations would not have been sufficient to justify the capital investment required for the construction of these reservoirs.

(*c*) As stated previously, the maintenance of such storage reservoirs would have been difficult and expensive and might have become a nuisance from a sanitary point of view.

The construction of sewage pumping stations of adequate capacity was therefore considered preferable to the construction of storm water storage reservoirs with pumping stations of slightly reduced capacity.

A study was also made as to the desirability of building independent collectors to intercept such water from the higher sections of each district as could be discharged by gravity.

In this case, for the lower sections of these same districts, it would still have been necessary to build pumping stations and fairly large intercepting sewers, although their capacity would have been reduced. It was found that such a project would not have been justified from an economical point of view. The construction cost of these additional collectors would have been much greater than the capitalization of the savings made on the operating cost and on the capital required for the construction of works of slightly reduced capacity.

Before determining the most economical course to be followed by the main south shore intercepting sewer, a number of different plans were studied and comparative estimates prepared. Two alternatives were considered for the district of Quebec South. The course which has been adopted and which is described in the following pages is shown on Fig. 3 by a thick black line. With the alternative course, the intercepting sewer would have followed as closely as possible the shore of the St. Charles river. In some places it would even have been constructed in the river and a wharf would have been built over the collector.

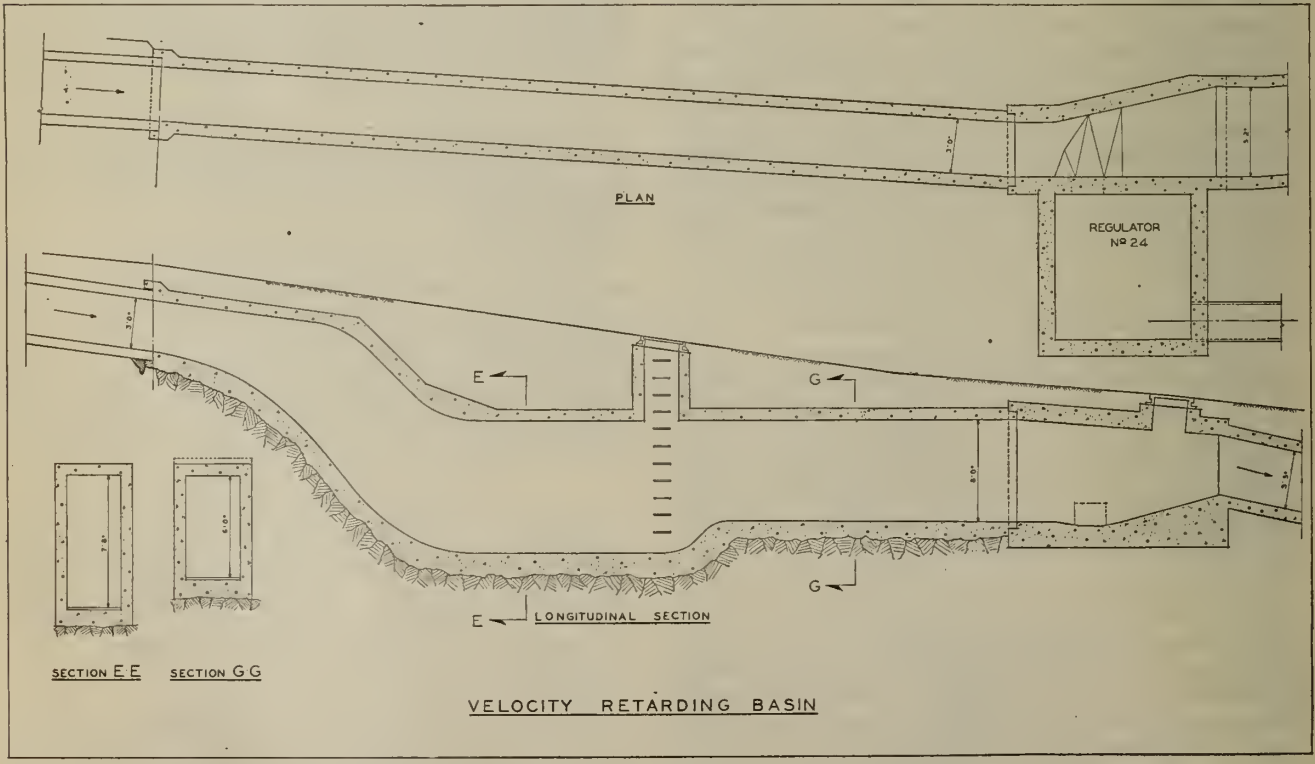


Fig. 4—Plan of velocity retarding basin necessitated by steep slope on Dambourges street.

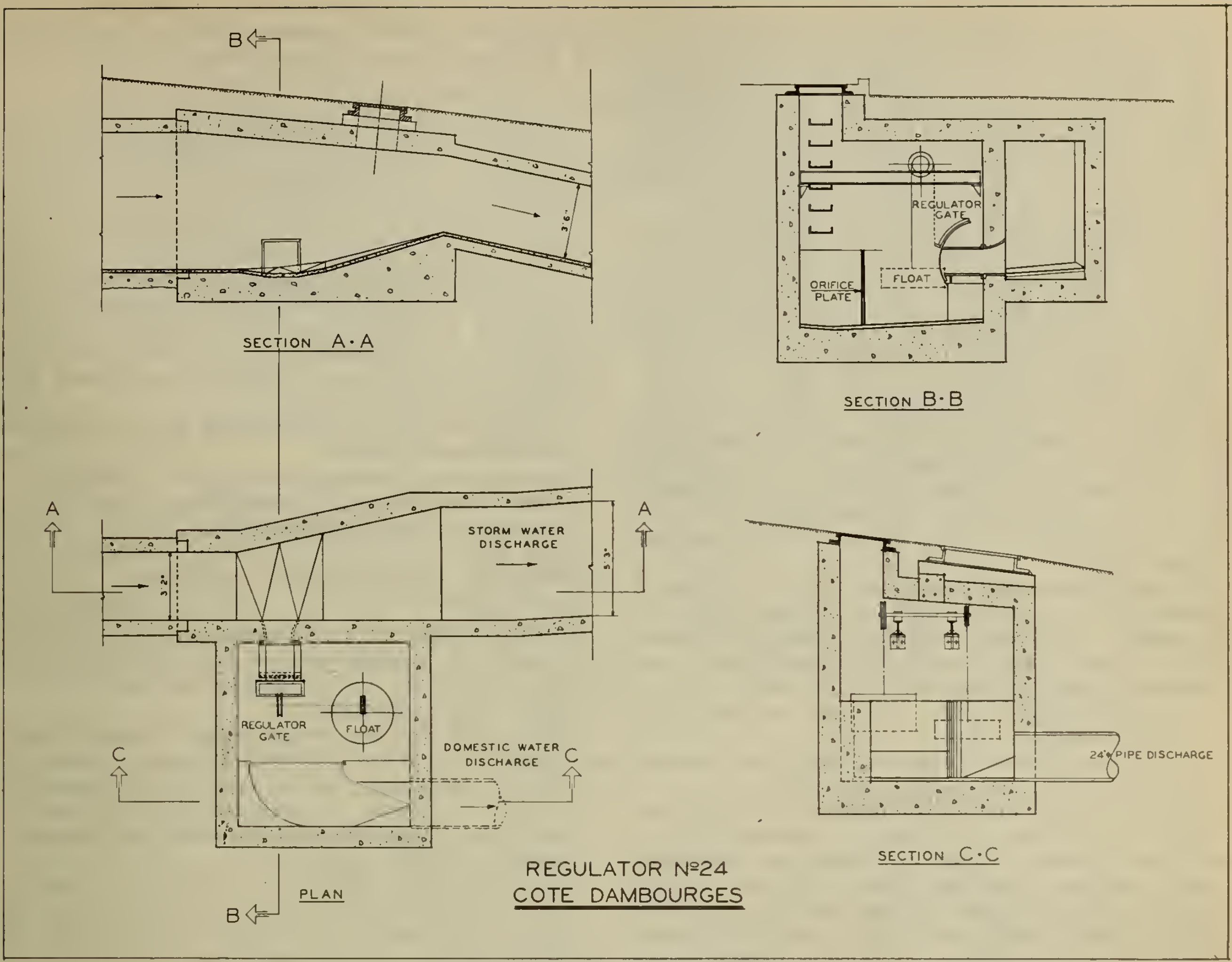


Fig. 5—Plan of typical regulator.

This course would have greatly improved the whole shore, but unfortunately, its cost would have been prohibitive due to the construction of the new wharves. Moreover, the maintenance of the intercepting sewer would have been very expensive, and repairs in case of accident would have been difficult.

General Description of Proposed Intercepting Sewer System

The proposed intercepting sewer system to correct and prevent the pollution of the St. Charles and Lairet rivers and to improve the sanitary conditions of the shores can be briefly described as follows: (See Fig. 3):

In each of the three drainage districts, an intercepting sewer will be built together with a sewage pumping station. The main intercepting sewer will be located in the district of Quebec South which is the most important. The domestic sewage water intercepted in the district of Limoilou and Quebec West will be discharged into the main collector of Quebec South by means of siphons crossing under the St. Charles river. All sewage water from the three drainage districts will be discharged into the St. Lawrence river by a main outfall sewer located at Pointe à Carcy. Whenever possible, only sewage water will be admitted into the intercepting sewers. But the storm water will have to be intercepted and pumped for a certain section of each of the three drainage districts where the level of the ground is too low to permit at high tide the storm water to be discharged by gravity into the St. Charles river or the St. Lawrence river.

The plan in Fig. 3 shows, for each district, the course followed by the intercepting sewers, together with the locations of the sewage pumping stations, regulators and siphons. The collectors are shown by a full line in black, the siphons by a broken black line, the regulators by a circle along the collectors and the pumping stations by a black square. The areas enclosed in dotted lines are those where the storm water must be intercepted and pumped.

District of Quebec South

The proposed construction for this district comprises:

1. A main intercepting sewer starting from St. Valier street, and following the St. Charles river, along the south shore to St. Roch street and then across the C.P.R. yard and along St. Andrew street to the St. Lawrence river.
2. A series of control chambers or regulators installed along the present outlets and near to the collector.
3. A main sewage pumping station located on St. Andrew street close to the St. Lawrence river.
4. A main outfall sewer from the pumping station to the St. Lawrence river to discharge in deep water at a point located approximately 200 ft. from the shore.

The intercepting sewer should collect from all the present outlets of Quebec South district or of this part of the city of Quebec which is drained along the south shore of the St. Charles river.

An area of about 200 acres, representing about 10 per cent of the total area of the Quebec South district, corresponds to the lower section of the district where storm water cannot be discharged by gravity during high tide, and must therefore be intercepted and pumped. The diameter of the collector varies from 36 to 96 in. or its equivalent. Between Ramsey street and the pumping station, the old stone sewer will be used again, together with the new intercepting sewer.

A regulator will be installed at the proper elevation along each of the 17 outlets presently discharging into the St. Charles river. The domestic sewage flow will be automatically diverted by gravity into the new intercepting sewer. Whenever the flow of the present outlets is more than three times the future dry weather flow, or in other words, whenever the storm water flow is sufficient to dilute the domestic sewage up to three times their average future flow, then all surplus storm water will be directly discharged into the St. Charles river by means of the present outlets or by new storm water outlets. The flow at the regulator will be controlled by means of a float acting directly upon an automatic valve.

The installation of such a control system makes it possible to use a much smaller intercepting sewer. Accordingly, its designed capacity at each intercepting point or at each outlet was based on the higher of the following requirements as estimated for 1970:—

1. A flow equal to three times the average future dry weather flow.
2. A flow equal to the average future dry weather flow plus the maximum storm water flow.

It was estimated that, at the Quebec South pumping station, the cumulative average dry weather flow in 1970 would be 69 cu. ft. per sec., while the cumulative storm water flow might reach 383 cu. ft. per sec. The interceptor at the station was therefore designed for a capacity of 69 + 383 or 452 cu. ft. per sec. and various sections of the interceptor were proportioned in the same way.

As regards the regulators to be installed at the various intercepting points, their capacities range from 9 to 320 cu. ft. per sec. depending on their location and the drainage area which each controls.

SEWAGE PUMPING STATION OF QUEBEC SOUTH

The most important of the three pumping stations to be built for the proposed intercepting sewer system is the Quebec South pumping station on St. Andrew street at the lower end of the main collector between Dalhousie street and the St. Lawrence river. Its capacity will be sufficient to pump into the St. Lawrence river, at high tide, all storm water intercepted in the lower section of this district plus the total domestic sewage flow intercepted by the intercepting sewer of each of the three drainage districts. During low tide, it will be possible, for short periods, to discharge the total flow by gravity.

The fluctuations of the water flow to be pumped at the station are as follows:

Present average domestic sewage flow...	38 c.f.s.
Future average domestic sewage flow....	69 c.f.s.
Three times future average domestic sewage flow........................	207 c.f.s.
Maximum flow including intercepted storm water......................	452 c.f.s.

During low tide, the water flow will be passed through the station by suitable control apparatus to be discharged by gravity to the main outfall sewer, either directly or after screening.

During high tide the sewage will go through a series of comminutors before entering the main suction pit supplying each pump. In this manner any suspended solids liable to hinder the operation of the pumps or to float after being discharged into the St. Lawrence river will be entirely removed.

To provide proper flexibility in the rate of pumping required, two 30-cu. ft. per sec. and four 110-cu. ft. per sec. sewage pumps will be installed. Each unit will be controlled by an automatic float control switch installed in the suction pit. As the water level in the suction pit will vary according to the increase or the decrease

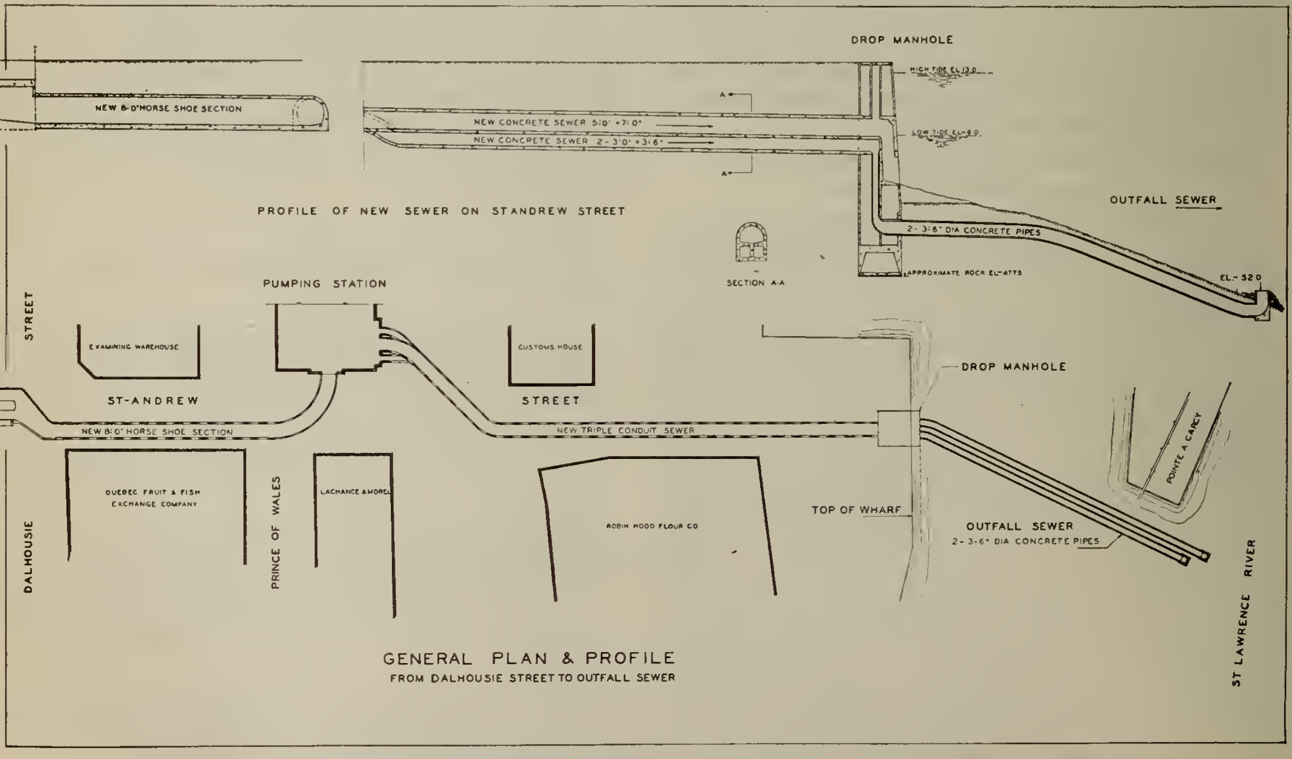


Fig. 6—General plan showing work still to be done.

of the volume of water intercepted, the different pumps will successively come into operation or will cease to operate according to the fluctuation of the sewage and storm water flow. Whenever the level of the tide permits, sluice gates will automatically be opened to allow gravity discharge. The conduits at the outfall will be connected so that the domestic sewage water will be discharged in deep water until there is a dilution equal to three times the average dry weather flow. All excess storm water will be directly discharged into the Pointe-à-Carcy basin located at the end of St. Andrew street. In case of accident or of electric power failure, weirs will permit the discharge of all water by gravity.

The electric power demand for the main pumping station of Quebec South will depend on the sewage flow and the tide. The limits of the power demand between low and high tide periods will be as follows:

For the present domestic sewage flow	0 to 125 hp.
For the future domestic sewage flow	0 to 230 hp.
For a flow equal to three times future dry weather flow	0 to 620 hp.
For the maximum sewage and storm water flow	0 to 1,200 hp.

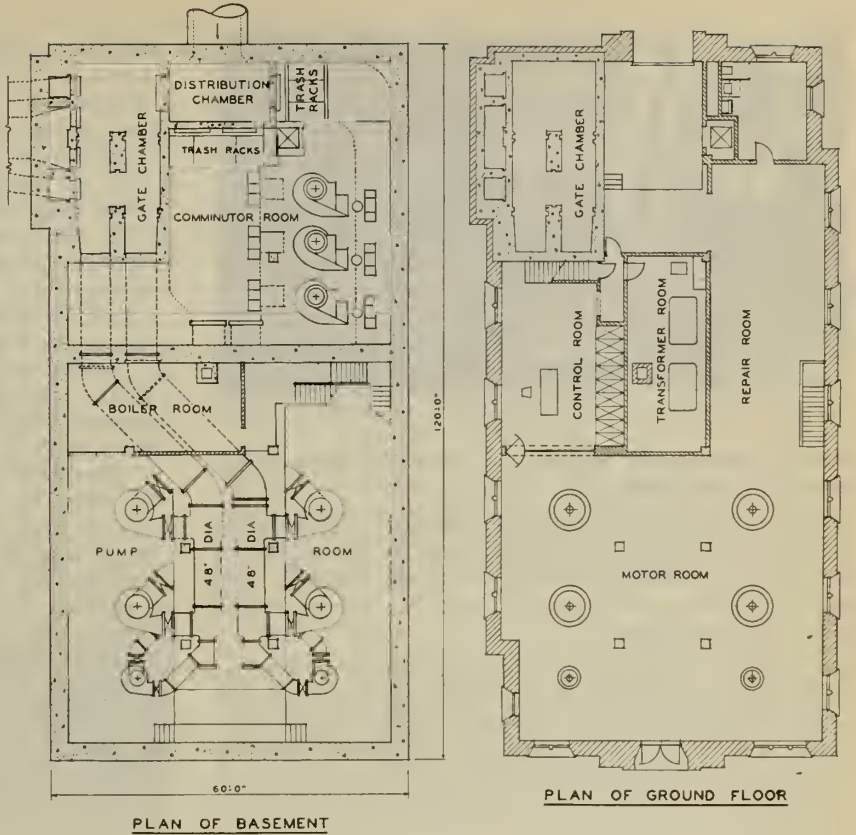


Fig. 7—Plan of pumping station.

The power demand will therefore be subject to great variation. Moreover, the maximum demand will be reached only a few times a year and for a short period during a cloud burst or an extraordinary rainfall. Similar conditions will exist at the two other pumping stations at Limoilou and at Quebec West, so that the maximum power demand at the three pumping stations might reach 1740 hp., subdivided as follows:

Main pumping station	1,200 hp.
Limoilou pumping station	450 hp.
Quebec West pumping station	90 hp.
Total	1,740 hp.

DISTRICTS OF LIMOILOU AND QUEBEC WEST

Similar calculations were made to determine the required intercepting sewers, regulators, pumping stations, and appurtenances for the districts of Limoilou and Quebec West.

Construction Details

In general, precast concrete pipes were used for the smaller size sewers or whenever local conditions were favourable, and cast-in-place or monolithic conduits of special shapes were used for the larger sizes and whenever the sewers had to be constructed in special locations.

For instance, for the lower section of the intercepting sewer, from the C.P.R. yard to Dalhousie street on St. Andrew street the space available was very restricted and the sewers had to be built along the old stone sewer and under railroad tracks, through old wharves with backfilled soil and below tide level. In location of this nature, it was thought that the cast-in-place conduits would assure a more solid and even foundation bearing on the soil, whilst the precast pipe would have had to be bedded on a refilled or special foundation. Due to the restricted space available, special shapes had to be resorted to in numerous cases. The water tightness was also better with cast-in-place conduits, for despite most elaborate precautions it is very difficult to make a real tight joint in ground of this nature, within the tidal range. It should be noted that all sewage and storm water flowing in this section will have to be pumped and any leakage would result in an increase in the annual pumping charges.

The work involved also included the removal, displacement, modification and reinstallation of all the numerous existing water and gas mains, utilities, underground electric conduits, sewer pipes and services encountered during the execution of the contract.

CONCRETE DESIGN

In the design of the concrete conduits and structures, the following live and dead loads were used:

Horseshoe section. Train load of 10,000 lb. per lin. ft. of track. With the crown of the sewer at a depth of 10 ft. below the track, a uniform pressure of 800 lb. per sq. ft. was assumed, or, in other words, the train load was assumed to be distributed over the width of the excavated trench only. The weight of the fill over the sewer was taken as 120 lb. per cu. ft. No reduction of the loads was taken into consideration due to friction between fill and the side walls of the trench.

Full hydrostatic pressure due to ground water was added to the above loads. Maximum ground water level was assumed to reach the level of the street surface.

Double conduit sewer. This sewer was designed for the same loads as the horseshoe section with the exception of the train load, which was increased to 2,000 lb. per sq. ft. applied at the level of the crown of the sewer. This was done because the fill over the sewer is only 5 ft. deep.

Unsymmetrical loads on sewers. Full allowance was made for the possibility that a railway track may be

Fig. 8—Storm water outlet chamber on St. Andrew street.

located immediately adjacent to the sewer, and running parallel to its centre line.

Method of calculation of bending moments. The bending moments were determined according to the theory of elasticity by using Sutters fixed point method. The author's partner, E. Nenniger, M.E.I.C., was in charge of the concrete design.

Stresses in concrete and steel. Compression in the concrete, and tension in the steel was kept well within stresses specified by the Canadian Engineering Standards Association specifications. Diagonal shearing stresses were found to be very low. Three thousand lb. concrete was used for all concrete sewers and structures.

Construction. The concrete sewers were constructed by using steel surfaced forms, in order to ensure an accurate shape and a smooth finish. Where concrete had to be poured directly on the ground, the reinforcing steel had a concrete cover of at least three inches. But where exact work was obtainable by means of steel surfaced forms, the depth of the steel to the concrete surface was 1½ in. leaving 1⅜ in. of concrete cover over the steel.

This depth of the concrete cover over the reinforcing steel was adopted so as to make certain that tensile stresses in the concrete are kept to prevent surface cracks.

Pumping Station and Outfall Sewer

As stated previously the main pumping station and outfall sewer will only be built as post-war work. However, as all the construction plans and specifications have been prepared for this section, a brief outline of the work involved may be given.

Figure 6 is a general plan showing the work still to be done from Dalhousie street to the main outfall sewer into the St. Lawrence river, and in addition the profile of the work still to be done. It shows:

(*a*) One horseshoe section reinforced concrete sewer of 8 ft. dia. on St. Andrew street from the junction chamber already built at the corner of Dalhousie to the pumping station (an approximate length of 182 ft.)

(*b*) The main sewage pumping station measuring approximately 60 ft. wide by 120 ft. long and located between the Customs House and the Examining Warehouse. The installation will include sewage pumps having a capacity of 500 cu. ft. per sec. or approximately 275 million gallons per day, together with all mechanical, hydraulic and electrical equipment and accessories (Fig. 7). From the pumping station, one junction sewer and one triple conduit reinforced concrete sewer consisting of one 7 by 5 ft. and two 3 ft. by 3 ft. 6 in. conduits on St. Andrew street to the storm water outlet and drop manhole (an approximate length of 285 ft).

A reinforced concrete storm water outlet (21 by 25 ft.) and drop manhole located at the edge of the present wharf and discharging into the St. Lawrence river at Pointe-à-Carcy basin.

The main outfall sewer, consisting of two 3 ft. 6 in. diameter reinforced concrete pipes and outlets, laid in deep water from the storm water outlet and drop manhole across the Pointe à Carcy basin to the exterior line of Pointe à Carcy wharf in the St. Lawrence river (an approximate length of 207 lin. ft.)

Construction Costs

The cost of the main pumping station and outfall sewer still to be built is estimated at about $500,000. The cost of the construction of the lower section of the intercepting sewer system has been about $450,000. The unit contract prices for the principal items of construction of this section are as follows:

7′0″ Horseshoe section concrete sewer (970′ length):
Excavation.......................$30 per lin. ft.
Reinforced concrete................$30 per lin. ft.

Double conduit sewer on St. Andrew street:
6′6″ x 6′0″ and 6′6″ x 4′5″. Approx. length: 711′:
Excavation.......................$28 per lin. ft.
Reinforced concrete................$42 per lin. ft.

6′0″ Horseshoe concrete sewer (914′ length):
Excavation.......................$27 per lin. ft.
Reinforced concrete................$27 per lin. ft.

Double conduit concrete sewer on
St. Valier street (6′0″ x 3′6″ and 6′0″ x 2′6″):
Excavation.......................$20 per lin. ft.
Reinforced concrete................$32 per lin. ft.

Storm water sewer, St. Valier street (6′0″ x 3′6″):
Excavation.......................$18 per lin. ft.
Reinforced concrete................$19 per lin. ft.

Storm water sewer from regulator No. 24
on Dambourges street (5′3″ x 3′6″):
Excavation.......................$10 per lin. ft.
Reinforced concrete................$14 per lin. ft.

Regulator No. 23 on St. Valier street:
Excavation and reinforced concrete..$1,200.
Equipment and accessories.........$3,800.

The unit prices given above are exclusive of pavement and of special backfilling. Whenever any rock excavation was encountered it was paid extra at the rate of $4 per cu. yd.

THE BAILEY BRIDGE

COLONEL E. C. THORNE, M.E.I.C,
Director of Engineer Development, Department of National Defence, Ottawa, Canada

The lifting of security regulations by military authorities, insofar as it affects bridging equipment, permits a brief description of the World War II military bridge, which has been universally adopted by the United Nations, and is known as the "Bailey Bridge."

The Bailey bridge takes its name from its inventor, Mr. D. C. Bailey, a British structural engineer, employed by the British Ministry of Supply, and was designed with a view to providing an equipment which could be assembled rapidly in various ways, in order to meet varying requirements of spans and loads.

Double-truss, double-storey type of Bailey bridge, with footway.

The Bailey bridge is of the "through" type, the roadway being carried between two main girders. The girders are simply a series of interchangeable lattice work panels of electrically welded special steel, approximately 10 ft. long. The panels are put end to end for whatever length is required and fastened together by steel pins. A panel can be lifted easily by six men. The bottom chords accommodate transoms and also carry fittings for swaybracing. The roadway is carried on stringers, and the road surface is built of wooden planks, all cut ready to standard size, dropped into position and held down by a curb which is bolted down with hook bolts with captive nuts.

The capacity of the Bailey bridge is increased by additional panels placed alongside the original panels, and/or by adding an extra storey of panels above the first. Such arrangements of panels are known as "trusses" and "storeys", thus double truss single storey would be one type of Bailey bridge that could be assembled.

The Bailey bridge can also be used as a floating bridge, the piers being formed by pontoons. By using the various combinations of trusses and storeys, varying spans and loads may be accommodated.

It is not possible, at the present time, to describe, in any detail, the construction details of the bridge. However, it may be said that it is easy to erect and particular attention has been paid to ease of handling, transport and manufacture, and the carrying capacity has been calculated and tabulated to meet existing requirements. No tools are required in the erection except standard spanners. In this way it becomes possible to eliminate noise, a condition necessary for the safety of work done under cover of darkness.

A crew of forty men with only one week's training is sufficient for most purposes. The span is assembled on land and then pushed forward on rollers. It has a special upturned nose on the landing end, to facilitate finding a bearing. Parts for the heaviest spans can be transported in three-ton trucks.

The roadway is wide enough to carry all military traffic. Additional traffic, two files of infantry on foot, can be carried at the same time by two footways. These run outside the panels, supported by cantilever beams. Upright stanchions are slotted into the outer ends of these and a rope rail is threaded through rings at the top.

Another feature is that such a bridge suffers the minimum damage from bombing. All parts are interchangeable and repairs are made easily. Every part fits perfectly, and is tested for accuracy and interchangeability in the plant before shipment. Every panel is tested by a special device. A 60-ft. length of panelling is assembled and tested by a hydraulic ram. This assembly moves forward constantly, a new panel being added on one end as a tested panel is taken off the other. This continuous method assures safety with high production.

As an example of the adaptability of industry, it is interesting to note that these bridges are being made in great quantities by a firm that formerly made only metal beds.

The Bailey bridge has been used in North Africa, Sicily and Italy, and is now playing an important part in the Normandy campaign. There are no indications that the Germans have a bridge embodying similar principles of construction and erection.

British vehicles crossing a Bailey bridge over the Caen canal during Gen. Montgomery's offensive of July 18.

From Month to Month

News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

RESULTS OF QUESTIONNAIRE ON COLLECTIVE BARGAINING

One of the most noticeable features of the returns to the questionnaire was the small number that were returned. With a subject that may set the pattern of the future for the profession, it is strange that only fifty per cent of those who received questionnaires completed and returned them. In this age of democratic demands it seems odd that "the people" do not exercise their franchise more fully.

Another unexpected feature was that junior engineers made a poorer response than senior engineers. For instance, with a mailing list of over six hundred, the junior section of one branch had an attendance of forty at a meeting called to hear about collective bargaining. Another group of junior engineers out of four hundred and fifty on the mailing list returned only ninety-seven questionnaires. The fear that the senior engineers were less interested that the juniors seems to be unfounded—to put it mildly.

In the actual statistics there is the report of the committee which shows that uniform results were obtained from all age groups and from all branches and all provinces. The answers on all questionnaires received were almost identical with the first hundred received, which is a source of some satisfaction. Thus it is evident that if everyone had returned his questionnaire, the final indication would have been the same. It is nice to know that the wishes of all members on this subject are reasonably uniform.

The report shows that ninety-two percent of the Institute members who returned the questionnaire have expressed themselves in favour of collective bargaining by means of a new order or by an amendment to P.C. 1003. As an example of the uniformity of opinion on this question the lowest percentage in favour for any province was 90 and the highest 95. Engineers under thirty years of age were 96% in favour, those from thirty to forty were 94% in favour while those over forty years of age were 90% in favour. Less than 1% were in favour of a trade union.

If a new order (or an amendment to P.C. 1003) cannot be obtained, 65% want total exclusion from P.C. 1003. On this question the young engineers were 67% in favour of exclusion, the intermediate age group 66% in favour and the older engineers 64% in favour.

Other interesting information obtained from the questionnaire is that 70% of those replying are members of a professional association or corporation. Of those under forty years of age, only 62% are members while of those over forty, 77% belong. Where agreements exist between the Institute and an association the percentage belonging to the association is very high, almost 100%—where no agreement exists the percentage is much lower.

A sub-committee under the leadership of two junior members of the committee, G. N. Martin and J. D. Sylvester, made a most exhaustive analysis and tabulation of the statistics shown by the questionnaire. Results were tabulated not only by provinces but by branches as well so that any differences of opinion that might develop because of local or provincial interests, could be discovered. The replies were also broken down into three age groups, up to thirty, thirty-one to forty and over forty, so that differences due to age or attainment in the profession could be detected. As stated before results were almost uniform for all divisions, which must be just as great a satisfaction for members as it was for the committee.

This uniformity of opinion leaves no doubt as to what the members want. It provides a very solid base from which to work, particularly as the questionnaire was "wide open," giving opportunity for expression of every point of view. The fact that over eight hundred people took advantage of question No. 10 to "Please add any further comments necessary to make this questionnaire a complete expression of your opinion," some writing several additional pages, shows that the comprehensiveness of the form was appreciated.

The favourable reception given to the brief and questionnaire justifies the length of time taken for their preparation. The committee's decision to issue nothing until the subject had been studied thoroughly and understood, has been proven wise.

COLLECTIVE OPINION ON COLLECTIVE BARGAINING

The fourteen societies which met in Ottawa in April to consider the implications of Order-in-Council 1003, met again on August 15th—this time to re-examine the situation in the light of the information gathered on this subject from their various memberships.

As each organization reported to the meeting the results of its canvas, it became apparent that in general, all groups were thinking alike. With one or two exceptions all favoured collective bargaining, and practically all wanted a new order rather than 1003. There were differences of opinion as to who should do the bargaining, some provincial associations wanting sole rights for engineers in their provinces, and others, including the Institute, recommending a joint control that would include allied professional groups such as chemists, science workers, architects, etc.

One provincial association reported that it had already set up a bargaining organization to cover its members. It was expected that this group would start to function almost immediately. All other organizations wanted a new order. These differences did not constitute any problem as the association in question agreed to go along with the other groups in an application for new legislation, on the understanding that it was prepared to operate under the new order if it proved to be more advantageous.

This unanimity made it possible to appoint a sub-committee to work on the desired new legislation. The committee consists of one representative from each of the following five national organizations: Canadian Institute of Mining & Metallurgy, Canadian Institute of Chemistry, Royal Architects Institute of Canada, Dominion Council of Professional Engineers, Engineering Institute of Canada. The sub-committee met the same day and reported back that it desired authority to engage legal counsel, recommending that the cost of this and all other expenses be met by the fourteen societies apportioned on a membership basis. The report was approved unanimously.

The sub-committee has its work well under way, and hopes to be able to present a draft of suitable legislation well in advance of October 12th—the date of the expiry of the present exemption for order 1003.

This brief account of a meeting which lasted all day will serve to keep members informed. There should be little delay in finding out what can or cannot be done. There is substantial reason to believe that with an united front well established, the wishes of professional workers can be attained.

The Institute's representatives at the meeting were: deGaspé Beaubien, President; R. E. Heartz, chairman of the committee and I. R. Tait, a member of the committee. The General Secretary acted as secretary to the meeting, and A. E. MacRae of Ottawa, a representative of C.I.M. & M., was chairman.

THE COMPOSITION OF INSTITUTE MEMBERSHIP

As a by-product of the inquiry into the opinions of the membership on collective bargaining, other interesting information has been disclosed for the first time. This relates to the nature of the membership in terms of branches of engineering.

For a long time there has been an interest in this subject both within and without the Institute; therefore when an opportunity to secure the information presented itself, it was utilized. On the questionnaire for collective bargaining a question was asked as to the classification in which each member grouped himself. Here are the results expressed in percentages of total membership:

Civil	46
Mechanical	23
Electrical	21
Chemical	5
Mining	3
Miscellaneous	2

The Institute's figures, extended into numbers, indicate that the membership is made up of approximately 2,800 civil engineers, 1,500 mechanical, 1,300 electrical, 300 chemical, 200 mining and 130 miscellaneous.

Considering the three large groups by themselves, the Institute's figures are very close to the proportions established by the registration with the Wartime Bureau of Technical Personnel. The Bureau figures are:

Civil	42
Mechanical	29
Electrical	29

It is interesting to see how the membership has developed parallel to the development of Canada. Starting in 1887, at a time when there were few engineers in Canada other than civil, it is reasonable to find that at that time practically all members were civil. In 1944 after a steady national industrial development the make-up of the membership has changed, apparently proportional to change in numbers and branches of the profession itself. To-day less than one half of the membership is civil.

It will be particularly gratifying to the officers of the Institute to see that the society's make-up is in keeping with the requirements of the times. It is an encouraging manifestation of the Institute's place in Canada and the part it plays in the life of the profession of engineering.

COAL AND CONSERVATION

It is no news for Canadians to hear about coal shortages. The press is full of it. For most of us it is of no avail to ponder the reasons for the shortage, but it is of serious import that the significance of the situation be appreciated. A lot of people are going to be cold this winter, and a lot of industries are going to be seriously handicapped.

Only a few weeks ago, a distinguished English engineer who has examined the coal situation in many parts of the world came to Canada and the United States, not for coal but for a specific type of equipment urgently needed in a far part of the world where coal was present in abundance. He told the writer that coal was the number one priority for the Allied Nations to-day. He painted a not very pleasant picture, and he spoke as one who knows.

In Canada the production of coal per man and in total has decreased materially, while the cost has gone up. This phase of the subject gets into industrial and political considerations on which it will do no good to expatiate here. The fact remains that coal will be in "short supply", and everyone needs to be careful of it. Substitutes and lower grades will have to be accepted, but, at that, Canada will be a lot better off than many other countries.

The following letter from the coal controller addressed to the president is important. The president desires to bring it to the attention of members, with the request that the conservation of fuel asked for by the controller be a part of the policy, both domestic and industrial, of every member.

DEPARTMENT OF MUNITIONS AND SUPPLY
OTTAWA, CANADA

July 24, 1944.

Dear Mr. Beaubien:

I am writing to you on behalf of The Coal Conservation Committee to ask for your help in overcoming a serious situation, which we feel must be faced with determination.

On the North American continent, bituminous coal is being consumed at a greater rate than it is being mined. The continued drop in Canadian production of deep-mined coal is disappointing and causes grave concern. Stocks of bituminous coal in the United States have shrunk from 90,000,000 tons to 50,000,000 tons within eighteen months. Obviously we cannot continue to deplete the present stocks without jeopardizing the war effort. Furthermore, as our Armed Forces advance in Europe, the United States will be called upon to fill additional requirements outside of this continent.

Every effort is being made to stimulate production, but the difficulties are great. Requirements must be reduced to the point that they are no greater than production, and this we believe can best be accomplished by the rigourous conservation of fuel. Not only is it essential that industry recognize the situation, but also the need for conservation in the home should be instilled in the minds of the employees. The Coal Conservation Committee, composed of business executives and technical personnel who have volunteered their services, recognizes and appreciates the valuable contributions made by Canadian industry during the past year.

I feel that your association can be of much help to us in winning this battle on the home front and will much appreciate your co-operation and assistance.

Yours very truly,
(*Signed*) E. J. Brunning,
Coal Controller.

ERRATUM

Attention is called to a serious error made in the July Journal in the paper "Improved Soil Stabilization" by G. Piette, Jr.E.I.C. In laying out the pages, two galleys were inadvertently interchanged with the result that the continuity of the paper was badly broken. The text on page 416, contained between the third paragraph starting with the words "Below is given . . . . " down to the end of the table in the second column "Specific gravity . . . .," belongs on page 415 just ahead of the paragraph starting with the words "The dry powdered material . . . . " near the bottom of the first column.

Reprints of the article have been made and any member desiring a corrected copy may secure it without cost upon request. Both to the author and to readers we apologize for this error.

CANADIAN LUMBERMEN'S ASSOCIATION ESTABLISHES NEW PRIZE

Some time ago the Canadian Lumbermen's Association offered the Institute the sum of one hundred dollars annually for the establishment of a prize for papers on lumber, timber, wood and wood waste. Council readily accepted the generous offer and recently, negotiations have been completed whereby the rules and regulations for the award have been agreed upon.

The purpose of the prize is to encourage the study of the uses of wood. Wood is already a versatile material, and it is likely that additional uses will be found for it in the near future. It is a Canadian material, of particular significance in many Canadian industries. Its usefulness can be increased, and The Engineering Institute of Canada will be happy to play a part in this development by encouraging the presentation of papers and discussions before the branches. The offer of a substantial cash award should stimulate the preparation of papers in this field.

As will be seen from the following rules a very comprehensive field is offered. These rules were drawn up by a committee appointed for this purpose by the president consisting of:

Chairman:T. A. McElhanney, superintendent, Forest Products Laboratories, Department of Mines and Resources, Ottawa.

W. J. LeClair, Secretary-Manager, Canadian Lumbermen's Association, and Editor, *Timber of Canada*, Ottawa.

Gordon McL. Pitts, Maxwell & Pitts, Architects, Montreal.

Rules

A prize of $100.00 will be awarded by the Canadian Lumbermen's Association for the best paper presented in any prize year on the use of lumber or timber in construction; or on the use of wood, including wood waste, in the manufacture of useful products; or on the development of methods of treating wood to make it more resistive to destruction from decay, insects, marine organisms or fire; or in such other related subjects in wood utilization as may later be designated.

The following rules shall govern in the competition:

1. The competition shall be open to any bona fide resident of Canada.

2. An award shall be made only if, in the opinion of the examiners, a paper has been presented for publication in the *Journal* of The Engineering Institute of Canada and/or in *Timber of Canada* of sufficient merit to justify the award.

3. The award shall not be made oftener than once a year, and the prize year shall be from July 1st to June 30th.

4. The award shall be made at the Annual Meeting of The Engineering Institute of Canada.

5. A committee of five shall judge the papers entered for competition, all of whom shall be members of The Engineering Institute of Canada.

6. All papers presented shall be the work of the author or authors and must not have been made public previously except as part of the literature of The Engineering Institute of Canada, or of the Canadian Lumbermen's Association. Proper credit shall be given in the papers for any assistance obtained from other parties or from other reports.

7. Should the Committee not consider the papers presented in any one year of sufficient merit to justify a prize, no award shall be made, but in the following year or years the Committee shall have power to award accumulated prizes if papers of sufficient merit to justify prizes are presented.

8. In the case of two or more authors presenting a paper, the amount of the prize shall be divided equally among such authors.

9. For the first year the award shall be made for the best paper on the structural application of timber and/or plywood as for example:

(1) Laminated structural wood members.

(2) Composite wood and plywood structural members.

(3) New ideas in the design of structural timber units.

Special consideration will be given to papers dealing with the application of low grade material to structural uses.

POST-WAR PLANNING

The following discussion, on the papers delivered at the last annual meeting in Quebec, is printed in full as the abridgement published previously was misleading —*Ed.*

The papers on Post-War Planning vigorously emphasized the development of a high rate of production hoping thereby to bring about a full and continuous employment, but the history of the last twenty-five years indicates that it was a high demand that brought about prosperous times and that the further extension of production (in order to absorb the demand for it as quickly as possible) caused periods of depression. This fact surely points to the necessity, not for a high rate of production, but for its regulation with a view to levelling the supply to probable normal demand. Such an evening-up process would eliminate excessive overtime employment, discontent due to fatigue of the labourer, over-extension of certain lines of industry which in turn lead to unemployment and to an undesirable turnover of workers.

Turnover of employees in construction is inevitable, but with industry the situation could be controlled so as to curtail the over-production followed by periods of saturation and idleness. Such control would ensure more permanent jobs for the workers and provide more reasonable opportunity for them to engender a loyalty to their employment.

The post-war aim is to secure permanent employment, i.e. security from enforced idleness. It is claimed that the reinvestment of the profits of industry can bring this about. Does not this mean the return of all earnings to circulation. Wages and salaries automatically return to circulation but dividends produced by the workers are too often hoarded during dull times when they should be expended while they are readily invested when work is prevalent, therefore why not earmark the excess profits for definite expenditure and so avoid such conditions?

To create loyalty among employees by giving them a lasting interest in their work should be one of the principal objects of post-war planning, and, with this end in view, should not the excess profits be credited to those who helped to make them ? i.e. to the employees in the form of non-transferable shares in the industry they work for ? The capital represented by these shares could be used for developing the industry and so provide employment during the dull times. Something of this nature has a more attractive prospect than collective bargaining (odious and repelling word) between the contracting parties whose aims so often conflict.

Ever-increasing production leads to forced selling, instalment (i.e. debt) buying and saturation. We have all observed this in the case of radios, motor cars, electric lighted signs, etc., which, by their over-production and crowding, have somewhat destroyed the peace and beauty of life. Surely there should be more expenditure devoted to employment in connection with education, the fine arts, culture and beautifying of our cities and countryside. Such expenditure would not bring in direct money returns but it would supply a higher standard of living for the Nation. In Canada the appropriation of funds for such expenditures are sadly inadequate.

These remarks are not intended as destructive criticism of the excellent and valuable papers heard at the meeting, but are intended to lead engineers, now so much involved in industry, to look to the future and occasionally to place themselves in the other fellow's shoes and to seek out the means by which everybody can be fully interested in the success of his work, instead of planning to provide a mere competence for employees.

F. P. Shearwood, M.E.I.C.

WASHINGTON LETTER

Two of the books at the top of the best-seller list these days are Bob Hope's "I Never Left Home" and Sumner Welles' "Time for Decision". Both are recommended. Some comments on the latter, however, may be justified in this letter. "Time for Decision" is not, in any narrow sense, an engineering subject but it is nevertheless recommended to the attention of engineers. The war has posed great problems to engineers and scientists. They have responded magnificently with appropriate engineering and scientific contributions. Even more important, engineers and scientists have shown a wide grasp and appreciation of logistics and of the world wide controls necessary for the prosecution of a world wide effort. As these letters have several times mentioned, many of the most significant advances in international machinery have been made in matters governing supply, transportation, production, and raw materials control—all matters of interest to engineers and fields in which engineers have made outstanding contributions. Donald Nelson and Charles E. Wilson of the War Production Board, W. L. Batt of the Combined Raw Materials Board, Brehon Somervell of the U.S. Army's Supply Service and C. D. Howe of Canada's Department of Munitions and Supply, to mention but a few, are all engineers by training and background. It is to be hoped that the future will continue to demand of engineers this kind of participation in world affairs. The problems, however, will be even more complicated and involved. International trade must be increased throughout the world, sub-standard countries must be opened up, devastated areas must be rebuilt, war industries converted. Any enduring peace arrangements must include plans for vast engineering developments designed to take up the slack or to redress throughout the world balances altered so drastically in the last few eventful years. As never before, engineers will need the broader understanding and wider vision which the war has done so much to advance. Mr. Welles' book, therefore, could well be read as a kind of text book on international affairs.

Mr. Welles' analysis of the history of the League of Nations is particularly interesting. His high commendation of England's Eden and Russia's Litvinov as consistent and outstanding proponents of League principles is particularly heartening to one who has for a long time, in good years and bad, been an executive member of the League of Nations Society in Canada. As far back as the mid-twenties, I was one of those responsible for establishing a League of Nations Society in Montreal. Welles admits that the terms of the Covenant of the League of Nations and the method of its introduction combined to form one of the three major weaknesses in the Treaty of Versailles. He hopes that many of the mistakes made in connection with the implementation of the League principle will be avoided this time. He believes that some other type of organization may be necessary. With respect to the principles behind the League, however, Welles is in full accord. He makes the significant observation that the Covenant of the League should have been forged during the war years and that the Allied Nations should have reached an agreement on the main principles by the time of the Armistice in 1918. If this had been done, the concept of the League would have become a part of the thinking of Allied peoples and particularly of the men who were doing the fighting. Had this been the case it would have been much simpler for the Covenant to have been regarded as the heart of the peace treaty rather than an afterthought grafted on to it and accepted with reluctance by many of the governments represented.

Welles' clear cut denunciation of the British and United States policy with respect to Spain will come as a reassurance to many people who were baffled and bewildered by the policy at the time.

With respect to Russia, Welles makes an important observation. The glib assumption that a common cause against Hitler has brought the United States and Russia together is, he thinks, both dangerous and harmful. Such talk clouds the real issue. There are many major problems to be solved and difficulties to be resolved before any real understanding can be achieved. He adds that "unless both governments and both peoples make a sincere and determined attempt to find a new foundation for the relationship between the two nations, the very cornerstone of any future international organization will be lacking."

As a companion to Mr. Welles' book, Walter Lippmann's "U.S. War Aims" might also be read with profit. His "U.S. Foreign Policy", published last year, forms the background against which his new book is written. Lippmann is highly regarded in many circles in Washington and his opinions are, therefore, of considerable significance. In his "Foreign Policy", his analysis, as always, was brilliant and penetrating. The latter half of the book, however, did not appear to offer anything more than a return to power politics. I therefore looked forward to his new book in which he has developed his position further. However, he has only reaffirmed his stand. A frank and outspoken regionalist, he faces squarely the difficulties of his position, but develops his arguments with power and skill.

All three books deal with the matters which will come under discussion at the forthcoming conference between United States, United Kingdom and Russia. This meeting is scheduled to start in a few days at "Dumbarton Oaks"—that charming and famous Georgetown estate here in Washington. This is the first conference designed to tackle the general question of international security.

The conferences at Casablanca, Quebec and Teheran were mainly strategic, although each added materially to international understanding. Considerable progress has also been made with some of the separate problems which will confront the world with the coming of peace. The food conference last year at Hot Springs, the civil aviation discussion recently completed in London, the monetary conference at Bretton Woods, the petroleum conference which has just signed a satisfactory agreement in Washington and the UNRRA conference to be held in Montreal next month—these will all contribute their share in pointing the way and in relieving the statesmen of the world from the crushing burden of technical problems which did so much to wreck the peace conferences after the last war.

This letter commented last month on the Bretton Woods Monetary Conference which was then taking place. This conference has since completed its work. An agreement was signed which appears to be a satisfactory document and one which will lay the foundation for world co-operation in the monetary sphere. This agreement has yet to be ratified by all governments concerned. An interesting technique was adopted in the case of this conference in that the various representatives were allowed free scope in reaching an agreement to be signed by the conference but the final agreement itself was to be subject to ratification by home governments. This had the advantage of giving the delegates greater freedom of action and probably resulted in a more liberal and comprehensive document. The dangers in the technique are obvious and only time will tell as to the wisdom of its adoption.

Two of the most significant terms in the agreement are to be found in article IV, sections 6 and 7. Section 6 sets up machinery to prevent any member of the Fund from changing the par value of its currency except as authorized by the fund. Section 7 makes it possible for a majority of the total voting power of the Fund to make uniform proportionate changes in the par values of the currencies of all members provided each such change is approved by every member which has 10 per cent or more of the total of the quotas. In respect of this clause, it is interesting to note that only the three leading powers will, under the present arrangement, hold 10 per cent or more of the total quotas. Another interesting provision in the agreement is the one which provides for the addition of two extra seats to a governing body of twelve. These seats are reserved for any nation, other than the "Big Five" (United States, Great Britain, Soviet Russia, China and France) which demonstrates over a two-year period that it has a sustained creditor position with respect to the fund. Under this clause it is quite possible that Canada may win one of the extra seats. Article IX on Status, Immunities and Privileges is also particularly interesting and was the cause of very considerable discussion at the conference. With the entry of government and quasi-government instrumentalities into international operations which have hitherto been largely the province of private organizations, the whole question of governmental immunity and privilege is under review. State Department officials are giving this matter most serious study. The decisions reached in the agreement are, therefore, both interesting and significant.

This letter opened with a reference to Bob Hope. His doings are of more than usual interest to me as he has just landed in Australia on another tour. He says "Road to Australia" should make a good movie title. He suggests substituting a kangaroo for Bing Crosby. Both have about the same sized pouch.

August 19, 1944. E. R. Jacobsen, M.E.I.C.

CORRESPONDENCE

Appreciation of Canadian Hospitality

The following letter comes from one of the war guests in whom the Institute has been interested since 1940. The secretary of the Institution of Mechanical Engineers (of Great Britain) gave Mrs. Clark a letter of introduction to the Engineering Institute, thereby affording the Institute an opportunity to be of service.

Members, and particularly those in the Toronto Branch who took such a leading part in extending hospitality to Mrs. Clark and her son and daughter, will be pleased to know that she has arrived home safely and without mishap. (*Ed.*)

68 Kings Road, Berkhamsted,
Herts, England.
July 4, 1944.

The General Secretary,
The Engineering Institute of Canada.

Dear Sir:

Your very kind letter has just reached me here, having gone to the wrong address in Toronto, as you will now know.

I would like to thank the Institute, and also those members who have been so generous to me and my family, for the kindness they showed us while we were in Canada. We came suddenly and uninvited, and they rose to the occasion in a way I shall never forget. Although being a war guest was not at all times easy, nevertheless we have very happy memories of Canada, and we are deeply appreciative of, and grateful for, your care of us, and the welcome you accorded us.

For the children especially, the experience was something they will never forget, and it broadened their outlook, gave them an idea of the vastness of Canada, with its traditions and beauty. We all hope that we may have the good fortune to visit Canada again.

(Yours sincerely,
(*Signed*) Elspeth Clark.

Change to Metric System

51 Chudleigh Avenue, Toronto 21, Ontario,
August 11, 1944.

Dear Sir:

It has occurred to the writer that the transition from wartime to peacetime production in industry would present an excellent opportunity to accomplish a very desirable change-over in the system of linear and volumetric measurements from the English to the metric.

Great Britain, United States, and Canada appear to stand alone among the highly industrialized countries in their apparent hesitance to adopt the metric system.

Under the post-war international trade conditions, Canada will be obliged to consider the requirements of prospective customers in South America, Europe, and the Orient, in order to sustain the extensive exports considered essential to prosperity. Use of metric measurements would appear to be desirable in the furtherance of this objective. It is quite possible that steps have already been taken in support of the adoption of the metric system in Canada, and any information you may have in this connection will be greatly appreciated. It is presumed that, if such steps are under serious consideration, every effort will be made to collaborate with similar movements in Great Britain and the United States.

Yours very truly,
(*Signed*) J. R. Montague, M.E.I.C.

MEETING OF COUNCIL

A meeting of the Council of the Institute was held at Headquarters on Saturday, August 19th, 1944, at nine thirty a.m.

Present: President deGaspé Beaubien in the chair; Vice-Presidents C. K. McLeod and E. B. Wardle; Councillors J. E. Armstrong, R. S. Eadie, E. V. Gage, R. E. Heartz, J. A. Lalonde, P. E. Poitras, H. J. Ward, and W. J. Ward; General Secretary L. Austin Wright and Assistant General Secretary Louis Trudel.

Annual Meeting 1945—It was noted that the Winnipeg Branch had formally acknowledged Council's acceptance of their invitation to hold the next annual meeting in that city. Tentative reservations have been made at the Royal Alexandra Hotel for Wednesday, Thursday and Friday, February 7th, 8th and 9th, 1945. Following the usual custom, the Council meeting and the retiring president's dinner will be held on the first day, the annual general meeting on the morning of the second day, and professional sessions on the afternoon of the second day and the third day, with the banquet taking place Friday evening.

Employment Conditions (Collective Bargaining)—The president reported that a delegation from the Institute consisting of himself, R. E. Heartz, Irving R. Tait and the general secretary, attended a joint meeting of the fourteen societies in Ottawa on August 15th for a further discussion of collective bargaining. The purpose of the meeting was to resurvey the situation in relationship to the opinions expressed by ballot of the membership of the various societies so that a policy could be determined before the expiry of the period of exemption from Order in Council 1003, namely, October 12th. The president then called on Mr. Heartz, the chairman of the committee, for a detailed report.

After presenting the report Mr. Heartz expressed his appreciation of the co-operation which he had received from the Headquarters staff and from the members of the committee established by the Junior Section of the Montreal Branch under the direction of G. N. Martin. He explained that the results of the ballot were broken down into three age groups so that the opinions of the senior members in relationship to the junior members could be determined. It was interesting to observe that the senior members attended meetings and completed their questionnaires in better proportions than did the junior members and that the senior members gave almost unanimous support to the proposals for collective bargaining. Mr. Heartz explained that the senior members expressed themselves as not being personally concerned in collective bargaining but desiring to support the junior members who felt collective bargaining would be helpful to them.

In response to an inquiry from the president, Mr. Heartz explained that the subcommittee appointed at Ottawa hoped to have a draft of the new proposal prepared by September 20th so there would be some time for study and discussion by the various societies.

The president explained that, at the Ottawa meeting, the president of the Ontario Association announced that his association was proceeding to set up a bargaining organization for its members under Order in Council 1003. He gave details of the organization and methods of operating, although he agreed to support the application for a new order on the understanding that the association could switch over to it if it should prove to be more advantageous than Order in Council 1003.

It was moved, seconded, and approved unanimously that Mr. Heartz' report be accepted, and that at the same time the thanks of Council be expressed to Mr. Heartz and his committee for the unusually fine work they had done.

Following this resolution, there was a further discussion in which Mr. Poitras raised the question of labour legislation in relationship to provincial controls. He thought that if all engineers belonged to the associations it would be a very simple matter for the associations, with the support of the voluntary societies, to administer such legislation relating to engineers.

In reply, Mr. Heartz explained that the legal advisor with whom the subcommittee had consulted had explained that it would be impossible to get legislation that would give to any one agency sole bargaining rights, either provincial or federal. He further mentioned that it was expected that a co-operative organization representing several societies could be established to administer the new legislation. This proposal had been made by the Engineering Institute representatives at the meeting. Such an organization would provide bargaining facilities for engineers and others such as chemists, architects, science workers, surveyors, etc. The legal consultant advised that it should be possible to obtain legislation adequate for this purpose.

Mr. Heartz emphasized the need of maintaining unanimity of opinion. He thought that any endeavour to assign to any one organization exclusive bargaining rights would definitely do away with the necessary unanimity. By way of illustration, Mr. Heartz referred to the Association of Scientific Workers established in Great Britain. This organization of over 14,000 members was the organized labour agency in Great Britain for a group similar to that being considered in Canada. The British association includes technicians as well as professional workers, but it does not have sole bargaining rights. The president of the association is Sir Robert Watson-Watt, the discoverer of Radar, and the board includes many of the most outstanding scientists of Great Britain. Mr. Heartz thought much could be learned from a close study of this organization.

The general secretary explained that, from a study of the experience in other countries, there seemed to be no evidence of exclusive bargaining rights ever having been given to any single organization. Certainly they had not been given in Great Britain or the United States.

Committee on Professional Interests—The president announced that Mr. Challies had asked to be relieved of his duties as chairman of the Committee on Professional Interests, and his resignation was accepted with regret. The president stated that he had approached Mr. J. B. Stirling, who had agreed to accept the chairmanship of the committee, and he asked Council's approval of this action. On the motion of Mr. Armstrong, seconded by Mr. Heartz, it was unanimously resolved that Mr. Stirling be appointed chairman of the Committee on Professional Interests.

Proposed Agreement in Quebec—The president reported that following the last meeting, in accordance with Council's request, he had appointed a committee consisting of J. A. Lalonde, chairman, J. E. Armstrong and René Dupuis, to represent the Institute in negotiations with the Corporation of Professional Engineers of Quebec relative to a co-operative agreement between the two bodies. Mr. Lalonde stated that he had been absent from the city and had been unable to hold a meeting, but expected to do so at an early date.

Proposal for New Central Engineering Organization—The president explained that following the discussion on collective bargaining in Ottawa on August 15th the same group had gone on to discuss the proposal submitted some time ago by the Dominion Council for a new central engineering body. For Council's information he explained that a subcommittee, upon which Mr. Challies was the Institute's representative, had been formed some time ago to draw up the draft of a new charter. After some meetings, Mr. Challies had resigned inasmuch as he felt that such a new organization would serve no useful purpose and that the present situation was sufficiently complicated by a multiplicity of engineering organizations without creating a new one.

The president then returned to the discussion at Ottawa, explaining that the Canadian Institute of Mining and Metallurgy had presented a resolution of its Council supporting the proposal and that it had submitted a further document which had not yet received the approval of its Council, but which recommended that the new organization be established on a firm basis with a permanent secretariat and not a rotating system as had been suggested originally, and that such an organization should be well financed by assessment, probably on an amount of $1.00 or up to as high as $2.00 per member for each organization.

Mr. Beaubien pointed out to the Ottawa meeting that if such an organization were to be really useful the representatives on it would have to have authority to commit their societies to policies determined by the new board, otherwise it would simply be a group of representatives who had to report back to their bodies for authority to do anything. Such a group would be nothing more than the groups which are now called together from time to time as matters of co-operative interest develop. He thought that no organization was prepared to assign to its representative the powers of commitment that would be necessary to give the new organization any usefulness.

Mr. E. P. Muntz and Mr. C. C. Lindsay, representing the Corporation of Professional Engineers of Quebec, had stated that their organization was not in favour of the Dominion Council proposal and as an alternative they suggested the establishment of a committee made up of the presidents of the various societies, perhaps to be known as the Committee of Presidents or the Presidents Conference Committee. This proposal was well received by the group and, with certain rewording which was made by the chairman of the meeting, Mr. Alex. MacRae, it appeared to have the support of most bodies represented. However, neither Mr. Muntz' motion, nor the proposal of the Dominion Council, was put to vote, it being decided that for the moment it would be sufficient to have had the discussion so that the situation could be better understood by everyone. The chairman suggested that perhaps at some later meeting, after further thought had been given to the matter, the proposals could be presented again.

Committee on the Engineer in the Active Services—The president reported that following the presentation of the resolution to the Minister of National Defence, passed at the June meeting of Council in Toronto, complaining of the failure to appoint engineers as officers of the Royal Canadian Electrical and Mechanical Engineers (R.C.E.M.E.), a letter had been received from the Master-General of the Ordnance, Major-General J. V. Young, to whom the resolution had been referred, stating generally that the Institute had misunderstood the situation and suggesting that the president call at his office at some time convenient to him for further information. On July 25th he, accompanied by Lieut.-Col. L. F. Grant, vice-president of the Institute, and the general secretary, had called on the M.G.O., who had with him Brigadier Major, Deputy M.G.O., and Colonel R. L. Franklin, M.E.I.C., administrative officer of the R.C.E.M.E. A very cordial and pleasant interview took place during which the M.G.O. stated that the reason there were not more engineers in the R.C.E.M.E. was that more engineers were not available, and further that they were making every endeavour to fill all openings with engineers.

A few days later a letter was received from the office of the M.G.O. stating that they had overlooked telling the president of a large number of candidates now in training for commissions everyone of whom, with one exception, was a university graduate in engineering. The president called Council's attention to editorials in the *Engineering Journal* about which there had been considerable comment. He stated that a further editorial would appear in the August *Journal* based on the interview in Ottawa. On the whole, the president said, he was very pleased with the interview and he was hopeful that conditions about which the Institute had been complaining, almost since the outbreak of the war, had now been overcome.

Town Planning—The general secretary reported that on a recent visit to Ottawa he had been able to have an interview with a small group of persons specially interested in the subject of town planning. From this interview it appeared as if the Town Planning Institute should be revived with the support of the Institute and the Royal Architectural Institute of Canada. It was possible that considerable financial assistance could be obtained from several organizations now interested in developing the subject. He reported that he had relayed all this information to the R.A.I.C. and that he believed the proposal was acceptable to the architects as well as to the engineers.

Engineers' Council for Professional Development—On the motion of Mr. McLeod, seconded by Mr. Poitras, it was unanimously resolved that Dean C. J. Mackenzie be asked to accept appointment as the Institute's representative on the Engineers' Council for Professional Development (E.C.P.D.). This appointment is for three years and is to replace Dr. J. B. Challies, whose term of office expires in October.

On the motion of Mr. Heartz, seconded by Mr. Armstrong, it was unanimously resolved that Dean C. R. Young be reappointed as the Institute's representative on the Executive of E.C.P.D.

Technical Institutes—On the motion of Mr. Armstrong, seconded by Mr. Eadie, Council unanimously approved of a report prepared by a special committee of E.C.P.D., which among other things, recommended that E.C.P.D. assume the responsibility for the accrediting of technical institutes in the United Sates. As a constituent member of E.C.P.D. the Institute had been asked to express its opinion of the report. Dean Young had recommended strongly that the Institute approve it.

Financial Statement—It was noted that the financial statement to July 31st had been examined and approved, the financial position being somewhat better than at the same time last year.

Post-War Policy for the Institute—The Finance Committee reminded Council that several months ago it had reported on additions to the Headquarters staff whereby additional activities could be undertaken. One of these was the employment of an engineer to work on (a) the rehabilitation of the members from overseas and (b) the re-establishment in peace time industry of members who would be released from wartime industry. It was pointed out that the present duties of the general secretary and the assistant general secretary would make it impossible for them to adequately handle such additional work. The committee emphasized the desirability of such a person being at work now and presented the subject again to Council in an endeavour to determine some means by which the necessary financing could be secured.

It was suggested that such a representative might establish a branch office of Institute Headquarters at Toronto with the object of rendering a special service to the Ontario branches. It was felt further that such a representative should be a member who has returned to Canada from overseas, and it was pointed out that such a position would be an excellent one for someone who had suffered some physical disability in the war.

Mr. Armstrong, a member of the Finance Committee, inquired as to the feasibility of assessing the members of the Institute in Canada on a temporary basis, suggesting an amount of $2.00 or $3.00 a year.

The president stated that while the Institute would have no authority, without a by-law amendment, to change the fees, he thought that a voluntary assessment might be successful. He stated that at several branches he had mentioned the desirability of employing someone for this purpose and he was greatly pleased at the willingness to assist which had been exhibited.

Mr. Lalonde inquired as to whether or not the Institute's present finances would permit a start in this direction and the president pointed out that the service should be started immediately and he thought that the financing could be arranged as required. It was agreed that such a service should be established and the subject was referred back to the Finance Committee for further study and recommendation.

Recognition of Attainments of Engineers in the Active Forces—A report had been received from the committee appointed by Council to look into the matter of a suitable form of recognition of the outstanding services of members of the Institute in the armed forces. Quotations had been secured for the preparation of plaques based on the design submitted to the February meeting of Council, but the Finance Committee did not feel justified in recommending to Council the probable expenditure of from $50.00 to $75.00 for each award. It was recommended that a similar design, in less costly material, or an alternative design be sought. This met with the approval of Council.

Financing of Annual Meetings—The general secretary explained that for some time the Finance Committee had been endeavouring to prepare a set of rules and regulations or instructions for the guidance of annual meeting committees, with particular reference to the financing of such meetings. He submitted a memorandum which the Finance Committee recommends be issued to annual meeting committees in advance of the meetings.

In the light of his experience with the last annual meeting held in Montreal, Mr. Eadie felt that one or two points in the memorandum needed some clarification. At the president's request he undertook to submit any suggestions or recommendations he had to the Finance Committee for inclusion in the final draft of the memorandum. The general secretary suggested that copies of the memorandum might be sent to the chairman of former committees with a request for suggestions. In the meantime Council approved of the memorandum in its present form, and suggested that a copy be sent to the Winnipeg Annual Meeting Committee for their information and guidance.

Treasurer of the Institute—A letter was presented from Mr. F. C. Mechin advising that as he would be leaving Montreal to take up residence in Toronto in September he would be unable to continue as treasurer of the Institute. Under the circumstances, Mr. Mechin's resignation was accepted, and it was left with the president to appoint a new treasurer for the balance of the year.

New Councillor from Alberta Association—It was noted that P. M. Sauder, of Edmonton, a past vice-president of the Institute, had been appointed by the Association of Professional Engineers of Alberta to represent the Association on the Council of the Institute, this in accordance with the recent amendment to Section 78 of the by-laws whereby associations having co-operative agreements with the Institute have the right to elect such representatives.

Wartime Bureau of Technical Personnel—The president reported that in response to a joint letter sent to the Minister of Labour by the presidents of the Mining Institute, the Chemical Institute and The Engineering Institute, an interview with the Minister had been arranged for July 24th. At this interview the three presidents had followed up the proposal made in their letter that the Wartime Bureau of Technical Personnel be instructed to proceed with a survey which would aid in determining a post-war employment plan for the professional persons registered with the Bureau. Most of the necessary information is now in the records of the Bureau but additional staff would be required in order to take off the information and list it significantly, as well as to follow up in the many instances where essential details were missing.

At the same interview the presidents recommended that the service of the Bureau be maintained in the post-war period and that the employment service to be operated by the Department include a professional group such as the Bureau for the placement of professional workers. Reference was made to a report submitted to the British Ministry of Labour by Lord Hankey covering the post-war employment policy of the British government. This report had made recommendations almost identical to those made by the advisory board of the Bureau and the presidents of the institutes.

The president reported that subsequently he had received a letter from the Minister in which it was stated that a committee had already been set up to deal with the matter and that H. W. Lea, director of the Bureau, was on the committee. This committee was studying the Hankey report and found it of particular interest.

The president was of the opinion that the Minister was prepared to support the recommendations of the presidents.

Elections and Transfers—A number of applications were considered, and the following elections and transfers were effected:

ELECTIONS AND TRANSFERS

Members

Charron, Roland, B.A.Sc., C.E. (Ecole Polytechnique), engr., Union Quarries & Paving, Ltd., Quebec, Que.

East, Lawrence A. W., B.A.Sc. (Univ. of Toronto), chief engr., communications dept., C.P.R. Co., Montreal, Que.

Elkins, William Henry Pferinger, Major-General, (graduate of R.M.C.), "Ravenswood," Dutch Village Road, Halifax, N.S.

Foley, William J., B.A.Sc. (Univ. of Toronto), branch mgr., Standard Paving Ltd., Ottawa, Ont.

Hesse, William A., "Diplom Ingénieur" (Royal School of Mines, Berlin), exploration engr., Algoma Ore Properties, Ltd., Sault Ste. Marie, Ont.

Hopper, Charles Houghton, B.A.Sc., M.E. (Univ. of Toronto), consltg. engr., Boyles Bros. Drilling Co. Ltd., Kirkland Lake, Ont.

Knight, George Frederick, (Manchester Coll. of Technology), wks. engr., Consumers Gas Co. of Toronto, Ont.

Lefebvre, Joseph Louis Paul, B.A.Sc., C.E. (Ecole Polytechnique), senior engr., Provincial Fire Commissioner's Office, Dept. of Public Works (Prov. of Que.), Quebec, Que.
Matthews, Benjamin Frank, (Merchant Ventures Tech. Coll.), vice-pres., and wks. mgr., Dominion Truck Equip. Co. Ltd., Kitchener, Ont.
McKee, Neal Trimble, B.M.E., M.E. (Univ. of Kentucky), vice-pres., The Superheater Co. Ltd., New York, N.Y.
Roche, Robert S., petroleum engr., Works & Bldgs., Naval Service, Ottawa, Ont.
Rudge, Frederick William, Sgt., R.C.A.F., B.Sc. (Univ. of N.B.), lab. technician, paving dept., No. 8 Constrn. & Mtce. Unit, Tuft's Cove, N.S.
Stockwell, Henry P., Jr., B.Sc. (McGill Univ.), asst. water wks. engr., Ottawa Water Works Dept., Ottawa, Ont.
Vollmer, George Latimer Thomas, B.Sc. (Chem. Engrg.), (Queen's Univ.), chem. engr. and deputy chief inspr., Canadian Drawn Steel Co. Ltd., Hamilton, Ont.

Juniors

Clawson, William Kennerley, Captain, B.A.Sc. (Univ. of Toronto), Adjutant, Headquarters R.C.E., 1st Canadian Corps Troops, C.M.F.
Cockburn, Kenneth Oscar, Sgt., R.C.A.F., B.Sc. (Metallurgical Engrg.), (Queen's Univ.), metallurgical inspr., No. 11 Aeronautical Inspection Dist., R.C.A.F., Montreal, Que.
Haldane, Donald Edward, Lieut., B.Sc. (Mech.), (Univ. of Sask.), Armament Section Officer, 9 C.I.B. Wksp., R.C.O.C. C.A.O.
Idenden, Francis Stevenson, B.A.Sc. (Mech.), (Univ. of Toronto), mech. engr., Demerara Bauxite Co. Ltd., Mackenzie, British Guiana, S.A.
Jackson, Philip Berney, 2nd Lieut., B.Sc. (Sheffield Scientific School, Yale University, New Haven), O.M.E., R.C.O.C., Officers' Mess, A.21, C.O.C.T.C., Barriefield, Ont.

Transferred from the class of Junior to that of Member

Green, John Scott, B.A.Sc. (Univ. of Toronto), res. inspr. and acting technical officer, British Air Commission, Beech Aircraft Corp., Wichita, Kansas.

Transferred from the class of Student to that of Member

Erickson, Peter O. M., B.Sc., M.E. (Univ. of Sask.), production supt. and production planning mgr., Sutton-Horsley Co., Leaside, Ont.

Transferred from the class of Student to that of Junior

Davis, Bruce Lumbers, B.A.Sc. (Univ. of Toronto), mech. supervisor, Ore Plant No. 1, Aluminum Co. of Canada Ltd., Arvida, Que.

Houghton, James Scott, F/O, R.C.A.F., B.Eng. (Mech.), (McGill Univ.), Engineer Officer, Aeronautical Engrg. Divn., A.F.H.Q., Ottawa, Ont.
Rees, Frederick, B.Eng. (Mining), (N.S. Tech. Coll.), representative, Dominion Steel & Coal Corp. Ltd., Bathurst Iron Ore Mine, Bathurst, N.B.
Uruski, Frank William, B.Eng. (Civil), (Univ. of Sask.), seismograph engr., International Petroleum Co., Guayaquil, Ecuador, S.A.

Students Admitted

Greene, Michael Stephen, B.Eng., (N.S. Tech. Coll.), 14 Prince St., Halifax, N.S.
MacLean, Murray Delbert, (Univ. of N.B.), Lady Beaverbrook Residence, Fredericton, N.B.
Marshall, Donald Macgregor, B.Sc. (Univ. of Alta.), 6318 Jasper Ave., Edmonton, Alta.
Reid, James McPherson, (Lawrence Inst. of Technology), 1589 Hall Ave., Windsor, Ont.
Saunders, Harold L., B.A.Sc. (Univ. of B.C.), 4246 Girouard Ave., Montreal, Que.
Wilson, John Edwin, B.Sc. (Queen's Univ.), 1040 Allard St., Verdun, Que.

By virtue of the co-operative agreements between the Institute and the provincial associations of professional engineers, the following elections and transfers have become effective.

ALBERTA

Junior

Livingston, Donald David, B.Sc. (Chem. Engrg.), (Univ. of Alta.), lab. asst., Madison Natural Gas Co. Ltd.

NEW BRUNSWICK

Transferred from the class of Student to that of Member

Olts, George Lounsbury, B.Sc. (Civil), (Univ. of N.B.), constrn. engr., New Brunswick Contractors, Ltd., Fredericton, N.B.

NOVA SCOTIA

Members

Arsenault, William Alexander, B.Eng. (Nova Scotia Tech. Coll.), asst. mtce. engr., Imperial Oil, Ltd., Dartmouth, N.S.
Risley, Wilfred C., Flt. Lieut., B.Sc. (Mech.), (Nova Scotia Tech. Coll.), Mech. Officer, Eastern Air Command, R.C.A.F., Halifax, N.S.
Wise, Charles Graham F., Captain, B.Sc. (Chem. Engrg.), (Queen's Univ.), Engr. Staff Officer, Atlantic Command, Halifax, N.S.

Personals

Relatives and friends of members in the active forces are invited to inform the Institute of news items, such as locations, promotions, transfers, etc., which would be of interest to other members of the Institute and which should be entered on the member's personal record kept at Headquarters. These would form a basis of personal items in the *Journal*.

News of the Personal Activities of members of the Institute

R. A. C. Henry, M.E.I.C., of Montreal, former Deputy Minister of Railways in the Dominion government has been named Canadian member on the newly created Transportation Equipment Committee set up by the Combined Production and Resources Board to survey rail, port and inland waterway transportation needs in liberated war areas. The committee will gather data concerning supplies and production of transportation equipment that may be required to maintain or re-establish shipping services outside the United States, the United Kingdom and Canada. It will work closely with existing agencies in Allied countries and with the United Nations Relief and Rehabilitation Administration.

E. L. Cousins, M.E.I.C., Wartime Administrator of Atlantic Ports, Halifax, and **J. E. St. Laurent,** M.E.I.C., vice-chairman of the National Harbours Board, Ottawa, were appointed "controllers of the business, undertakings, affairs and operations of the Montreal Tramways Company on behalf of the Canadian Government" following the tramway strike in Montreal last month.

Professor G. Ross Lord, M.E.I.C., associate professor in the department of mechanical engineering at the University of Toronto becomes in charge of research and instruction in hydraulics as a result of changes due to the retirement of Professor R. W. Angus, HON.M.E.I.C., and the promotion of Professor E. A. Allcut, M.E.I.C., to head the department. Professor Lord was graduated at Toronto in 1929, later earning his S.M. degree at Massachusetts Institute of Technology and the degree of Ph.D. at Toronto. He studied in Germany for 15 months on a Freeman Scholarship and returned to his Alma Mater as lecturer in hydraulics in 1934, later receiving successive promotions to his present rank. Dr. Lord has been engaged at various times by the Hydro-Electric Power Commission of Ontario on hydraulic studies and investigations.

A. T. Cairncross, M.E.I.C., has recently been transferred from Arvida to the head office of the Aluminum Company of Canada Limited at Montreal. He was secretary-treasurer of the Saguenay Branch of the Institute.

H. R. Fee, M.E.I.C., succeeds A. T. Cairncross as secretary-treasurer of the Saguenay Branch of the Institute. A graduate in electrical engineering from the University of Alberta in the class of 1934, he was afterwards engaged for three years in private contracting work. From 1937 to 1941 he was employed with International Nickel Company of Canada, Limited, and since 1941 has been with the Aluminum Company of Canada, Limited, being first employed in the test department of the Saguenay Power Company and later as plant engineer. His present position is that of system operating engineer at Arvida.

F. J. Leduc, M.E.I.C., consulting engineer of Montreal, has been re-elected to represent the constituency of Laval in the legislative assembly of the Province of Quebec.

T. A. Carter, M.E.I.C., of Aluminum Company of Canada, Limited, has recently returned to Canada after having spent the past few years in India upon work vital to the war effort. Mr. Carter is at present stationed at Shawinigan Falls, Que.

D. D. Low, M.E.I.C., of Canadian National Railways, has recently been transferred from Regina to North Battleford, Sask., where he is assistant district superintendent.

Captain S. N. Tremblay, M.E.I.C., was recently transferred from Quebec to Rimouski, where he is second in command of No. 5 Vocational Training School.

Major H. L. Hurdle, Jr.E.I.C., was recently made an officer of the Order of the British Empire for gallantry in the invasion of Normandy. Before being commissioned in the Canadian Army with the rank of lieutenant in September 1939, he was employed with the Calgary Power Company at Calgary, Alta.

G. L. Archambault, Jr.E.I.C., of the Aluminum Company of Canada, Limited, was transferred, a couple of months ago, to Montreal where he is now employed in the sales engineering department.

F. M. Near, Jr.E.I.C., has recently joined the North York Township, near Toronto, as assistant engineer. A graduate of the University of Toronto in 1943, he served for about a year with the Royal Canadian Engineers.

A. J. Ring, Jr.E.I.C., has been recently transferred from the Montreal works to the Nobel works of Defence Industries, Limited, as supervisor in their cordite department.

E. A. Russell, Jr.E.I.C., has been transferred from the Winnipeg works to the Nobel works of Defence Industries, Limited, as resident engineer.

W. R. Workman, Jr.E.I.C., of the Department of Public Works of British Columbia, was recently transferred from the position of assistant district engineer at Nelson to the same position at Smithers, B.C.

Lieutenant Zavie Miller, S.E.I.C., was reported wounded in action in Normandy recently. He graduated in mechanical engineering from McGill University in 1943 and took his officer's training at Barriefield, Brockville and London, Ont. He went overseas with the Royal Canadian Electrical and Mechanical Engineers in March of this year.

W. A. Pegler, S.E.I.C., works engineer in the alkali division of Canadian Industries, Limited, at Shawinigan Falls, was recently transferred to Defence Industries, Limited, at Nobel, Ont.

André Prudhomme, S.E.I.C., who graduated from Ecole Polytechnique last spring, has joined the Quebec Hydro-Electric Commission as an electrical engineer in the Beauharnois division at Beauharnois, Que.

Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Frederic Harold Fay, M.E.I.C., a consulting engineer of great reputation died at his home in Boston, Mass., U.S.A., on June 5th 1944, after a protracted illness. He was a member of the firm of Fay, Spofford & Thorndike, Boston.

Born in Marlborough, Mass., on July 5th 1872, he received his primary education in the local public schools and in 1889 entered Massachusetts Institute of Technology where he received the degrees of Bachelor of Science in civil engineering in 1893 and Master of Science in civil engineering in 1894, being the first to receive a Master's degree in civil engineering from that institution.

Before his graduation he had served as transitman for the city engineer of Marlborough and after graduation he was employed for a short time by the Boston Bridge Works. In February 1895, he entered the engineering department of the City of Boston as draughtsman and later became assistant engineer in charge of design and construction of the city's bridges and of waterfront developments. After the death of City Engineer William Jackson, Mr. Fay assisted in the development of the plan for the consolidation of the engineering, street, and water departments of Boston into a Department of Public Works, and in July 1911, he was appointed division engineer in charge of the bridge and ferry division of that department. Under this division were placed the design, construction, maintenance, and operation of the municipal bridges and ferries, also the abolition of grade crossings and the general engineering work formerly done by the city engineer. He was also made the commissioner representing Boston on the Boston and Cambridge Bridge Commission. During this period as associate of the late John E. Cheney, and also acting independently, he served as consultant on sundry bridge and structural engineering projects and acted as expert in legal cases.

In 1914, he resigned his position with the city and, in association with Charles M. Spofford and the late Sturgis H. Thorndike, organized the engineering firm of Fay, Spofford & Thorndike. This firm, in whose operations he played a leading part until a few months before his death, made numerous engineering and economic reports on various undertakings, and it also designed and gave engineering supervision during construction to many government, state, municipal, and private projects, including army bases, bridges, airfields, harbour works, industrial buildings, sewerage and waterworks systems. Among the more important of these constructions were the Boston Army Supply base, built during the first world war; the Bourne and Sagamore bridges across the Cape Cod canal, for the former of which the firm received the award of the American Institute of Steel Construction for the most beautiful bridge built at a cost of over $1,000,000 in 1934; a bridge across Lake Champlain, which received a Phebe Hobson Fowler architectural-engineering award in 1930; the Hampden County Memorial bridge at

Springfield, Mass.; the State pier at Portland, Maine; the waterworks system of Warwick, Rhode Island; and the sewer system and sewage treatment works of Cranston, Rhode Island. During 1941-1944, the firm was the engineer member of the architect-engineer organization which designed 15 northern North American and off-continent bases for the U.S. War Department, and during this same period was associated with other engineering firms under the title of Dry Dock Engineers, which organization designed numerous dry docks and other harbour works for the U.S. Navy Department.

Mr. Fay was at one time president of the American Institute of Consulting Engineers and president of the Boston Society of Civil Engineers. He joined The Engineering Institute of Canada as a Member in 1909.

Robert Allan Gurnham, M.E.I.C., former works manager of Darling Brothers, died at the hospital in Montreal, on August 12th 1944, after a short illness.

Born at Montreal on May 25th 1886, he was educated in the local secondary schools. His engineering career started when he became employed as a junior draughtsman with Sleeper Engine Company of Montreal in 1903. The following year and until 1905, he was employed in the same capacity with the Canadian Pacific Railway Company, Montreal; then for a period of five years came successive employment as draughtsman with John McDougall Caledonian Iron Works, Montreal; Hart-Otis Car Company, Montreal; Canadian Buffalo Forge Company, Montreal; and Century Engineering Company, at Ogdensburg, N.Y. In 1910 he returned to the John McDougall Caledonian Iron Works as chief draughtsman, being made works superintendent in 1915. In 1918 Mr. Gurnham joined the staff of Darling Brothers, Montreal, as sales engineer later becoming works manager. Two years ago he had left the company to join the staff of the Dominion Bridge Company Limited, at Lachine, Que.

Mr. Gurnham joined the Institute as an Associate Member in 1925 becoming a Member in 1940.

Charles Burrard Kingston, M.E.I.C., a mining engineer of international repute, died at his home at Forest Row, Sussex, England, on December 30th, 1943.

He was born at Montreal on May 15th 1867, and entered McGill University in 1885, graduating with the degree of B.A. in mathematics in 1887. After a year's topographical surveying in British Columbia he returned to McGill and in 1892 received the degree of B.A.Sc. with honours in mining engineering. The university conferred on him the honorary degree of LL.D. in 1930. From 1892 until 1895 he was employed as foreman, surveyor and superintendent in silver-lead mines operated through the Cowenhaven Adit (a 2½-mile tunnel at Aspen, Colorado), and from 1895 to 1903 inspected and managed properties in Western Australia, making a short visit to a Siberian copper mine in 1900. In 1903 he went to Italy and spent two years in shaft-sinking and development work at the Val d'Evancon for Messrs. Lewis & Marks. In 1905 he left for South Africa to open up the Grootvlei auriferous area for the same firm, and on the retirement of Dr. F. H. Hatch was appointed consulting engineer for the Lewis & Marks interests in South Africa, a position which he held until 1926. During this long period, Dr. Kingston inspected and supervised many mining activities, including the Lonely Reef and Sheba gold mines, the Crown diamond mine, and the firm's collieries. In 1913 he was asked to act as chief witness in the long law-suit in London between the Globe and Phoenix Company, and the Rhodesian Amalgamated Gold Mines, and subsequently became consulting engineer and later a director of the Globe and Phoenix Company, positions which he still held at the time of his death. From 1926 to 1929 he was consulting engineer to the Anglo-American Corporation of South Africa Ltd., in connection with the development of that company's interest in the Northern Rhodesian copper field, but in the latter year retired to England for health reasons.

Dr. Kingston joined the Institute as a Student in 1890, transferring to Associate Member in 1896 and to Member in 1903. He was also a member of the Institution of Mining and Metallurgy of Great Britain, of which he was president in 1938-39.

Alan Carleton Penman, M.E.I.C., died at New York on July 24th, 1944. Born in London, England, on September 19th 1883, he received his education at the Northern Polytechnic of London, and at Columbia College, New York, later studying civil engineering under a private tutor. He served an apprenticeship with Middletown Car Works at Middletown, Pa., from 1903 to 1906. For the following five years he was employed successively as a draughtsman, inspector and designer with the Atlantic Coast Line, Wilmington, N.C.; New York Central, New York, N.Y., and the Central Inspection Bureau of New York. From 1911 until 1914 he was resident engineer and power plant designer with L. B. Stillwell, consulting engineer of New York. From 1915 to 1922 he was with the American Car and Foundry Company at New York in the capacities of draughtsman, designer, chief estimator and resident engineer. From 1922 to 1926, he was engineering assistant and confidential manager at Montreal, to W. S. Lee, vice-president and chief engineer of J. B. Duke's interests.

From 1927 to 1941, Mr. Penman was employed as manager of the contracts division of Consolidated Edison Company of New York. For a few months in 1942, he was assistant purchasing agent for Walsh-Driscoll Company of New York, contractors for the Trinidad Army Base.

Mr. Penman joined the Institute as an Associate Member in 1925, becoming a Member in 1940.

COMING MEETINGS

Canadian Good Roads Association—Inter-provincial conference of highway ministers, their deputies, engineers, and other department officials of the provincial governments, September 26-27th, 1944, Cornwallis Inn, Kentville, N.S. Secretary: Mr. G. A. McNamee, New Birks Building, Montreal, Que. Attendance will be restricted to those mentioned above.

Canadian Institute on Sewage and Sanitation—Annual Convention, Royal York Hotel, Toronto, November 2-3, 1944. Secretary: Dr. A. E. Berry, Ontario Department of Health, Toronto, Ont.

American Society of Mechanical Engineers—Annual Meeting, New York, N.Y., November 27–December 1, 1944. Secretary: C. E. Davies, 29 West 39th Street, New York, 18, N.Y.

The Engineering Institute of Canada—Fifty-Ninth Annual Meeting, Royal Alexandra Hotel, Winnipeg, Man. February 7-8, 1944. General Secretary: L. Austin Wright, 2050 Mansfield Street, Montreal 2, Que.

News of the Branches

Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

BORDER CITIES BRANCH

W. R. Stickney, m.e.i.c. - *Secretary-Treasurer*
G. W. Lusby, m.e.i.c. - - *Branch News Editor*

The regular monthly meeting of the Border Cities Branch was held in Sarnia on the afternoon and evening of May 20, 1944. At 3.30 p.m. the Windsor and Sarnia members and guests assembled at the main gate of the Polymer Corporation, and through the courtesy of Mr. Lantz of the Polymer Corporation, Mr. E. W. Dill of the St. Clair Processing Corporation and several other employees of the same company, Mr. G. L. MacPherson and Mr. C. E. Carson of the Imperial Oil Limited, were treated to a well planned and exceedingly interesting tour of inspection of the synthetic rubber plant and power house until shortly after 6.00 p.m. One hundred and one members and guests then assembled at the Sarnia Golf Club for dinner at 7.00 p.m.

At the conclusion of the dinner, the chairman, Mr. Dowler, called the meeting to order, and then turned the meeting over to Mr. G. L. MacPherson. Mr. MacPherson after a few introductory remarks called on Mr. E. W. Dill, Superintendent of the Power Plant of the St. Clair Processing Corp. to introduce the speaker of the evening, Mr. F. F. Walsh, Combustion Engineer for the St. Clair Processing Corp. Mr. Walsh gave an illustrated talk entitled **Description of the Polymer Steam and Power Plant.** (This paper will be published in a future issue of the *Journal.*) A very interesting discussion period followed. After thanking the speaker for his splendid paper Mr. MacPherson turned the meeting back to Mr. Dowler who thanked the Sarnia members for their interest and co-operation in making the meeting such a success.

* * *

On June 14, members of the Border Cities Branch welcomed our president, de Gaspé Beaubien, on his annual visit to the branch. In company with the president were Dr. L. A. Wright and Mr. R. E. Heartz of Montreal also Messrs. H. F. Bennett and J. A. Vance of London.

The Canadian Bridge Co. entertained the president's party and members of the executive at luncheon in their offices on Walker Road. After luncheon, the party was taken on a tour of inspection of the Walkerville plants of the Canadian Bridge Co. and then were driven to Ojibway where they enjoyed a short boat ride on one of the company built harbour tugs.

About 6.45 p.m. 60 members and guests assembled at the Prince Edward Hotel for dinner and the evening meeting.

The chairman, Mr. J. B. Dowler, opened the meeting and Mr. A. H. MacQuarrie introduced Mr. Beaubien. Mr. Beaubien stated that by a great effort Canada has developed industrially more than any other country during this war, and many problems have resulted, chief of which is employer-employee relations. Engineers have been too apt to concentrate on technical work and have suffered in reputation for lack of a more general interest. In his opinion the engineer is the only one qualified to solve the employer-employee relations problem, because they work with both, and if he does not assume this obligation it is doubtful if the industry we have built can survive. The invaded countries will all need food and help, and Canada has the supply and demand of an unlimited world market ahead of her. Slackening off in production because of tiredness has been apparent lately in Canadian industry and this must be stopped if we are to take our place in the industrial world to come.

Mr. Dowler then introduced Dr. Wright who spoke briefly on Institute affairs.

Mr. Heartz was next called on to discuss collective bargaining rights for engineers as they are or may be affected by the Wartime Labour Relations Act P.C. 1,003. A very interesting discussion followed.

Mr. H. F. Bennett spoke very briefly about the work of his Committee on the Training and Welfare of the Young Engineer.

A hearty vote of thanks was extended to the speakers and the meeting adjourned at 10.50 p.m.

SAGUENAY BRANCH

H. R. Fee, m.e.i.c. - *Secretary-Treasurer*

On August 3rd 1944, the Saguenay Branch held a special meeting to welcome President de Gaspé Beaubien and the general secretary of the Institute to the Lake St. John district.

Mr. Beaubien and Dr. Wright accompanied by their wives, were entertained at noon hour luncheon by the branch executive and their wives.

Following the luncheon party, the president and the general secretary were conducted on a tour of the Shipshaw and Chute-à-Caron power plants by Messrs. A. C. Johnston and A. O. Hawes.

At 7.30 o'clock, the Branch dinner meeting was held in the Grill of the Saguenay Inn. Cocktails were served and forty-six members and friends sat down to dinner. The tables were set in the form of a U and seen at the head table were: Messrs. B. E. Bauman, Keith Booth, L. C. Wellington, Adam Cunningham, President Beaubien, Branch Chairman Chas. Miller, Brig. Gen. J. A. Westrop, Chief of India Supply Mission, L. Austin Wright, M. G. Saunders, Claude Beaubien, F. T. Boutilier, N. F. McCaghey and A. T. Cairncross.

When dinner was finished, the chairman introduced the president who spoke on the subject: **The Engineer—His Opportunity in the Post-War Labour-Management Problems.** President Beaubien opened with general remarks in French and then delivered his address in English.

The president said that engineers, during the war years, had displayed ingenuity and skill in erecting plants of vast magnitude while faced with a shortage of labour and serious labour problems. In meeting and overcoming the labour difficulties, the engineer demonstrated that he had ability to get and retain the good will of labour and, at the same time, hold the respect and confidence of management. The speaker believed that since the engineer had the good will of both labour and management, he should be able to give leadership to the post-war labour-management problems that are bound to arise.

Following the address of the president, Mr. N. F. McCaghey, a charter member of the branch in 1923, briefly outlined the history of the branch since its inception.

PRESIDENT AND MADAME BEAUBIEN VISIT THE SAGUENAY BRANCH

Left—*First row:* Mrs. M. G. Saunders, Mrs. de Gaspé Beaubien, Dr. Helen Cairncross, Mrs. Adam Cunningham, Mrs. J. T. Madill, Mrs. A. O. Hawes. *Second row:* M. G. Saunders, Alex. T. Cairncross, Mrs. Charles Miller, Mrs. L. Austin Wright, A. O. Hawes, Adam Cunningham. *Back row:* A. C. Johnston, L. Austin Wright, President Beaubien, Chairman Miller, J. T. Madill.

Above—J. T. Madill, D. J. O. Barry, John Stonehewer, E. A. Allwright, Antoine Rousseau, P. M. deChazal. *Right foreground:* W. N. Cann.

Above—L. C. Wellington, Adam Cunningham, A C. Johnston, President Beaubien, Chairman Miller, Brig. Gen. J. A. Westrop, R.E.

Left—R. M. Fullerton, Claude Bedard, Jerome Saintonge, L. A. Cantin, F. T. Boutilier (at end of table); *Right:* P. C. Kirkpatrick, F. N. Duffy, Roland Lemieux, R. E. Joron.

The chairman introduced Brig. Gen. Westrop, recently returned from the Burma Front and asked him to say a few words. The brigadier in an interesting way briefly described how airfields and roads were built by the 'teeming millions' using ancient methods. The speaker said that on the Far Eastern Front, the engineer was also confronted with serious labour problems—problems that were different from those encountered by the Canadian engineer but, as in Canada, essential work was accomplished through good organization, planning, hard labour and the will to do.

The general secretary, after being introduced by the chairman thanked the Branch for the welcome extended to the president's party. He brought greetings from Geo. Moxon, vice-chairman of the Branch who was in Montreal and R. J. Durley, Secretary Emeritus of the Institute.

Dr. Wright spoke on current Institute affairs and paid particular attention to the engineer in the armed forces and the collective bargaining legislation. The meeting was drawn to a close by the general secretary answering questions and was adjourned at 10.40 p.m.

During the afternoon, Mesdames Beaubien and Wright were taken on a tour of Arvida, Shipshaw and Kenogami by Mrs. A. O. Hawes. On returning from the drive, a tea was held in their honour in the lounge of the Saguenay Inn. The tea was arranged by Mrs. Chas. Miller and attended by wives of the branch membership.

ST. MAURICE VALLEY BRANCH

A. Trudel, Jr.E.I.C. - - *Secretary-Treasurer*

A meeting was held on July 25th at the Cascade Inn, Shawinigan Falls, under the chairmanship of R. Dorion. The meeting took the manner of a forum on collective bargaining for engineers and all those interested in asking questions were privileged to do so. Mr. G. N. Martin, of Montreal, enlightened the members on many points and stressed the fact that a full return of all questionnaires was very important.

Mr. E. B. Wardle, vice-president of the Institute, summed up in a few appropriate remarks, the arguments and viewpoints brought forth by the junior and senior engineers in their discussion of the subject. Thirty-two persons attended the meeting.

On Monday, August 14th, a joint meeting of the Branch, the Rotary Club and members of the Shawinigan Falls Chemical Association was held, with R. Dorion in the chair. The speaker, Mr. W. M. Gifford, general sales manager of the Aluminum Company of Canada, Limited, spoke on **Aluminum, Past, Present and Future.** Three reels of film were used to illustrate the subject and, as a special courtesy, Mr. Gifford also showed a picture of the attack on Pearl Harbour. There was a display of aluminum samples and everyone had a chance to ask questions regarding processes, utilities and facilities for the manufacture of aluminum parts. The speaker was thanked by Dr. James McCoubrey, president of the Shawinigan Falls Chemical Association.

Library Notes

Book notes, Additions to the Library of The Engineering Institute, Reviews of New Books and Publications

ADDITIONS TO THE LIBRARY

TECHNICAL BOOKS

American Standards Association:

C19.1—1943: American standards for industrial control apparatus.—C62.1—1944: American standards for lightning arresters for alternating-current power circuits.—Z32.10—1944: American standards for graphical symbols for electronic devices.—Z32.11—1944: Coordination of electrical graphical symbols.

American Institute of Electrical Engineers—Standards:

1B: Report on guiding principles for the specification of service conditions in electrical standards.—No. 3: Standards for guiding principles for the selection of reference values for electrical standards.—No. 31: Standards for capacitance potential devices and outdoor coupling capacitors.—No. 45A: Modification of and supplement to A.I.E.E. standard No. 45, Recommended practice for electrical installations on shipboard.

REPORTS

Canada—Civil Service Commission:

Thirty-fifth annual report for the year 1943.

Hydro-Electric Power Commission of Ontario:

Thirty-sixth annual report for the year ended October 31, 1943.

Ontario—Department of Mines:

Fifty-first annual report being Vol. LI, Part VIII, 1942.

Manitoba—Department of Mines and Natural Resources:

Annual report on mines and minerals for year ending April 30, 1943.

U.S.—Bureau of Mines—Technical Paper:

No. 662: Thermodynamic properties of carbides of chromium.

Saint John, N.B.:

Report of the Committee on Post-War Reconstruction, 1944.

Anglo-American Caribbean Commission:

Report of the West Indian Conference held in Barbadoes, March 21-30, 1944.

Asphalt Institute:

Research Series No. 10: Soil bearing tests and flexible pavement design.—Construction Series No. 69: Construction and resurfacing of primary highways.

Agricultural and Mechanical College of Texas—Bulletin No. 77:

Friction heads of water flowing in six-inch pipe and the effects of pipe surface roughness and water temperatures on friction heads by F. E. Giessecke and J. S. Hopper.

Harvard University—Graduate School of Engineering—Publications:

No. 388: Pressure loss in elbows and duct branches.—No. 389: Domestic electric rates and consumption.—No. 390: Shear failure of anisotropic materials.

Electrochemical Society—Preprint:

No. 86—1: A study of the possibility of precipitation of antimony as oxychloride in copper-refining electrolyte.

Engineering Materials and International Power Review:

London, Paul Elek (Publishers) Ltd. Issued quarterly. 10 sh. a year.

BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet all of these books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

AMERICAN SOCIETY FOR TESTING MATERIALS, Proceedings of the Forty-sixth Annual Meeting held at Pittsburgh, Pa., June 28-July 1, 1943. Vol. 43, Committee Reports, Technical Papers.

Published by the American Society for Testing Materials, 260 S. Broad St., Philadelphia, 1944. 1349 pp., illus., diagrs., charts, tables, 9¼ x 6 in., paper, $8.50; cloth, $9.00.

This volume contains the committee reports presented at the Annual Meeting and the technical papers, symposia and lectures delivered.

CHEMICAL ENGINEERING THERMODYNAMICS (Chemical Engineering Series).

By B. F. Dodge. McGraw-Hill Book Co., New York and London, 1944. 680 pp., diagrs., charts, tables, 9 x 5½ in., cloth, $6.00.

After a thorough treatment of the fundamental laws, this book develops various applications of particular interest to chemical engineers. The following applications have been selected for detailed treatment: thermodynamic properties of fluids, expansion and compression of gases, fluid flow, heat transfer, refrigeration, chemical reaction, equilibria, and distillation equilibria and processes. A working knowledge of elementary physics, physical chemistry and mathematics through calculus is assumed.

ELECTRICAL ESSENTIALS OF RADIO

By M. Slurzberg and W. Osterheld. McGraw-Hill Book Co., New York and London, 1944. 529 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $4.00.

An introductory textbook, by two high school teachers, intended for readers with limited mathematical background. It aims to provide the knowledge of electricity necessary for the study of radio circuits.

ENGINEERING INSPECTION PRACTICE

By A. T. King, foreword and preface by H. H. Sheldon. Chemical Publishing Co., Brooklyn, N.Y., 1944. 242 pp., illus., diagrs., charts, tables, 9 x 5½ in., cloth, $3.00.

This book is intended to meet the need for a text covering the inspection methods necessary for the efficient functioning of today's high-speed production. Beginning with the reading of working drawings, it continues with descriptions of the types of measuring instruments and their methods of use. Engineering materials, engineering hardening processes, hardness testing and other mechanical testing methods are discussed, and a separate chapter is devoted to aeronautical inspection.

GEARS

By H. E. Merritt. Sir Isaac Pitman & Sons, London; Pitman Publishing Corp., New York, 1943. 420 pp., illus., diagrs., charts, tables, 9 x 5¾ in., cloth, $8.50.

The subject of gears and gear action is treated from a general viewpoint with the object of emphasizing similarities. The early chapters cover gear classification, fundamental characteristics and the principles and analysis of tooth contact. Gear tooth generation is dealt with at length, followed by a discussion of gear materials and the mechanical properties of gear teeth. The chapter on tooth proportions is extensive, and chapters are also devoted to lubrication, tolerances, gear trains and tooth reactions.

INTRODUCTION TO NAVAL ARCHITECTURE

By J. P. Comstock. Simmons-Boardman Publishing Corp., New York, 1944. 209 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $4.00.

A text based upon a course given to hull-drawing apprentices by the Newport News Shipbuilding and Dry Dock Company. It presents the fundamentals of theoretical naval architecture in a form understandable by high-school graduates, shows how these fundamentals are interrelated and how they are applied progressively in designing a ship.

JIG AND FIXTURE PRACTICE

By H. C. Town. Paul Elek, Ltd., London, 1944. 120 pp., illus., diagrs., charts, tables, 8 x 5 in., cloth, 10s. 6d.

A concise compendium of information on the design and construction of conventional jigs and on pneumatic and hydraulic operation, plastic jigs, welded jigs and router jigs.

MATHEMATICS FOR EXTERIOR BALLISTICS

By G. A. Bliss. John Wiley & Sons, New York and London, 1944. 128 pp., diagrs., charts, tables, 8 x 5 in., cloth, $2.00.

The major part of this book deals with the elementary calculus and differential equations used in the theory and computation of the trajectories of shells and their differential corrections listed in range tables for artillery fire control. There is also a brief general discussion of bombing from airplanes. Tables for computation are included.

MICROFILMING

By R. De Sola. Duell, Sloan & Pearce (Essential Books), New York, 1944. 258 pp., illus., diagrs., charts, tables, 6¼ x 4 in., cloth, $1.50.

This small book gives an excellent account of this process of reproduction, its uses and advantages. Much practical information is supplied on cameras, methods of processing and printing, and on enlarging and reading microfilm.

(The) MICROSCOPE AND ITS USE

By F. J. Munoz in collaboration with H. A. Charipper. Chemical Publishing Co., Brooklyn, N.Y., 1943. 334 pp., illus., diagrs., charts, tables, 8¾ x 5½ in., cloth, $2.50.

This is an excellent general guide for users of microscopes. It is clear and detailed, is in non-technical language and occupies a position between the pamphlets published by manufacturers and the large textbooks. The authors are respectively a manufacturer and a teacher of biology with years of experience in using microscopes.

MODERN OPERATIONAL MATHEMATICS IN ENGINEERING

By R. V. Churchill. McGraw-Hill Book Co., New York and London, 1944. 306 pp., diagrs., tables, 8½ x 5¼ in., cloth, $3.50.

In this volume, a companion to a previous one on Fourier Series, the two principal topics treated are partial differential equations of engineering and Laplace transformations. The operational properties of the Laplace transformation are derived and carefully illustrated, and are used to solve problems in vibration and resonance in mechanical systems, with some attention to electrical analogues of these problems. Problems in the conduction of heat, potential, etc., are treated by this or related methods.

RADIO DIRECTION FINDERS

By D. S. Bond. McGraw-Hill Book Co., New York and London, 1944. 287 pp., illus., diagrs., charts, maps, tables, 8½ x 5¼ in., cloth, $3.00.

This text and reference work is intended for electrical engineers specializing in the design or theory of direction finders for aircraft, shipboard, or fixed station use. It combines qualitative description of the practical systems in use with an analytical study of the underlying phenomena. Particular attention has been paid to current trends, such as the use of ultra-high frequencies and the employment of visual and automatic direction finders.

(The) RAILROADS AND PUBLIC WELFARE, their Problems and Policies

By E. R. Johnson. Simmons-Boardman Publishing Corp., New York, 1944. 336 pp., tables, 9½ x 6 in., cloth, $3.00.

In this volume an expert student of transportation surveys the railroad situation. He traces the development of our railroads, analyzes their wartime problems and discusses their future. Important questions, such as government versus private operation and the relations of railroad transportation to waterway and highway transportation, are discussed.

WAGE INCENTIVES

By J. K. Louden. John Wiley & Sons, New York; Chapman and Hall, London, 1944. 174 pp., charts, tables, 8½ x 5 in., cloth, $2.50.

Written for the men of management and of labour, rather than for engineers, this book tells concisely what wage incentives are, what their history has been and what they can do. The fundamental types of plans are compared. Policies and relations to other functions of management are discussed.

PRELIMINARY NOTICE

of Applications for Admission and for Transfer

August 29th, 1944.

The By-laws provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described at the October meeting.

L. Austin Wright, General Secretary.

*The professional requirements are as follows:—

A Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science or engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainment or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

ANSLEY—RICHARD HERBERT, Lieut., R.C.E., of Winnipeg, Man. Born at Winnipeg, Man., June 25th, 1920. Educ.: B.Sc. (Civil), Univ. of Manitoba, 1942; 1938 (summer), chainman and instru'man., Manitoba Dept. of Mines & Natural Resources; 1939-40 (summers), concrete, asphalt and slab mix inspec'n., National Testing Laboratories, Ltd.; 1941 (summer), runway foreman, Suffield Airport, Alta., Nelson River Constrn. Co.; 1942 to date, Lieut., R.C.E., Cdn. Fd. Pk. Coy., Central Mediterranean Forces.

References: D. L. McLean, E. P. Fetherstonhaugh, N. M. Hall, A. E. Macdonald, G. H. Herriot.

BROAD—ROBERT L., of Toronto, Ont. Born at Kenora, Ont., Dec. 3rd., 1911. Educ.: B.A.Sc., Univ. of Toronto, 1936; R.P.E. Ont.; 1936-39, chemist, efficiency engr., dyer, Toronto Carpet Mfg. Co., i/c various research projects; 1939-40, asst. combustion engr., and 1940 to date, combustion engr., i/c combustion service dept., Rochester & Pittsburgh Coal Co. (Canada) Ltd., Toronto, Ont.

References: T. R. Loudon, J. J. Spence, H. W. Tate, W. S. Wilson, C. R. Young.

BUSHLEN—HARVEY EBY, of Calgary, Alta. Born at Brantford, Ont., June 21st, 1906. Educ.: B.Sc. (Civil), Queen's Univ., 1929; 1929-30, structural steel detailer, 1930-31, structural steel design, Cdn. Bridge Co. Ltd., Walkerville, Ont.; 1931-32, instru'man., Trans-Canada Highway Location Survey, Kenora Dist., Ont.; 1940, structural designer, Defence Industries, Ltd., Montreal, designed bldgs. at Nobel explosive plant, involving timber, reinforced concrete and struct'l. steel design; 1940-41, i/c bldg. constrn., No. 8 A.O.S., Ancienne Lorette, Que., for R.C.A.F.; 1941-44, senior asst. engr., No. 3 T.C., H.Q., R.C.A.F., Montreal, design and writing of specifications and tender forms for all schools in No. 3 T.C., sewerage systems, pumping stations, etc.; at present, with the engrg. dept., Western Division, McColl-Frontenac Oil Co. Ltd., Calgary, Alta.

References: G. R. MacLeod, J. Benoit, A. Tubby, W. L. Rice, H. J. A. Chambers, P. E. Adams.

COUSINEAU—YVON, of Arvida, Que. Born at Montreal, Oct. 25th, 1910. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1937; M.E., M.Sc., Queen's Univ., 1939 and 1940; 1936-37-38 (summers), gen'l. mining, miner's helper, mucker, survey, etc., Noranda Mines, Aldermac Copper Corp'n. and Francoeur Gold Mines; 1939-40 (summers), asst., Quebec Bureau of Mines; 1941, mgr., Quyon Molybdenite, Quyon, Que.; 1942, mtce. engr., and at present, mech. engr., Ore Plant No. 2, Aluminum Co. of Canada, Ltd., Arvida, Que.

References: A. Cousineau, A. Circe, L. Trudel, E. Gohier, A. Frigon, A. O. Dufresne, L. P. Cousineau.

DICK—SIDNEY ALEXANDER, of Toronto, Ont. Born at Milton, Ont., April 15th, 1913. Educ.: B.Sc., Queen's Univ., 1940; with Canada S.S. Lines, S.S. Quebec, as follows: 1935 (summer), fireman, i/c 3–1000 H. P. Scotch marine boilers, 1936 (summer), water tender, senior rating i/c 2 stoke holds, 1937 (summer), oiler, on 1–2500 H.P. triple exp. 4 cyl. steam marine engine; 1938-39, fireman, deep sea oil tanker, Imperial Oil Co.; 1940-41, graduate engr. in training at parent plant of Bailey Meter Co. Ltd., Cleveland, Ohio, and 1941-42, sales and service engr. at Montreal Branch; 1942-43, Sub-Lieut. (E), R.C.N.V.R., including 6 mos. as 2nd i/c mach. on minesweeper; 1943 to date, Lieut. (E), including 6 mos. as Engr. Officer i/c mach. on minesweeper.

References: L. M. Arkley, D. S. Ellis, A. Jackson, L. T. Rutledge, R. A. Low, A. Dick, H. J. Muir, H. M. Esdaile, J. A. H. Henderson.

FOX—JAMES CLARENCE, of Toronto, Ont. Born at Chatham, Ont., Dec. 5th, 1915. Educ.: B.A.Sc., Univ. of Toronto, 1941; 1941 (summer), dftsman., Federal Aircraft Ltd., Montreal; 1941-43, chief inspr., Sutton-Horsley Co. Ltd., Toronto; 1943 to date, stress analyst and engr. i/c "Mosquito" repairs, Dehavilland Aircraft of Canada, Ltd., Toronto, Ont.

References: W. H. Jackson, T. R. Loudon, C. R. Young.

FRASER—JOHN FERGUSON, of 5549 Queen Mary Road, Montreal. Born at Glasgow, Scotland, Jan. 7th, 1907. Educ.: Royal Technical College, Glasgow (evening classes) 1925-29; A.M., Institution of Civil Engineers, England (by exam); 1924-28, ap'ticeship, Crouch & Hogg, civil engrs., Glasgow, water supplies, including earth dams, filtration plants, etc., and 1928-29, asst., office and field work in connection with water supplies; 1929-32, asst., A. P. Cotterell & Son, civil engrs., Westminster, London, office and field work, wells, softening plants, etc., intercepting sewers, sludge gas utilization, and 1932-34, res. engr. at Sittingbourne, With Kingston Water Comm'n., Jamaica, B.W.I., as follows: 1934-37, asst. engr., i/c sewerage dept., 1937-39, res. engr., i/c constrn. of sewage treatment wks., etc., 1939-40, engr., i/c design of new water supplies; 1940-41, engr., Henriques Bros. Constrn. Co., Kingston, Jamaica, engrs., architects and contractors, also consltg. work; 1941 to date, engr., power div'n., engrg. dept., Defence Industries Ltd., Montreal.

References: I. R. Tait, H. C. Karn, J. R. Auld, C. R. Bown, J. M. Begg.

GODIN—FRANCOIS XAVIER, of Kenogami, Que. Born at Petit Rocher, N.B., Aug. 23rd, 1900. Educ.: 1923-28, I.C.S.; 1924-26, chairman, rodman and instru'man., U.S.A.; 1926-27, dftsman. and instu'man., Southern Canada Power; 1927, chainman., Monsarrat & Pratley; 1928-30, instr'man. and dftsman., Quebec & Chibougamou Rly. Co.; 1930-33, instr'man., Beauharnois Consldt. Co.; 1933-40, N. B. land surveyor; 1940-41, field engr., Foundation Co. of Canada; 1941-43, instr'man., H. G. Acres & Co.; 1943-44, asst. engr., to Town Engr., Jonquiere; at present, field engr., Arthur Surveyer & Co., consltg. engrs., Montreal.

References: H. W. R. Shepherd, P. E. Kirkpatrick, Noel Dixon, G. R. Adams, E. Nenniger.

MACLAREN—IAN NICHOLSON MURRAY, of Toronto, Ont. Born at Saint John, N.B., Nov. 6th, 1896. Educ.: B.Sc., M.Sc., Univ. of N.B.; 1920; R.P.E. Ont.; 1920-26, Cdn. Explosives, Ltd.; with the Rochester & Pittsburgh Coal Co. (Canada) Ltd., Toronto, as follows: 1926-28, combustion engr., 929-33, vice-pres., and 1933 to date, pres.

References: F. P. Flett, E. L. Cousins, E. B. Wardle, J. H. Stephens, E. O. Turner.

REYNOLDS—DAVID, Sqdn. Ldr., R.C.A.F., of 1006 Sherbrooke St., Montreal, Que. Born at Sutton, England, Oct. 8th, 1908. Educ.: 1st class Army Certificate, 1935; 1936-40, corres. course in maths., School of Science and Technology, Toronto; night classes in mach. shop, welding, chemistry, etc.; with the R.C.A.F. as follows: 1929-30, engine fitters course, 1930-31, servicing aircraft engines, 1931-32, testing aircraft engines, National Research, Ottawa, 1932, qualified for Air Engineer's certificate, 1932-35, repair and mtce. of motor vehicles, 1935-36, aircraft armours course, 1936-37, training armourers in weapons and mach. shop work, 1937-38, aircraft armament instructors' course, 1938-41, training and instructing pilots and air crews in aircraft armament and also (1941-42) responsible for all armament mtce. at station, Mossbank, Sask. With the Inspection Bd. of U.K. and Canada as follows: 1942-43, supt., Small Arms Experimental & Proof Establishment, Valcartier, Que., 1943-44, went to England to obtain information on development and proof of small arm weapons and ammunition; 1944 to date, Proof Officer, St. Maurice Proof Range, proving all 20 mm. ammunition for service use.

References: W. L. Shelden., G. R. Evans, D. C. M. Hume, J. D. Chisholm, M. S. Macgillivray.

Employment Service Bureau

NOTICE

Technical personnel should not reply to any of the advertisements for situations vacant unless—

1. They are registered with the Wartime Bureau of Technical Personnel.
2. Their services are available.

A person's services are considered available only if he is—

(a) unemployed;
(b) engaged in work other than of an engineering or scientific nature;
(c) has given notice as of a definite date; or
(d) has permission from his present employer to negotiate for work elsewhere while still in the service of that employer.

Applicants will help to expedite negotiations by stating in their application whether or not they have complied with the above regulations.

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.

SITUATIONS VACANT

CIVIL OR MECHANICAL ENGINEER wanted. See page 50 of the advertising section.

DRAUGHTSMAN WANTED—Wire and cable manufacturers require an experienced mechanical engineering draughtsman for shop and equipment layout work. To a man with initiative and energy the position offers an interesting prospect and is permanent. Apply to Box 2791-V.

ELECTRICAL DESIGNER WANTED—Graduate engineer with two to four years' design and layout experience in electric power utility installations. Location, mid-west. In reply give full particulars of previous experience, state salary expected, age, etc. Do not reply unless available under Order-in-Council P.C. 246. Apply to Box No. 2792-V.

MECHANICAL ENGINEER for well-established firm in Ontario for a position combining engineering with training for supervision of field service on larger pulverized coal and stoker-fired boilers. Require written application stating age, experience and salary expected. Apply to Box No. 2810-V.

ENGINEERING DEPARTMENT of a specialty paper mill in southern Ontario requires the services of a mechanical or civil engineer with a minimum of three years' experience (not necessarily in the paper industry). Do not apply unless your services are available under regulations P.C. 246, Part III, Jan. 19, 1943, administered by the Wartime Bureau of Technical Personnel. Apply to Box No. 2816-V.

SITUATIONS WANTED

ELECTRICAL ENGINEER, graduate, 20 years' broad experience, desires responsible position with progressive company. Apply to Box No. 278-W.

GRADUATE MECHANICAL ENGINEER, age 32, total of nine years good industrial experience. For past three years has been in charge of industrial engineering department in one of the larger war industries making ammunition. Familiar with process control systems, methods, time-study, training, production, personnel and employee relations work. Most interested in contacting small or medium-sized peace-time industry to do organization and development work in Maritimes, Ontario or British Columbia. Available after reasonable notice. Apply to Box No. 1500-W.

GRADUATE ELECTRICAL ENGINEER with over fifteen years' experience in design, construction, operation and maintenance of electrical installations in industrial plants. Available on short notice. Registered with W.B.T.P. Apply to Box No. 1718-W.

M.E.I.C., UNIVERSITY GRADUATE with manufacturing experience, mechanical and chemical processes, design and supervision, seeks temporary or part-time employment. Apply to Box No. 1878-W.

STRUCTURAL ENGINEER, M.E.I.C., R.P.E. (Ont.) desires permanent position of responsibility. Experienced in design, estimates and detail in all types fabricated steel and plate work, also reinforced concrete construction. Apply to Box No. 2208-W.

MECHANICAL ENGINEER, Canadian graduate, age 36, married, with ten years of outstanding domestic and foreign experience in industrial engineering and management, seeks a responsible permanent position in this field with post-war opportunities. Accustomed to handling executive responsibilities and with a proven ability to secure the co-operation of others. Intimate knowledge of South America. Available at once. Apply to Box No. 2465-W.

PRELIMINARY NOTICE *(Continued)*

STANLEY—CARLETON ALEXANDER, of 8022 Bloomfield Ave., Montreal, Que. Born at Montreal, Que. April 29th, 1919. Educ.: 1937-40, Dalhousie Univ.; 1938 (summer), Nfld. Gov't. Geol. Survey; 1939-40 (summers), surveyor and geologist i/c party working on strategic war minerals, Nova Scotia Dept. of Mines; 1940-41, Allied War Supplies, sent to England to obtain technical information; 1941-43, supt., proof establishment and destroying ground, General Engineering Co. (Canada) Ltd., Toronto; 1943-44, tech. asst. to ammunition filling div'n., Allied War Supplies Corp'n.; 1944 to date, field engr. for John Stadler, consltg. engr., at present engaged on appraisal of Pulp & Paper Mills at Three Rivers, Que.

References: H. W. Scott, C. J. Jeffreys, G. V. Douglas, A. J. Lawrence, A. E. Cameron, G. J. Dodd, J. Stadler, C. H. Gordon.

THOMPSON—HAROLD WILLIAM, Flt. Lieut., R.C.A.F., of 643 Victor St., Winnipeg, Man. Born at Milton, N.D., July 11th, 1901. 1918-20, town power plant, Gull Lake, Sask. (producer gas); 1920-22, Moose Jaw Gas & Electric Co.; 1923-24, power plant supt., producer gas and Diesel power, Town of Broadview, Sask.; 1924-40, power plant supt., Town of Russell, Man., Diesel power; 1941, foreman, airdrome electricians; 1941 (Dec.) to date, Electrical Works Officer, Works and Bldgs. Branch, No. 2 T.C., H.Q., R.C.A.F., Winnipeg, Man.

References: A. J. Taunton, C. P. Haltalin, R. H. Andrews, W. E. Hobbs, L. Mackay, J. L. Pidoux.

THOMPSON—MURRAY O., of 9 Goswel Road, Islington, Ont. Born at Norwich, Ont., June 15th, 1905. Educ.: B.A.Sc., Univ. of Toronto, 1927; R.P.E. Ont.; 1927-29, chem. engr. and plant mgr., i/c fermentation, blending, lab. analyses, etc., and 1928-29, i/c plant distilling operations, Highland Scotch Distillers Ltd., Port Colborne, Ont.; 1929-40, combustion engr., i/c combustion service dept., and 1940-44, combustion engr., Rochester & Pittsburgh Coal Co. (Canada) Ltd., and vice-pres., Cargo Dockers, Ltd., Toronto, Ont.

References: E. A. Allcut, T. R. Loudon, F. P. Flett, R. E. Smythies, H. W. Tate, W. E. P. Duncan, D. Lloyd, C. D. Carruthers, W. F. Auld, D. C. Beam, J. C. Nutter.

FOR TRANSFER FROM THE CLASS OF JUNIOR

BORBEY—JOHN P., of 4860 Rosedale Ave., Montreal, Que. Born at New York, N.Y., Aug. 6th, 1910. Educ.: B.A.Sc., Univ. of Toronto, 1934; 1934-35, survey work, Dept. Northern Development, Ontario Gov't.; with the Dominion Bridge Co., Lachine, as follows: 1936-43, pressure vessel and boiler design, and 1943 to date, cost estimator, contracting dept.; (1942-44, on loan two days per week to McGill Univ. as lecturer in engrg. subjects). (Junior 1937).

References: R. S. Eadie, G. H. Midgley, A. S. Wall, G. J. Dodd, E. Brown.

SAINTONGE—JOSEPH MEDARD JEROME, of Arvida, Que. Born at Valleyfield, Que., Feb. 22nd, 1912. Educ.: Passed Institute's exams. for admission as Junior in 1943; 1937-38, receiving, checking and distributing material, 1939-40, building up information from blueprints and field notes to have spare parts made for machines, 1941-44, mech. inspr., Aluminum Co. of Canada Ltd., Arvida, Que. (Junior 1943).

References: M. G. Saunders, J. T. Nichols, V. J. Melsted, P. M. de Chazal, R. Saintonge, B. E. Bauman, L. A. Cantin.

FOR TRANSFER FROM THE CLASS OF STUDENT

BENSON—WILLARD MacLEAN, Corporal, R.C.E., of Fredericton, N.B. Born at Chatham, N.B., Jan. 11th, 1914. Educ.: B.Sc. (Civil), Univ. of N.B., 1935; 1935 (summer), Geological Survey of Canada; 1936-37, mech. dftsman., Buffalo; 1937-38, Ankerite Gold Mines; 1938 (summer) asst. to Ontario Land Surveyor; 1938-40, asst. underground engr., 1940, constrn. in steel wood, reinforced concrete, plant layout and design on surface, Hoyle Gold Mines Ltd., Pamour, Ont. At present, Company Surveyor, No. 2 Drilling Coy., R.C.E. Cdn. Army Overseas. (Student 1935).

References: E. O. Turner, J. Stephens, J. A. Gorman, W. R. Godfrey, D. D. Cunningham.

GAUTHIER—RAYMOND CLAUDE, of 554½ Des Meurons St., St. Boniface. Man. Born at St. Boniface, Man., July 26th, 1916. Educ.: B.S.c. (Civil), Univ. of Man., 1941; 1939 (summer), instru'man. on road constrn.; 1940 (summer), inspr. on Gunite repair work to dam, Seven Sister Falls Power Plant, Winnipeg Electric Co.; 1941 to date, asst. designer (reinforced concrete), Dominion Bridge Co. Ltd., Winnipeg, Man. (Student 1940).

References: E. V. Caton, H. M. White, A. E. Macdonald, A. Campbell, N. M. Hall.

KIRK—JACK WILLSIE, of 12 Maitland St., London, Ont. Born at Sarnia, Ont., Jan. 26th, 1920. Educ.: B.Sc. (Civil), Queen's Univ., 1944; 1941 (summer), inspection, C. D. Howe Co.; 1942 (summer), instr'man., i/c soil testing on Polymer project at Sarnia, H. G. Acres; 1943 (summer), pipe designing and detailing, W. K. Kellogg Co., also instructor in surveying, Queen's Univ.; 1944 to date, field engr., International Water Supply, London, Ont. (Student 1943).

References: D. S. Ellis, A. Jackson, H. W. Harkness, S. D. Lash, R. A. Low.

SAUNDERS—WILLIAM ALLISON BAXTER, P/O, R.C.A.F., of Claresholm, Alta. Born at Calgary, Alta., Nov. 11th, 1914. Educ.: B.Sc. (Civil), Univ. of N.B., 1941; 1938 and 1940 (summers), surveying on irrigation at Brooks, Alta.; 1941, Aeronautical Inspection Directorate, Winnipeg, Man.; 1942-43, res. tech. officer for British Air Comm'n. at Douglas plant, Santa Monica, Cal.; at present, Flying Instructor, No. 15, S.F.T.S., Claresholm, Alta. (Student 1940).

References: E. O. Turner, J. Stephens, A. F. Baird, L. C. Charlesworth, H. Grey, J. H. Moore.

SMITH—NORMAN JANSON WINDER, Lieut. Col., R.C.E., of 25 Rathnally Ave., Toronto, Ont. Born at Toronto, Ont., Jan. 27th, 1909; Educ.: B.Eng., McGill Univ., 1932; Military Engrg. courses in England 1932-33; 1933-34, Wks. Officer, M.D. No. 2, Toronto; 1934-36, N.D.H.Q. Ottawa, D.E.S. Branch; 1936-37, in England, attached to Royal Engrs.; 1937-38, in Singapore, attached to Royal Engrs.; 1938-41, A.Q.M.G. (Fortifications), N.D.H.Q., Ottawa; 1941 to date, overseas with R.C.E.; 1941-42, 2nd i/c, and 1942, C.O., 4th Btn., R.C.E.; 1942-43, C.R.E., 1st Cdn. Corps Tps.; 1943 to date, C.R.E., 2nd Cdn. Inf. Div'n. (Student 1931).

References: G. R. Turner, C. R. S. Stein, J. L. Melville, J. G. R. Wainwright, J. T. Wilson, A. J. Kerry.

THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 27 | MONTREAL, OCTOBER 1944 | NUMBER 10

"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

★ ★ ★

PUBLISHED MONTHLY BY

THE ENGINEERING INSTITUTE OF CANADA

2050 MANSFIELD STREET - MONTREAL

CONTENTS

THE TECHNIQUE OF TESTING HIGH VOLTAGE BUSHINGS . 532
G. W. N. Fitzgerald

CUTTING FLUIDS AND THEIR RELATIONSHIP TO METAL CUTTING 536
William H. Oldacre

STANDARDIZATION IN CANADA 538
W. R. McCaffrey, M.E.I.C.

NOMOGRAPH FOR EQUATIONS OF THE FORM $YX^n = Z$ . . 543
J. C. Barnes, M.A.Sc.

WITH THE CANADIAN ARMY IN FRANCE 546

FROM MONTH TO MONTH 547

PERSONALS 555

OBITUARIES 556

BRANCH NEWS 557

LIBRARY NOTES 558

PRELIMINARY NOTICE 559

EMPLOYMENT SERVICE 562

Price 50 cents a copy, $3.00 a year: in Canada, British Possessions, United States and Mexico. $4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, $2.00 a year. —Entered at the Post Office, Montreal, as Second Class Matter.

COVER PICTURE

This destroyed railway bridge at Elbeuf, near Rouen, France, blown up by the Germans in their retreat, looks stark and dreary against the rain and the sky. The demolition did not hold up the Canadian advance for very long.

(Canadian Army Overseas Photo.)

THE TECHNIQUE OF TESTING HIGH VOLTAGE BUSHINGS

G. W. N. FITZGERALD

Assistant Testing Engineer, Hydro-Electric Power Commission of Ontario, Toronto, Ont.

Paper presented before the Peterborough Branch of The Engineering Institute of Canada, at Peterborough, Ont., on March 2nd, 1944

For the past seven years, extensive use of the potential gradient method of testing transformer and oil circuit breaker bushings has been made by the Hydro-Electric Power Commission of Ontario. A live line tester was used by means of which tests were made on line apparatus without interruption to power.

The Commission has many types of bushings in service, ranging from the newest to some that are thirty and more years old. The voltage at which they operate ranges from 12,000 to 220,000 volts. Over 100 different types of bushings have been tested, consisting of oil-filled, compound filled, and dry type bushings. Construction of the bushing cores varied from those with condenser type insulation to those with bakelized tubing and others with insulated leads in a porcelain body.

Some years ago, at the request of the Research Subcommittee on Electrical Insulation, the Operating Department stated that their most pressing problem was the number of bushings that were failing in service. Work was started on this problem and considerable time was spent in investigating the progress of breakdown of insulation and the probable causes of failure. Power factor methods of testing were tried, but, in addition to the time, expense and inconvenience involved in arranging interruptions for test purposes, the readings obtained were too indefinite to form satisfactory criterion of the probable safety of the bushing.

It was observed, in the meantime, that usually a fault had progressed some considerable distance along or through the insulation before final failure. The possibility of detecting any variation from normal of the voltage gradient throughout the insulation was investigated. The results from the start were very encouraging and concentration on the development and application of the method of testing by checking the voltage gradient of a bushing has been well warranted. About seven years ago a long-term program of field and laboratory testing was begun using a potential gradient method of testing*, while power factor tests were made from time to time at the Laboratories.

Test Equipment

The equipment used in the field consists of an insulated test stick connected to a meter, which is grounded, by a shielded cable.

The test stick consists of 2, 3 or 4 sections, depending on the voltage of the equipment to be tested. Two sections are used up to 46 kv., 3 on 110 kv. and 4 for 220 kv. Each of the top sections contains resistors with a total resistance of 120 megohms and the bottom section has 60 megohms resistance. The bottom section of the stick is shielded, both to protect the operator and to prevent any capacity coupling to the operator, shunting current to ground. This prevents any reduction of meter readings. The shielded single conductor cable is connected to the meter case and through the primary of a coupling transformer to ground. The meter is grounded either by a clip lead to some recognized ground or by pushing the steel prod on the base of the meter into the ground. In series on the secondary of the transformer are two resistors and a rectifier. The measuring instrument is a sensitive microammeter. Across the primary of the transformer is a condenser controlled by a switch. This allows a change from 25 to 60 cycles. The scale is divided into 100 parts and is adjusted for each test to read per cent of line to ground voltage.

The operation of the test stick is simple. The test probe is placed in contact with the live line, and the meter adjusted, by means of the resistors, to read 100 per cent, or full scale. Contact is then made at equidistant points on the bushing from the line to the mounting flange. The test probe picks up the potential to ground at any point by capacity coupling and readings are taken from the meter.

A single reading only is necessary at each point and a bushing can be quickly tested. To fill out the test sheet and test the 6 bushings of a 110 kv. oil breaker requires about 8 or 10 minutes, without interruption to power.

Testing Technique

A definite technique must be acquired in testing bushings in order to get consistent readings.

Bushings with single piece porcelains are the simplest to test. The test probe is pushed up tight underneath each skirt or rainshed. On those bushings with multiple piece porcelains it is necessary to take care that the test probe does not touch the cement between porcelain sections. The cement will absorb moisture to varying degrees and cause inequality in coupling which will make the test results quite irregular.

It is also necessary to make some allowances for adjacent bus structures and other live equipment as the electrostatic field will affect the readings slightly. Once readings have been taken from one position, that

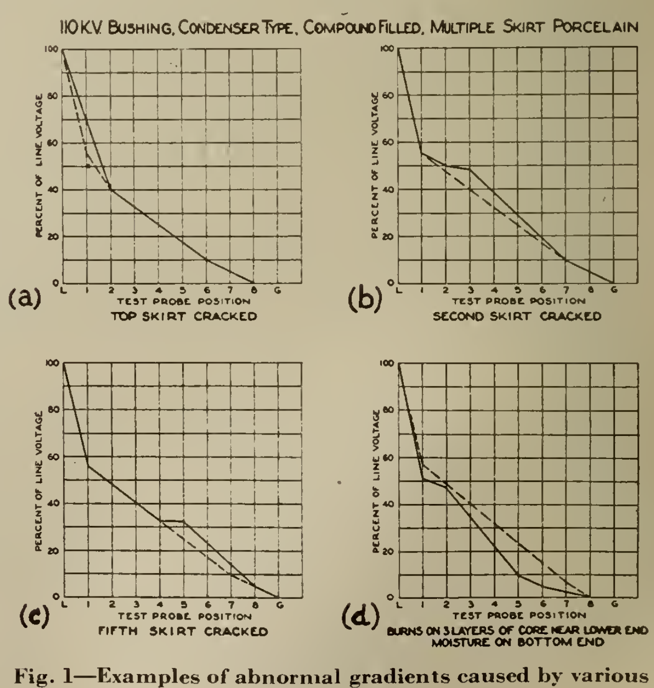
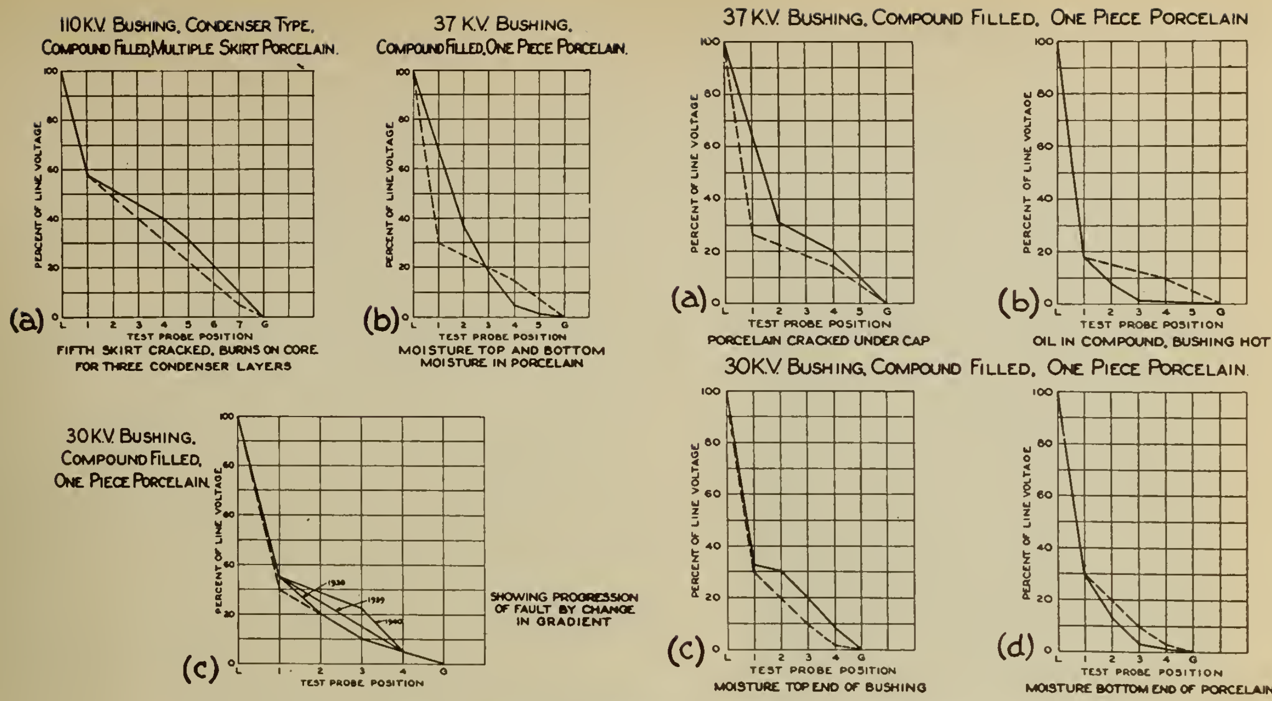


Fig. 1—Examples of abnormal gradients caused by various defects in bushings.

*Live Line Tests Find Defective Bushings, G. B. Tebo—*Electrical World*, May 8, 1937.



Figs. 2 and 3—Examples of abnormal gradients caused by various defects in bushings.

position should be used on subsequent tests to get the best results. When the operator has become experienced he will be acquainted with slight changes due to these causes and make allowances for them.

Test Readings Obtained

The tester collects the current to operate the meter, either by direct contact with the line, or by capacity coupling through the insulator body. Because of this, the first reading below line voltage (full scale) drops considerably depending on the voltage of the circuit. From this point the gradient curve for good bushings is usually nearly a straight line to the ground position.

Differences in the construction of bushings may alter the shape of this curve slightly, and it is necessary to determine the gradient curve of good bushings for each type. From test results on a number of bushings of one type, a curve of normal gradient may be plotted with allowable variations. The deviation from normal that can be tolerated varies with the type of bushing. Some types may be allowed 10 or 15 per cent above or below normal while others may only be allowed 5 per cent.

Variations of Gradient Curve Due to Defects in Bushings

Note:—All references to a bushing, in this discussion, will consider only that part of it outside of the equipment in which it is installed:

1. Higher readings near the line end of the bushing, causing a steeper gradient. See Fig. 1(a).
2. Lower readings near the ground end of the bushing, causing a flatter gradient. Fig. 1(d).
3. Successive readings the same, resulting in a horizontal gradient. Fig. 1(b, c).
4. The gradient curve laying above or below the normal curve for part of its length. Fig. 2(a).

These changes in gradient may be attributed to the following causes:

1. (a) Moisture entering the top end of the bushing through gaskets in joints between metal fittings; between metal and porcelain, or through cracks in the porcelain rain shield.
   (b) Damage to the upper end of the core (carbonized burns) of short-circuited layers of a condenser bushing. In a condenser bushing, damage at the lower end of the core has been found reflected through the condenser layers to the top end of the bushing, resulting in a higher gradient than normal.
2. (a) Moisture entering the bushing near the ground end usually through joints between metal and porcelain.
   (b) Changes in the resistance of the compound, due to excessive heat, or by contamination by some foreign substance.
3. (a) Breakdown of successive layers of insulation, or carbonized burns shorting out two or more layers (condenser bushing).
   (b) Cracks in the porcelain rain shield.
   (c) Moisture entering the bushing through joints in the rainshield, when it consists of porcelain sections cemented together.
4. (a) Breakdown of layers of insulation.
   (b) Carbon burns caused by moisture or voids in the compound.

Other changes in gradient not so frequently found, have been due to the following causes:

1. Moisture absorbed by the porcelain rainshield, raising the gradient. See Fig. 2(b).
2. Poor connections between the mounting flange and the core, causing an increase in the readings near the mounting flange. This effect may contribute to radio interference.

Interpretation of Readings

Most cases of abnormal gradient may be discovered on the first test of a group of bushings. Changes in the gradient on subsequent tests will show faults as they progress. In most cases the gradient becomes more abnormal, but in a few cases it may appear to return to

Fig. 4—Porcelain from a 34.5 Kv. bushing. Shaded area shows part of porcelain cracked in service.

normal. This is caused by a leakage path from line to ground. The potential is evenly distributed across this resistance making the gradient appear normal. If this condition exists at the time of the first test it may not be possible to detect it. However, if one bushing of a group is in this condition, other bushings in the group usually are in some state of deterioration. When this is so, the readings on all bushings are likely to be erratic and an insulation resistance test with a megger will usually show the bad bushing.

This is the only condition we have found, where the potential gradient method of testing does not show the correct condition of a bushing and it has been encountered only three times in 25,000 tests.

It has been our experience that tests one year apart may be duplicated on bushings in good condition and any change in the gradient will show up sufficiently to be detected. See Fig. 2(c).

Since the rate of deterioration of organic insulation, due to moisture or carbonization, increases as the voltage increases, it may be advisable to test the high voltage bushings more frequently.

Results of Field Tests

Accurate records have been kept on about 3,500 bushings of 100 different types, the results of tests during 1939 and 1940; and on about 5,000 bushings tested in 1941. These records form the basis for the discussion that follows:

Of the 100 types of bushings, of all voltages, that have been tested, the majority of the bushings are included in about 30 types. The number of bushings tested in each voltage range and the number of defective bushings are shown in Table I.

It has been possible to follow the progress of most of the bushings removed from service because of abnormal gradient through the Bushing Repair Shop. When the bushings were dismantled, care was taken to record any signs of deterioration.

The results may be broadly classified as follows:

Moisture in top of bushing	28%
Moisture in bottom of bushing	14
Moisture top and bottom	13
Porcelain cracked—one piece	5
Porcelain cracked—multiple	5
Oil in compound, foreign matter, separation of hard compound	20
Leaking compound	5
Core deeply burned	
No gaskets	
Condenser layers shorted	
Low oil	10
	100%

Table I

Voltage	No. of Types	1939			1940			1941		
		Bush. Tested	No. Abn.	% Abn.	Bush. Tested	No. Abn.	% Abn.	Bush. Tested	No. Abn.	% Abn.
220,000	4	84	0	0	150	0	0	150	1	.6
110,000	19	1,035	8	.7	938	9	.96	1,555	22	1.41
44,000	15	151	6	4.0	110	8	7.3	235	9	3.83
26,400	48	1,562	86	5.5	1,573	62	4.0	2,229	83	3.72
13,200	19	595	20	3.4	475	9	1.9	653	13	2.0
Totals	105	3,427	120	3.5	3,246	88	2.71	4,822	128	2.66

Voltage	No. of Types	1942			1943			1944*		
		Bush. Tested	No. Abn.	% Abn.	Bush. Tested	No. Abn.	% Abn.	Bush. Tested	No. Abn.	% Abn.
220,000	4	192	0	0	210	0	0	210	0	0
110,000	19	1,809	10	.5	1,292	9	.7	1,064	1	.1
44,000	15	287	3	1.05	600	9	1.5	90	0	0
26,400	48	1,616	36	2.2	1,668	29	1.74	1,188	7	.6
13,200	19	1,684	29	1.72	1,393	27	1.93	1,303	11	.85
Totals	105	5,588	78	1.40	5,163	74	1.43	3,855	19	.5

* Tests not complete.

Some rather unusual troubles have been found by the potential gradient method of testing bushings.

In one case, the bushing (110 kv. condenser type, covered with a herkolite cylinder) was exposed to water dripping from a roof ventilator. Water running down the outside of the bushing caused streamers that carbonized a path from line to ground. When dry, this was not noticeable in the dim light of the room but was immediately detected when starting to test the bushing.

After several failures of one make of bushing, in service only a short time, investigation showed the design to be at fault. With the gradient method of testing it was possible to pick out other bushings of the same make that were becoming dangerous and to remove them before failure. This was one case where only a slight deviation from the normal curve indicated trouble.

One bushing was subjected to a severe lightning surge. The transformer remained in service with the bushings appearing in good condition. The gradient test showed signs of low oil and when the bushing was dismantled the following defects were found:

1. Low oil.
2. Inner micarta sleeve shattered and burned.
3. Outer micarta sleeve split.
4. Evidence of power arc from conductor to mounting flange inside the bushing.
5. Porcelain rainshield cracked above the mounting flange, but held in place by compression spring so as to be oil tight.

One bushing was found to be so hot, when it was approached to be tested, that it was smoking. The gradient was very low and warranted immediate removal, Fig. 3(b). It was found that the low gradient was due to oil seeping up along the core and mixing with the compound. To make matters worse in this case, there was poor contact between the bushing and the bus.

Two bushings showing abnormal gradient in 1939, failed in service before they could be removed. Examination of one of these, a 110 kv. compound filled, condenser bushing, confirmed suspicion of moisture. The path of the power arc could be traced part way through the condenser insulation, then through the compound at a point where moisture was suspected, then back through the insulation.

Recently, several bushings have been found to have moisture in the porcelain, due in each case to fine cracks that defy detection by visual examination. One of these was subjected to a 10 lb. air test and lost only two pounds pressure in a week. The porcelain was then filled with oil and subjected to air pressure. The oil found its way through the crack and when the porcelain was broken it was found that the crack had extended two-thirds of the way around the bushing. See Fig. 3(a) and Fig. 4.

Some sign of deterioration was found in all bushings removed from service because of abnormal gradient. Maintenance engineers have stated that no bushing has been removed from service that was not in need of reconditioning, and failure in service was prevented in many cases by the removal of the bushings.

Power Factor Tests

Because of the difficulty of obtaining power interruptions, very few power factor tests have been made in the field. Power factor tests have been made in the laboratory on a low voltage bridge on bushings removed from service and on some bushings after reconditioning.

The power factor tests on abnormal bushings did not always indicate the fault in the bushing. In one case, while the power factor was higher than average, it was not as high as some recorded and the bushing was in imminent danger of failure. The bushing core had a deep burn from the top end to within two and a half inches from the mounting flange. Fig. 5.

In another case, very high power factor was found in a bushing that had some moisture in it but was not in a dangerous condition.

Tests after reconditioning show the power factor lower in most cases although in some cases it had increased. These bushings had been rebuilt and are considered in the same class as new bushings.

Fig. 5—Bushing core, showing carbonized burn on surface. Note that the burn extends nearly to the mounting flange.

Recent tests have convinced us that an overall test by the power factor method cannot be relied on to give the true condition of the bushing. It is necessary to take readings between the top of the bushing and each skirt, between the bottom of the bushing and each skirt, and between each skirt. Tests have been made in the laboratories, in which the following results were found on three bushings.

No. 1—Overall 1.0 per cent power factor; conductor to second skirt 10.0%.

No. 2—Overall 1.5 per cent power factor; conductor to first skirt 20.0%.

No. 3—Overall 3.5 per cent power factor; flange to bottom skirt 50.0%.

Tests on Insulators

Approximately 5,000 insulators have been tested each year. These include bus and station type insulators, pin type, and suspension insulators. The potential gradient method of testing has been found useful in locating cracked or short circuited sections of insulators. It is necessary to watch for the effect of electrostatic fields to a greater extent than in testing bushings, and a wider latitude must be used in discriminating between good and bad insulators, except in the case of suspension insulators, where, by making contact with the metal casting between each section, positive results are assured. (*Continued on page 545*)

CUTTING FLUIDS AND THEIR RELATIONSHIP TO METAL CUTTING

WILLIAM H. OLDACRE
President, D. A. Stuart Oil Company, Limited, Chicago, U.S.A.

Paper presented at a Joint Meeting of The American Society of Mechanical Engineers and The Engineering Institute of Canada, at Toronto, Ont., on September 30, 1943

The machining of metals involves three unsolved but fundamental problems:

What is the mechanism of metal cutting?

What characteristics of metals govern machinability?

How does a cutting fluid function?

Well informed authorities have stated that better tool grinding and more intelligent application of cutting fluids would make possible a 30 per cent increase in metal working production. The urgencies of war would seem to make the immediate acceptance of such a challenge imperative.

Some real work has been done. Drs. Boston and Ernst in the United States, Dr. Herbert in England, and two or three in Germany have made notable contributions to our knowledge of metal cutting, but their numbers are few and their time and attention largely allocated to more pressing and seemingly more important problems.

Mechanism of Metal Cutting

What is the mechanism of *metal cutting?* Our thinking on this subject has been superficial and our observations careless. Influenced by the wedge shaped supporting structure of the cutting edge, we have easily assumed that all cutting is a wedging action. The all-important function of the edge as a means of applying highly concentrated stresses has been neglected and we have given our whole attention to the tool faces or sides of the wedge.

The picture of the chip curling over the face of the tool is well known and in some form is widely accepted. (Fig. 1). However, a few minutes careful study of chip structure, comparisons of the contours, and dimensions of chips and tool craters will make obvious the basic fallacies in the assumptions underlying this picture. There are a few mechanical and metallurgical facts with which we are all familiar, but which are usually neglected in considering metal cutting phenomena. The compressive strength of most metals is roughly double their shear strength. Shear takes place at a 45 deg. angle to the direction of principal stress. It follows, therefore, that in metal at least a shear segment is always basically triangular with a pressure base of at least 70 per cent of the length of shear. In the case of segmented "shear chips" such a base must be and is formed by either fragmentation or plastic flow of interfering metal.

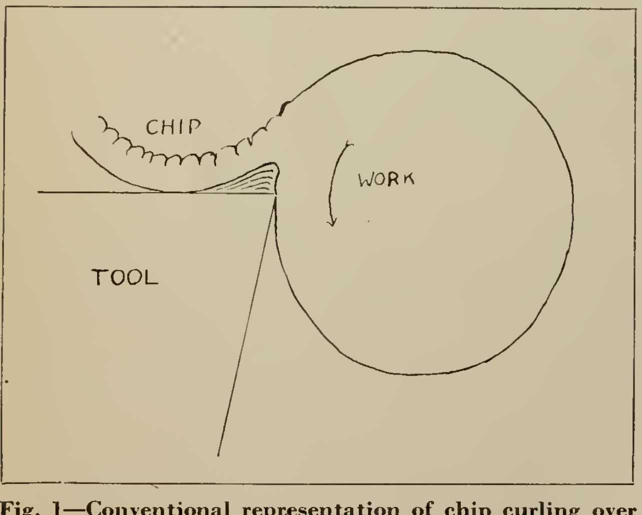


Fig. 1—Conventional representation of chip curling over top rake surface of tool with built-up nose.

It is a peculiar fact that chips in their almost infinite variety have been considered as scrap or junk and their interesting structures with their definite bearing on the metal cutting problem neglected.

Chips may be classified as: (1) fragmented, (2) segmented, and (3) flow. However, many, and probably most chips do not easily fall into any one class, but are compound as to structure. Thus most so-called segmented chips consist of segments formed by plastic flow and shear and held together with a continuous flow chip.

Fragmentation as a factor in chip formation is encountered only with the more brittle metals of which cast iron is an example. Such materials are usually "free cutting" and do not greatly complicate our tool and cutting fluid problems. It is the flow and segment chip formations that are associated with most of our difficulties.

Fig. 2—Photomicrograph of a continuous flow type chip.

The true flow type chip is plastically extruded between the advancing mass of the work-piece and the tool edge. The chip formation is governed by the rate of plastic deformation of the material, the velocity of the cut and the depth of cut. Temperature, of course, affects the plasticity of the work material. The forces necessary to produce such continuous plastic deformation are of considerable magnitude and the wool edge must be strong enough and rigid enough to stand up under their destructive attack. Figure 2 is a photomicrograph of a flow chip structure which cannot be explained on any basis other than plastic flow.

We are indebted to Dr. Ernst for calling our attention to the rather sharp line of demarcation between the undistorted metal of the work-piece and the much distorted metal of the chip. In a flow chip this line connects a point near the tool edge, and a point on the surface of the work-piece where the distortion from chip formation starts. The lines of chip structure, however, do not parallel this line as inferred by Dr. Ernst, but intersect it at a definite angle (Fig. 3).

It seems a safe assumption that the lines of chip structure are the result of plastic deformation along strain lines. Figure 4 suggests the contours involved. The elastic penetration of the tool edge generates elastic pressures within the work-piece, which stretches the surface underneath the chip until tensile separation at the tool edge releases the stretched and drawn layer and it becomes a part of the chip. If the material being machined is stiff enough and the depth and velocity

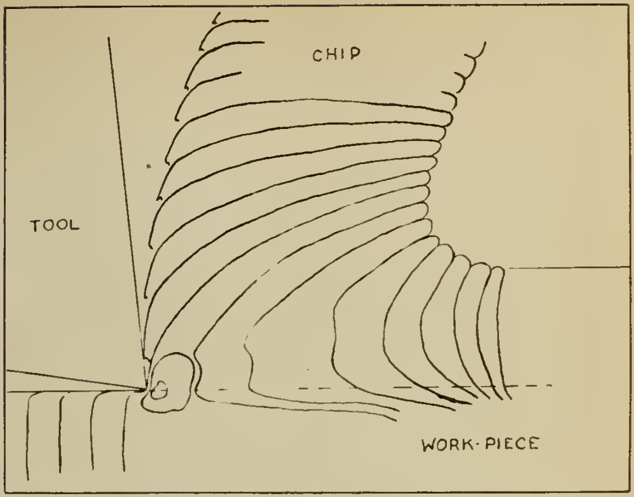


Fig. 4—Suggested contours of flow or strain lines on basis of which flow chip formation develops.

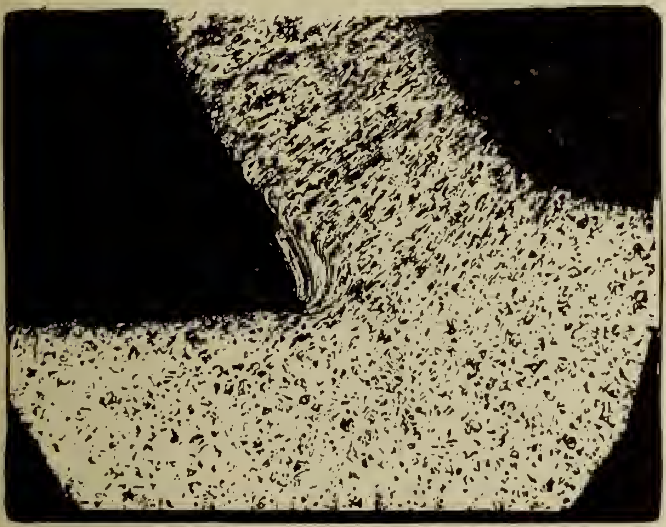


Fig. 3—Photomicrograph of chip and work-piece at the tool edge showing the line of demarcation between chip and work-piece and also the built-up nose formation.

of cut balanced, a chip will be formed which will not touch any appreciable area of the rake surface of the tool. If the material is more plastic, the end of the chip forming layer may contact the tool rake surface and be immobilized. A secondary separation isolates this small section and leaves it as a thin layer on the tool surface adjacent to the edge. Successive layers thus laid down constitute the "built-up edge". The continuity between chip structure and built-up nose structure is easily seen in many photomicrographs. (Fig. 3).

Metals Characteristics Governing Machinability

The foregoing affords us some clues regarding the properties of metals which affect machinability. While our knowledge of plastic flow is extremely limited and in a very fluid state, it may be safely assumed that the plastic properties of metals are very important factors in machinability. Elasticity likewise is important and, of course, the hardness of the material with respect to the tool is vital. There is great need for widening research in this field and it is to be hoped that competent men with modern equipment may become interested in increasing numbers.

Functions of Cutting Fluid

How does the cutting fluid function? Primarily as an anti-weld agent, a coolant, and a lubricant. Its anti-weld properties effectively prevent the welding of the work-metal to the tool at points of high pressure, high temperature contact. One such point is on the tool face just back of the built-up nose, where the freshly separated ends of the chip forming layers rub across the tool face at high temperatures and velocities developing highly localized pressures. It is at this point that cratering takes place due to scuffing of the tool surface. There are undoubtedly other places in the tool chip relationship where the anti-weld characteristics of the oil are helpful. Research on gear lubricants during the past ten years has definitely established the place of active sulphur compounds as anti-weld agents in lubricants.

One question which has consistently plagued the cutting fluid engineer is "How does the cutting fluid reach the point of the tool?" Under theories of chip formation in which the chip slides over the face of the tool and away from its point, it would seem impossible for the cutting fluid to reach the bearing area in sufficient volume to perform lubricating functions. However, once we notice that the chip does not slide over the face of the tool, but rather moves away from the face, the entrance of the cutting fluid becomes easily possible and this question ceases to perplex us.

The cooling function of the cutting fluid is obvious, which is the main reason that so many investigators have been inclined to claim cooling as its sole function. Temperature affects the plasticity, elasticity, hardness, and, as well, most other properties of metals, and therefore temperature regulation is a most effective means of controlling these properties to the benefit of the cutting operation.

Lubrication, apart from the above noted anti-weld function, is not too easily comprehended or defined. It promotes the mobility of surfaces in contact and, therefore, without a doubt plays a part in the mechanism of metal cutting. The increasing use of "lubricity" additives such as chlorine and phosphorous compounds bears testimony to this fact.

It is hoped that the above remarks, which of necessity have been brief, will have served to impress upon the metal cutting manufacturer and the machine operator the necessity of more accurate observation and recording of the machining processes to afford a basis for more definite conclusions regarding speeds, feeds and tools; more intelligent laboratory work to control, within narrower limits, the properties of metals and finally a greater appreciation of the part the cutting fluid plays in metal cutting.

STANDARDIZATION IN CANADA

Origin and Development of Canadian Standards Association

W. R. McCAFFREY, M.E.I.C.
Secretary, Canadian Standards Association, Ottawa

From a paper presented before the Montreal Branch of The Engineering Institute of Canada on April 5th, 1944

Organization of the Canadian Engineering Standards Association (CESA)

Like many other standardizing organizations, the CESA came into being at the close of the first Great War, as a result of the obvious need for a national standardizing body in Canada.

Functional standardization in Canada dealing with such matters as weights and measures has long been the accepted responsibility of the federal government. The work of the CESA is primarily concerned with dimensional standardization, the object of which is to achieve simplification, unification and interchangeability. It may also represent an indirect method of specifying quality.

The Imperial Conference in 1930 recommended the co-ordination of standardization under a central body in each country, to which support should be given by the government. It urged closer co-operation between standardizing bodies in the British Empire and also recommended the adoption of marks or brands by the various standardizing bodies, to be protected throughout the British Commonwealth, and suggested measures to promote adherence to standard specifications and practices. It further urged that the standardizing body in each part of the Commonwealth should be accorded the support of the respective governments by way of financial assistance, the co-operation of government purchasing departments and otherwise.

The need for industrial and manufacturing standardization in Canada has been emphasized repeatedly at important gatherings of the Canadian manufacturing and purchasing interests and has been discussed in the parliament of the Dominion.

In 1919, two years after its formation, the Canadian Engineering Standards Association received its charter by letters patent of the Department of the Secretary of State. The CESA was established in 1917 by a group of public-spirited citizens, most of whom were members of The Engineering Institute of Canada then the Canadian Society of Civil Engineers, whose foresight recognized the growing need for such an organization to serve the interests of both producer and consumer in Canada. The Memorandum of Agreement associated with the letters patent of incorporation gave the Association extremely wide powers in the field of standardization related to engineering subjects.

It will be noted, therefore, that, contrary to the idea held by many uninformed Canadians, the CESA is an autonomous body, but it is affiliated with the Dominion Government through its association with the National Research Council, in which the CESA Main Committee is Associate Committee on Engineering Standards.

For twenty-five years it has steadily maintained a policy of conducting its affairs in the interests of manufacturer and consumer alike, with the object of co-ordinating the elements of quality, economy and safety in the preparation and publication of standard specifications for specified commodities that may be acceptable and useful to all interests concerned. Representatives of these various interests, in fact, form the membership of the working committees which discuss and draw up the proposed standards for approval by the Association.

The Association is governed by a Main Committee, consisting of from 80 to 100 members, in which are represented such interests as:—

Departments of the Dominion Government,
Provincial governments,
The manufacturing industries of Canada,
Public utilities,
Educational institutions,
Professional bodies,
Labour organizations,
Insurance interests, etc.

Members of the Main Committee serve for a period of three years but may be re-elected for further periods of three years.

The administration of the affairs of the Association is in the hands of an Executive Committee, a group, not exceeding twenty in number, elected by the Main Committee also for a period of three years and subject to re-election for further similar periods.

The active work of standardization comes under the direction of appropriate sectional committees in eight or ten fields of engineering, such as civil, mechanical, electrical, ferrous metallurgy, steel construction, railway, aeronautical and so on. Appointments to such committees are made by the Executive Committee on a permanent basis.

Under the appropriate sectional committees, working committees are organized, as and when required, to deal with specific subjects. Unless retained for the purpose of providing for interpretations and anticipated revision, these are disbanded on the completion of their work. It is quite customary, however, to appoint such committees as "standing committees" for a period of several years after their reports have been published, in order to provide for possible revision after specifications have been subjected to field experience. A proposed standard must be approved in turn by the appropriate working committee and sectional committee and by the Main Committee prior to its publication as a CESA standard. In all committees it is attempted to have a balanced representation of producer and consumer interests.

Forty or more CESA working committees are in existence, although some are inactive during the present war conditions and these, together with sectional committee memberships and memberships in the Main Committee, make a total of approximately eight hundred members in the Canadian Engineering Standards Association. It is believed that this membership represents a true cross-section of Canada's industrial and professional engineers, comprehending a broad range of seniority in industrial technical staffs as well as a broad distribution on a geographical basis.

CESA Membership

For obvious reasons, personal membership in the CESA is available, generally, only to those who are willing to work actively on behalf of the principal object of the Association, namely, the establishment of standard specifications and codes of practice that are mutually acceptable to consumer and producer. Such membership is granted to members of established committees and ceases as and when committees are disbanded. This is the general membership policy of the Association.

There is another type of membership, however, which is just as essential to CESA operation and that is the sustaining membership classification which may be obtained on application by industrial organizations, government departments, the various types of engineering organization, etc., and involves the payment of a specified fee. There is no limit as to the number of sustaining memberships that may be taken out by such organizations. It is by this means that the CESA obtains much of its financial support.

The financial picture may be completed by stating that the CESA has, for many years, received a small government grant, but in view of anticipated increased activities involving a broadening of scope and possible greater activity in the international field, the Dominion Government has this year agreed to increase, materially, the financial support that it has been giving.

Nature of Standards and Standardization

In considering the nature and value of standardization, reference may well be made to a recent article in *Industrial Standardization*, the monthly journal of the American Standards Association. In this, Messrs. L. F. Adams, and P. C. Alger, of the General Electric Company, gave the following definition of the term "standards":—

"By 'standards' we mean accurately defined processes, sizes, qualities, and tests of materials and equipment that have been generally agreed upon by makers, users and the public, as proper and desirable for general use. A standard may be brief, only a sentence or a paragraph, while again it may be a very long, and in some cases a highly technical document. Such standards have four distinct values:

First, they educate. They set forth ideals, or quality goals for the guidance of manufacturers and users alike. They are invaluable to the manufacturer who wishes to enter a new field, and to the naive purchaser who buys a new product.

Second, they simplify. They reduce the number of sizes, the variety of processes, the amount of stock, and the paper work that largely account for the overhead costs of making and selling.

Third, they conserve. They save the losses of defects, left-over pieces, and inadequate tooling that must accompany odd-lot manufacture, by allowing large-scale production of standard designs. Each step in this direction justifies better tooling, more careful design, and more precise controls—all conserving both time and materials.

Fourth, they certify. They serve as hall-marks of quality of inestimable value to the advertiser who points to proven values, and to the buyer who sees the accredited trade mark, nameplate, or label."

Commenting on the value and limitations of standardization, Messrs. Adams and Alger stated:—

"Standards are truly the basis of the American system of providing more goods for more people at lower cost. They enable manufacturers to enter business by matching standard qualities. They enable more goods to be produced with less materials, in shorter time. They aid buyers to find and judge the goods they want. They reduce costs at every stage of production and distribution. They are, therefore, a potent influence in spreading employment and raising the standard of living.

However, like all good things in life, standards have their limitations. They do not of themselves generate inventions or create new methods. In fact, if overdone, standards may readily become a barrier to progress by making it so easy *not* to depart from obsolete designs.

Therefore, it is most important that standards should not in any way deter the free development of new and varied designs. They should be considered as norms, to which sensible people will conform because they are clearly good and economic. Emphasis should be placed on preferred sizes of bolts, buckets, frames, etc., giving logical gradations of capacity. No upper limit whatever should be placed on the strength of a standard size of bolt, or on the durability of a standard bucket, or the horsepower of a standard motor frame, even though normal values of these quantities may be recognized as good practice."

There is no doubt that the broad use of industrial standards, the co-ordination of basic designs and the simplification of practices involved in the production of similar articles contribute to the elimination of economic waste and permit reduction of much dormant capital tied up in manufacturers', jobbers' and retailers' stocks.

Further, the standardization of methods of sampling and testing is important so that appraisal of values and the probable performance of specific materials or manufactured articles may be determined on a sound basis.

Dormant stockpiles frequently result from an endeavour to satisfy diversified consumer preferences. Any effort resulting in the elimination of such conditions benefits directly or indirectly all industry and the nation at large.

The adherence, by manufacturers, to standards representing uniform basic designs permits the treating of non-standard requirements as "specials" and justifies compensation for increased costs resulting from a switch to other than normal operations.

Individuality of design, of quality and of performance of manufactured products is not jeopardized by standardization, since the principles of standardization must represent minimum requirements and there is, therefore, no restriction on the fulfilling of an ambition to produce "a better mouse trap."

Scope of CESA Work

An important feature of CESA standards, in which they resemble the products of all British and American standardizing bodies, is that they are "voluntary" or "advisory" standards. As such, they serve as recommendations to industry and may or may not be adhered to by manufacturers concerned. They may, however, become mandatory through adoption by a governmental department having legal authority to enforce their requirements in the matter of governmental purchases. The CESA has published approximately 200 such standards—distributed over the various sections of engineering—and dealing with specific materials or products.

Standards may also be in the form of codes of practice. The CESA has a number of these, such as, "Regulations Governing the Construction & Inspection of Boilers and Pressure Vessels," and a "Refrigeration Code"—both of which have the force of law by adoption in some of the provinces of Canada. There is a code on "Colour Identification of Piping Systems," and another on "Welding," both of which have been in considerable demand in various parts of Canada.

The most notable of CESA code publications, however, is the Canadian Electrical Code, which has been adopted by all the provinces of Canada. Thus it represents universal practice within Canada, for it provides for the requirements of electrical inspection and approval label service on a nation-wide basis. This is believed to be a unique position for a voluntary standard, and to be without parallel in at least the English-speaking nations. There has been much favourable comment by observers in other countries, which redounds to the credit of one of the hardest working groups in the CESA committee organization—that which was responsible for the establishment, and subsequently, the periodic revision of the Canadian Electrical Code. This code is divided into two parts—Part I, governing wiring methods, and Part II, consisting, to date, of some 75 or more individual minimum standards for as many items of electrical equipment and appliances.

Broad, and in some cases universal use of CESA standards in Canada has gradually brought the Association into a position where it has become generally recognized as the national standards body. This has been strengthened by the fact that by Order-in-Council, CESA standards, as and when published, become mandatory in the matter of purchases by the Government of Canada.

During the present war, this position has led to the organization of a number of special committees, at the request of Dominion Government war departments, to deal with standardization and simplification problems related to the war effort. There is a special CESA Committee on Steel and its Alloys, one on Aircraft Components, another on Components of Radio and Radar, and still another on Electric Wires and Cables.

These committees have been dealing successfully with such problems as the co-ordination of British, American and Canadian specifications and manufacturing practices, the conservation of materials by modification of chemical compositions and the recommending of suitable substitutes for critical materials.

To mention a few examples of CESA usefulness in this regard, it was reported to the CESA Committee XT-2 on Aircraft Standards, that the simplification of sizes and alloys of aluminum tubing produced in Canada, would reduce the number of aluminum tubing items required in aircraft construction, from 1700 to 320, and would reduce the time of production by about twenty per cent.

In another case the substitution of Class 17ST aluminum rivets, driven in age-hardened condition, for similar rivets driven after quenching, was reported by the representatives of aircraft contractors on the CESA committee, to represent an annual saving of $509,000. This was a case where a process used by one, or a few manufacturers, was standardized throughout the industry through dissemination of information within a CESA working committee.

The work of another special committee should be mentioned. This body, although not officially within the CESA, nevertheless was constituted and operated along the lines of CESA procedure and from the CESA head office. Seven of its nine members were members of the CESA, although it was formally recognized as a Technical Advisory Committee on Alloy and Special Steels acting in an advisory capacity to the Steel Controller.

Under the able chairmanship of the CESA chairman, Mr. J. G. Morrow, this committee successfully dealt with such problems as conservation of alloying elements by modification of chemical analyses of steels, variations in heat treatment and substitutions of more plentiful elements. These problems directly concerned gun steel, armour-plate, armour-piercing shot, gun mounts and parts, small arms, bullet-core steel, tool steel, and other important items.

As an example of the results of the work of this committee the number of specifications required for one well-known type of automatic gun was reduced, by the processes of simplification and co-ordination, from 102 to 20.

Problems concerning the shortage of natural rubber for insulating electrical conductors were investigated by an appropriate CESA committee and, based on investigation in the CESA Laboratory and the laboratories of manufacturers, specifications were revised to permit the use of suitable synthetic compounds. Substitutions for tin, steel and other metals normally used in the electrical industry were also successfully dealt with by this committee.

CESA Approvals Division

Regarding the above reference to the "CESA Laboratory," it should be explained that since May 1940, the CESA has operated, on a rental basis, a part of the Laboratory of the Hydro-Electric Power Commission of Ontario. In this, however, we are not in competition with our associates, the National Research Council. The CESA Laboratory is utilized entirely as the basis of a nation-wide test-approval and label service on electrical equipment.

Up until May 1st 1940, the Hydro-Electric Power Commission of Ontario operated this service, initially for the benefit of the province of Ontario; but later at the request and for the benefit of all of the provinces of Canada. Just prior to 1940, it was agreed by all concerned that the HEPC should not be required to bear the burden of a service extending beyond the borders of Ontario, from coast to coast, and that a national organization should assume the responsibility.

The CESA, as already explained, had prepared the document upon which nation-wide electrical inspection and approval label service was based. It was therefore proposed that this body should take the responsibility of applying its requirements to type-test approval and label services that would include all electrical equipment installed in Canada, which, if installed without meeting the prescribed tests, might hazard life and property of Canadian citizens. This met with unanimous agreement of the HEPC, of appropriate inspection authorities of all provinces, of manufacturers, and of the CESA, and on May 1st 1940, by authority of the CESA Executive and Main Committees and with the consent and approval of Dr. T. H. Hogg, M.E.I.C., chairman, and the members of the Hydro-Electric Power Commission of Ontario, the transfer of this responsibility to the CESA was effected.

The records of the CESA now show the results of the splendid co-operation given by Dr. Hogg, and members of his staff, in the transfer of this responsibility from the HEPC to the CESA. The transaction was completed without any interruption of the electrical approval service and the CESA Approvals Division has been established on a firm foundation.

In spite of war restrictions on the manufacture of electrical equipment, the Approvals Division has passed through four years of war conditions on the black side of the ledger. There have been no complaints from manufacturers or consumers, except routine complaints from the few people who resent having to submit samples for test and for periodic inspection at the manufacturing plants to determine whether or not they are living up to their approval agreements. These requirements, however, are mandatory by virtue of universal agreement of the provincial inspection departments, and in this matter the CESA therefore merely acts in their interests as their agent. The successful operation of the Approvals Division is in no small measure due to the untiring efforts of Mr. W. P. Dobson, M.E.I.C., the chairman of the CESA Approvals Administrative Board.

The CESA Approvals Service is maintained as a separate division of the Association work—even in the matter of financing. It is operated at cost, and an appreciable surplus in any one year may result in an appropriate adjustment of approval service fees in the next. Of course, the reverse condition would result in reverse action. A comparison of CESA test and approval fees with those of similar organizations in other countries definitely indicates that Canadian electrical manufacturers have no grounds for complaint from that angle.

In this division of our work, judging by British and foreign comment, we find ourselves in an enviable position, in that we are not only the producers of a nation-wide code of practice but are also the medium through which that code of practice is made effective.

In the operation of the label service of the Approvals Division, the CESA is gaining experience that may be useful later on in an application of a voluntary "certification label service" to consumer commodities and manufactured articles generally. The trend in the direction of certification labelling is very apparent in some other nations and, in time, manufacturers in Canada may generally endorse the claims that are made as to its advantages. This certification, however, should not be confused with the practice of "grade labelling," which is an entirely different proposition. The author believes that the use of national marks or symbols such as "Canada Standard" or "CESA Standard," based on accepted minimum standards of quality and performance, is beneficial rather than detrimental to free enterprise and does not affect the prestige of established standard brands of individual manufacturers.

Relations with Other Standardizing Bodies

In the preparation of CESA standards, the corresponding publications of British and American standardizing bodies are studied carefully. Reports and standards of the American Society for Testing Materials are reviewed with the assurance that they are based on sound investigation and adequate practical experience. Users of CESA standards will have noted many cases where the opening statement of a CESA specification is to the effect that, "this standard is in substantial agreement with (serial designation so and so) of the American Society for Testing Materials." We appreciate greatly the privilege that we have had in making such reference to so many publications of the ASTM.

Our close association with the British Standards Institution, the American Standards Association, and standards bodies of the British Commonwealth, has also been very beneficial. During the present war we have had the privilege of distributing, in Canada, the publications of the BSI, the ASA and also of the American Iron and Steel Institute. Our stocks of British standards have been maintained with considerable difficulty through the period of uncertainty in regard to ocean transport. Some twelve or fifteen thousand copies of British standards have been distributed through the CESA to war equipment contractors in the United States and Canada during the past four and half years. Instead of waiting for a month or six weeks, or more, for shipment of specifications directly from England, Canadian and American contractors have usually been supplied in a matter of a few hours. In the few cases where loss in transit from England temporarily depleted our stocks of specific items, mimeographed or photostat copies have been provided, when possible, to be replaced when printed copies again become available.

In peace time, the CESA maintained an exchange arrangement with some twenty or more British and foreign standards organizations, and our stocks of their publications have proved useful on certain occasions during this war when reference to German standards, for instance, has been urgently desired.

United Nations Standards Co-ordinating Committee

There is another important subject which concerns the field of international standardization. In December 1943, Mr. Percy Good, Director of the British Standards Institution, headed a mission to this country to discuss a proposal to co-ordinate British and American screw threads. Most engineers realize what a complex problem this presents, but appreciate the great benefit that would be derived from its successful solution. The mission met with representative screw thread interests of Canada and the United States, in New York, for four days. All present believed, at the end of the conference, that progress had been made towards at least a partial solution. Each party admitted certain advantages in some features of the other's forms of screw thread—which is more, than had been achieved previously. Definite proposals tending towards unification of practice were introduced, that gave some promise of progress toward the ultimate goal of agreement in the English-speaking nations.

A recent conference between representatives of the CESA and the ASA screw thread committees agreed to the holding of a further general conference on the subject in the near future, either in Great Britain, or preferably, in Canada.

During his visit on this continent, Mr. Good introduced a proposal for the establishment of a United Nations Standards Co-ordinating Committee, embracing, in the early stages, representation of the national standards bodies of Australia, Canada, China, Great Britain, New Zealand, South Africa, the United States of America, and the Union of Soviet Socialistic Republics. Standards bodies of other allied nations may be invited to become members as and when the time seems to be propitious.

The proposal has been accepted by the American Standards Association, the British Standards Institution, and the Canadian Engineering Standards Association, each of which has agreed to contribute towards the financial support of the organization. Each of these will have the privilege of appointing a member to the administrative body. Executive offices will be maintained in New York and London, with equal executive status.

Typical subjects that might logically receive early attention by such an organization are:—The development of an international screw thread (which subject will no doubt be transferred formally to this new UNSCC); standardization of food containers and of packaging in general; farm implement accessories and replacement parts; rehabilitation materials; visible and radio aids to movement in the air; aircraft subjects and parts, such as voltage and frequency of the electrical supply, and the interchangeability of attachment plugs and sockets, oxygen cylinders, etc.—all requiring standardizing treatment in order to permit replacement in all parts of the post-war world and thereby obviate the necessity of carrying stocks of similar items of equipment which now differ considerably in design.

This organization is intended to replace, at least temporarily, the former International Standards Association. As a member of the UNSCC, the CESA will be in a position to take part in international discussions intended to promote standardization between member organizations, and it is believed may also be of assistance to the Canadian Department of Trade and Commerce in the post-war struggle to re-establish our foreign trade.

Standardization Problems in Canada

It is believed that the need for standardization will become more and more apparent as industry in Canada swings back to peace-time production. Canadian industry has not recognized the value of standardization in the past to the same degree as has Great Britain, the United States, and many European nations, and possibly in this respect was less prepared to meet the requirements of unprecedented mass production during the present war.

In spite of this, Canada's industrial war effort has been remarkable. It will be realized, however, that our production of war equipment was based largely on the established standard specifications and designs of Great Britain and the United States, many of which were primarily intended for peace-time production.

Canadian industry is planning now for post-war production, and such plans should, in the interests of economy, comprehend the standardization of the basic features of manufactured products that are fundamentally similar. Furthermore, consumers are entitled to know upon what minimum basis a product may be judged as to quality, performance and, possibly, as to durability. Such qualities can be reasonably assured only on the basis of uniform adequate tests acceptable to consumer and producer alike.

Standardization of this nature is the recognized function of organizations such as the Canadian Engineering Standards Association. The CESA is supported largely by Canadian industry and welcomes at all times opportunities to serve that industry and the public generally by providing standard specifications and safety codes that will be acceptable to consumer and producer alike, and thereby contribute to the maintenance of a sound national economy.

CESA Widens Scope and Changes Name

Since the beginning of the war a number of requests for the standardization of non-engineering subjects have been considered by the CESA, but, due to the fact that our constitution, according to letters patent, limited our standardizing activity to the field of engineering, the CESA Executive Committee has been reluctant to authorize the exceeding of our scope, and has declined to undertake extraneous projects.

The growing appreciation, by Canadian industry, of the value of standardization, as well as the obvious acceleration of standardizing activities in other countries, has led to careful consideration of a proposal to broaden the scope of CESA work. In this, encouragement by departments of the Dominion Government had some influence.

As a result, at an extraordinary meeting of the Association, on April 18th, 1944, it was unanimously decided that application would be made to the Secretary of State for supplementary letters patent to permit the scope of Association activities to be broadened to embrace any and all subjects and to permit the change in the name of the organization to "The Canadian Standards Association." On May 5th, supplementary letters patent were received from the Department of Secretary of State, fully authorizing these changes.

The Canadian Standards Association is, therefore, now in a position to operate with a much wider scope. Its activities can now deal with the standardization of materials and processes of all kinds. The methods which have been so successful during the past twenty-five years will be continued, acting in the interests of manufacturer and consumer alike, with the object of co-ordinating quality, economy and safety in respect of industrial products.

It is believed that the engineering aspects of standardization in Canada will lose nothing by this change but, on the contrary, will gain by the development of the larger, more vigorous, and more useful Canadian Standards Association.

NOMOGRAPH FOR EQUATIONS OF THE FORM $YX^n = Z$

J. C. BARNES, M.A.Sc.
Assistant Research Engineer, National Research Council, Ottawa, Ont.

This nomograph provides a graphical method of handling all equations of the form $YX^n = Z$. In the equation, Z replaces the more customary C, which for a family of curves is no longer a constant.

By means of the chart the following operations may be carried out very simply and with a considerable degree of accuracy (the latter depends to a certain extent on the values involved, but in the majority of cases met with in engineering practice it will be amply sufficient for rough calculations and checking purposes).

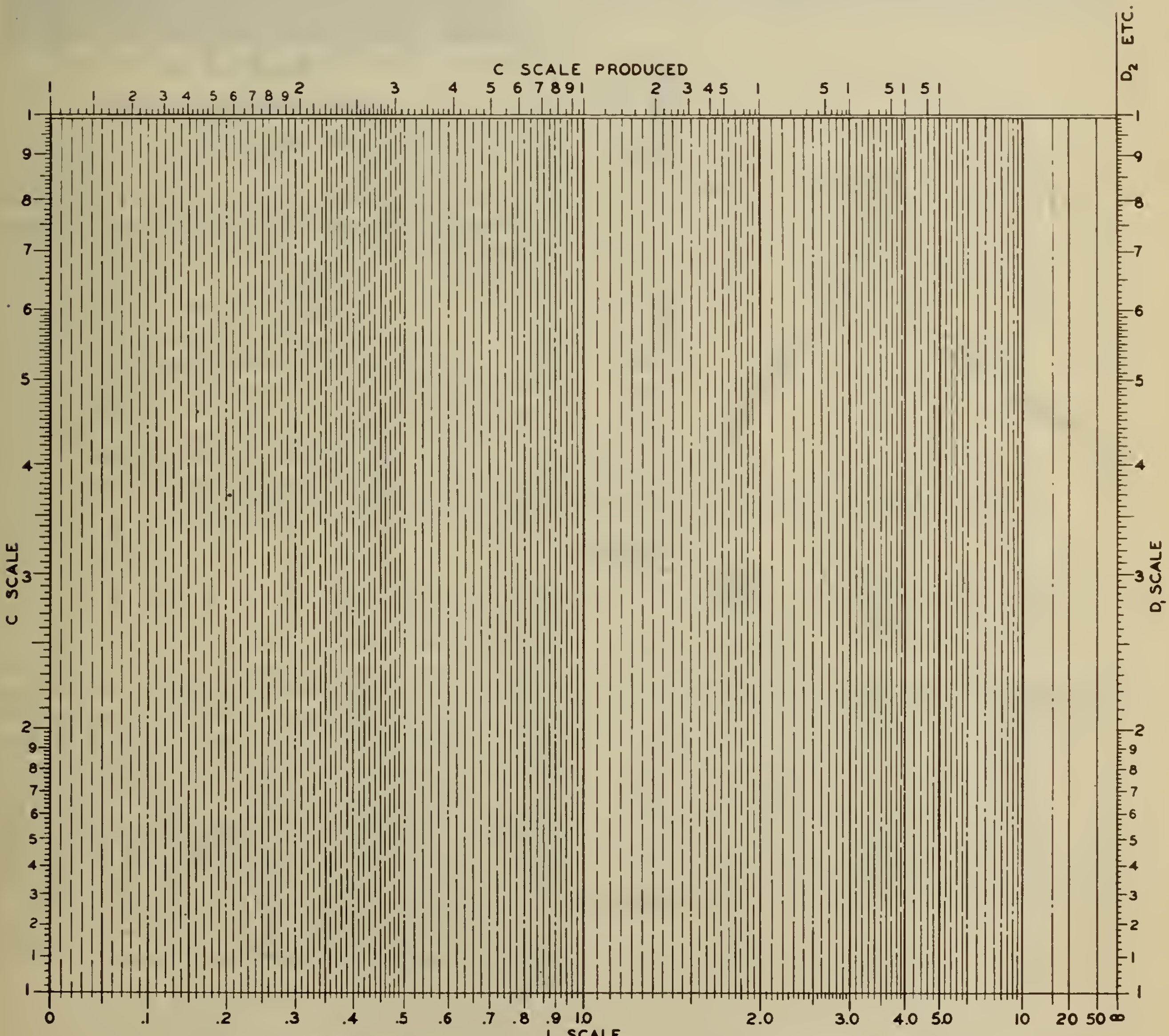
1. Determination of any one of the four quantities involved, given the other three. (When $n = 1$, the operation obviously becomes one of straight division or multiplication).
2. Determination of logs to any base. (Base 10, e, or any other).
3. Determination of the equations of curves having the form $YX^n = Z$.

The chart is extremely useful where n or $1/n$ is not an integer, or is greater than 3, since the ordinary slide rule will not handle these conditions, and the log-log slide rule is, at best, a complicated instrument.

When using the chart it is desirable to have one transparent straight-edge slightly longer than the diagonal of the chart, drilled for a pivot point at one end; and another of length about twice the width of the chart. For problems involving the determination of curve equations, another straight-edge of the second type will be needed. As an alternative to the use of straight-edges, the required lines may be drawn in lightly with a fine pencil and erased when the calculation is complete.

The chart in Fig. 1 consists of three scales:—

1. The C scale which is equivalent to the C scale of an ordinary slide rule.
2. The D scale which is equivalent to the D scale of



UNIVERSAL NOMOGRAPH FOR EQUATIONS OF THE FORM — $YX^n = Z$

Fig. 1

an ordinary slide rule, repeated as often as necessary along the D axis.

3. The L scale which is the log scale for the chart. In the construction of this scale, $d = S/(n+1)$, where

d = distance in inches from the D scale axis.
S = length in inches of the L scale.
n = scale marking.

In all operations the C scale is used for values of Y: the D scale for values of X: the L scale for values of n: and the C scale (or C scale produced) for values of Z. As a matter of convenience, the C scale produced is located across the top of the chart instead of continuing up the left side. Recommended dimensions for the chart are 12 in. horizontally by 10 in. vertically, but in a large office where much calculating is done, it would probably be worth while to lay out the chart to a fairly large scale and to make the D_2, D_3, scales, etc., a permanent part of the chart, instead of using the transposition method described later in the text.

The following points should be kept in mind when using the chart:

1. Since the index of Y is always unity, the section 1-10 of the C scale serves for all values of Y from zero to infinity.

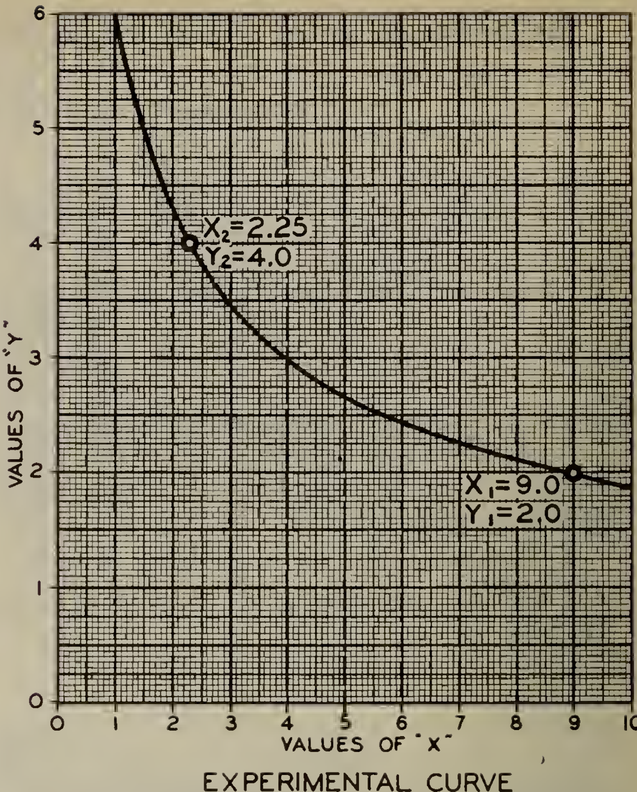


Fig. 1

2. Since the index n of X may have any value, the subscript number of the D scale to be used is given in Table I.

Table I
Subscripts of D

n or $1/n$	Values of X or 10/X				
	1 to 10	10 to 100	100 to 1,000	1,000 to 10,000	Etc.
1	1	1	1	1	..
2	1	2	1	2	..
3	1	2	3	1	..
4	1	2	3	4	..
5	1	2	3	4	..
Etc.					

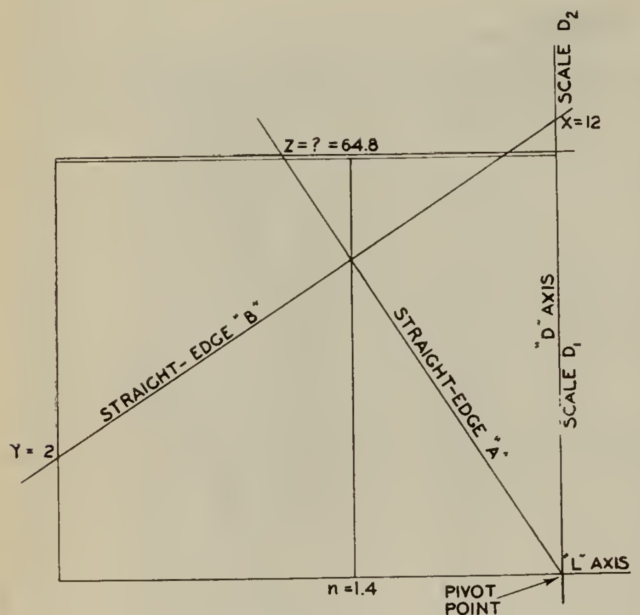


Fig. 2

The D_1 scale is that shown on the chart. The D_2 scale is a second repetition of the D scale along the D axis to be used in accordance with Table I. The D_3 scale is a third repetition, and so on. These scales have been omitted for the sake of convenience in publication but if it is necessary to use them the following method shown in Fig. 2 may be employed. Draw a vertical line (D axis) at the right side of a fairly large piece of plain paper (say 14 by 36 in.) and a horizontal line (L axis) at the base. Set the chart on these two lines, mark the top point of the D scale and shift the chart up the D axis to locate X: then return it to the base line (L axis) where it may be fixed in position by means of drawing pins.

When n or $1/n$ is not an integer, the D scale can only be used continuously: i.e. X = (1-10) is set on D_1 : X = (10-100) is set on D_2, etc., regardless of the value of n.

The following examples are given as illustrations of the method of using the chart:—

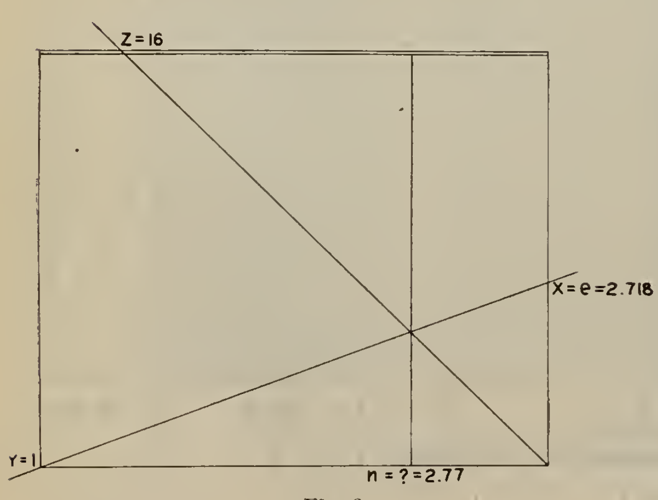


Fig. 3

1. To find Z, given Y = 2, X = 12, n = 1.4, see the example in Fig. 2. In this case, the intersection of the two straight-edges falls within the area but in some cases it may be necessary to produce the L scale lines vertically upward to meet the intersection point.

2. To find log 16 to base e, see the example in Fig. 3 where Y = 1, X = e = 2.71828, Z = 16, and n is the unknown.

3. To find the equation of a curve, pick off values of X and Y for two points on the curve in Fig. 4 and set these values on the chart shown in Fig. 5. The equation of the curve is given by the intersection of the two straight-edges, and is seen to be $YX^{0.5} = 6$.

It is recognized that the necessity for superimposing the D_2, D_3, etc. scales above D_1, may prove to be somewhat of a disadvantage, and if this is felt to be the case, the chart may be modified for certain calculations by producing the D scale horizontally to the left across the top, instead of vertically upwards. The modified chart will then give logarithms to any base and values of X raised to any power but it should be noted that the value of Y in $YX^n = Z$ must always be unity: i.e., the chart is limited to the equation $X^n = Z$. Equations of this form are very readily determined from curves, merely by selecting corresponding values of X and Z for one point on the curve and setting these on the chart.

4. To find n given X = 270, and Z = 9.39, representing one point of a curve whose equation is known to be of the form $X^n = Z$, see the use of the chart shown in Fig. 6 to give the equation $X^4 = Z$.

From an educational standpoint, the modified form of chart is ideally suited to the purpose of showing the relationship existing between common logs, Naperian logs and indices.

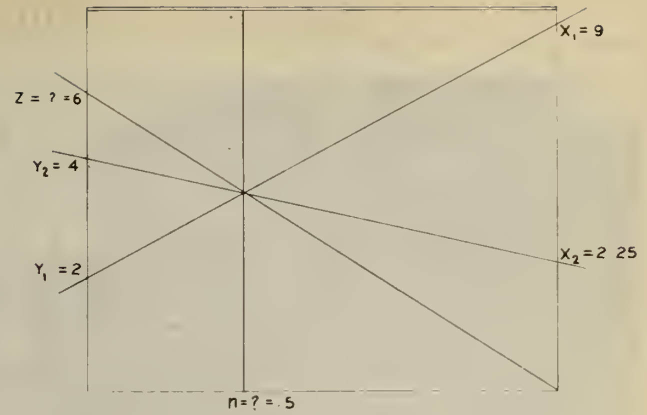


Fig. 5

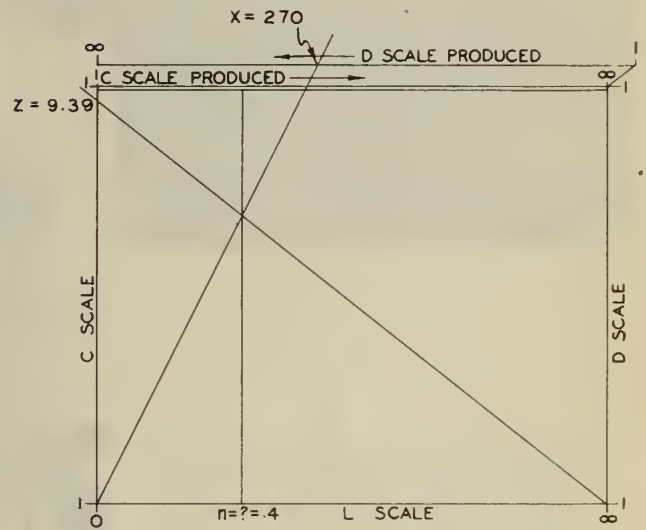


Fig. 6

TECHNIQUE OF TESTING HIGH VOLTAGE BUSHINGS

(*Continued from page 535*)

Excellent results have been obtained, however, and insulators removed from service because of abnormal readings have shown visible cracks or failed on flash-over test.

Conclusions

By means of the potential gradient method of testing bushings, the following faults may be detected.

Presence of moisture in a bushing, which may lead to carbonized burns on the core and ultimate failure.

More advanced deterioration caused by burns or sections of insulation short-circuited.

Cracks in the porcelain rain shield that will admit moisture.

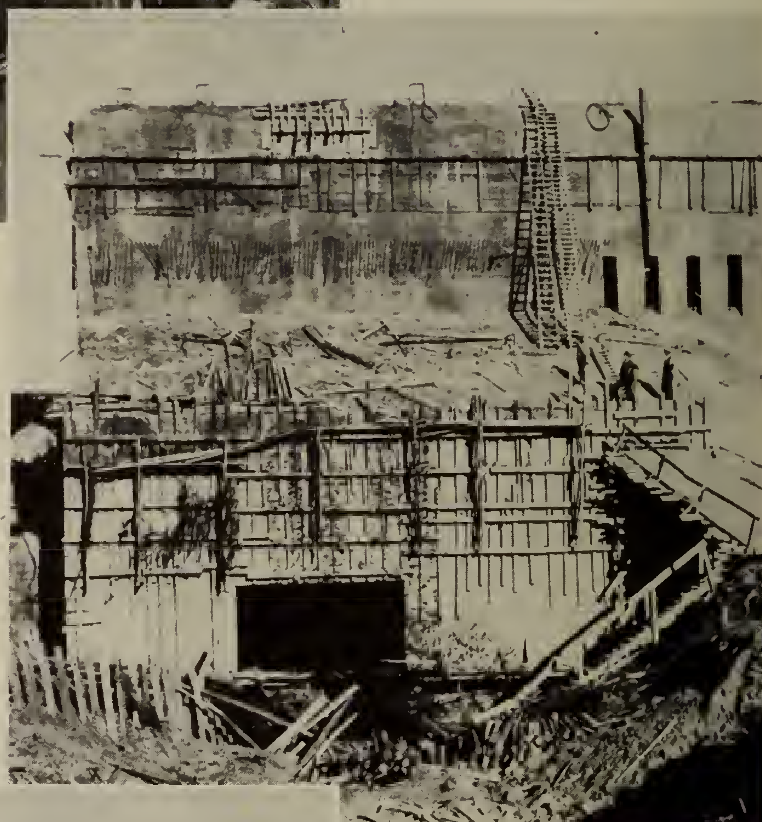
The shape of the gradient curve is of substantial assistance in predicting which of the above faults will be found, and thus materially helps in the reconditioning of bushings.

The gradient test, being a live line test, eliminates the necessity for power interruptions and provides a quick method for testing insulation in the field.

Tests being made at operating voltage, afford more chance of picking out faults that might not appear at lower test voltages.

From experience in the field in the last seven years, it is considered that the potential gradient method of testing bushing and insulators is valuable in avoiding failures in service due to faults in insulation.

The cover picture and the one at the left will give some idea of the difficult work which faces the Royal Canadian Engineers in the pursuit of retreating Nazis in France and Belgium. The valuable train shown at the left was deliberately wrecked and left on the right of way as a barrier to the Canadian Army's forward progress. The train included a fully equipped machine shop and many cars of precious food and medical supplies.



French civilians declared that the building shown at the right was to be used by the Nazis to house a secret ray machine which the Germans claimed was capable of stopping our planes in flight. Our boys bombed it 33 times before work was abandoned.

The rock crusher outfit shown at the left is operated by Royal Canadian Engineers in Colombelles, France. It provides surface materials for rebuilding damaged roads, necessary for the traffic of heavy equipment to the front.

(Canadian Army Overseas photographs.)

"INVEST IN VICTORY"

From Month to Month

News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

THE CLASSIFICATION AND REMUNERATION OF ENGINEERS

It is probably a natural development that in times like these, engineers and engineering organizations should ponder the problem of a suitable schedule of wages in terms of the work to be done. Within the last two years, several reports on this subject have been prepared and presented either to employers or to members of the organization making the reports, and the likelihood is that many more will appear from time to time.

The Institute has been a pioneer in this field, and it is interesting to go back over its reports of 1922, 1923, 1930, 1931 and 1943. The strange thing is that the report of 1922 shows a better and more balanced plan than any of those that have appeared recently. It seems that as far as a theoretical set-up is concerned, engineers have not "raised their sights" in all these years. Perhaps this can be explained by the suggestion that the original theoretical scale has not yet been reached, and until it is reached, there is no sense in setting up new schedules at higher levels. By the same token, however, it would be foolish in these busy times to establish schedules with lower levels.

Starting Wage Can be Obstacle

Another factor that must be kept in mind in doing work of this kind is that the starting wage must not be so great that it will be an obstacle to securing employment. In most instances, employers will say that an engineer just out of college is not worth much money in terms of the work he is able to do. However, it is recognized that he must be paid in order to live, and the employer is prepared to pay more than the service actually is worth at the time, in expectation of increased value later on. At least some employers will find means of getting along with fewer young engineers if the starting salary becomes unreasonable.

The thing that is really most important of all to the young engineer is that he shall receive a decent salary during the principal years of his life when his professional responsibility and his domestic obligations are at their maximum. In his younger years he may survive on apprentice's pay, but he needs much more for his senior years.

Confusion in Findings

A comparison of several schedules shows some interesting contrasts, and considerable lack of unanimity between committees studying the problem. The most recent proposals of other organizations that have been examined at Headquarters are the "Annual Compensation for the Eight professional Grades in a Major Engineering Organization" published by the Association of Professional Engineers of Ontario in September; and "Classification and Compensation Plan adopted by the Board of Direction" of the American Society of Civil Engineers published in August and a brief "to the members of the Civil Service Commission of the Province of Quebec" presented by the Corporation of Professional Engineers of Quebec in February. For purposes of comparison, there is also the brief on salaries paid in the Civil Service presented to the Coon subcommittee by the Engineering Institute in March 1943, and the "Report of Committee on Classification and Remuneration of Engineers" which appeared in the *Journal* in November, 1922.

The starting wages recommended in these reports are as follows:

Quebec Corporation	$2,700 to $4,000
Ontario Association	2,450 to 2,850
Am. Soc. of C.E.	1,980 to 2,460
E.I.C. Committee of 1922	1,800 to 2,400

The starting wage developed by averaging the three groups shown in the Institute's graph of 1943 (*Eng. Journal*, March, 1943) as presented to the Coon subcommittee is $1,900. This is not a hypothetical or theoretical figure, but is one developed from actual salaries now being paid by a group of employers made up of three public utilities, three general contractors, and three crown companies.

Wages for Senior Engineers

Now let us look at salaries recommended by these same engineering organizations for senior engineers. It is difficult to find in all reports classifications that are alike in description, but here is a definition of a position that is identical in the report of the Ontario Association and the American Society of Civil Engineers and is recognizable as well in the other reports. "Under general supervision, responsible charge of a division of an engineering organization, to direct a staff on design and construction." The salaries recommended by each organization are—

Quebec Corporation	$5,000 to $6,000
Ontario Association	5,050 to 6,250
A.S.C.E.	5,280 to 6,480
E.I.C.	5,400 to no limit

From this we see that the Engineering Institute, although starting out at the lowest level, has established the highest level in later years. Actually the Institute schedule passes all others at the level identified as "graduation plus five years of professional experience." At this level the Institute starting wage is $200 a year higher than any other and the maximum is $400 higher than any other.

Lowest Beginning Leads to Highest Attainment

On the chart prepared for the Coon subcommittee the highest salaries are indicated as paid by the public utilities group. This salary range starts at $1,300—the lowest of any group—but at a point "13 years out of college" it passes above the other two groups, and from there on shows an advantage of from three to four hundred dollars a year. Thus it is apparent that the starting wage is not the most important consideration. In fact, those companies that are known to be the best employers can have their choice of graduates at almost any figure they see fit to offer. Many of them take on more graduates than they are going to require, in order to try them out and find the best. If the starting wage is made too high such companies will take on fewer men, thereby in ordinary times, denying to many the opportunity to make good.

It is important that young engineers should not become confused in their values. While being encouraged to expect more than sweat shop wages at all times, they must not be allowed to lose track of the fact that the starting wage is of little importance compared to the subsequent salary scale. In preparing schedules this point should be kept in mind, or there is the chance that more harm may be done than good.

Institute Policy Consistent

The Institute has always advocated fair wages for engineers and in its history are many accounts of efforts it has made with individual employers as well as with employers in general to improve a single case or to raise the whole general level, but according to all records, it has always advocated reasonable starting levels with adequate scales for the following years. The report of 1922 proves this. Made 22 years ago, it still represents a better remuneration over a lifetime than anything that has appeared recently, and yet the starting wage for new graduates is lower than that recommended by others. This same principle has been followed in all subsequent reports.

Employers May Well be Confused

One of the principal things to be noted in a survey of recent schedules is the lack of uniformity. The figures given in the sixth paragraph of this article clearly indicate this situation. It is not to be wondered at if employers are confused when they read the schedules of several important engineering organizations, only to find that they are not agreed among themselves as to what an engineer should receive.

Many employers claim that no one but themselves can make out a job description or evaluation that will mean anything to them. A few weeks ago a senior officer of a large employer of engineers read over the job descriptions of a recently issued schedule, and stated that although there were many dozens of engineers on their staff, he could not find a single description on the schedule that fitted one of them. This is but an indication of the difficulty of devising a useful or acceptable description that is limited to general terms.

All this leads to the observation that salary schedules are interesting principally to the engineers themselves. It is not likely that they have much, if any, influence on employers. Good employers will still go on being good employers according to their own valuations of merit, and bad employers will still go on endeavouring to get something for nothing. Until engineering organizations can find and agree on one common sensible schedule, as a first step and are prepared to have their own members who are employers accept it, there is little likelihood of the cause of the engineer being advanced greatly by such procedures, and young engineers should be so informed. This goes for the Engineering Institute as well as for others.

COMING MEETINGS

Canadian Institute on Sewage and Sanitation—Annual Convention, Royal York Hotel, Toronto, November 2-3, 1944. Secretary: Dr. A. E. Berry, Ontario Department of Health, Toronto, Ont.

The Engineering Institute of Canada—Fifty-Ninth Annual Meeting, Royal Alexandra Hotel, Winnipeg, February 7-8, 1945. General Secretary: Dr. L. Austin Wright, 2050 Mansfield, Montreal, Que.

ENGINEER-GENERAL

The announcement of A. G. L. McNaughton's promotion to the rank of General and his retirement from active service, produces conflicting emotions in the mind of many Canadians. The promotion is well deserved and favourably received, though long overdue; the retirement is more difficult to understand and less well received. Is it that good men are no longer scarce?

Let us join together to rejoice in the acknowledgment of service rendered to his country, that is implied in the promotion of General McNaughton. Our congratulations and our thanks go to our fellow member, with our wishes that in the immediate future he may choose an outlet for his extraordinary talents whereby he may again render great service to his country.

With the rest of Canada, we salute a great general, a distinguished engineer, and a fine gentleman. We are proud to share with him the title "engineer".

THE PRESIDENT VISITS THE WEST

Before this is printed the president will have started his tour of the western branches, and some members will read it after the event is over, but members in the east and those nearer the west coast may still find in it news of interest.

The accompanying itinerary gives all the details. It will be seen that several unusual features are included. For instance, the Lakehead Branch visit with the president to the Steep Rock Development, the Council meeting in Edmonton, the meetings at Banff and Penticton. It is planned also to stop at Trail to see the huge operations of the Consolidated Mining and Smelting Company and at Blairmore as well. It will be the first time that the tour has run through the Crow's Nest Pass to Vancouver.

With the president will be Madame Beaubien, Councillor R. E. Heartz and Mrs. Heartz, and the General Secretary. Vice-President Brereton and Mrs. Brereton will join the group at Winnipeg and will attend the meetings there and at Regina, Saskatoon and Edmonton.

All along the route detailed arrangements have been made to welcome the party and to conduct them through local industries of special interest.

MONTREAL	Lv.	Mon.	Oct. 9th	8.00 p.m.
	(C.P.R. No. 7)			
SUDBURY	Arr.	Tues.	Oct. 10th	6.50 a.m.
SUDBURY	Lv.	Tues.	Oct. 10th	8.25 a.m.
SAULT STE MARIE	Arr.	Tues.	Oct. 10th	2.00 p.m.

Windsor Hotel
Meeting with Branch, Tuesday, October 10th.

SAULT STE MARIE	Lv.	Wed.	Oct. 11th	8.30 a.m.
FRANZ	Arr.	Wed.	Oct. 11th	4.40 p.m.
FRANZ	Lv.	Wed.	Oct. 11th	9.55 p.m.
	(C.P.R. No. 1)			
PORT ARTHUR	Arr.	Thurs.	Oct. 12th	8.20 a.m.

Prince Arthur Hotel
Meeting with Branch, Thursday, October 12th.

PORT ARTHUR	Lv.	Friday	Oct. 13th	5.00 p.m.
ATIKOKAN	Arr.	Friday	Oct. 13th	
Visit to Steep Rock Development, Saturday, October 14th.				
ATIKOKAN	Lv.	Sat.	Oct. 14th	
FORT FRANCES	Arr.	Sun.	Oct. 15th	1.35 a.m.
FORT FRANCES	Lv.	Sun.	Oct. 15th	2.00 a.m.
WINNIPEG	Arr.	Sun.	Oct. 15th	9.45 a.m.

Royal Alexandra Hotel

Monday, Oct. 16th—
2.30 p.m. Address the students, Lecture Theatre "A", University of Manitoba.
6.30 p.m. Executive Dinner Meeting, Royal Alexandra Hotel. Engineers' Wives Association will entertain Madame Beaubien.

Tuesday, Oct. 17th—
12.15 p.m. General Branch Luncheon Meeting, Hudson Bay Company.
12.00 noon Engineers' Wives Association's Regular Monthly Luncheon Meeting.

WINNIPEG............Lv. Tues. Oct. 17th 9.00 p.m.
(C.P.R. No. 1)
REGINA...............Arr. Wed. Oct. 18th 6.40 a.m.

Hotel Saskatchewan

Wednesday, Oct. 18th—2.00 p.m. Executive Meeting.
6.30 p.m. Dinner Meeting.
Tea for Mme. Beaubien.

REGINA...............Lv. Wed. Oct. 18th 11.55 p.m.
(C.P.R. No. 303)
SASKATOON..........Arr. Thurs. Oct. 19th 6.50 a.m.

Bessborough Hotel

Thursday, Oct. 19th—Luncheon meeting with branch members.
Meeting with students at the University.

SASKATOON..........Lv. Thurs. Oct. 19th 4.30 p.m.
(C.P.R. No. 51)
EDMONTON...........Arr. Friday Oct. 20th 7.05 a.m.

Macdonald Hotel

Friday, Oct. 20th—Afternoon—Meeting with students.
Evening —Banquet and General Branch Meeting (including ladies).
Saturday, Oct. 21st—9.30 a.m.—Council Meeting.

EDMONTON...........Lv. Sat. Oct. 21st 11.55 p.m.
(C.P.R. No. 522)
CALGARY.............Arr. Sun. Oct. 22nd 6.20 a.m.

Palliser Hotel

Sunday, Oct. 22nd—Visit to Banff accompanied by Mr. and Mrs. Trowsdale. Party to be met by P. J. Jennings, Supt. of Banff National Park —Tour of vicinity.
Evening—Mount Royal Hotel, Banff.
Dinner for the president's party and members of the Calgary Branch and their wives residing in Banff.
Monday, Oct. 23rd—Drive back to Calgary, visiting power developments on the way.
Tuesday, Oct. 24th—
10.00 a.m. Branch Executive Meeting.
12.15 p.m. President to address Rotary Club.
7.30 p.m. Dinner Meeting at the Palliser Hotel (including ladies).

CALGARY.............Lv. Friday Oct. 27th 9.45 a.m.
LETHBRIDGE.........Arr. Friday Oct. 27th 1.45 p.m.
Friday, Oct. 27th—Meeting with Branch.
LETHBRIDGE.........Lv. Friday Oct. 27th 9.30 p.m.
BLAIRMORE...........Arr. Sat. Oct. 28th 1.10 a.m.
Visit to coal mines.
BLAIRMORE..........Lv. Sun. Oct. 29th 1.10 a.m.
NELSON................Arr. Sun. Oct. 29th 9.55 a.m.
NELSON................Lv. Sun. Oct. 29th a.m.
(By motor)
TRAIL.................Arr. Sun. Oct. 29th a.m.
Visit with members in Trail, and
Visit to C. M. & S. plant.
TRAIL.................Lv. Tues. Oct. 31st a.m.
(By motor)
CASTLEGAR...........Arr. Tues. Oct. 31st a.m.
CASTLEGAR...........Lv. Tues. Oct. 31st 11.20 a.m.
PENTICTON...........Arr. Tues. Oct. 31st 10.30 p.m.
Visit with members in Penticton and Kelowna.
PENTICTON...........Lv. Wed. Nov. 1st 11.00 p.m.
VANCOUVER..........Arr. Thurs. Nov. 2nd 10.00 a.m.

Hotel Vancouver

Friday, Nov. 3rd—
Noon Meeting with University students.
Luncheon in University Cafeteria.
5.00 p.m. Informal Meeting with Branch Executives.
6.30 p.m. Branch Dinner Meeting—Hotel Georgia.
The ladies are planning to entertain Mme. Beaubien at tea on Friday or Saturday afternoon.
Possibility of luncheon with Professional Engineers or Board of Trade or jointly.

VANCOUVER..........Lv. Sat. Nov. 4th Midnight
(By boat)
VICTORIA.............Arr. Sun. Nov. 5th 7.00 a.m.

Empress Hotel

Meeting with Branch

1945 ANNUAL MEETING AT WINNIPEG

For the first time since 1911, the annual general and professional meeting of the Institute will be held in Winnipeg, on Wednesday and Thursday, February 7th and 8th 1945. These days have been selected at the request of the hotel in order to avoid the Friday night congestion, both in the hotel and on railways.

It is interesting to note, from the Proceedings of the Twenty-Fifth Annual Meeting, that the railways in those days provided free haulage of a special train carrying the delegates from Montreal to Winnipeg. Such munificence is not expected from the railway authorities for the Fifty-Ninth Annual Meeting, but the Winnipeg Branch hopes that it will be possible for many members from the far west and from the east to join with them in making a success of the meeting.

A special committee has been appointed under the chairmanship of F. V. Seibert, Industrial Commissioner for Canadian National Railways at Winnipeg. The programme is practically complete and details will be published in an early issue of the *Journal*.

The Royal Alexandra Hotel will be headquarters for the meeting.

PAPER SHORTAGE

To the average person, paper seems to be a most peculiar commodity. On all sides, citizens are urged by radio and by printed word, as a patriotic duty, to salvage paper—a war material essential to victory. At the same time, on all sides waste of this precious commodity is flaunted by governments as well as by others.

It is a most confusing situation. Surely if there is a shortage of paper there are better ways of establishing conservation than by having the people save their old papers and magazines. Why not stop the printing and distribution of needless and even harmful literature and cut the waste at the source? Why let it be printed at all if it is necessary to get it back for "vital war purposes".

To-day, all publications and printing, regardless of character or usefulness, are controlled as far as paper supply is concerned. *The Engineering Journal* suffers considerably from such restrictions. No additional supply will be given even to meet increases in membership. At a time when membership is climbing, when technical papers are more plentiful, when there is greater need for disseminating technical information, and even when advertising is expanding, the *Journal* must get along on a quantity well below its requirements.

To meet these restrictions, the weight of paper has been reduced to the limit, pages have been cut in size, departments have been discontinued, and articles have been blue pencilled substantially or refused entirely, and yet the *Journal's* account is overdrawn and further reductions become necessary.

These reductions include the elimination of the two pages next to the "contents" page which have been used for the list of Institute officers, personnel of committees, and branch officers. It is hoped that they can be published every three or four months as the information is important to many members. The Purchasers' Classified Directory has also been laid away for better times, and the Industrial News has gone the same way.

With these reductions and a further cut in the weight of paper, in the advertising sections, it is believed the situation can be met, but if readers see the *Journal* getting thinner and thinner they will understand what is going on.

No one can blame the Administrator for what he finds necessary to do. His policy is controlled by the legislation and he is not responsible for that. His concern is to see that the supply is divided between users in the same proportion as existed at the time the regulations became effective. However, one cannot help chafing under restrictions that control activities of a professional technical journal, when he looks around and sees what some others are doing with this precious commodity.

Not long ago the writer looked over a newstand—one of those that exist in almost every block in the average city. A quick count revealed on the shelves 36 separate magazines on crime and detection, 18 on love, 18 westerns, and 16 on movies. There were dozens of others of similar calibre and bulk touching on a variety of subjects, including so-called wit and humour. Almost all of these made no contribution to good living, and yet in total their publication must have consumed untold tons of paper that we are told is precious. Why waste precious material on publications that do nothing but drag down the average of our citizenship, and then urge citizens to save it and return it as a patriotic duty ?

Controls apply only to publications and printing whose income from advertising is greater than the income from sales. In other words, if there is no advertising, there is no restriction on the amount of paper that can be used. As long as the printer has paper, he can print almost anything for such persons and purposes. Political speeches and propaganda of all kinds are not restricted, and yet thousands and thousands of citizens are daily throwing tons of such stuff into their waste paper baskets, unread, only to see and hear on all sides the plea to conserve paper, and to participate in some great new salvage drive.

Not long ago, a communication came to the Institute from a Department of the Government at Ottawa. Across the bottom of a heavy manilla envelope, measuring 9½ by 15 in. were printed these words, "Don't waste words—don't waste paper". The contents of the envelope could have been accommodated nicely in a standard No. 8 envelope measuring 3⅝ by 6½ which would require approximately 20 per cent of the amount of paper used in the large envelope. In the light of paper restrictions this goes down badly, particularly when it carries a message admonishing *you* to conserve.

The way of a controller is not easy, and the *Journal* does not desire to make that of the Administrator of Publishing, Printing and Allied Industries any worse than it needs to be, but it would be a wonderful relief if someone could explain the overall policy that is wreaking so much havoc on many worthwhile publications to-day, particularly those of non-profit and non-political organizations. In the meantime, we beseech the indulgence of our members.

LIST OF NOMINEES FOR OFFICERS

The report of the Nominating Committee, as accepted by Council at the meeting held on August 19th, 1944, is published herewith for the information of all corporate members as required by sections 19 and 40 of the by-laws:

List of Nominees for Officers for 1944 as Proposed by the Nominating Committee

President	E. P. Fetherstonhaugh	Winnipeg
Vice-Presidents:		
*Zone "A" (Western Provinces)	R. A. Spencer	Saskatoon
*Zone "B" (Province of Ontario)	C. E. Sisson	Toronto
*Zone "C" (Province of Quebec)	J. E. Armstrong	Montreal
	A. Frigon	Montreal
Councillors:		
†Vancouver	J. N. Finlayson	Vancouver
†Edmonton	C. W. Carry	Edmonton
†Saskatchewan	J. McD. Patton	Regina
†Lakehead	R. B. Chandler	Port Arthur
†Border Cities	G. G. Henderson	Walkerville
†London	J. A. Vance	Woodstock
†Toronto	W. H. M. Laughlin	Toronto
†Kingston	R. A. Low	Kingston
†Ottawa	W. L. Saunders	Ottawa
‡Montreal	R. C. Flitton	Montreal
	C. C. Lindsay	Montreal
†Saguenay	A. Cunningham	Kenogami
†St. Maurice Valley	J. F. Wickenden	Three Rivers
†Saint John	A. A. Turnbull	Saint John
†Halifax	A. E. Flynn	Halifax

* One vice-president to be elected for two years.
† One councillor to be elected for two years.
‡ Two councillors to be elected for three years each.

WASHINGTON LETTER

So rapid is the march of events these days that it is difficult to write to a deadline a month ahead of publication. As this is being written, the Siegfried line has been breached, the allied armies are marching on Cologne and General Brereton's paratroop landings behind the German lines are being effectively maintained. The Quebec Conference ended several days ago after having presumably reached agreement on strategy of Stage II of the war. The conference at Dumbarton Oaks and the UNRRA Conference at Montreal are at present progressing. Several months ago this letter commented on the relative lag in reconversion plans. In recent weeks much has been done to overcome this lag and the reports of Krug of War Production Board, War Mobilization Director Byrnes, and the Colmer Report of the Special House Committee have all marked significant advances in the field.

U.S. Reconversion Policies

Following Mr. Nelson's departure for China and Mr. C. E. Wilson's rather spectacular resignation, Mr. J. A. Krug was recalled from the Navy to take up the acting chairmanship of War Production Board. A few days before the appearance of the Byrnes Report, Mr. Krug had surprised Washington with the announcement of plans for a sweeping 40 per cent cutback in war production and the abolition of priorities, programming and allocations, except in the case of certain essential war programmes, as soon as hostilities in Europe cease. The Krug plan parallels closely the more formal and extensive Byrnes report. These reports to a large degree recommend the removal of Government from the reconversion picture and the placing of the main onus on private enterprise for the ensuring of full employment. Two days after the Byrnes report, the Colmer report of the House Post-War Planning Committee was made public. This report also agrees with the general line in the other two reports and goes on to make major recommendations in the fields of tax revision, shipping controls, revision of the Maritime Acts and in international trade and currency controls. The second week in September was a very significant week in terms of crystallization of American reconversion policy.

Steel Works and Steel Makers

Apart from the normal run of duties, several things have happened during the last month to direct my attention to steel production. One was the visit to this country of Mr. Essington Lewis, head of the Australian Broken Hill Proprietary steel enterprises. It was Mr. Lewis who, as Director General of the Ministry of Munitions, arranged for our tour of the Australian munitions industry, a report of which appeared in the May issue of the *Journal* last year. Also during the last month, the United States Steel Corporation arranged for our Director General and myself to visit the Pittsburgh area. During the course of our visit, we went through both the Irvin and the Homestead plants of the Carnegie-Illinois Steel Company. Both these plants represent the most modern installations of their kind and both have been completed within the last few years. The Irvin plant specializes in plates and sheets and has an annual capacity of about one and a half million tons. A large portion of the Irvin mill sheet capacity was switched to the production of shipbuilding plates shortly after the plant came into operation. An interesting feature of the Irvin plant are the high speed continuance electrolytic tinplate mills. The new Homestead Works were built and are operated by the United States Steel Corporation for the Government Defense Plant Corporation and came into operation about a year ago. These have an annual rated capacity of one and a half million tons of steel ingots, one million tons of slabs and just under half a million tons of plates and forgings. Of particular interest were the eleven 225-ton open hearth furnaces, the 45-inch slabbing mill with twenty gas-fired soaking pits, the 160-inch plate mill and a 7,500-ton forging press. As adjuncts to the eleven furnaces, there are two 800-ton molten metal mixers and three 24,000-lb. charging machines. As a structural engineer, I was particularly interested in the structure of the building itself, particularly the 10-ft. deep double plate girders which carry the three 275-ton casting pit cranes on a 105-ft. span over the open hearth furnaces. These furnaces are the latest in design in this country. They are the only furnaces from which the slag may be run off simultaneously from both front and back of the furnace. I was surprised to learn that they have operated at as low as 2.9 million B.t.u. per ton of steel. The Homestead plant extends for about three miles along the banks of the Monongahela river and occupies the site which, in 1888, saw steel made for the first time on a successfully commercial basis by the basic open hearth method. It was the introduction of basic open hearth production at Homestead which made possible the use of phosphorus ore deposits, thus making possible the opening up of the immense ore reserves of the Great Lakes districts. As we skirted the plant, driving along the banks of the Monongahela river, the plant manager remarked that a greater tonnage moved along a thirty-mile stretch of that river than passed through the Panama canal.

In discussing the contribution which steel has made in winning and shortening the war, several of the executives to whom we talked emphasized the particular importance which attaches to production of wide steel plate. Some years before the war, leading United States steel companies extended their plate rolling capacities both as to tonnage and as to size. The industry has furthermore been able to convert sheet mills to plate mills and have also been able to produce thick plates on mills which were designed for very much thinner rollings. Without these developments, the colossal shipbuilding programme which launched some 20 million tons of shipping, exclusive of naval craft, during the last year would not have been possible.

On the subject of steel production, news came not long ago from Chungking of the passing of John Keenan, one of the colourful figures in that most colourful fraternity of steelmakers. Some years ago, he returned from Jamshedpur having retired as manager of the great Tata Works. With the coming of war, he knew there was a job for him to do in the Far East and so he returned to work and finally to die amongst the people and conditions he knew best. Keenan's career recalls the fascinating story of the building in India of one of the largest steel plants in the British Empire. The beginnings of this great Indian enterprise go back to the last two decades of the nineteenth century. For twenty years after his discovery of ore deposits in Central India, Jamshedjee Tata laid the ground work for an Indian steel works and he made several trips to England and the United States. At the turn of the century he was ready to put his plan into effect and he visited the United States to enlist their aid. Many famous names enter the story. Jamshedjee was armed with letters to George Westinghouse and Mark Hanna, and he enlisted the support of people like Judge Gary, Elihu Root, Admiral Dewey and Charles Page Perin. Lord Curzon and Lord Hamilton were also invaluable allies to Jamshedjee Tata. Charles Page Perin was also to play a major role in the Indian development, first with Jamshedjee and later with Sir Dorab Tata. The Tata Works, with a capacity of over one and a quarter million tons of pig iron, have proved their great worth in two wars. Tatas produced steel for the munitions so vitally needed in the Eastern and Middle Eastern theatres which would have been most difficult to have obtained anywhere else. The Tata Works also, of course, have been one of the major factors in the industrialization of India. In addition to Keenan's story, "A Steel Man in India," there is another interesting steel book recently published entitled "Bootstraps". This is an autobiography of Tom Girdler of Republic Steel.

Kultur à la Nazi

I remember experiencing a sensation of relief on reading that Florence was to be an open city and have, therefore, been doubly shocked at the recent photos of wanton German destruction before their evacuation of that city. Most of the buildings and beautiful bridges on the Arno date back to the thirteenth century. I remember losing my way in Florence and coming out at the corner of the Lungarno at the Ponte Santa Trinita and realizing just where I was from Holiday's famous picture of the meeting of Dante and Beatrice. There was the Ponte Vecchio with the green hills and monasteries behind and to the left was the tower of the Palazzo Vecchio. Never again will the visitor to Florence stand on that corner and look up the quiet Arno and see much the same scene as did Dante Alighieri. The Florence of the Medici is no more.

Washington, D.C.
September 21st, 1944.

E. R. Jacobsen, m.e.i.c.

MEETING OF COUNCIL

A regional meeting of the Council of the Institute was held in the Board Room of the Gymnasium at Queen's University, Kingston, Ontario, on Saturday, September 16th, 1944, convening at nine thirty a.m.

Present: President de Gaspé Beaubien (Montreal) in the chair; Past-President K. M. Cameron (Ottawa); Vice-Presidents L. F. Grant (Kingston) and C. K. McLeod (Montreal); Councillors H. E. Brandon (Toronto), R. E. Heartz (Montreal), Alex. Love (Hamilton), H. R. Sills (Peterborough), W. S. Wilson (Toronto), and General Secretary L. Austin Wright.

There were also present by invitation—Past-Councillors D. S. Ellis and D. M. Jemmett of Kingston, and H. N. Macpherson of Vancouver; Branch Chairmen W. L. Saunders (Ottawa), and C. R. Whittemore (Peterborough); Irving R. Tait (Montreal), member of the Institute's Committee on Employment Conditions; Dr. S. D. Lash, chairman, and J. Douglas Lee, secretary-treasurer of the Kingston Branch.

President Beaubien welcomed all councillors and guests, and expressed appreciation of so many out of town members attending.

Employment Conditions (Collective Bargaining)—The chairman of the Committee on Employment Conditions, Councillor R. E. Heartz, reported that the sub-committee appointed to negotiate a draft of new legislation for collective bargaining had had no further word from the lawyer employed for the purpose. He expected this material would be in hand in time for the fourteen societies to meet again early in October so that an appointment could be made to appear again before the Wartime Labour Relations Board prior to October 12th, which date will be the end of the six months period for which exemption of engineers from Order-in-Council 1003 was granted by the Board.

Mr. Sills inquired as to whether or not the proposed legislation would be restricted to engineers or would be sufficiently comprehensive to include members of other professions. In reply, Mr. Heartz explained that it was expected that by the new legislation it would be possible for other professions to be included.

Mr. Brandon asked if the legislation being considered would be in the form of an amendment to the present order or if it would be a new order, to which Mr. Heartz replied that it was expected to have an entirely new order but that an amendment would be in the background in case the request for the new order was not granted.

Colonel Grant expressed the hope that collective bargaining would not force engineers into a position where they would have to go out on strike with other parts of a collective bargaining organization, but Mr. Heartz replied that the proposed legislation would not require the employees in this group to go on strike for any reason.

Committee on the Engineer in the Active Services—Dean Ellis, as chairman of the Institute's Committee on the Engineer in the Active Services, reported that considerable progress had been made, particularly in relationship to the establishment of a separate corps for mechanical and electrical engineers, and the appointment of engineers to such a corps. He thought the Institute's activities had had much to do with the establishment of the Royal Canadian Electrical and Mechanical Engineers, and with the newly adopted policy of giving commissions for technical appointments only to technically qualified engineers. He pointed out that the story had been told in recent issues of the *Engineering Journal* and as he had not been able to accompany the president, Colonel Grant and the general secretary at the time they called on the Master General of the Ordnance, he asked Mr. Wright to report further details on behalf of the committee.

Mr. Wright reviewed recent developments in this matter and gave Council information which it had not been possible to include in the editorial. He concluded by informing Council that Colonel Franklin, M.E.I.C., who was the administrative officer of R.C.E.M.E. and Director of Mechanical Engineers, was now in England and that Colonel H. G. Thompson, M.E.I.C., who had recently returned from England, was now acting in Colonel Franklin's place as Director of R.C.E.M.E.

Colonel Grant commented on the difficulty of replacing present non-technical personnel with technical personnel and he felt that it would take a long time to eliminate the non-technical persons. However, he thought that the campaign had been well worth while and that the Institute had taken a very judicious stand.

The president inquired as to whether it would strengthen the hands of the officials in removing non-technical persons to have the Institute make a definite and specific request for their removal. Colonel Grant emphasized the difficulty of removing persons from such positions and thought there was little to be gained by going beyond that which had been done already.

The general secretary drew Council's attention to a resolution passed by the Advisory Board of the Wartime Bureau of Technical Personnel which commented on the August editorial. The resolution records the Board's regret that the editorial in question carries a suggestion that the Bureau had not been able to provide engineers in sufficient number to meet the needs of R.C.E.M.E. It goes on to say that "the Board is satisfied from the records of the Bureau that a sufficient number of suitable candidates have always been referred to meet the recorded needs of all technical branches of the three services."

Community Planning—The general secretary reported on conversations which he had had with Mr. John S. Galbraith, M.E.I.C., Head of the Community Planning Division of the National Housing Administration. Mr. Galbraith is now in the maritime provinces and is making a point of meeting with the executive of all the branches so that he may inform them of the government's policy and encourage them to take part in this important work. So far as the re-establishment of the Town Planning Institute was concerned, he had had no further news and apparently there was no progress to report. He emphasized the great shortage of technical personnel familiar with this field and pointed out that it is desirable that the Institute promote thinking along these lines so that civil engineers would be encouraged to study it and participate in it.

Dean Ellis observed that lack of experienced engineers had been noted for several years. He referred to the activities in Kingston under the leadership of Dr. Lash and Professor Low. He thought an endeavour should be made to develop the engineers' interest in the work as it was principally engineering and therefore a logical field for the engineer.

Mr. Sills reported that in Peterborough there was a town planning committee and that six engineers were on the board.

Mr. Macpherson told something of the planning being done in Vancouver by an American firm of consultants.

Mr. Brandon referred to the elaborate plans made in Toronto and in response to an inquiry from Colonel Grant as to the number of engineers associated with its preparation, indicated that engineers had had a definite part in it.

Colonel Grant was of the opinion that the engineers should do some definite publicity work, not only to interest engineers in community planning, but also to inform the public that it was principally an engineering field.

Dr. Lash referred to publicity work done on this subject by the Institution of Civil Engineers about a year ago. They had developed the thought that town planning required the services of engineers in all stages of its development.

Eventually, it was decided that a small committee should be set up to determine a policy to be followed by the Institute. It was left with the president to select the personnel of the committee.

Financial Statement—Vice-President McLeod, as chairman of the Finance Committee, presented the report of the committee, from which it was noted that the income from fees and *Journal* was well ahead of last year. Certain additional expenses would offset the increases, but the net situation was substantially better than at this time last year.

Post-War Policy of the Institute—Mr. McLeod reported that the Finance Committee had given further consideration to methods of meeting the cost of employing a member to assist in the rehabilitation of Institute members who are now in the active forces. The committee had recommended such an appointment and at the previous meeting of Council approval was given to this recommendation and the matter returned to the Finance Committee for further study of the methods of financing. Accordingly, the committee made the following recommendations:

(1) That a member be appointed to the position as soon as a person with suitable qualifications can be found.

(2) That a general assessment of $2.00 be made on all corporate members.

(3) That consideration be given to the advisability of charging a fee for the employment service, both to the man seeking employment and to the prospective employer.

Mr. McLeod pointed out the difficulty of finding a suitable candidate, who should be someone who has returned from this war and who has, as well, all the other qualifications necessary for such employment.

The committee was of the opinion that the members in Canada would be prepared to meet the voluntary assessment which would make possible the extension of this service to returned men. It was the committee's opinion that in many instances members would wish to contribute more than the $2.00 and therefore this should be indicated on the account as a minimum contribution.

The committee approved of the suggestion made at the last meeting of Council that the Institute open an office in Toronto and that this new member of the staff be placed there.

Messrs. Wilson and Brandon, representing the Toronto Branch, thought this suggestion excellent. They believed that an office at that location would be of real assistance to the Toronto Branch as well as to the other Ontario branches.

There was a discussion of the relative merits of placing such a man in Toronto, Ottawa or Montreal, and also of the possibility of the Toronto Branch assessing its members an additional amount in expectation of this additional service. Eventually, it was agreed that such an appointment was necessary and should be made just as soon as a suitable man could be found. The motion to this effect was carried unanimously.

Canadian Radio Technical Planning Board—Mr. Cameron reported that in compliance with a request from the president he had represented the Institute at a recent meeting in Ottawa, called by a group of industries and organizations interested in radio, to consider the establishing of a Radio Technical Planning Board similar to the board already established in the United States. The meeting was called under the auspices of the Department of Transport. The purposes of such a board would be to assist in the planning for an orderly future development in such fields as production and designing of electronic equipment, telecommunications, including broadcasting; also the application of electronic principles to other commercial fields. The board would be a central fact-finding and recommending body acting in an advisory capacity to the Department of Transport and the industry generally.

Many organizations were represented at the meeting including the following: Radio Section, Department of Transport; Canadian Broadcasting Corporation; National Research Council; Radio Manufacturers' Association; Canadian Manufacturers' Association; Telephone Association of Canada; The Institute of Radio Engineers; Association of Canadian Broadcasters, and others.

Mr. Cameron reported that it was agreed that such an organization should be established to be known as the Canadian Radio Technical Planning Board. Sustaining members would be assessed $250.00 and several representatives committed their organizations to such a contribution. Others, including the Institute, found it necessary to report back before committing themselves on this point. Mr. Cameron thought the idea was a good one and that the Institute would be justified in giving support to it, although the contribution was too much as far as the Institute was concerned. He thought, however, that some smaller amount might be contributed so that the Institute could show its support and could sit in with the other representatives as the work of the board was developed. He recommended that the Institute maintain an interest in this activity and announced that there was to be another meeting within a short period of time at which more details would be established. The report was noted.

Post-War Policy for Wartime Bureau of Technical Personnel—The general secretary, as the Institute's representative on the Advisory Board of the Bureau, read a report which had been prepared by the Board and which was being submitted to the three Institutes sponsoring the Bureau. The purpose of this report was to outline a policy by which the usefulness of the Bureau, both to the profession and to Canada, could be extended after the conclusion of the war, at which time the compulsory restrictions would be removed. The report was so far-reaching and involved matters of such importance that it was agreed, after considerable discussion, that the proposal should be studied by a small committee to be appointed by the president. The president agreed to select a small group to deal with the matter and to report back to Council before the next meeting on October 21st.

ELECTIONS AND TRANSFERS

A number of applications were considered, and the following elections and transfers were effected:

Members

Allen, Fred Louis, B.S., M.E. (Clarkson College of Technology), mgr. of mfg., newsprint div'n., Cdn. International Paper Co., Montreal, Que.

Broda, Joseph George, B.Sc. (Civil Engrg.), (Univ. of Manitoba), designer and dftsman., C. D. Howe Co. Ltd., Port Arthur, Ont.

Brouillet, Ignace, B.A.Sc., C.E. (Ecole Polytechnique), professor of reinforced concrete, Ecole Polytechnique, and consltg. engr., Brouillet & Carmel, Montreal, Que.

Carmel, E. Guy, B.A.Sc., C.E. (Ecole Polytechnique), consltg. engr., Brouillet & Carmel, Montreal, Que.

Cromwell, A. Ross, B.Sc. (Civil Engrg.), (McGill Univ.), Montreal regional representative, Wartime Bureau of Technical Personnel, Montreal, Que.

Douglas, Robert Bell, B.Sc., M.Sc. (Mass. Inst. of Technology), wks. mgr., propeller div'n., Canadian Car & Foundry Co. Ltd., Montreal, Que.

Fife, Thomas, (South Shields Marine School), Acting Cmdr. (E) R.C.N., O.C., Mech. Training Establishment, West Coast.

Porter, Cornelius James, B.A.Sc. (Univ. of Toronto), elec. engr., Steel Co. of Canada, Hamilton, Ont.

Juniors

Carmichael, John William, B.Sc. (Chem. Engrg.), (Queen's Univ.), asst. chemist, Dept. of Public Works, Ottawa, Ont.

Forbes, Hugh Donald, B.A.Sc. (Univ. of Toronto), junior metallurgist, Deloro, Ont.

Hahn, Herman Gustav, B.Sc. (Mining Engrg.), (Queen's Univ.), tech. supervisor, engrg. div'n., Canadian Vickers Ltd., Maisonneuve, Que.

Transferred from the class of Stundent to that of Member

Breeze, John Ellis, B.A.Sc., M.A.Sc., (Univ. of B.C.), asst. research engr., National Research Council, Ottawa.

Saunders, John Bruce, B.Sc., (Elec. & Mech.), (Queen's Univ.), supt., Wasaga Beach R.P.D., Hydro-Electric Power Comm'n. of Ontario, Stayner, Ont.

Transferred from the class of Student to that of Junior

Campeau, Charles Edouard, B.A.Sc., C.E. (Ecole Polytechnique), engr., City Planning Dept., Montreal, Que.

Dunn, Russell Arthur, B.Eng. (McGill Univ.), asst. dist. mgr., Canadian Liquid Air Co. Ltd., Toronto, Ont.

Symons, Lloyd George, Major, R.C.E.M.E., B.Sc. (Mech. Engrg.), (Univ. of Sask.), officer i/c R.C.E.M.E. workshops, Westmount, Que.

Students Admitted

Gregory, Peter Grosvenor, B.Eng. (McGill Univ.), junior engr., Aluminum Company of Canada Ltd., Arvida, Que.

Langenek, Frederick, B.A.Sc. (Univ. of B.C.), telephone plant engr., Bell Telephone Co. of Canada, Montreal, Que.

By virtue of the co-operative agreements between the Institute and the provincial associations of professional engineers, the following elections and transfers have become effective.

ALBERTA

Member

Williamson, Harold James, B.Sc. (Elec.), (Univ. of N.B.), dist. radio aviation engr., Dept. of Transport, Edmonton, Alta.

Junior

Lukes, Harold Norman, (Queen's Univ.), inspr. of unfired pressure vessels, Dept. of Public Works, (Mech. Branch), Calgary, Alta.

Student

Milner, Gamaliel, (Institute of Technology and Art, Calgary), senior inspr., Aircraft Repair Ltd., Edmonton, Alta.

Transferred from the class of Student to that of Junior

Marshall, Donald Macgregor, B.Sc. (Univ. of Alta.), asst. constrn. engr., power plant extension, University of Alberta, Edmonton, Alta.

NOVA SCOTIA

Members

Kent, Gordon Neville, B.Eng. (McGill Univ.), engrg. dept., Clare Shipbuilding Co. Ltd., Meteghan, N.S.

Lemmon, Cyril Cooper, B.Sc. & E.M. (Michigan College of Mines, Houghton) tech. inspr., Ministry of War Transport of the U.K., Montreal, Que.

McCann, Harry Joseph, Jr., B.Sc. (Elec.), (Marquette Univ., Milwaukee, Wis.) mgr., Wm. Stairs Son & Morrow, Ltd., Sydney, N.S.

Mackenzie, Harry, supervisor, Railway Drydocks, Atlantic Coast, Dept. of Munitions & Supply, Halifax, N.S.

Messervey, John Perham, B.Sc. (Mining), (N.S. Tech. Coll.), inspr. of mines and mining engr., Dept. of Mines, Province of N.S., Halifax, N.S.

Thomas, Sydney, (Carisbrooke Road Tech. Coll., Liverpool), production engr., Halifax Shipyards, Ltd., Halifax, N.S.

Transferred from the class of Student to that of Member

Thompson, Alvin Henry., B.Eng. (Mech.), (N.S. Tech. Coll.), engr., dfting. dept., Foundation Maritime Limited, Pictou, N.S.

CORRESPONDENCE

Collective Bargaining For Engineers

213 Germain St., Saint John, N.B.
Sept. 25th, 1944.

The Editor, *Engineering Journal*,
Montreal, Que.

Dear Sir:

Now that an attempt is being made by the "Group" to obtain from the Privy Council a new order for engineers it is fair to consider what might be obtained by such action, the costs of which are to be paid by us all.

Some of us do not wish to see the engineering profession placed in a position of fighting for rights that it should not possess as against other persons.

Everyone possesses the right to join in collective bargaining with others, the only hitch being the ability to get employers to listen to the bargainers. No government authority is needed to prosecute this right. All that government can do is to compel employers to listen. But to apply such compulsion there must be some motive of weighty import. In the case of labour it has been the motive of avoiding strikes if possible. That was why P.C. 1003 was passed, under the War Measures Act. Does the "Group" contemplate action being taken under this same act? If so, does the "Group" maintain that our profession has the right to strike and still remain a profession? Many of us do not consider that this can be so. What other motive can be put forward? Will the war effort be promoted by passage of a new order or will it be threatened if not passed?

Let us suppose that a new order is passed in spite of these considerations, where would it get us. A federal order will not run against non-war industry in this matter, because provincial governments alone have the power to regulate labour and professions. So to acquire general application the provincial governments will have to make special enactments, similarly to what they have passed in respect to P.C. 1003. It may be possible to get something through the P.C. by a wide interpretation of the War Measures Act, but its effect will be but temporary and limited in scope. It will be a different proposition to get something that is not truly reasonable from the provincial legislatures, with all their powers of criticism.

The solution of this matter surely lies, not in seeking more powers from government, but in organizing the profession itself to co-operate and bring its powers of persuasion to bear on the welfare and prestige of its members.

Contrary to what has been said I do not believe that the young engineers are pressing the older men to do anything specific, other than to co-operate sympathetically and effectively in bringing about better salaries for engineers of all grades. They do not desire to see the profession divided by legislation into two sections, employers and employees. They realize that that would surely bring about antagonism from the employer section as well as from managements.

In the few cases where engineers have been forced into labour units against their consent, the remedy lies in co-operative protest by the profession to the provincial Labour Relations Boards concerned, not in setting up counter units at the tremendous sacrifice entailed to the professions as a whole, including splitting it wide open.

Yours truly,
(*Signed*) C. C. Kirby, M.E.I.C.,
Past-President, Dominion Council.

Personals

Relatives and friends of members in the active forces are invited to inform the Institute of news items, such as locations, promotions, transfers, etc., which would be of interest to other members of the Institute and which should be entered on the member's personal record kept at Headquarters. These would form a basis of personal items in the *Journal*.

News of the Personal Activities of members of the Institute

Major-General Christopher Vokes, M.E.I.C., has recently been made a Commander of the Order of the British Empire. He has served through the Sicily and Italy campaigns and was awarded the Distinguished Service Order for his gallantry in action during the battle for Leonforte in Sicily in July 1943.

Major-General H. F. G. Letson, C.B.E., M.C., E.D., M.E.I.C., of Vancouver, has been appointed commander of the Canadian Army Staff at Washington and chairman of the Canadian Joint Staff, Washington. He had been adjutant general in the Department of National Defence headquarters at Ottawa for the past two years. Before that, he was Canadian Military Attaché in Washington.

R. A. C. Henry, M.E.I.C., president of Defence Communications Limited, a Crown company, has been named chairman for a period of ten years of the new Canadian Air Transport Board. A deputy minister of the former Department of Railways and Canals of Canada, he was also a vice-president of the Montreal Light, Heat and Power Consolidated.

Air Vice-Marshal Alan Ferrier, M.E.I.C., of Ottawa, a pioneer in the development of Canada's air transport system, has been appointed for seven years a member of the new Canadian Air Transport Board. Marshal Ferrier is a member of the Air Council in the Royal Canadian Air Force.

Dr. Augustin Frigon, M.E.I.C., has been appointed general manager of the Canadian Broadcasting Corporation. Joining the CBC as assistant general manager when it was formed in 1936 he had been acting general manager since November of last year.

F. C. Mechin, M.E.I.C., former manager of the Montreal refinery of Imperial Oil Limited, has recently been transferred to Toronto where he has been appointed assistant to the president of the company, in charge of employee relations and personnel.

Eugene M. Whitby, M.E.I.C., retired to private life in July after having served under five city engineers over a period of 38 years in the City Engineer's Department, Hamilton. He started with the city as a draughtsman, was appointed roadway engineer in 1914 and in 1930 was appointed deputy city engineer.

W. H. Collins, M.E.I.C., was appointed deputy city engineer in July. He had been with the City Engineer's Department, Hamilton, for the past 23 years and prior to his latest appointment held the position of sewer engineer.

A. R. Hannaford, M.E.I.C., was appointed building commissioner for the city of Hamilton on September 1st. He has held the position of office and designing engineer in the City Engineer's Department since June 1921. Previous to that he was district engineer of the Hamilton division of the Grand Trunk Railway. Mr. Hannaford is a past secretary of the Hamilton Branch of the Institute.

W. D. Hurst, M.E.I.C., formerly engineer of waterworks for the city of Winnipeg, who was promoted to the position of assistant city engineer last May, has been appointed city engineer last month, succeeding W. Aldrich who has retired. Only 36 years of age, Mr. Hurst is one of the youngest city engineers in Canada. He was born and educated in Winnipeg, graduating in civil engineering from the University of Manitoba in 1930. Awarded a teaching fellowship at Virginia Polytechnic Institute, Blacksburg, Va., he obtained the degree of civil engineer at that Institute in 1931. Mr. Hurst has been with the City of Winnipeg ever since graduation, having successively occupied the positions of resident engineer on construction, engineer of waterworks and assistant city engineer.

V. E. Thierman, M.E.I.C., has been appointed city engineer of Swift Current, Sask., succeeding **J. I. Strong,** M.E.I.C., who resigned recently to accept an appointment as assistant city engineer of Calgary, Alta. A graduate of the University of Saskatchewan, he has had extensive experience in municipal engineering work and has been employed with the cities of North Battleford, Weyburn, Watrous and Melfort, as well as Moose Jaw, in Saskatchewan. He has also been associated with the irrigation development carried out in that province by the Prairie Farm Rehabilitation Administration.

H. J. A. Chambers, M.E.I.C., has been appointed vice-president and general manager of the Hamilton Bridge Company Limited, Hamilton. He has been general manager of the company since February 1943.

G. A. Bradford, M.E.I.C., is now plant engineer of Carbide and Carbon Chemicals, Limited, Bakelite Plastics Division, Toronto. He was formerly with H. G. Acres and Company at Niagara Falls.

K. B. André, M.E.I.C., is now employed in the Dominion Department of Mines and Resources, engineering and construction service, at Banff, Alta.

Neville Beaton, M.E.I.C., has resigned from Wartime Shipbuilding Limited with which company he occupied the position of division manager for the Quebec and Maritime areas, and has joined the Marathon Paper Mills of Canada, Limited, Toronto as assistant to the vice-president. Mr. Beaton was resident engineer with Powell River Company, B.C., prior to joining Wartime Shipbuilding Limited.

C. E. Carson, M.E.I.C., of Imperial Oil Limited was recently transferred from Sarnia to Toronto, Ont.

C. E. Cleveland, M.E.I.C., has taken up residence in Vancouver, B.C., after having been superintendent of the Takla Mercury Mine near Fort St. James, B.C., for the past year.

J. Knox Davidson, M.E.I.C., has recently returned from Australia to the Electric Reduction Company Limited, Buckingham, Que. For the past five years he had been manager of an associated company, Albright and Wilson (Australia), in Melbourne, Australia.

G. W. Lawson, M.E.I.C., formerly employed with Defence Industries Limited at Brownsburg, Que., is now with Canadian Tube & Steel Products Limited, Montreal.

Paul LeBel, M.E.I.C., has recently entered the contracting business, specializing in asphalt paving under the name of LeBel Construction Limited, Montreal. A graduate of Ecole Polytechnique, Montreal, he had been employed for the past eighteen years with Imperial Oil Limited, joining the company in 1926 as a chemical engineer.

Captain W. P. C. LeBoutillier, M.E.I.C., a prisoner of war captured by the Japanese at Hong Kong on Christmas Day, 1941, is reported in good health and suffering no ill treatment, according to letters received in Canada last July. Before the war, Captain LeBoutillier was employed with Price Brothers & Company Limited at Kenogami, Que.

A. M. Mills, M.E.I.C., who has been employed on the construction of the Alaska highway with W. H. Harvey and Sons, road-builders and general contractors, has now returned to the Department of Highways of Ontario and is located at Timmins.

L. A. Petrie, M.E.I.C., of the Aluminum Company of Canada Limited has recently been transferred from Arvida, Que., to Toronto, Ont.

Sarto Plamondon, M.E.I.C., engineer in charge of the Division of Industrial Hygiene of the Department of Health of the Province of Quebec, received the M.Sc. degree in sanitary engineering last June from Harvard University after an eight-month post graduate course. He was at the same time made a member of the Delta Omega Honorary Public Health Society.

R. H. Stevens, M.E.I.C., was appointed last summer municipal engineer for post-war public works for the corporation of the township of Esquimalt, B.C. He was previously waterworks and assistant engineer for the Royal Canadian Air Force at Comox, B.C.

W. D. Harkness, Jr.E.I.C., has recently left the Abitibi Power & Paper Company Limited at Port Arthur, Ont., to join the woodlands division of Bathurst Power & Paper Company Limited at Bathurst, N.B.

Raymond Bolduc, S.E.I.C., is now employed with the Aldermac Copper Corporation at Sherbrooke, Que.

Gilbert Dumas, S.E.I.C., a graduate of Laval University, is employed with the Saguenay-Quebec Telephone Company at Chicoutimi, Que.

J. B. Lalande, S.E.I.C., is employed at Canadian Westinghouse Company Limited, Hamilton, Ont. He graduated last spring from Ecole Polytechnique, Montreal.

Samuel Levinoff, S.E.I.C., is employed with the Toronto Iron Works Limited as a mechanical engineer. He graduated this spring from McGill University, Montreal.

Lieut. (S.B.) W. G. Ward, S.E.I.C., who is attached to the Royal Navy, took part, as Radar Officer aboard the flagship *H.M.S. Scylla*, in the D-Day invasion of France on June 6th, 1944.

Capt. John A. Webster, S.E.I.C., has recently been promoted from the rank of lieutenant and transferred to the Canadian Signals Research and Development Establishment, measurements and test division, at Ottawa, Ont.

Ross W. Bastable, M.E.I.C., has now retired to the reserve of officers of the Royal Canadian Air Force and has resumed his former position as superintendent of buildings, eastern area, Bell Telephone Company of Canada, Montreal. He was previously serving with the rank of squadron-leader at R.C.A.F. headquarters, Ottawa.

Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Colonel Arthur Edouard Dubuc, M.E.I.C.

Colonel Arthur Edouard Dubuc, D.S.O. & BAR, V.D., Chevalier de la Légion d'Honneur, M.E.I.C., former vice-chairman and chief engineer of the National Harbours Board of Canada, died suddenly at his home in Ottawa on September 6th, 1944. Born at Montreal on May 18th 1880, he received his primary education at Mont St. Louis College and studied engineering at the Ecole Polytechnique of Montreal, where he graduated in 1901. Upon graduation he joined the Department of Public Works of Canada at Montreal as assistant engineer. In 1912 he was appointed district engineer for the Department at Montreal.

Returning to Canada in 1919 after the Great War, Colonel Dubuc was appointed superintending engineer for the province of Quebec of the Department of Railways and Canals of Canada, and in 1924 became chief engineer of the Department at Ottawa. In 1935 he was appointed a member of the National Harbours Board, becoming vice-chairman and chief engineer in 1937. He occupied this position until his retirement in 1942.

A distinguished engineer, Colonel Dubuc was also a gallant soldier. He served during the first Great War, enlisting as a captain in the 22nd Canadian Infantry Battalion. He was promoted to major in 1915 and second in command in 1916. He was lieutenant-colonel and officer commanding the battalion in 1917 and 1918. He saw action at Ypres, Vierstraat, Kemmel and Courcelette. He commanded the glorious French Canadian Battalion at Regina Trench (1916), Vimy Ridge (1917), Neuville-Vitasse, Mercatel, Amiens, Meharicourt, Arras to Cherisy (1918). He was wounded in action three times. In 1917 he was awarded the Distinguished Service Order and was made a Chevalier de la Légion d'Honneur. He was awarded a bar to the D.S.O. in 1918 and was twice mentioned in despatches. He was demobilized in 1919 and in 1920 he was appointed colonel in command of the 11th Infantry Brigade, transferring to the reserve of officers in 1924. From 1922 to 1924 he was a member of the Royal Commission appointed to investigate soldiers' pensions and re-establishment. He was an Hon. A.D.C. to three Governors-General: Lord Byng of Vimy, Lord Tweedsmuir, and the present Governor-General, the Earl of Athlone. In 1935 he received the King's Jubilee Medal. In 1943 Colonel Dubuc received the honorary degree of Doctor of Applied Science from the University of Montreal. He was a life governor of the Notre-Dame Hospital, Montreal.

He joined the Institute as a Student in 1899, transferring to Associate Member in 1906 and became a Member in 1917. Colonel Dubuc served on Council of the Institute in 1923. He was president of the Alumni Association of the Ecole Polytechnique in 1921 and also at one time president of l'Association des Anciens Eleves du Mont-Saint-Louis.

Major Alexandre Dugas, Jr.E.I.C.

Major Alexandre Dugas, JR.E.I.C., of Le Régiment de Maisonneuve, has recently been reported killed in action in the Battle of Normandy.

Born at Montreal on September 1st 1909, he was educated at Mont St. Louis College and at the Ecole Polytechnique of Montreal, where he graduated as a civil engineer in 1933. Upon graduation he was engaged on geological survey work with the Quebec Bureau of Mines, and in 1935 he was resident engineer on the construction of a wood stave pipeline for the town of La Tuque, Que. In 1936 he joined the staff of the Quebec Electricity Commission as technical secretary to the chief engineer and later became engaged in inventory work with the Commission, then called the Provincial Electricity Board. At the outbreak of the war he was an engineer with the Board.

Major Dugas had become interested in military activities when he joined the C.O.T.C. of the University of Montreal during his course at the Ecole Polytechnique. He joined the Régiment de Maisonneuve in 1935 as a lieutenant and at the outbreak of war enlisted for active service. He went overseas in August 1940. He was posted back to Canada early in 1942 and was stationed for a while at the Officers' Training Centre at Brockville, Ont., as an instructor. Later he took the war staff course at Kingston, returning overseas in October 1942.

Major Dugas joined the Institute as a Junior in 1939.

Richard Crosby Harris, M.E.I.C., died suddenly at Calgary, Alberta, on June 19th 1944. Born at Hebron, N.S., he studied civil engineering at the University of Toronto. In 1906 he joined the Canadian Pacific Railway and was employed on construction work in Alberta. From 1912 to 1915 he was resident engineer at Calgary in charge of construction of the Ogden shop yards. From 1915 to 1918 he was resident engineer at Edmonton in charge of maintenance of way and construction. He became division engineer at Calgary in 1918, a position which he occupied until his retirement.

Mr. Harris joined the Institute as an Associate Member in 1919, and transferred to Member in 1926.

Lieutenant Richard Bucknam Logie, S.E.I.C., was killed in action in Normandy on August 8th, 1944.

Born at Toronto, Ont. on August 12th 1919, he received his primary education at Belleville, Ont., and studied engineering at the University of New Brunswick, where he graduated in civil engineering in 1940. Upon graduation he joined the staff of the Canadian National Railways in the district engineer's office at Ottawa. Later he enlisted with the Royal Canadian Engineers and had been overseas since 1942.

Mr. Logie joined the Institute as a Student in 1940.

John Woodman, M.E.I.C., died at Winnipeg on May 17th, 1944. Born at Oshawa, Ont. on October 5th 1861, he graduated from the Royal Military College at Kingston in 1883 and joined the Canadian Pacific Railway and for twenty years was employed in railway construction work in the west. In 1903 he went into practice in Winnipeg as an engineer and architect. In this capacity he was connected with several large building construction projects in Western Ontario and the Prairie Provinces. He was succesively a partner in the firms of Woodman & Carey and Woodman & Cubbidge. Owing to illness Mr. Woodman had retired a few years ago.

He joined the Institute as an Associate Member in 1896 transferring to Member in 1877. He was made a Life Member in 1930.

HAMILTON BRANCH NEWS

W. E. Brown, M.E.I.C. - *Secretary-Treasurer*
L. C. Sentance, M.E.I.C. - *Branch News Editor*

On Monday, July 3rd, 1944, a special meeting of the branch was called to discuss the implications of the recent Wartime Labour Relations Regulations—P.C. 1003; H. A. Cooch, branch chairman, presided.

The discussion was opened by C. A. Hutton who gave a resumé of the provisions of P.C. 1003, and of the findings of the Branch Committee on Collective Bargaining.

T. S. Glover presented the opinions of the Canadian Institute of Chemistry who were strongly in favour of complete exclusion from the provisions of the act.

A general discussion followed, in which the practical exclusion of engineers presently in the armed services from voicing their opinions in regard to collective bargaining was deplored; the dependency of the employee engineer on the employer groups and consequent restriction of activity in respect of an employee organization were stressed; and the desirability of grasping an unparalleled opportunity to unite all engineers from one end of Canada to the other in a common bargaining organization was suggested.

As a result of the foregoing, the meeting passed, by an overwhelming majority, a resolution recommending the formation of a Canadian organization of technological employees for the purpose of bargaining collectively for its members in all ways and manners as provided for in regulation P.C. 1003. Membership in such an organization should not require membership in any existing engineering, scientific or professional societies, and qualifications for such membership should be based on scientific and technological training with due regard to experience. Attendance—46.

Library Notes

Book notes, Additions to the Library of The Engineering Institute, Reviews of New Books and Publications

ADDITIONS TO THE LIBRARY

TECHNICAL BOOKS

Conveyors and Related Equipment:
Wilbur G. Hudson. N.Y., John Wiley and Sons, Inc., c. 1944. 5½ x 8½ in. $5.00.

Statically Indeterminate Structures:
R. Gartner. London, Concrete Publications Ltd., 1944. 93p. 5s.

Handbook of Aluminum Alloys:
Montreal, Aluminum Company of Canada Ltd., 1944. 81p.

Direct-Current Circuits:
Earle M. Morecock. N.Y., Harper and Bros., 1944 (Rochester Technical Series). 6¼ x 9½ in. $3.25.

Heating Ventilating Air Conditioning Guide 1944:
Volume 22. Published annually by American Society of Heating and Ventilating Engineers. 6 x 9¼ in. $5.00.

American Society for Testing Materials:
1943 Supplement to A.S.T.M. Standards including tentative standards. Part 1: Metals. Part 2: Nonmetallic metals-constructional. Part 3: Nonmetallic materials—general. Philadelphia, American Society for Testing Materials, 1944.

REPORTS

Canada—Advisory Committee on Reconstruction:
Final report of Subcommittee No. 4—Housing and Community Planning. March, 1944 (called Curtis Report). Ottawa, King's Printer, 1944. $1.00.

Canada—Dominion Bureau of Statistics:
Libraries in Canada 1940-42 (Part 3 of the biennial survey of education in Canada). Ottawa, King's Printer, 1943. 35c.

Canada—Dept. of Mines and Resources—Geodetic Service of Canada:
Publication No. 20: Precise levelling in Ontario north of Parry Sound.

Ontario—Dept. of Mines:
Fifty-first annual report being Vol. LI, Part V, 1942.

U.S.—Bureau of Mines—Technical Paper:
No. 656: Analyses of Virginia coals.—No. 665: Production of industrial explosives in the United States during the calendar year 1943.

The Institution of Civil Engineers—London:
Report of the Committee on fish-passes.

Electrochemical Society—Preprint:
No. 86-2: Current efficiency of the Hooker type S chlorine cell. No. 86-3: Historic development of caustic-chlorine cells in America.

BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet all of these books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

CHEMICAL MACHINERY, an elementary treatise on Equipment for the Process Industries

By E. R. Riegel. Reinhold Publishing Corp., New York., 1944. 583 pp., illus., diagrs., charts, tables, 9¼ x 6 in., cloth, $5.00.

This book presents information upon apparatus and devices used in the chemical industries. The field has been confined to devices that have general application in diverse chemical processes, that can be purchased from a manufacturer rather than made at home, and that serve large-scale operations. These apparatus are grouped, a chapter being devoted to each group. Each apparatus is thoroughly described and appraised and in many cases prices are given. Chemical manufacturers and chemical engineers will find the book useful.

ENGINEERING MATERIALS ANNUAL 1944, editor, H. H. Jackson

Paul Elek (Publishers), London, W.C.2. 108 pp., 8¼ x 5 in., cloth, 8s. 6d.

This little manual gives a concise review of important developments in engineering materials during the year 1943. It includes articles on ferrous and non-ferrous metals, plastics of all kinds, ceramic materials, fuels, lubricants, plywood and adhesives. Each review is accompanied by a bibliography.

ENGINEERING PRODUCTION ANNUAL 1944, editor, H. H. Jackson

Paul Elek (Publishers), London, W.C.2. 102 pp., 8¼ x 5 in., cloth, 8s. 6d.

This little volume reviews developments during 1943 in machine-shop methods, machine tools, welding, powder metallurgy, hardening, etc. Each review is accompanied by a list of references to the articles from which the review was prepared.

THE EXTRUSION OF METALS

By C. E. Pearson, with a foreword by R. Genders. John Wiley & Sons, New York; Chapman & Hall, London, 1944. 205 pp., illus., diagrs., charts, tables, 8¾ x 5½ in., cloth, $3.75.

We have here a concise account of extrusion practice relating to different classes of work and materials, based on the widely scattered information available in the literature and on the author's own studies. Chapters on flow phenomena in the process and on the influence on the extrusion of metals of such factors as temperature and the speed and extent of deformation are included. Impact extrusion is also discussed.

LAYING OUT FOR BOILER MAKERS AND PLATE FABRICATORS, revised by G. M. Davies

5th ed. Simmons-Boardman Publishing Corp., New York, 1944. 522 pp., illus., diagrs., charts, tables, 11¼ x 8½ in., cloth, $7.00.

This book is designed as a practical text for the solution of problems in laying out plate for boilers and similar vessels. Only simple mathematics is used. The new edition has been thoroughly modernized. New material has been added on laying out boiler patches and on laying out for welded construction.

METALLOGRAPHY OF SOME ALUMINUM ALLOYS

(Association Series No. R.R.A. 635)

By M. D. Smith. British Non-Ferrous Metals Research Association, Euston St., London, N.W.1, Nov. 1943. 12 pp., illus., charts, tables, 9¾ x 6¼ in., paper, 2 s.

This brochure describes work on the constitution and metallography of aluminium alloys in common use. Cooling curves were taken and the structure of the alloys examined in the cast condition and after quenching from various temperatures. There are twenty-eight photomicrographs.

ORDINARY DIFFERENTIAL EQUATIONS

By E. L. Ince. Dover Publications, New York, 1944. 558 pp., diagrs., tables, 9¼ x 5½ in., fabrikoid, $3.75.

This book originally appeared in 1927 and was at once accepted as a standard work on its subject. It has for some time been out of print, and this edition, costing about one-fourth the original price, will be welcomed by mathematicians, engineers and others.

THE SYSTEM OF MINERALOGY OF JAMES DWIGHT DANA AND EDWARD SALISBURY DANA, Yale University 1837-1892, Seventh edition, entirely rewritten and greatly enlarged

By C. Palache, H. Berman and C. Frondel.

Volume I, Elements, Sulfides, Sulfosalts, Oxides

John Wiley & Sons, New York; Chapman and Hall, London, 1944. 834 pp., diagrs., charts, tables, 9¼ x 6 in., cloth, $10.00.

The new edition of this classic reference book will be welcomed by all students of mineralogy. As now issued, it is essentially a new book. Among the improvements are a new system of classification, a revision of morphological elements, a new way of presenting crystellographic data, introduction of optical characters and other changes occasioned by the advances in the science during the last fifty years.

PRELIMINARY NOTICE

of Applications for Admission and for Transfer

Sept. 27, 1944.

The By-laws provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described at the November meeting.

L. Austin Wright, General Secretary.

*The professional requirements are as follows:—

A Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science or engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examination of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainment or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

ASSELSTINE—JOHN WILLIAM, of 983 Pierce Avenue, Windsor, Ont. Born at Marlbank, Ont., May 26th, 1916. Educ.: B.E. (Mech.Engrg.), Detroit Inst. of Technology (1938-44, evening classes); 1940-41, tool design, Truscon Steel Co.; 1941 to date, mech. engr., engine development div'n., Ford Motor Co. of Canada, Windsor, Ont.

References: J. B. Dowler, G. W. Lusby, F. C. Ansley, W. R. Stickney, E. Chorolsky, J. F. G. Blowey.

BACH—JAMES R., of London, Ont. Born at Brockville, Ont., Jan. 12th, 1909. Educ.: B.Sc. (E.E.), Univ. of Manitoba, 1931; 1926-29 (summers), rly. constrn. engrg., west div'n., C.P.R.; 1929-31 (summers), highway constrn., Dept. of Highways, Manitoba; 1931-33, engr., radio div'n., 1933-35, service mgr., radio div'n., and 1942 to date, mgr. and engr., instrument div'n., Sparton of Canada, Ltd., London, Ont.

References: V. A. McKillop, E. V. Buchanan, A. L. Furanna.

BAILEY—LOUIS, of Montreal and Red Rock, Ont. Born at Ottawa, Ont., Jan. 31st, 1913. Educ.: Completed 3rd year of gen'l. engrg. course at Ecole Polytechnique, 1935; partial course in geological and mineralogical subjects at McGill Univ. (1 yr.); 1935-36 and 1937-38, mine prospecting; 1938 (9 mos.), highway surveying, Dept. of Roads, Que.; 1938-39, mining prospecting; 1939-41, mech. dftsman., stock pile surveyor, Dominion Glass Co., Pt. St. Charles; 1941 (summer), mine prospecting; 1941 (Aug. to Dec.), aircraft assembly inspr., Fairchild Aircraft Ltd.; 1941-42, time and motion study, Dominion Rubber Co.; 1942 to date, mech. and struct'l. designer, checker, rly. constrn. and stock pile surveyor, Brompton Pulp & Paper Co. (Red Rock div'n.).

References: A. Circe, L. Trudel, J. Stadler, C. A. Hellstrom, J. A. Dickinson.

BICKELL—WILLIAM ALBERT, Capt., R.C.E., of 85 Victoria St., Hull, Que. Born at Toronto, Ont., Sept. 3rd, 1896. Educ.: B.A.Sc., Univ. of B.C., 1922, and M.Sc., McGill Univ., 1923; R.P.E.B.C.; 1923-25, engr., 1925-28, mgr., and 1928-39, managing director, Coast Quarries, Ltd.; 1940-42, Deputy Asst. Dir., Dir. of R.E. Equipm't., M.O.S., London, England; 1942 to date, Capt., R.C.E., Dir. of Works and Constrn., N.D.H.Q., Ottawa, Ont.

References: W. O. Scott, T. V. Berry, W. H. Powell, P. B. Stroyan, E. M. Coles.

CLARKE—ROSS EUGENE, of Kingston, Ont. Born at Gananoque, Ont., May 22nd, 1913. Educ.: B.Sc. (C.E.), Queen's Univ., 1935; R.P.E. Ont.; with the Dept. of Highways, Ont., as follows: 1935, rodman, 1936-37, inspr. and 1937-40, res. engr.; 1940-41, instru'man. and 1941 to date, res. engr., Dept. of Transport, Air Services Airport Constrn., Kingston, Ont.

References: F. B. Whiteley, K. B. Andre, F. C. Jewett, R. A. Low, A. Jackson.

DEWAR—GEOFFREY PLUMMER, Major, R.C.E., of Kingston, Ont. Born at Montreal, Que., Nov. 27, 1917. Educ.: B.A.Sc., Univ. of Toronto, 1940; 1940 (summer), supervisor-in-training, Proctor & Gamble Co., Hamilton, Ont.; with the R.C.E. as follows: 1940 (July), joined as 2nd Lieut. and received commission as Lieut. in Nov.; 1941, proceeded overseas with 18th Cdn. Fd. Coy., and remained as a unit officer with this Coy. until March, 1942, employed in field defences and invasion preparations; 1942, posted to H.Q., R.C.E., 2nd Cdn. Div'n. as Asst. Adjutant and later to H.Q., 1st Cdn. Div'n. as Liaison Officer; 1943, Staff Officer, Grade 3, Chief Engrs. Branch H.Q., 2nd Cdn. Corps., and later posted to R.M.C., Kingston, to take the Cdn. War Staff Course, thence to H.Q. 14th Cdn. Inf. Bde., as Brigade Major; at present, Directing Staff Officer (G.S.O. 11), Cdn. War Staff Course, R.M.C., Kingston, Ont.

References: C. R. Young, W. J. T. Wright, R. R. McLaughlin, E. A. Allcut, T. R. Loudon.

DEWAR—PETER STEWART, of 525 Bruce Avenue, Windsor, Ont. Born at Windsor, Ont., April 23rd, 1920. Educ.: B.A.Sc. (Mech.Engrg.), Univ. of Toronto, 1943; 1939 (summer), ap'tice. toolmaker, Standard Machine & Tool Co. Ltd., Windsor; with the Ford Motor Co. of Canada as follows: 1940 (summer), mach. mtce., millwright dept., 1941 (summer), mach. mtce., tool repair dept., 1942 (summer), mech. design, foundry div'n., engrg. dept. and 1943 to date, mech. engr., foundry div'n.

References: C. R. Young, J. B. Dowler, G. W. Lusby, C. G. Walton, J. E. Daubney, E. Chorolsky, V. W. MacIsaac, W. D. Donnelly, A. D. Harris, H. Lillie.

DIXON—WILLIAM ANDREW, of Winnipeg, Man. Born at Liverpool, England, June 8th, 1887. Educ.: 1901-1903, Liverpool Central Tech. (evening classes); 1903-06, National Telephone Co., Liverpool; 1909-16, with the Manitoba Telephone System, Winnipeg; 1916-19, on active service; with the Manitoba Telephone System as follows: 1919-20, wire chief, 1923-43, plant automatic traffic engr., and 1943 to date, traffic engr. responsible for traffic observations, mtce. of balanced traffic load, design of special traffic observation circuits, recommendations of type and quantities of equipm't. to meet P.A.X. or P.B.X. requirements; design of trunking schemes, etc. (Asks for admission as an Affiliate.)

References: J. D. Peart, A. T. McCormick, T. E. Storey, V. C. Jones.

EON—LOUIS GUY, Lieut.-Col., of Kingston, Ont. Born at Montreal, Que., April 6th, 1913. Educ.: 1929-31, Quebec Tech. School, Quebec; Course in Electron Physics, Sir George Williams College; A.M. British Inst. Radio Engrs.; 1935-40, sound engrg., Northern Electric Co. and Dom. Sound Equipment Ltd.; 1940-42, Canadian Army (active) attached to British Army i/c of mtce. on Divisional H.Q. Staff; 1942-43, i/c mtce. wing of radio location unit overseas from its formation to its disbanding; 1943 (7 mos.), Radar Staff Officer, Canadian Military H.Q., London, England; 1943 to date, Commanding Officer and Chief Instructor, A.36, Cdn. Radar Training Centre, Barriefield, Ont.

References: L. A. Wright, A. G. L. McNaughton, L. F. Grant, A. D. Turnbull.

GODIN—CAMILLE RENE, of Montreal, Que. Born at Montreal, Que., Feb. 28th, 1915. Educ.: B.A.Sc., C.E. Ecole Polytechnique, 1935; R.P.E. Que.; 1935-36, engr. i/c No. 5 highway constrn., Richmond-Danville section for Laganiere & Houde, gen'l. contractors; with the Canadian General Electric Co., Toronto, as follows: 1936-38, H.O. specialist in panelboards and L.-V. switchbds., hospital signalling equipm't., etc., 1938-39, distribution equipm't., transformers, meters, instruments, etc., 1939-40, panelboards, etc.; 1940-42, D.O. sales engr., Montreal; with the Ecole Polytechnique from 1942-43 as professor of maths. and drawing, and 1943 to date, asst. professor of maths.

References: A. Circe, H. Gaudefroy, L. Trudel, A. Duperron, T. J. Lafreniere.

HALL—PER, of 46 Summit Circle, Westmount, Que. Born at Copenhagen, Denmark, June 29th, 1911. Educ.: B.Sc. (Civil Engrg.), Royal Technical College, Copenhagen (accredited), 1935; post-graduate work at Univ. of Toronto, 1940 (4 mos.); 1931 (summer), constrn. on large dry dock, St. Nazaire, France; 1933 (6 mos.), topgl. survey; with Manniche & Hartmann Ltd., Copenhagen, as follows: 1935-36, designing and supervising erection of 5 tennis halls (main structure in reinforced concrete arches spanning 65 feet), also factory and roof constrn., 1937-39, res. engr., Gothenburg, Sweden, responsible for constrn. of a large hippodrome, and on completion of this work, continued in Sweden i/c Swedish Branch of the company, planning and constrn. of industrial bldgs. and airport developments; 1939, design of reinforced concrete structures and gen'l. layout of bldg. sites, London, England, for Christiani & Nielson, Ltd.; 1940 to date, with Aluminum Co. of Canada, Ltd., on constrn. in connection witb gen'l. war expansion, also planning and engrg. of harbour facilities for loading fluorspar, and layout and engrg. of temporary bauxite trans-shipment facilities. At present, asst. project engr., Demerara River navigation development.

References: C. R. Young, R. F. Legget, A. W. Whitaker, Jr., M. P. Weigel, F. L. Lawton, A. I. Cunningham.

HENTHORN—WILLIAM EDWIN, of Toronto, Ont. Born at Montreal, Que., March 22nd, 1886. Educ.: Engrg. ap'ticeship in shops of Marsh & Henthorn, Ltd.; home study and I.C.S. course, 1903-06; 1907, 2nd i/c R. W. Survey, Bessemer; 1907-14, engrg. office and 1914-18, mech. engr., Cdn. Rubber Co., Montreal; 1918-25, mech. engr., Dom. Rubber Co. (6 plants); 1926-27, constrn. engr., and 1927-28, plant engr., St. Lawrence Paper Co., Three Rivers, Que.; 1929-32, steam engr., Lake St. John Paper, Dolbeau, Que.; 1933, install'n. engr., automatic control system, Shell Oil, Montreal; 1934-35, chief engr., Trinity Bay Rosing Mill, Que.; 1935-36, plant engr., Cdn. Wire & Cable, Leaside; 1937-39, mtce. and estimating engr., Goodyear Rubber; 1940 to date, Inspecting Officer, Artillery Amm., Inspection Bd., U.K. and Canada, Toronto, Ont.

References: L. A. Wright, G. M. Wynn, J. T. Farmer, J. G. Hall, W. H. D. Horsfall.

JARMAIN—EDWIN ROPER, of 13 King St., London, Ont. Born at London, Ont., July 24th, 1907. Educ.: B.A.Sc., Univ. of Toronto, 1930; Honour Chemistry, Univ. of Western Ontario (1 yr.); 1927 (summer), surveying, Dept. of Public Works, Canada; 1931-32, sales engr., Fuel Saving Equipm't & Engrg. Co., Windsor; 1932-34, manager and production engr., and 1934 to date, proprietor, Forest City Laundry, involving responsibility for erection of new steam plant; 1942-43, chief consultant, laundry and dry cleaning, Dept. of Munitions & Supply, responsible for the determination of equipment requirements and plant layouts for 5 Navy and R.C.A.F. service laundry and dry cleaning plants; 1942 to date, engr., Kelco Engineering Ltd., London, Ont., and 1943 to date, asst. assoc. director, War Industries, Dept. of Labour, Ottawa, Ont.

References: E. V. Buchanan, H. G. Stead, V. A. McKillop, W. M. Veitch, R. W. Garrett.

KENNEDY—ROBERT, of Montreal, Que. Born at Paisley, Scotland, May 25th, 1897. Educ.: 1913-15 and 1919-21, evening classes, Royal Technical College, Glasgow, Scotland; 1919-21, ap'ticeship, Wm. Simon's Co. Ltd.; 1922-24, structural dftsman., Babcock & Wilcox, Ltd., Renfrew, Scotland; 1924-25, structural designer and estimator, Fall River Iron Works, Fall River, Mass.; 1925-27, structural designer and estimator, Builders Iron & Steel, Everett, Mass.; 1927-30, fitter (1st class and charge), Fore River Shipbldg. Co., Quincy, Mass.; 1939-41, structural designer and estimator, Crozier & Slozies, Somerville, Mass.; 1942-43, foreman shipfittter, United Shipyards Ltd.; 1941-42 and 1943-44, tech. asst. to records engr., Allied War Supplies Corp'n.; at present, structural designer, Canadian Car & Foundry Co. Ltd., Montreal.

References: C. J. Jeffreys, D. Goldwag, J. R. C. Macredie, W. L. Yack.

KETCHUM—VERNE, of New York, N.Y. Born at Le Roy, Mich., July 28th, 1890. Educ.: B.S., Mich State College (accredited), 1912; 1912-16, surveyor and dftsman., U.S. Forest Service, i/c surveying and dfting. parties; 1916-17, dftsman., Comm'n. of Public Docks, Portland, Oregon; 1917-21, engr., U.S. Shipping Board, Seattle, Wash., design, detail and constrn. of wood and steel ships; 1921-26, engr. with various consltg. engrg. firms, Portland; 1926-27, asst. res. engr., Robinson & Steinman, i/c surveys, estimates and constrn.; 1927-31, appraisal engr., Pacific Power & Light Co., Portland, i/c crew of engrs. on appraisal of 12 Hydro-electric plants; 1931-32, designing engr., Bonneville Dam; 1933-41, consltg. engr., Portland; 1941 to date, chief engr., Timber Structures, Inc., New York, N.Y.

References: C. P. Richards, M. W. Hanson, L. A. Wright, D. B. Steinman, L. Trudel.

McCUAIG—DONALD ALEXANDER, of Winnipeg, Man. Born at Minto, Man., April 7th, 1897. Educ.: B.Sc. (E.E.), Univ. of Man., 1923; 1916-17, surveying, Gr. Wpg. Water Dist.; 1920-21 (summer), records engr., Great Falls Power Plant; 1923-27, dftsman., designer, checker and junior engr. (elec.), Stone & Webster, Boston, Mass.; 1927 to date, western district mgr., Ferranti Electric Ltd., Winnipeg, Man.

References: T. H. Kirby, T. E. Storey, E. P. Fetherstonhaugh, E. V. Caton, A. B. Cooper, H. L. Briggs.

MOKRZYCKI—GUSTAV ANDREW, of 2720 4tb Ave., San Diego, Cal. Born at Lwow, Poland, October 1st, 1894. Educ.: Diploma in Mech. Engrg., Inst. of Tech., Lwow, 1919, and Diploma in Aer. Engrg., Ecole Superieure Nationale de L'Aeronautique, 1920; Assoc. Fellow, Royal Aero. Soc., London; 1915-20, observer and tech. officer, military aviation; 1921-27, vice-pres. and chief engr., aeroplane factory, Poznan, Poland; 1926-27, lecturer, aviation, and 1927-39, professor of mecb. engrg., Dept. of Aeronautics, Inst. of Technology, Warsaw; 1927-29, advisor to factories in Polish aeroplane industry; 1930-32, chairman, Aeronautics Research Inst. (Polish War Ministry); 1934-39 visiting professor of aer. engrg., Inst. of Tech., Lwow; 1939, dean, faculty of military engrg., Inst. of Tech., Warsaw; 1939-41, captain, Polish Air Force, France and England; 1941, engr., Victory Aircraft, Toronto; 1943-44, professor of aeronautics, Ecole Polytechnique, Montreal; at present, research engr., Consolidated Vultee Aircraft Corp'n., San Diego, Cal.

References: W. Czerwinski, A. D. LePan, L. Austin Wright, J. H. Parkin, C. R. Young.

MUIR—WILLIAM GORDON, of Shawinigan Falls, Que. Born at Shelburne, N.S., August 9th, 1908. Educ.: B.Sc. (Mining Engrg.), N.S. Tech. Coll., 1931; 1927-31 (summers), topographical surveys, Dept. of the Interior, Ottawa; 1931-37, sales engr., paving material, Alexander Murray & Co.; 1937-42, underground engrg. dept., Falconbridge Nickel Mines, Falconbridge, Ont.; at present, plant engr., St. Maurice Chemicals, Ltd., Shawinigan Falls, Que., responsible for constrn., mtce., etc.

References: H. K. Wyman, C. R. Morris, E. T. Buchanan, M. Eaton.

O'CONNOR—PATRICK ARTHUR, Major, R.C.E., of Winnipeg, Man. Born at Port-of-Spain, Trinidad, B.W.I., October 16th, 1901. Educ.: B.Sc. (Forestry), Univ. of Toronto, 1926; 1926-30, i/c forest survey party, aerial mapping, Northern Manitoba; 1930-40, district forester, Manitoba, design and constrn. of forestry bases, living accommodation, storage warehouses, workshops, docks, aircraft slipways, also design and constrn. of macadam road system to Whiteshell Provincial Park and water control system, Whiteshell River, Man., including constrn. of 4 dams and spillways; 1940, Engr. Works Officer, M.D. No. 10, i/c constrn. of internment camps at Neys and Angler, Ont.; 1941, Officer i/c constrn. of extensions to Brandon, Fort Garry and Portage la Prairie military camps; 1942-44, O.C. No. 10 Coy., R.C.E., responsible to the D.E.O. for all constrn. in M.D. No. 10, and at present, District Engineer Officer, M.D. No. 10, Winnipeg.

References: P. E. Doncaster, H. J. Bird, W. W. Ramsay, J. N. McLean, D. M. Stephens, F. S. Adamson.

PERRIN—JAMES VINCENT, of Quebec, Que. Born at Woodstock, Conn., May 19th, 1884. Educ.: Ph.B. (Civil Engrg.), Sheffield Scientific School (Yale Univ.);1907 (summer), engrg. dept., Bridgeport Gas Co.; 1908-10, surveying timberlands, Riordan Paper Co.; 1910-11, forest engrg., Clark & Lyford, Vancouver, preliminary flowage survey, dam site locations, etc.; 1911-12, Gouin Dam, St. Maurice River, St. Maurice Hydraulic Co. and Quebec Streams Comm'n.; 1912-13, location transmission line, Shawinigan to Three Rivers, Shawinigan Water & Power Co.; with the Brown Corporation as follows: 1913-17, forest and logging engrg., timber estimating, etc., 1917-23, local woods mgr., 1923-44, woods mgr., responsible for dam and river improvement, constrn., logging equipm't., etc.

References: J. B. Challies, H. J. Racey, R. Packard, H. Cimon, E. D. Gray-Donald.

RICHARDSON—FRANK COCKBURN, of Shawinigan Falls, Que. Born at Sturgeon Falls, Ont., Feb. 26tb, 1913. Educ.: B.A.Sc. (Chem. and Met.), Univ. of Toronto, 1935; 1935-40, research engr., copper refining divn., International Nickel Co. of Canada Ltd., Copper Cliff; 1941-44, asst. works metallurgist, Shawinigan Works, and at present, metallurgical engr., gen. tech. dept., Aluminum Company of Canada, Montreal, Que.

References: R. H. Rimmer, P. E. Radley, J. W. Stafford, W. M. Harqey.

RODDICK—JAMES OLIVER, of Toronto, Ont. Born at Brantford, Ont., Dec. 25th, 1882. Educ.: B.A.Sc., Univ. of Toronto, 1906; 1904 (summer), working in engr's office on plans for constrn. of cement plant; 1905 (summer), constrn. of Chicago & North Western Rly.; 1906-07, i/c engrg. party, mtce. of way and 1908 (summer), location work for C.P.R., Alberta; 1908-12, asst. to dist. engr., Dept. of Public Works of Canada; 1912-18, constrn. and engrg. work under own name; 1918-21, constrn. and engrg. work under name of Russell & Roddick; 1921-34, vice-pres., and 1934 to date, pres. and gen'l. mgr., Russell Construction Co. Ltd., Toronto.

References: K. M. Cameron, T. H. Hogg, G. W. Rayner, E. L. Cousins, R. W. Angus.

SCHLANCHE—HERMAN GARMAN, of Gorham, N.H. Born at Philadelphia, Pa., Jan. 19th, 1895. Educ.: B.Sc. (Forestry), Pennsylvania State College (accredited), 1918; with the Abitibi Power & Paper Co. Ltd., as follows: 1919-23, chief forester, 1923-29, mgr. of woods operations, 1929-43, gen'l. mgr., woods operations (enlarged Abitibi Plant); with the Brown Co., Berlin, N.H., and Brown Corp'n., Quebec, as follows: 1943-44, gen'l. mgr., and at present vice-president i/c woods operations.

References: F. G. Coburn, W. L. Campbell, J. B. Challies.

UNDERWOOD—JOSEPH BRUCE, of 144 Hampton Ave., Toronto, Ont. Born at Saskatoon, Sask., May 16th, 1913. Educ.: Diploma in Civil Engrg., British Inst. Engrg. Tech., 1943 (corres. course); 1943 to date, corres. course, McKinley-Roosevelt, Chicago, Ill.; 1933-36, junior surveyor, highways, township and bridge constrn., gen'l. dfting., Underwood & McLellan, Saskatoon, Sask.; 1941-42, mech. and elec. dfting., Research Enterprises, Ltd.; 1942-43, checker and supervisor, engrg. dept., Cdn. Aircraft Instruments & Accessories, Leaside, Ont.; 1943 (7 mos.), structural steel detailer, Link Belt Ltd.; 1943 (5 mos.), designer, mech. section, Armstrong Wood & Co., Toronto; 1943 to date, dftsman., and struct'l. steel and reinforced concrete detail, rapid transit dept., Toronto Transportation Commission.

References: W. H. Patterson, A. Chernick, J. E. Underwood.

WALLINGFORD—VIVIAN MILES, of 726 Bayview Ave., Toronto, Ont. Born at Timmins, Ont., Feb. 27th, 1914. Educ.: B.A.Sc. (Civil), Univ. of Toronto, 1944; 1937-39 (summers), surveyor's helper (underground), rodman, leveller, topographer, Hollinger Consldt. Gold Mines, Ltd., Timmins, Ont.; 1940 (3 mos.), Hydro-Electric Power Comm. of Ont.; 1940-42, instru'man. and field engr., Chemical Construction Corp'n. and Welland Chemical Works, Niagara Falls, Ont.; 1943, instru'man and dftsman., Canadian Kellogg Company, Sarnia, Ont. (5 mos.); at present, Wartime Surveys Engr., Grade 2, Geodetic Service of Canada, Dept. of Mines & Resources, Ottawa, i/c of one unit (6 men) of a precise levelling party operating on the Northern Alberta Rly.

References: S. H. deJong, R. F. Legget, C. F. Morrison, W. M. Treadgold, W. S. Wilson.

WORLEY—HAROLD GORDON, of 2168 Sherbrooke St. W., Montreal, Que. Born at Ashton, Ont., Oct. 31st, 1911. Educ.: B.A.Sc., Univ. of Toronto, 1935; 1935-40, structural design, layout and drawing, International Nickel Co., Copper Cliff, Ont.; 1940 to date, asst. project engr., Canadian Industries Ltd., Montreal, Que.

References: I. R. Tait, J. N. Smith, B. A. Evans, C. H. Jackson, H. V. Serson, C. O. Maddock.

FOR TRANSFER FROM JUNIOR

BREWS—ROBERT WILLIAM, of 30 Harmer Avenue, Ottawa, Ont. Born at Winnipeg, Man., June 18th, 1913. Educ.: B.Sc. (E.E.), Univ. of Alberta, 1936; 1936-37, student course at Automatic Elec. Co., Chicago, Ill.; 1937-42, partner, R. L. Brews & Son, Calgary, dealing in power apparatus, telephone signal equipm't.; 1942 to date, Inspecting Officer, Inspection Bd. of U.K. and Canada, as asst. to inspr. of fuses, responsible for statistical methods of inspection, gauges, local design changes and material acceptance for tbe fuse. div'n. (Jr. 1940.)

References: H. J. MacLeod, J. G. MacGregor, T. A. Lindsay, J. E. Openshaw, H. B. LeBourveau.

FURANNA—ANTHONY LEWIS, of 732 Wellington St., London, Ont. Born at London, Ont., May 17th, 1915. Educ.: B.Sc. (Elec.), Queen's Univ., 1939; 1934-39 (summers), electrician's helper, London Public Utilities Comm'n.; 1939-40, demonstrator in elect'l. engrg., Queen's Univ.; 1940-43, asst. to engr., London Public Utilities Comm'n.; 1943 to date, engr., instrument div'n., Sparton of Canada, Ltd., London, Ont. (Jr. 1942.)

References: E. V. Buchanan, V. A. McKillop, H. F. Bennett, R. W. Garrett, H. G. Stead.

NORTHOVER—ARTHUR CLINTON, of Peterborough, Ont. Born at Southey, Sask., Oct. 7th, 1913. Educ.: B.A.Sc. (Civil), Univ. of Toronto, 1937; 1937-38, struct'l. steel dftsman., Hamilton Bridge Co., Hamilton, Ont.; 1939-40, asst. to research engr., Toronto Transportation Comm'n.; 1940-41, field engr., Trinidad Leaseholds, Ltd., Trinidad, B.W.I.; 1941-42, concrete engr., Shipshaw project, Aluminum Co. of Canada; 1942 to date, struct'l. engr., Peterborough Works, Canadian General Electric Co. Ltd., Peterborough, Ont. (Jr. 1940.)

References: R. L. Dobbin, W. F. Campbell, H. W. Tate, S. E. Flook, C. R. Young, C. B. Muir, I. F. McRae, J. Cameron.

FOR TRANSFER FROM STUDENT

ANGLIN—THOMAS GILL, of Nitro, Que. Born at Philadelphia, Pa., Sept. 25th, 1919. Educ.: B.Eng. (Mech.), 1942; R.P.E. Que.; 1937 (summer), asst. engr., i/c dock reconstrn., Three Rivers, Que., for Anglin-Norcross; 1939 (summer), lineman, Bell Telephone Co.; 1940-41 (summers), asst. power house supt., C.I.L. Beloeil Wks. and D.I.L. DeSalaberry Wks.; 1942-43, simplification engr., C.I.L. Beloeil Wks.; 1943 to date, tech. advisor to supt., L. H. and P. dept., D.I.L., Nitro, Que. (St. 1942.)

References: I. R. Tait, H. C. Karn, R. deL. French, J. A. Coote, C. M. McKergow, R. E. Heartz, D. G. Anglin.

BOUSQUET—PAUL, of 374 St. Patrick St., Ottawa, Ont. Born at Nominingue, Que., May 1st, 1915. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1941; 1939-40 (summers), surveying and road constrn., Dept. of Roads, Que.; 1941-42, plant engrg., Bell Telephone Co., Montreal; 1942 to date, tech. translator, General Staff, N.D.H.Q., translation and preparation of tech. training manuals on engrg., electricity and radio communications. (St. 1938.)

References: A. Circe, H. Gaudefroy, L. Trudel, A. Duperron.

BRIEN—FRANCOIS, of Shelburne, N.S. Born at Montreal, March 11th, 1916. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1940; R.P.E. Que.; 1940-41, asst. engr., Pitt Leblanc & Montpetit; 1941 (3 mos.), asst. engr., Truscon Steel Co.; 1941 to date, elec. engr., Canadian Fairbanks-Morse, Shelburne, N.S. (St. 1939.)

References: A. Circe, M. Gerin, R. Boucher.

CUTHBERTSON—ROBERT SHEDDEN, of 6115 Monkland Ave., Montreal, Que. Born at Greenock, Scotland, Nov. 29th, 1915. Educ.: B.Sc. (Mech.), Queen's Univ., 1941; 1935-37, asst. fireman, steam power plant, Canada Starch Co., Cardinal, Ont.; 1938 (summer), mining, Hollinger Consldt. Gold Mines; 1939 (summer), dfting. and instrument work, Canada Starch Co.; 1940 (summer), sub-station, constrn. and instrument work, Hydro-Electric Power Comm'n. of Ontario; 1941 to date, junior engr., dept. of mfg. methods engr., telephone div'n., Northern Electric Co., Montreal. (St. 1941.)

References: J. G. Little, J. W. Fagan, C. A. Peachey, A. Jackson, D. S. Ellis.

DUFFY—FRANK H., of 5th St., Arvida, Que. Born at Saint John, N.B., March 31st, 1918. Educ.: B.Sc. (E.E.), Univ. of N.B., 1939; 1939-41, broadcast station operator, Station CFNB, Fredericton, N.B.; 1941-42, asst. distribution engr., Saguenay Transmission Co. Ltd., Arvida, Que.; 1942 to date, asst. meter and relay engr., Aluminum Co. of Canada Ltd., Shipshaw, Que. (St. 1939.)

References: A. F. Baird, E. O. Turner, J. R. Hango, C. Miller, A. C. Johnston, J. E. Thicke.

GARRETT—RICHARD HUDSON, Flying Officer, R.C.A.F., of Victoria, B.C. Born at Victoria, B.C., May 18th, 1916. Educ.: B.Eng., McGill Univ. 1939; 1936-37 (summers), Ordnance Mech. Engr., R.C.O.C., Petawawa; 1939-40, asst. supervising engr., MacKenzie River Transport Co. of Hudson's Bay Co., involving office work and field work, the latter comprising mtce. and refit yearly of steam and diesel install'ns. up to 200 H.P.; 1939 to date, pilot, R.C.A.F. (Student 1939.)

References: D. Hutchison, R. Bowering, R. F. Legget, C. M. McKergow, L. F. Grant.

HAMILTON—JOHN C., of Shawinigan Falls, Que. Born at Westport, Ont., March 26th, 1918. Educ.: B.Sc., Queen's Univ., 1942; 1937-38, labourer, power house constrn.; 1939 (summer), underground C.P.G.M.; 1940 (summer), instr'man., field survey, Dept. of Transport; 1941 (summer), lab. work, Cdn. Bitumuls; 1942-43, junior chemical engr., Cdn. International Paper Co., Three Rivers; at present, shift supervisor, Cdn. Resins & Chemicals, Shawinigan Falls, Que. (St. 1942.)

References: C. H. Champion, H. K. Wyman, C. T. M. Robinson.

HEBERT—GUY P., of 710 Champagneur Ave., Outremont, Que. Born at Quebec, Que., May 27th, 1917. Educ.: B.A.Sc., C.E., Ecole Polytechnique, R.P.E. Que.; 1935-37 (summers), instru'man., surveys, 1938-41, asst. to res. engr., Dept. of Roads, Quebec; 1942-44, field engr. and later engr., welding dept., Marine Industries, Ltd., Sorel. (St. 1940.)

References: J. A. Lalonde, A. Circe, H. Labrecque, A. Gratton, R. Boucher, H. Gaudefroy, E. MacKay.

LAMARCHE—MARCEL, of Shelburne, N.S. Born at Mascouche, Que., Feb. 11th, 1917. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1940; R.P.E. Que. 1940; 1938 (summer), Frood Mine, Sudbury, Ont.; 1939 (summer), inspr., Dept. of Roads, Que.; 1940-43, asst. logging div'n. engr., Price Bros. & Co. Ltd., Chicoutimi, Que.; 1943 to date, engr. on mech. and hull install'n., marine div'n., Cdn. Fairbanks-Morse Co. Ltd., Shelburne, N.S. (St. 1937.)

References: H. Gaudefroy, A. Circe, R. Boucher, A. Duperron, E. S. M. Lovelace, M. Gerin, G. E. Lamothe.

LAVIGUEUR—BERNARD, Flt. Lieut., R.C.A.F., of 980 Cherrier St., Montreal, Que. Born at Montreal, Que., March 1st, 1918. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1941; 1938-39 (summers), Quebec Streams Comm'n., 1940 (summers), res. engr., Dept. of Roads, Quebec; 1941 to date, Aeronautical Engr., R.C.A.F. (St. 1938.)

References: J. A. Lalonde, A. Circe, H. Gaudefroy, A. Duperron, T. J. Lafreniere, H. Massue.

MACDONALD—IAN MALCOLM, of 163 Jackson St. W., Hamilton, Ont. Born at Saltsprings, N.S., March 9th, 1919. Educ.: B.Eng., Nova Scotia Tech. Coll., 1942; 1941-42, i/c instruments and testing, mech. dept., Nova Scotia Tech. Coll.; 1941 (summer), engrg. dept., Steel Co. of Canada; 1942-44, ap'ticeship course, Cdn. Westinghouse Co., and at present, mech. engr., design, experimental work on materials, writing specifications, etc., Cdn. Westinghouse Co. Ltd., Hamilton, Ont. (St. 1941.)

References: F. H. Sexton, E. M. Coles, L. C. Sentance, H. A. Cooch, H. A. Ripley, H. W. McKiel.

MACKAY—WILLIAM RONALD, of Three Rivers, Que. Born at Pictou, N.S., March 1st, 1919. Educ.: B.Eng., McGill Univ., 1941; R.P.E. Que.; 1938 (summer), surveyor, geological survey, Nfld. Govt.; 1940 (summer), electrician's helper, constrn. at Arvida, and 1941 (summer), dfting. and elect'l. layout, Cdn. Comstock Co.; 1941-43, job engr. on constrn. (elec.) at Aluminum Plant, Arvida, and at Shipshaw Power House; at present, engr., commercial and distribution dept., Shawinigan Water & Power Co. Three Rivers, Que. (St. 1940.)

References: C. V. Christie, A. D. Ross, J. W. Ward, A. C. Abbott, A. W. Peters, G. A. Wallace, W. P. Copp, D. E. Ellis.

MANUEL—OLIVER HEMPHILL, Lieut. (SB) (E), R.C.N.V.R., of Dartmouth, N.S. Born at Florenceville, N.B., Oct. 20th, 1918. Educ.: B.Sc. (Civil Eng.), Univ. of N.B., 1940; 1938-39 (summers), picketman on transit party, and chainman, surveying, Dominion Topographical Survey; 1940 (summer), chainman and rodman for Town Engineer, Truro, N.S.; 1940-42, dftsman. and estimator, Imperial Oil Refinery, Imperoyal, N.S.; 1942-44, i/c mtce. dept., Bedford Magazine, N.S.; at present, Mtce. Officer, R.C.N. Armament Depot, Dartmouth and Bedford Magazine. (St. 1940.)

References: S. Phillips, C. Scrymgeour, E. O. Turner, J. Stephens, C. H. Wright.

OUELLETTE—ROBERT PASCAL, of Montreal, Que. Born at Lachine, Que., March 29th, 1918. Educ.: B.Eng., McGill Univ., 1942; R.P.E. Que.; 1938-41 (summers), dftsman., Dominion Bridge Co.; 1942-44, asst. engr., United Shipyards, Ltd., Montreal, Que. (St. 1941.)

References: F. P. Shearwood, G. J. Dodd, R. E. Jamieson, R. deL. French, R. S. Eadie, P. G. A. Brault, R. M. Robertson.

PHILLIPS—RONALD EDWARD, Elect. Lieut., R.C.N.V.R., of Edmonton, Alta. Born at Banff, Alta., Feb. 18th, 1920. Educ.: B.Sc. (Elec.), Univ. of Alberta, 1942; 1941-42, instructor, R.C.A.F. Radio School; 1942 (May to Dec.), test course, Cdn. Gen'l. Electric, Toronto and Peterborough; 1943 (Dec. to May), instructor, elec. engrg. dept., and 1943 to date, Elect. Lieut., R.C.N.V.R., instructing in Elect'l. Artificers' course, Univ. of Alberta, Edmonton. (St. 1942.)

References: R. S. L. Wilson, W. M. Cruthers, J. W. Porteous, E. G. Cullwick, I. F. Morrison.

RICHARD—ADRIEN, of 670 Leman St., Montreal, Que. Born at Newport, Que., Sept. 21st, 1911. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1940; R.P.E. Que.; 1939-40 (summers), surveying, Provincial Government; 1941 to date, engr., heating apparatus div'n., Mongeau & Robert Co. Ltd., Montreal. (St. 1939.)

References: A. Circe, C. L. Dufort, H. Gaudefroy, J. G. Lefrancois, J. A. Kearns.

ROY—MAURICE, Major, of 76 Turnbull Ave., Quebec, Que. Born at Quebec, Que., March 4th, 1915. Educ.: B.Sc. (Civil Engrg.), Queen's Univ., 1939; 1938 (summer), Lamaque Gold Mine; 1939 (summer), plans, survey, inspection, Archer & Dufresne, consltg. engrs., Quebec; 1939-40, asst. to Ballistic Officer, D.C.I.A. (Q), proof of amm. and administration; 1940 to date, Dominion Arsenal, Quebec. (St. 1937.)

References: R. Dupuis, P. E. Gagnon, P. Vincent, G. F. St. Jacques, A. E. Laframboise, D. S. Ellis, Pierre Warren.

ROY—PHIL, of 242 Frontenac St., Kingston, Ont. Born at Ottawa, Ont., Jan. 4th, 1903. Educ.: B.Sc., Queen's Univ., 1929; 1929 (6 mos.), Dominion Bridge Co. Ltd.; 1929-32, steam plant control, elec'l. installns. and mtce., Brompton Pulp & Paper Company Ltd.; 1932-37, City of Ottawa waterworks, 6 mos. elec'l. installns. at water purification plant, 5 years mtce. and operation; last two or three years classed as chief operator of pumping and purification plant and latterly night supt.; 1937 to date, plant engr., elec'l. and mech'l. mtce., Canadian Locomotive Co. Ltd., Kingston, Ont. (St. 1928.)

References: A. Jackson, D. M. Jemmett, R. A. Low, W. Casey, W. E. Macdonald, C. E. McPherson.

SMITH—PAUL M., of Sorel, Que. Born at St. Guillaume, Que., Nov. 16th, 1916. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1942; R.P.E. Que.; 1939-40 (summers), surveying, Dept. of Roads, Que.; 1941 (summer), inspr., Quebec Streams Comm'n., 1942-43, technical ap'ticeship course (elec.), Southern Canada Power; 1943, planning engr., erection of ships, and at present, i/c elect'l. work in the drawing office, Marine Industries, Sorel. (St. 1941.)

References: J. A. Lalonde, A. Circe, R. Boucher, H. Gendron.

VALIQUETTE—PIERRE FRANCIS, of Victoriaville, Que. Born at Montreal, July 21st, 1915. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1940; R.P.E. Que.; 1940, asst. constrn. supt., Shawinigan Chemicals, Ltd.; at present, business agent, Shawinigan Water & Power Co. Ltd., Montreal, Que. (St. 1940.)

References: J. S. Whyte, H. K. Wyman, V. Jepsen, L. Trudel.

WALDRON—JOHN ROSS, Lieut., R.C.E.M.E., of Sydney, N.S. Born at Moose Jaw, Sask., Sept. 3rd, 1918. Educ.: B.Sc. (E.E.), Univ. of Man., 1943; 1936-40, engr's. 2nd and 1st helper, Hudson Bay Mining & Smelting Co., Flin Flon; 1941 (summer), instrument wk., helper to articled surveyor; 1944, Army Elec. Mtce. Officer, R.C.O.C. and R.C.E.M.E., and at present, elec. and mech. engr. (Radar) Army, No. 6 Coy., R.C.E.M.E., Sydney, N.S. (St. 1942.)

References: E. P. Fetherstonhaugh, G. H. Herriot, G. W. O'Neill, J. A. Sanger, A. E. Macdonald.

WHITE—WILLIAM BARR, Capt., R.C.E., of Lethbridge, Alta. Born at Winnipeg, Man., March 23rd, 1915. Educ.: B.Sc. (C.E.), Univ. of Man., 1937; 1936 (summer), rodman, Manitoba Govt. Surveys; with the Dominion Bridge Co., Winnipeg, as follows: 1937 (summer), detailer, 1938, dftsman. and steel detailer, and engr. on T.C.A. Hangar; 1938-41, tech. dftsman. and calculator, surveys branch, Dept. of Mines & Natural Resources, Province of Man.; 1941 (summer), Admin. and Training Officer, No. 10 Dist., Reserve Engrs. (Lieut.); 1941-42, Lieut., Sect. Cmdr., 20th Fd. Coy., R.C.E., C.A. (A); 1943-44, Wks. Officer and Camp Engr., M.D. No. 10 and Shilo Military Camp; at present, Engr. Wks. Officer and Camp Engr., 133 Internment Camp, Lethbridge, Alta., with rank of Capt. since Feb., 1944. (St. 1937.)

References: D. M. Stephens, E. Gauer, A. E. Macdonald, F. S. Adamson, E. S. Kent, G. H. Herriot, D. N. Sharpe.

WILLIS—LLOYD EVERETT, of Edmonton, Alta. Born at Edmonton, Alta., Feb. 4th, 1918. Educ.: B.Sc. (C.E.), Univ. of Alta., 1942; 1937-38, rodman, Dept. of Roads, Alberta; 1938 (summer), labourer, Jasper-Banff Highway; 1940 (summer), instru'man., topgl. survey, Dept. of National Resources; 1941 (summer), instru'man, airport layout and design, Dept. of Transport; 1942, engrg. asst., Alaska Highway; 1942-43, junior mtce. engr., D.I.L., Nobel, Ont., mtce., design, reports, etc.; 1943 to date, sapper, R.C.E., Debert, N.S. (St. 1941.)

References: R. S. L. Wilson, I. F. Morrison, A. M. Reid, R. M. Hardy.

Employment Service Bureau

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.

NOTICE

Technical personnel should not reply to any of the advertisements for situations vacant unless—

1. They are registered with the Wartime Bureau of Technical Personnel.
2. Their services are available.

A person's services are considered available only if he is—

(a) unemployed;
(b) engaged in work other than of an engineering or scientific nature;
(c) has given notice as of a definite date; or
(d) has permission from his present employer to negotiate for work elsewhere while still in the service of that employer.

Applicants will help to expedite negotiations by stating in their application whether or not they have complied with the above regulations.

SITUATIONS VACANT

CIVIL OR MECHANICAL ENGINEER wanted. See page 67 of the advertising section.

MECHANICAL ENGINEER for well-established firm in Ontario for a position combining engineering with training for supervision of field service on larger pulverized coal and stoker-fired boilers. Require written application stating age, experience and salary expected. Apply to Box No. 2810-V.

ENGINEERING DEPARTMENT of a specialty paper mill in southern Ontario requires the services of a mechanical or civil engineer with a minimum of three years' experience (not necessarily in the paper industry). Do not apply unless your services are available under regulations P.C. 246, Part III, Jan. 19, 1943, administered by the Wartime Bureau of Technical Personnel. Apply to Box No. 2816-V.

A POST-WAR PROPOSITION—An established manufacturer of steel building products contemplates post-war expansion. The situation will call for the services of a graduate engineer, preferably mechanical with production and executive experience, to act as plant and production superintendent. He must be adaptable and desirous of co-operating in the development of new products and the production of same.

Our purpose is to establish contact now with suitable applicants, on the definite understanding that the position will not be open until after the war. Apply to Box No. 2834-V.

EXPERIENCED MECHANICAL ENGINEER from 30 to 35, preferably a discharged veteran, to act as assistant manager in charge of purchases and stores for a large paper company. The position will involve the purchase of supplies, machinery and parts for five mills and an ability to write specifications and check values in different designs will be helpful. Apply to Box No. 2835-V.

SITUATIONS WANTED

MECHANICAL ENGINEER, Canadian graduate, age 45, married, with eighteen years' experience in foundry, machine shop, structural fabrication and assembly work, seeks a responsible position in this field with post-war opportunities. Accustomed to handling executive responsibilities and with a proven ability to secure the co-operation of others. Intimate knowledge of light metal fabrication. Apply to Box No. 251-W.

GRADUATE MECHANICAL ENGINEER, age 32, total of nine years good industrial experience. For past three years has been in charge of industrial engineering department in one of the larger war industries making ammunition. Familiar with process control systems, methods, time-study, training, production, personnel and employee relations work. Most interested in contacting small or medium-sized industry to do organization and development work. Available after reasonable notice. Apply to Box No. 1500-W.

GRADUATE ELECTRICAL ENGINEER with over fifteen years' experience in design, construction, operation and maintenance of electrical installations in industrial plants. Available on short notice. Registered with W.B.T.P Apply to Box No. 1718-W.

M.E.I.C., UNIVERSITY GRADUATE with manufacturing experience, mechanical and chemical processes, design and supervision, seeks temporary or part-time employment. Apply to Box No. 1878-W.

STRUCTURAL ENGINEER, M.E.I.C., R.P.E. (Ont.) desires permanent position of responsibility. Experienced in design, estimates and detail in all types fabricated steel and plate work, also reinforced concrete construction. Apply to Box No. 2208-W.

CIVIL ENGINEER, R.P.E. (Ont.) P.G. III, Toronto Graduate, Age 31, married, seven years' experience including structural engineering, traffic and mass transit study. Experienced in design, maintenance, estimates, preparation of reports and specifications, administration and supervision of construction. Possesses ability to supervise and to co-operate with others. Would consider foreign assignment. Seeks municipal position as assistant city engineer or consultant in charge of town planning and city development. Available immediately. Apply to Box No. 2466-W.

MECHANICAL ENGINEER, McGill Graduate, age 26, with four years, design and executive experience in manufacturing plants, desires position with progressive organization. Highest references from present employer. Alppy to Box No. 2467-W.

FOR SALE

One Buff and Buff transit in first class condition, 3½" needle, erecting telescope, solid silver graduation, full vertical circle. Apply to Box No. 54-S.

THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 27 | MONTREAL, NOVEMBER 1944 | NUMBER 11

"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

★ ★ ★

PUBLISHED MONTHLY BY

THE ENGINEERING INSTITUTE OF CANADA

2050 MANSFIELD STREET - MONTREAL

Price 50 cents a copy, $3.00 a year: in Canada, British Possessions, United States and Mexico. $4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, $2.00 a year. —Entered at the Post Office, Montreal, as Second Class Matter.

CONTENTS

THE MANUFACTURE OF LARGE CALIBRE CARTRIDGE CASES . . . 564
John T. Harris, M.E.I.C.

THE GROWTH OF RESEARCH IN THE BRITISH ELECTRICAL INDUSTRY . . . 570
V. Watlington, M.I.E.E.

EARTHQUAKE DAMAGE AT CORNWALL . . . 572

HOW CAN WE IMPROVE ENGINEERING EDUCATION? . . . 573
Geo. B. Langford, Ph.D., F.R.S.C., M.C.I.M.

NUTRITION IN RELATION TO EFFICIENCY . . . 576
K. E. Dowd, M.D., F.A.C.S.

"PORTABLE" INVASION HARBOUR . . . 581

FROM MONTH TO MONTH . . . 582

PROPOSED AGREEMENT WITH QUEBEC CORPORATION . . . 585

PERSONALS . . . 591

OBITUARIES . . . 592

NEWS OF THE BRANCHES . . . 594

LIBRARY NOTES . . . 597

PRELIMINARY NOTICE . . . 599

EMPLOYMENT SERVICE . . . 603

COVER PICTURE

Some idea of the activity off the coast of Normandy while the invasion harbours were being assembled can be gathered from this scene. From the decks of the Canadian infantry landing ship, *H.M.C.S. Prince David,* can be seen barges, harbour craft, tugs, landing craft, the breakwater of sunken merchant ships and sections of the "portable" harbour which have already been moved into position. (*R.C.N. Photo by Photographer Thorndick, R.C.N.V.R.*)

THE MANUFACTURE OF LARGE CALIBRE CARTRIDGE CASES

JOHN T. HARRIS, M.E.I.C.
Plant Engineer, Munitions Department, Dominion Bridge Company Limited, Toronto

The purpose of this paper is to explain, in a general way, the method used in manufacturing large calibre brass cartridge cases in Canada.

Ammunition for large calibre guns is of two main classes: fixed, and unfixed. In fixed ammunition, the complete round consists of a brass cartridge case, which holds the propelling charge, and a projectile, which is inserted tightly in the mouth of the cartridge case; the whole is handled as one unit.

In unfixed ammunition, the cartridge case is one unit, and the projectile is another, each being loaded into the gun separately. It will be seen later how this affects manufacture.

There is also another type for very large guns, which has no cartridge case, but utilizes the breech of the gun to hold the propellant, the latter being contained in silk bags. This last type will not be discussed, as this article is concerned only with the cartridge case proper.

Figure 1 shows a typical fixed assembled round. The primer in the base contains explosive, which detonates upon being struck by the striker in the firing mechanism of the gun. This explosion is transmitted through the magazine, and explodes the main propellant charge in the cartridge case, which, in turn, drives the projectile through the gun barrel—where rifling starts it spinning for greater accuracy—and thence through the atmosphere to the object at which it was aimed. After firing, the cartridge case remains in the gun breech, from which it is extracted by mechanism actuated by the recoil of the gun.

General Requirements

In order to serve its purpose, a cartridge case must have certain properties. First, it must fit the breech of the gun. The force of the firing explosion expands the case to the full limits of the size of the breech, thus preventing any escape of gas. This is known as "obturation". The breech of the gun then takes the load, but the cartridge case must be so proportioned that this expansion takes place within the elastic limit of the brass, which must then contract to allow of easy extraction. The hole containing the primer must not deform enough to cause difficulty in removing a used primer after firing, as cases may have to be used several times without reforming. The inside of the case must be perfectly smooth. Any roughness or pits on the inside cause rapid deterioration of the brass, as gas under high pressure will get into these surface imperfections and cause extra stresses in the metal. The cartridge case must also be made of a material that will retain its original properties for long periods of time.

Brass will satisfy these conditions when properly worked, and this, coupled with its comparative ease of working, makes it a very suitable metal for cartridge cases. The brass used is known as 70-30; that is, 70 parts copper to 30 parts zinc, including a small percentage of other impurities. The metal is rolled into strips at the mill, and discs are punched (or "blanked") to correct size; these discs form the starting point in the drawing of cartridge cases.

The process of drawing, particularly in the case under discussion, consists of elongating hollow cylinders by displacement of metal, at the expense of thickness. In deep drawing, a punch and a die are used in a press, and as the punch moves through the die, the brass is squeezed up the punch ahead of the die, thus forming the walls of the case. The action of drawing brass works the metal, and breaks up the grains in the structure of the metal, hardening it. The amount of hardness obtained depends upon the amount of metal displaced, and therefore, the amount of work done. Figure 2 shows the various stages in the manufacture of a 3.7 Mk. I cartridge case, from the disc to the finished case.

Presses, Punches and Dies

The presses used are of the hydraulic type, having a self-contained power unit, consisting of electrically driven rotary piston pumps, which deliver oil at a pressure of 2,500 lb. per sq. in. to the main ram. Unlike mechanical presses, hydraulic presses can be regulated to give a predetermined working load, which will automatically build up (within the press capacity), or decrease, as the work required demands. They are so designed that there is no pressure exerted before the tool is in contact with the piece to be drawn. Thus, there is little or no impact, as, of course, there would be with a crank operated press. The ram operates directly on a guided moving crosshead, upon which the punch is mounted. The base of the press carries the pot, which holds the die. The latter is set concentric with the punch to give an even draw on the walls. Figure 3 is a diagrammatic view of such a press set up, showing the tools in place, with a draw in position to be worked. The "tonnage" or force required varies with the size and length of the draw, as may be noted from Fig. 2.

Punches and dies are made from tool steel, hardened and ground to size and shape, and then polished to a mirror finish by hand. It has been found that the useful life of draw tools can be increased up to five times by hard chrome plating. This is deposited electrically on a highly polished tool, to a sufficient thickness to allow of a final polishing, and to leave about 0.0015 in. thickness of plating at the finish.

Opinions differ as to the relative merits of the various tool steels used for draw tools. Nevertheless, a steel having an analysis of carbon 0.9, manganese 1.15, chromium 0.5, and tungsten 0.5, hardened and quenched in oil to give a Rockwell reading of 55 to 60 points, makes a very satisfactory punch, with a long-wear life, provided that the screwed end is drawn back to increase its toughness, so as to prevent this comparatively weak section from breaking in use.

For draw dies, a steel containing 1.2 carbon, 0.25 manganese, and 0.5 chromium, hardened and quenched by running water through the hole in the die, has proved

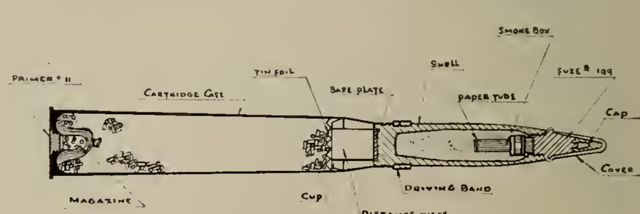


Fig. 1—Fixed round.

very useful. Quenching from the "inside" makes the die hard where it is subject to wear, and leaves a softer, tougher outside to resist bursting. Dies, in particular, show a marked increase in wear life with hard chrome plating, which also gives a smoother and cleaner draw.

In drawing brass, it is necessary to use a liquid to lubricate and cool the tools. A soluble oil, mixed with water, makes a satisfactory compound. The strengh of the mixture varies with the length of the draw—a long draw needing a richer mixture—and the method of application. Two methods are used. The product can be dipped in the compound, in which case the latter should be about 50-50 oil and water. The other method is flood lubrication, in which the compound is pumped continually through pipes on to the work, and drained into a sump, from which it is recirculated. If flooded, the mixture can be much thinner, about one part of oil to two of water.

Before further working can take place on the brass which has been hardened by drawing, the metal must be given suitable heat-treatment, by annealing, to restore its grain structure.

If the drawing compound is allowed to remain on the case during annealing, it becomes baked on, and is extremely difficult to remove, so an alkaline wash is used in a washing machine.

Washing and Annealing

A washing machine consists of two chambers. In the first, the alkaline solution is sprayed on to the draws, which are moved through the chambers on a chain link conveyor. In the second chamber, a hot water spray is used to remove any remaining alkali. Both liquids are heated to about 150 deg. F. by thermostatically controlled steam in coils, and the conveyor travels at ten

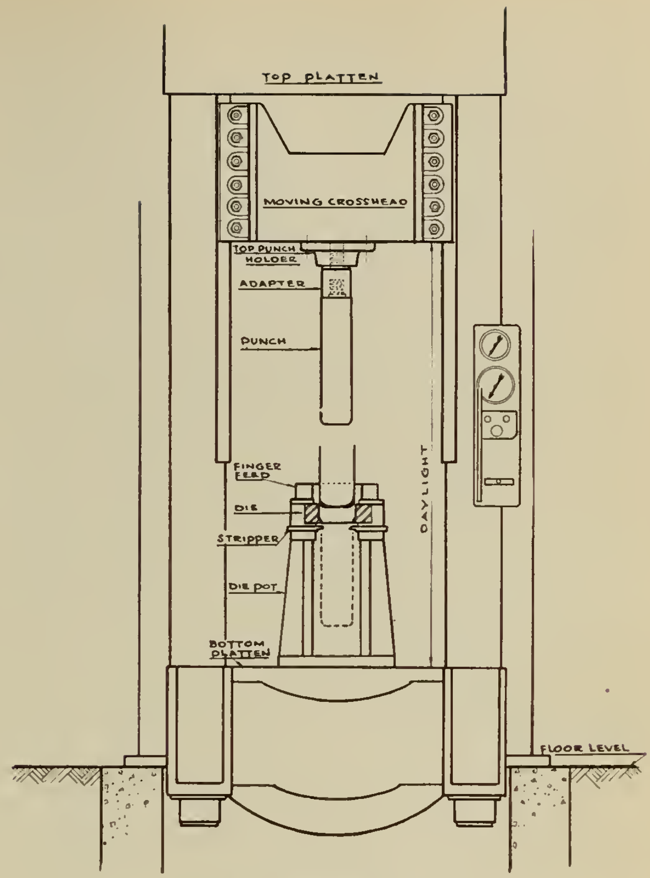


Fig. 3—Drawing a case.

feet per minute, this giving sufficient time to clean the draw.

The annealing furnace performs the next operation. In annealing, new grains are formed in the drawn metal. The time and temperature of this process depend on the weight of brass, and the amount of work which has been done on the metal. The more work done, the less time taken to grow grains. A temperature of 1,100 deg. F. for sixty minutes grows grains 0.08 to 0.09 mm in size, and the draws will have a hardness of 55-65 Vickers points, which is a satisfactory state in which to redraw the brass.

Furnaces for full annealing are fired by light fuel oil, through burners which have motorized valves to control the fuel supply. These valves in turn are regulated thermostatically by electric pyrometers, thus keeping the heat at any predetermined level. Pyrometers are actuated by thermocouples, which are placed as close to the product as possible, as it is obviously important to know the temperature of the brass itself, and not necessarily that of the furnace. Any difference between the temperature of the brass, and that shown on the pyrometer must be ascertained, and due allowance made in order to obtain satisfactory annealing.

The flame from the burner heats a refractory hearth, above which the product is moved. This separation reduces the deposit of products of combustion (mostly carbon) on the brass, which is very desirable, as such deposit must be removed before the case is redrawn.

The furnace proper consists of a heating chamber, and a quenching chamber. Roller rails run through both of these to carry the trays of draws, and extend beyond at both ends. A tray is loaded with draws on the roller extension at the front end. At the proper time, furnace doors at both ends are opened, and the loaded tray is pushed in, thus moving a heated tray from the furnace

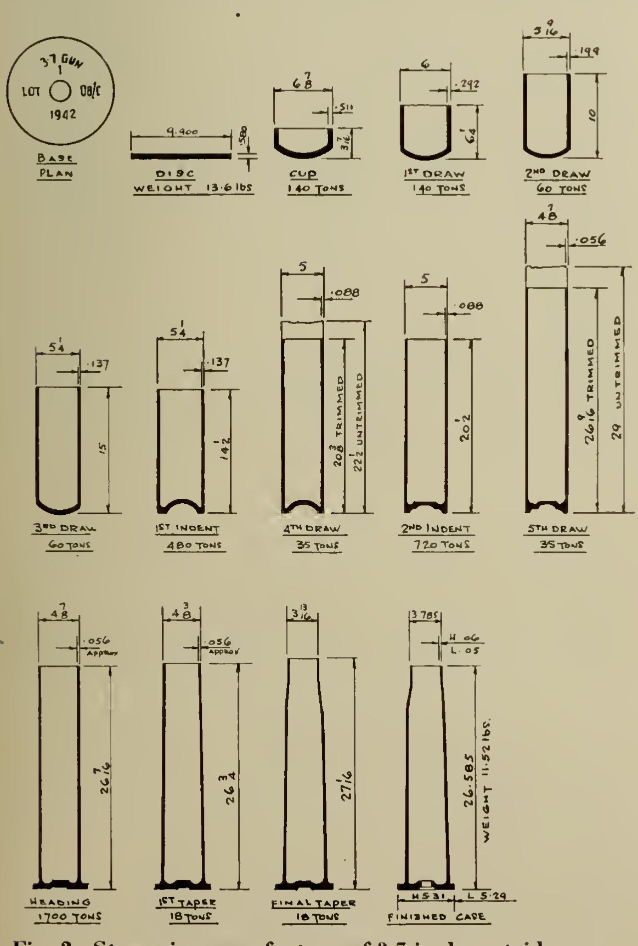


Fig. 2—Stages in manufacture of 3.7 inch cartridge case.

into the quenching chamber. Doors are then closed, and water at the spray heads turned on, thus quenching the tray of brass. This is only to cool the draws for ease of handling, and does not affect the hardness of the case. It can readily be seen that knowing the time required to anneal, the number of trays in the furnace (in one line) at any one time, the number of "pushes", and the times at which they occur can be calculated to give the requisite total time to properly anneal.

Carbon on the draws after anneal, particularly when mixed with the drawing compound, forms a cutting agent which scores punches and dies, and spoils them for future use, so products of combustion are removed by pickling. After quenching the draws are therefore passed through a washing machine for this purpose.

The acid washing machines have three rubber lined compartments. In the first one, the brass is sprayed with a solution of from 2½ to 5 per cent sulphuric acid in water at a temperature of 150 deg. F., this solution being recirculated by rubber lined pumps. The spray in the second compartment is recirculated water at about the same temperature, to remove the acid which may remain on the brass from the first operation. In the final compartment there is a spray of cold water. The product is then placed in stainless steel baskets, moved through the machine on a conveyor made up of rubber covered stainless steel ropes. Acid solution and water are heated by thermostatically controlled steam in lead coils.

The time of washing is largely a matter of experience —the idea being to get a clean case without etching by the acid. Moving at about ten feet per minute, the draws would remain in the acid solution for about a minute, and this has been found to give a satisfactory result. Acid will not remove grease or oil, but this has already been removed by the alkali wash before anneal, so the case is now ready to proceed to the next draw.

It will be seen from the foregoing that the cycle of operations necessary to cold-draw brass is firstly, draw; then wash with alkaline solution to remove grease and drawing compound; anneal to regrow grains and restore the plastic state of the metal; and lastly, wash in acid solution to remove the products of combustion. This cycle is repeated each time a draw is made, if the case has to have further drawing.

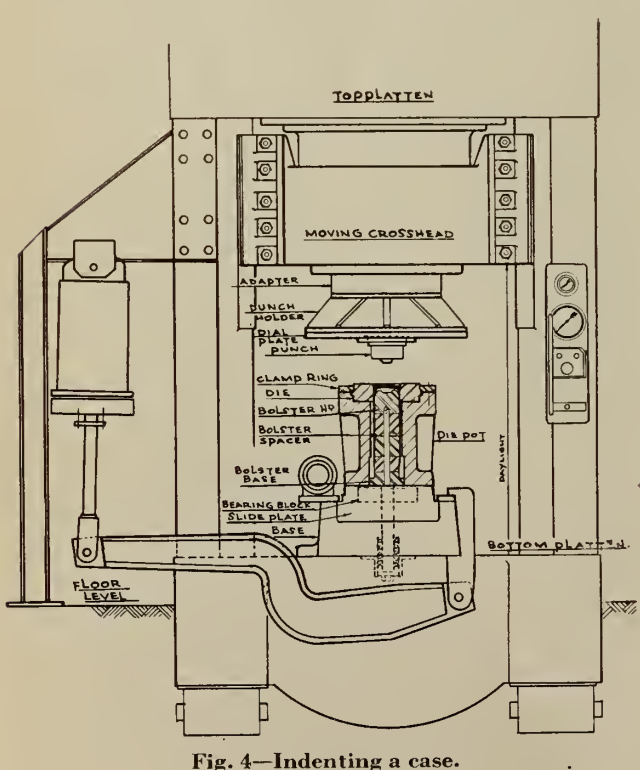


Fig. 4—Indenting a case.

Indenting and Trimming

The number of draws required depends on the length and thickness of the walls of the case. The base and primer boss are formed by heading. In order to leave enough metal in the base to head, indenting is introduced after one or more of the earlier draws. Its object is so to bend or displace the metal so that it will not be drawn up the sides of the case, and to place it in such a position that in the heading operations it is moved or worked to give the required hardness (or strength) in the finished base.

The process of indenting is illustrated in Fig. 4. The press tools required consist of a punch to move the metal with pressure, a bolster head to fit and so form the inside, and a die to prevent the draw from spreading under load. The "tonnage" or force required is ascertained by trial on the particular indent in question. It is not necessary to anneal before indent, as there is very little work done on the base in drawing, and it is still in a workable state. The actual hardness of the indented base has very little effect on the hardness of the finished base, because the result of work is destroyed in subsequent annealing. When a large number of draws are made, it is sometimes found necessary to have two indents, spaced after appropriate draws to give the necessary form for heading.

During the drawing operations, the damaged or diseased metal, caused through blanking the disc, is trimmed off, at the same time squaring up the end of the draw. If tools are not set concentrically, one side of the case is drawn longer than the other (known as a lip), and this condition presents difficulties in the next drawing operation. Unequal loading tends to destroy the alignment of the tools, and thus aggravate this condition.

Trimming machines have a spindle revolving at about 300 r.p.m., on which is screwed a mandrel, which fits the inside of the draw, and incorporates a hardened back cutter set to cut the draw to the proper length. A free running wheel with a cutting edge is pressed against the revolving case in line with this back cutter, thus shearing the metal. This type of trimmer will handle metal up to ⅛ in. thick. To cut metal thicker than this requires what is known as an open mouth trimmer. This has a hollow, revolving head, with a chuck, into which the draw is placed, mouth out, and it is trimmed with an ordinary parting tool held in a conventional cross slide to feed the tool to the work.

Heading

Cases are headed after the final draw without further annealing. As considerable pressure is required in this operation, any dirt or grease left inside the draw would be pressed into the metal, and this is almost impossible to remove by ordinary methods. To be sure that the inside of the case is clean, it is steamed on the inside before heading—the heat and the blast of steam effectively removing the foreign matter. For the sake of speed, the cases are then cooled with a cold water spray, and then blown dry with compressed air, as water on the inside of the case would be trapped in the heading, and cause marks or indentations on the inside of the finished case.

The heading tools required are similar to those for indenting, namely, a punch, a die, and a bolster assembly. In some cases, it is found necessary to have two

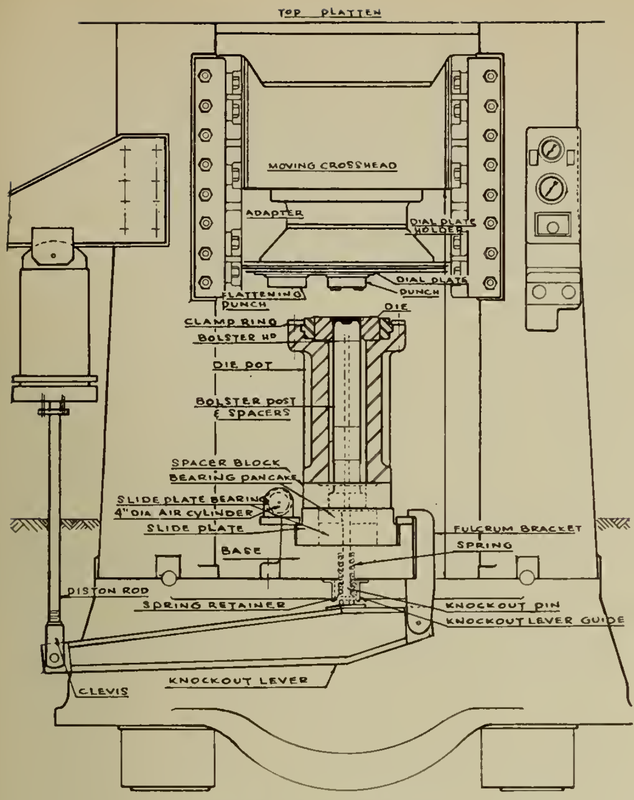


Fig. 5—Heading a case.

punch operations, a punch to cause the metal to flow to fit the inside profile, and a flattening punch to form the head or flange that is used to extract the spent cartridge from the gun. Reference to Fig. 5 shows this set-up.

To remove the headed case from the die takes considerable force. An air cylinder of five tons capacity at 100 p.s.i. working through a leverage of 5½ to 1 is used to push against the base of the post carrying the bolster head. This pushes the draw out of the die, after which its extraction can be completed by the operator, who uses a lifter shaped like a horseshoe, which fits under the newly formed flange, to lift out the case by hand.

The same practice is followed at the indent, but as there is no flange in this case, a lifter consisting of a hinged split ring with two extended handles is used. The operator places the lifter on the case, squeezes it tight by gripping the two handles together, and so lifts out the case.

Both for indenting and heading in continuous operation, a slide base, having a hardened steel block at its centre, is fastened across the base of the press. A moving slide, running in this base, carries two pots, each pot containing a die and a bolster head assembly. When up against a stop provided, one pot (and, therefore, the die and bolster) is in register with the punch and the centre line of the press. In this position, the assembly is directly over the steel block in the centre of the slide base, which transfers the pressure applied by the ram through itself to the base of the press. At the same time, the other pot is in register with a pin in the slide base, which is actuated by the knockout lever to push the case out of the die. A similar knockout is assembled at the other end of the slide base. So it can be seen that while a case is being headed (or indented, as the case may be), another case is being expelled from its die, which is then reloaded. An air cylinder moves the slide with its two pots to the opposite end of the base, thus bringing the re-loaded pot into position for heading, and the pot containing the headed case over the knockout, which removes the case, enabling another draw to be loaded into this pot. Thus, continuous operation is provided for and the process is known as a shuttle feed.

Punches, dies and bolsters for heading and indenting should be made of tool steel to stand high pressure. An analysis of carbon 1.5; manganese 0.30; chromium 12.0, molybdenum 0.80; vanadium 0.25; is found satisfactory.

Tapering

It is undesirable to interfere with the hardness of the base after heading by full annealing, so to prepare the case for tapering, a wall anneal is used, softening the walls only far enough down to allow the movement of metal in tapering.

A tunnel furnace is used for this operation. The machine consists of a refractory "tunnel", on the side walls of which are placed coal gas burners with overlapping flames so as to provide an even heating. The cases are conveyed on separate trays attached to a moving chain by vertical spindles. To further ensure an even anneal, these trays are revolved while in the flames, by means of a sprocket attached to each tray spindle, which engages with a suitable rack. At the end of the furnace, water spray quenching is provided to cool the hot cases quickly for ease in handling. After wall anneal, the cases are pickled in acid solution in the usual way to remove any products of combustion that may be present.

It will be seen from Fig. 6 that tapering is accomplished by setting the case on its base in a horseshoe guide at the lower end of the press. A cast pot, lined with hardened steel chrome plated inserts is brought down by the press on the previously lubricated case, which squeezes the walls in, to take the required tapered shape. When the press reaches the limit of travel, it automatically builds up pressure, and reverses itself, pulling the pot off the case, which is held fast by the horseshoe guide, part of which fits over the flange of the case. Considerable work is required from the press in order to strip the tapering dies from the case, and this at the moment of reversal, or in other words, when motion of the ram is zero. (work = load x distance). To overcome this, a spring loaded platform was developed, the spring being compressed by the pressure of the down stroke. The stored up energy, or resilience of this spring, liberated at the point of reversal—(that is, zero pressure and zero motion)—sets the ram in motion upwards, and relieves the hydraulic pumps of the task of moving the ram under adverse loaded conditions. The spring, of course, was designed to absorb the tonnage required to taper the case.

In unfixed ammunition, the cartridge case usually has very little neck, and one tapering operation is usually sufficient to form it.

Fixed ammunition, on the other hand, is generally necked down at the mouth to fit the shell, requiring a second taper, with a wall anneal in between. Then the mouth of the case must be annealed in order that the case may be crimped on the shell. This latter is part of the assembly of the round, and is performed at the filling plant. The displaced metal in tapering is taken up by a decided thickening of the walls, and a slight increase in the length of the case.

Forming the Primer Hole

Now we come to base turning and forming the primer hole. A turret lathe with a hollow head, fitted with an air-operated collet chuck, is used. Details of the hole

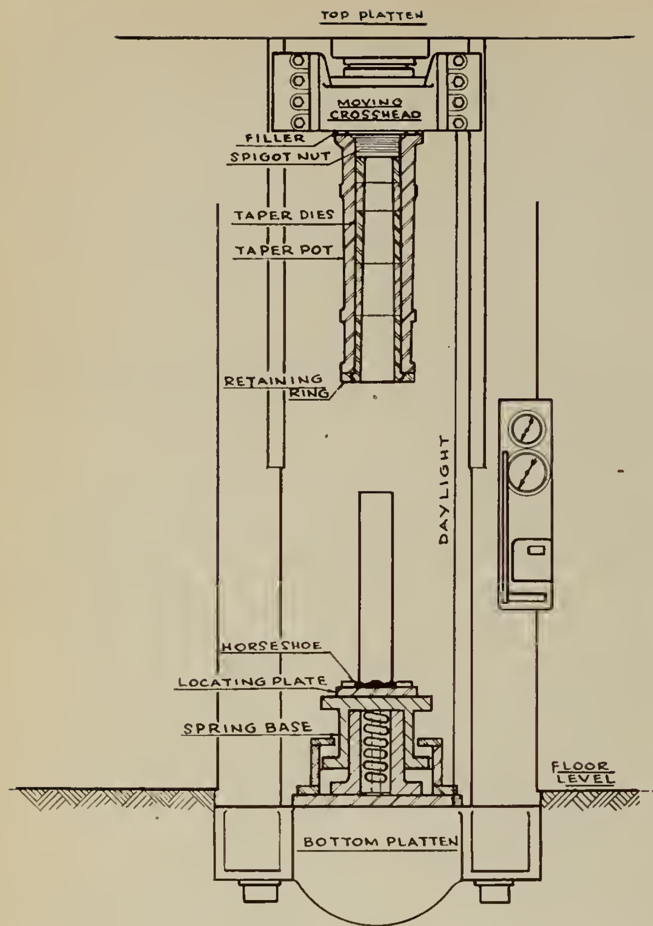


Fig. 6—Tapering.

are shown in Fig. 7. In operation, the case is inserted in the chuck, mouth first, and pushed by means of a wooden plug in the turret up against a stop, which, in turn, is connected by a rod to a small air cylinder at the back of the lathe. This, in its rear position, forms the aforesaid stop—(to position the case with relation to the other tools), and when the case is finished, the air cylinder moves the whole assembly forward, and ejects the case from the chuck. With the case in position against the stop, the collet chuck is collapsed by compressed air, and the lathe is run at about 525 r.p.m. The first turret tool, a drill, is brought into action, and a hole is drilled in the centre of the case. Then the cross slide is fed across the face of the base, and takes a cut. At the right time, and in the same movement, the profile tool is fed against the flange, and cuts the profile on the flange, and cleans up under the head. When the slide is backed out, the facing tool takes a very fine cut to finish, this being caused by the spring in the tool. The turret is now revolved "one hole", bringing the reamer into play. Fed into the previously drilled hole in the case, the reamer cuts the recess at the head, reams the hole to size for tapping, and starts to size the plain part at the back of the hole. The "wings" form an effective stop to limit the depth of cut. and ensure the hole being the right dimensions. They also "tramp down" the burr. The next turret tool is advanced. It consists of a boring bar with two small cutters in its side. When brought into contact with the sides of the primer hole, one cutter cuts a groove where the end of the thread will come, and the other tool removes the burr at the far end, previously caused by the drill. Next comes the collapsible tap to cut the thread, necessary because the machine is not stopped after threading, and reversed in order to run the tap out again. The chasers of this tap are separate, and are held in place by a spring while tapping, and are released when a stop comes in contact with the case. The final tool in the turret reams the back part of the primer hole to size. This completes the work on the base. At the other end of the lathe head is a tool, which, when fed into the mouth of the case, bores the diameter (if the case in question is of the fixed ammunition type), and the tool on the side trims the case to length. Once again the spring of the tool allows a slight cut on its withdrawal.

All tools are lubricated with a compound of soluble oil and water.

The lathe is fitted with a swinging head, operated by an air cylinder, which swings the head of the case out past the tools. If this feature were not included, it would mean that the turret would have to be moved away back on its slide in order to insert and remove the long case, thus losing valuable time. The air cylinder on the knockout is now brought into play, ejecting the case. A new case is put in the chuck, the lathe head swings back into its position on the centre line of the lathe, and the work carries on.

The case is now given a thorough degreasing, either through a washing machine (previously described), or through a similar machine, in which the case is given a vapour bath of tri-chlorethylene.

In Fig. 2 a complete line-up of draws, indents and heading, with their dimensions, has been given; the press tonnages are stated for the various draws; also the length of trim, and the weights of the disc and the finished case.

Inspection and Stress Relief

The next process is a complete dimensional inspection. This is accomplished by the use of suitable gauges made to "go" and "no go", to keep the size of the case within the tolerances allowed. The thread in the primer is checked for pitch with a screw gauge, the internal diameter of thread is checked with a plug gauge. Diameter and depth of recess calls for another plug gauge with limits. Snap (or horseshoe) gauges are used to check diameters of flange, underhead, etc. The diameter of the mouth is approved with a large plug gauge, and the thickness of metal at various places is checked with "go" and "no go" gauges designed for the purpose. Thickness of base, length of primer boss, thickness of flange, are all checked, and finally the case is put into the chamber gauge. This is so dimensioned as to ensure the easy fitting of the cartridge case into the breech of the gun. Any defective pieces, (including metallic defects) are removed at this stage, and the cases are ready for stress relief.

The stress relief furnace is similar to the full annealing furnaces described earlier, except the heat is produced by electric elements under the hearth (instead of oil burners), and the heated air is kept circulating by blowers or fans to make sure of an even temperature throughout. One hundred minutes (100) at 480 deg. F. is sufficient to let loose locked up stresses that may remain in the case due to working. In stress relief, a

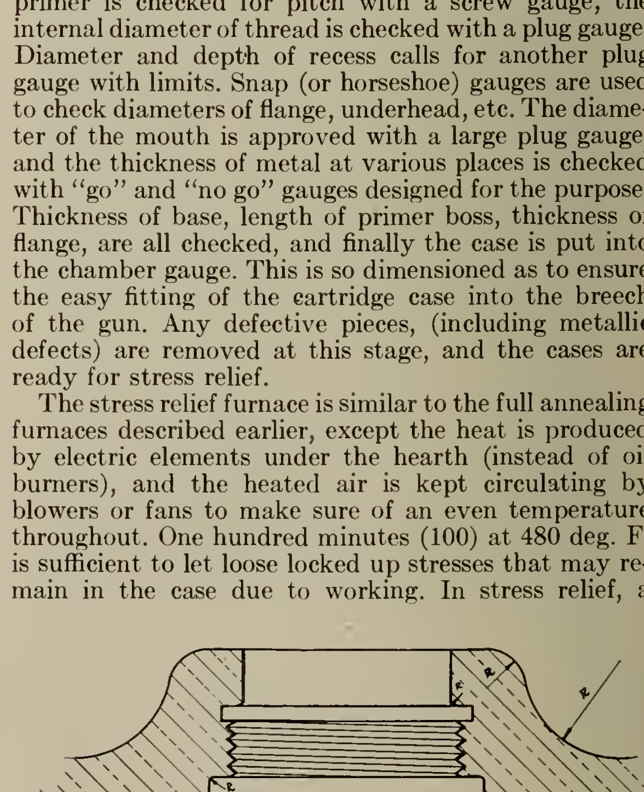


Fig. 7—Details of finished primer hole.

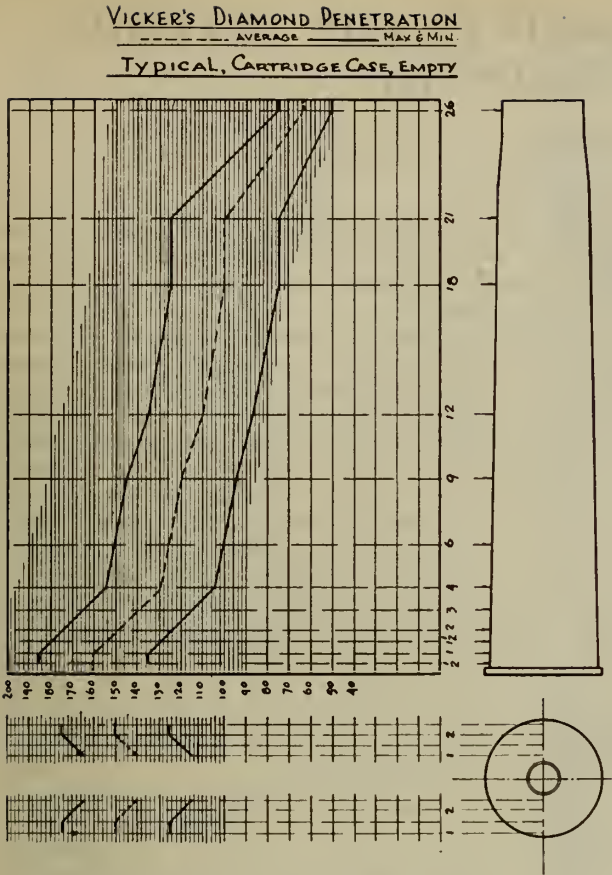


Fig. 8—Permissible hardness in metal of case.

slight rise in the hardness of the case on the thin walls may be expected, but the thicker metal in the base, and around the primer hole, is not affected.

After stress relief (sometimes termed low temperature anneal, or L.T.A.), the cases are cleaned by pickling, and then buffed. Machines with revolving, double ended spindles are used forthis purpose. The spindles are covered along the length and ends with hard felt, and a 50-50 mixture of MacConnesville sand and hardwood sawdust is used dry as the cleaning agent. Some of this mixture is put inside the case, which is then placed on the spindle and worked to clean the inside. The operator, with heavy gloves, cleans the outside with a handful of sand and sawdust.

The product is now ready for final inspection, and acceptance by the Government. Here they are 100 per cent inspected as to size, shape, and examined for metallic defects. A firing test is picked out—the number of cases selected being set by Government specifications—and these cases are tested for hardness.

Hardness Tests

Hardness is a measure of tensile strength, and in order to satisfy conditions mentioned before, the hardness on a case varies. Figure 8 shows a cartridge case with typical hardness curve. It will be noticed that the base end of the case is the hardest, being, of course, that part which receives the greatest punishment in firing.

In order to find the hardness of cases, a machine, known as the Vickers Hardness Testing Machine, has been developed in England, and all British readings are given in Vickers Hardness Numbers—(V.P.N.)

Intrinsically, the machine consists of a diamond point, which, when automatically loaded—in this case with 10 kgs—makes an impression in the brass which can be measured with a microscope attached to the machine, and this measurement—or number—gives the comparative hardness of the brass. The Vickers machine is used in preference to other methods of hardness testing, as the indentation made is very small, and does not materially affect the cartridge case, whereas if a large indentation were made, the tested case would be damaged, and would be of no further use as ammunition.

Cases are also tested to determine the effect of age. The cases are immersed in a solution of mercurous nitrate for fifteen minutes, and then allowed to stand for twenty-four hours. The deposit of mercury, which ensues, forms an amalgam with the brass, thus forming a substance much weaker than the original brass. This, of course, will not offer the same resistance to any locked in stresses that may remain, and these stresses will show themselves to be present by cracking the case. Of course, there must be no cracks during the twenty-four hour period mentioned before, equal to three years of age.

After final inspection, the cases are marked on the base with a designating description, a lot number, the manufacturer's insignia, and the year of manufacture, by placing the case on a mandrel, which is pushed up against a steel roller having on it the various marks. A small air cylinder keeps the mandrel pressed against the roller, while the latter is rolled across the base of the case. After being stamped with the acceptance mark, the cases are ready to be shipped for filling and assembly.

In conclusion, Fig. 9 shows a typical flow sheet of the whole process of manufacturing brass cartridge cases in Canada, in World War II.

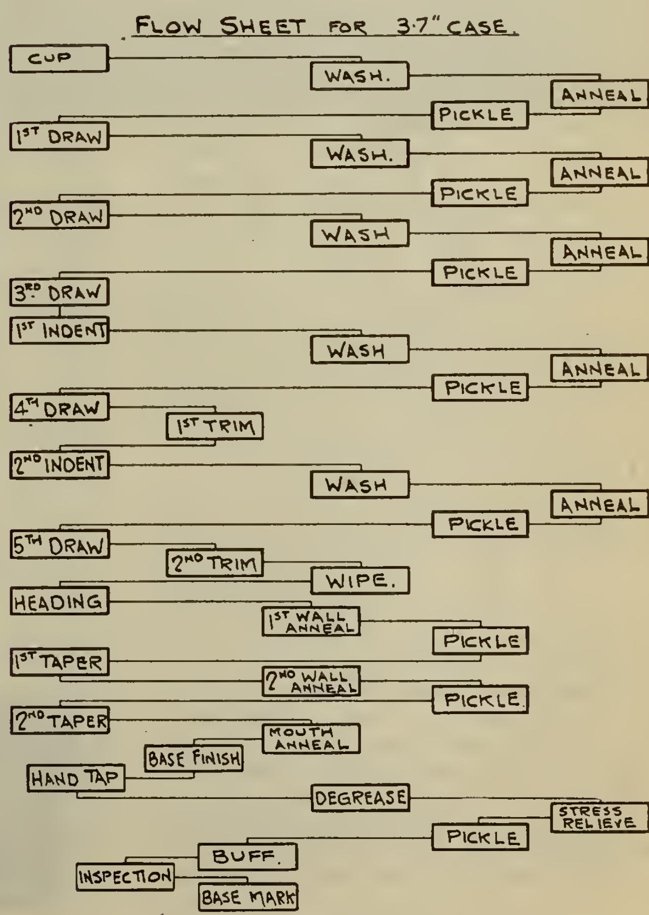


Fig. 9—Flow sheet for 3.7 case.

THE GROWTH OF RESEARCH IN THE BRITISH ELECTRICAL INDUSTRY

V. WATLINGTON, M.I.E.E.
Director, The British Electrical and Allied Manufacturers' Association

Until the power and possibilities of electricity began to command the concentrated attention of scientists, research, as we understand the term to-day, had little to do with the progress of industry. The great engineering concerns of the North—home of the millwrights and iron smelters, of the Maudslays, of Watt and Stephenson and many other famous pioneers— were often founded by men who worked in their shirt-sleeves at bench or forge, took their orders in person, and kept their accounts in little notebooks. Nasmyth, inventor of the steam hammer and originator of automatic tools, worked thus in Henry Maudslay's modest machine-shop; and in still earlier days the small skilled class of millwrights executed every kind of engineering operation, from making the wooden patterns to erecting the engines which had been constructed by their own hands.

With the dawn of the electrical age, however, men had to deal with a force so mysterious in its phenomena, so bewildering as wonder after wonder emerged from its application to human affairs, that investigation and exploration became essential to its development, and electrical research, gaining its most powerful stimulus from Faraday's untiring genius, lagging at first behind the growing industry, at last outstripped it and led the way to fresh triumphs. Before Faraday's time many others had examined, experimented, discovered, recorded; but it was left to him to make the fundamental experiments and with infinite perseverance and extraordinary insight to deduce from them the principles of electrical action on which the whole modern electrical industry is based. In his laboratory at the Royal Institution, London, with apparatus so simple and equipment so primitive that a schoolboy of to-day might smile at it, we see the prototype of all the elaborate electrical laboratories of the world.

Years had yet to pass, the industry had to establish itself, before the need for research on a large scale was regarded seriously. Individual firms, many of which, as in the preceding age, had been founded by practical men, carried on their own simple advances in the scientific field, their object being in the main technical development as an aid to manufacturing progress; and here we may note that the line between technical development and research is sometimes difficult to draw. Professors and teachers of electrical engineering did their best with deplorably inadequate facilities. Ayrton borrowed a neighbouring cellar to contain some of his apparatus when he founded that celebrated training centre, the City and Guilds of London Institute, in 1880. Kelvin's first laboratory at Glasgow had, to use his own words, "absolutely no provision of any kind for experimental investigation or for students' practical work." Sir Ambrose Fleming relates that all the accommodation he had when in 1884 he became professor of electrical engineering at University College, London, was "a piece of chalk and a blackboard", until a grant of £150 enabled him to obtain "a gas-engine, a storage battery, and one small apartment as a laboratory and another as a lecture room."

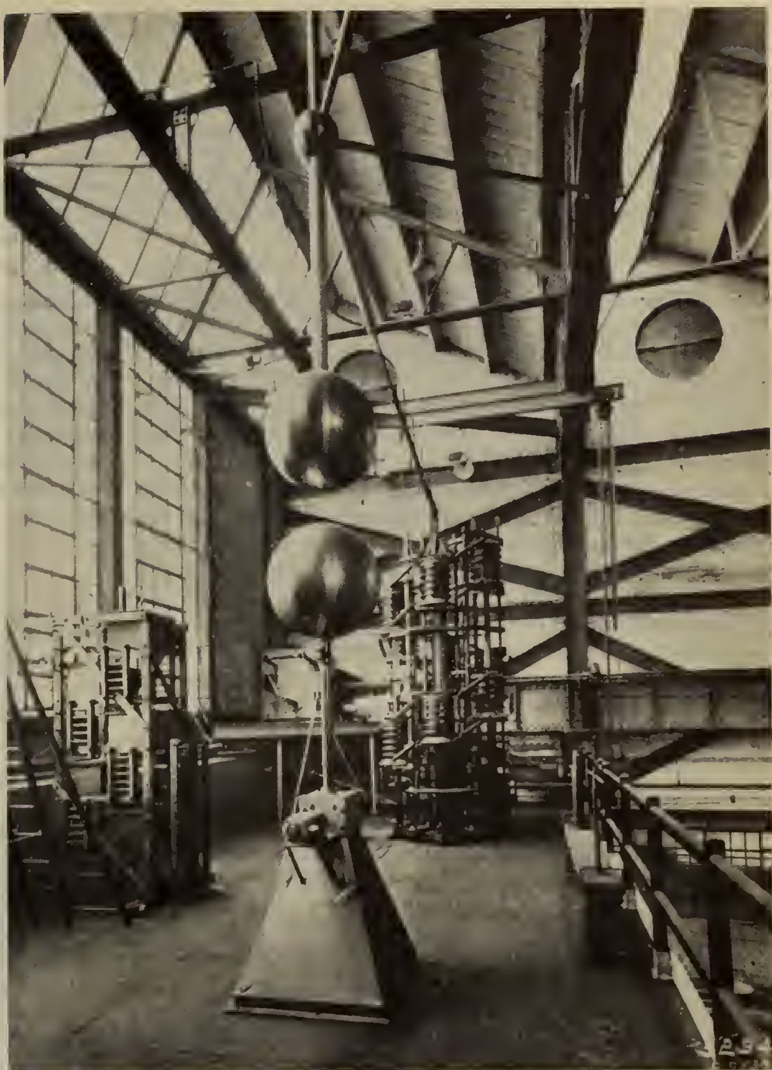
As knowledge grew and wisdom—which is not always the same thing—reinforced it, we might almost say that research, of a sort, became the fashion, but often in industrial concerns what was called the "Research Department" was little more than a testing laboratory for raw materials. Such activities do not represent scientific research; the real research laboratory is free of routine testing and process problems, and has a long-term policy of investigation. That high standard of research, constantly contributing fresh knowledge to the scientific industrial field, is carried on by many firms to-day. The research departments of large electrical firms such as The General Electric Co. Ltd., Metropolitan-Vickers Electrical Co. Ltd., The British Thomson-Houston Co. Ltd., The English Electric Co. Ltd., are outstanding examples of this enterprise in the electrical engineering industry, well known throughout the world; and several others might be mentioned.

The war of 1914-1918 gave a great stimulus to research of all kinds. In 1915 the British Government created its Department of Scientific and Industrial Research, which set up Research Boards for the purpose of advising on problems of national importance that could not be dealt with by other bodies. The Fuel

Faraday's magnet and disc, 1831.

Research Board and the Food Investigation Board are examples. The National Physical Laboratory became part of the new Department in 1918, but its scientific direction by an executive committee appointed by the Royal Society was left undisturbed. A fund of £1,000,000, in addition to the normal yearly estimates, was voted by Parliament for the assistance of research carried on by industrial research associations; these associations, formed by representative groups of manufacturers desiring to undertake investigations for the benefit of their own branch of industry, are aided financially by a grant, usually for a five-year period, proportioned to the amount contributed by the industry itself. Each of these associations is self-governing and responsible for its own programme.

The British Electrical and Allied Industries Research Association, formed in 1917, is one of the most active and influential of these bodies, and has grown from small beginnings into an integral part of the industry, with a modern and finely-equipped laboratory staffed by specialists in the various sections. The electrical industry is unique in one respect: its ramifications extend to practically every other industry and are the mainstay of many. There was a time when the brain of one man could master the sum of electrical knowledge; to-day a lifetime may be spent in the study of one of its branches. Therefore we find an astonishing number of subjects coming within the scope of electrical research. Some of these, such as insulation and insulating materials, have been the theme of study for very many years. The reason is easily understood; transmission pressures have grown from a few hundred volts to the 132,000 volt of the British Grid, and still higher pressures are in use. Obviously such a development must react on the whole question of insulation and control; thus in parallel with improved insulating practice proceeds the research which concentrates on cables and overhead conductors, and the equally important research concerned with circuit-breakers, switchgear, and fusegear. All this work still goes on, while new problems continually appear which press for attention. Surge phenomena, radio interference, rural electrification, efficiency of steam power plant, and many other matters, come within the province of the British Electrical and Allied Industries Research Association, and the knowledge thus recorded and analysed has saved the industry many hundreds of thousands of pounds annually.



(Courtesy, British Thomson Houston)

A million-volt impulse generator.

Practically every university in Great Britain is closely linked with one or more of the principal industries through scientific research. The fame of the Cavendish Laboratory at Cambridge has spread around the world. Founded by a group of British scientists, financed in its building by the Duke of Devonshire, great-nephew of Henry Cavendish, and having for its aim "the best means of giving instruction to students in Physics, especially in Heat, Electricity, and Magnetism," the occupants of its Chair of Experimental Physics have been men of international repute. Clerk Maxwell, an Edinburgh man, who brought his superb mathematical skill to bear on the exposition of the theoretical problems arising from Faraday's conclusions which had been derived from practical experiments; Lord Rayleigh, an Essex man, whose long series of investigations on the fundamental electrical units and the establishment of standard electrical values formed a store of information serving as the basis for other researches of equal importance; Sir J. J. Thomson, a Manchester man, exploring the strange new world of the infinitely small, and discovering the elusive electron; Lord Rutherford, a New Zealand man, journeying even farther than Thomson into that realm of the remote and minute; these clear-minded intellectual giants, happy, homely men in their private lives, opened page after page of the book of science to our wondering gaze.

It is inspiring to look back upon great names and great deeds; bearing them in mind, we can harbour no misgivings as to the future. Scientific research suggested at one time a mental picture of grey-beards peering into crucibles and intent upon profitless experiments of interest only to themselves; but to-day youth is vigorously engaged in discovering nature's secrets, providing new knowledge that brings a broadened basis for enquiry, a field for fresh endeavour, in which, as in the past, distinguished leaders will continue to maintain this country's traditions.

EARTHQUAKE DAMAGE AT CORNWALL

NOTE:—The following is an abstract from the report on earthquake damage at Cornwall, prepared by Robert F. Legget, M.E.I.C., for *Engineering News-Record*, where it appeared on September 14th. It is published here through the courtesy of the editors of ENR.

One of the heaviest earthquake shocks ever recorded in the northeastern part of the continent caused damage estimated at almost one million dollars in Cornwall, Ont., on September 5th. Although the shock was severe throughout a wide area any noticeable damage seems to have been restricted to the immediate vicinity of Cornwall, where 90 per cent of the town's chimney stacks were either demolished or cracked.

Geologically, Cornwall is somewhat removed from the stretch of pre-Cambrian rocks that cross the St. Lawrence in the vicinity of the Thousand Islands, being located above an Ordovician formation, but founded on overlying sediments, chiefly sandy in nature. Foundation conditions are described locally as "poor" and settlements of some of the larger buildings are quite noticeable, one or two having had to be left in an uncompleted state. The worst earthquake damage is centred around an area where the sub-soil is described by local builders as "quicksand".

Much of the total extent of the damage done is made up of broken chimney stacks. Some stacks were fractured on a horizontal plane and then rotated through about 45 deg. This strangely uniform rotation appears to coincide with the deduced position of the epicenter of the 'quake, about 18 miles northwest of the town. Brick houses were badly cracked; cracks usually started at windows and doorways, exhibiting in many cases intersecting double sets of cracks each at 45 deg. to the horizontal. Broken plate glass windows and falling plaster caused much minor damage.

Almost all the school buildings suffered by the collapse of parts of the coping walls built to surround the flat roofs of the newer types of school construction. The most serious of all occurred in a newly built section of the high school and will necessitate rebuilding at a cost which may be as high as $50,000. Here a large section of single brick coping fell from a height of three stories onto the thin timber roof of a gymnasium, crashing through to the floor and carrying a large part of the roof with it.

The latest section of this large building has a structural steel frame, the columns of which have been encased in hollow tile plaster-covered pilasters. Many of these have broken away from the adjacent walls, revealing no connection between them and the column or curtain wall other than that provided by plaster. The steel framework was declared to be structurally sound and safe.

Cornwall High School, showing parapet wall after failure due to earthquake shock.

No damage was reported to the canal system with the exception of a few small cracks to the plaster in the administration building. Neither was any damage noted to the Roosevelt railroad and highway bridge over the St. Lawrence, just east of the town boundary. Major city services were not disrupted but many individual water connections to private houses are said to have been broken.

Broken roof of girls' gymnasium in Cornwall High School caused by collapse of parapet above.

In its September 21st issue, *Engineering News-Record* calls attention editorially to the startling similarity between this case of the coping trouble and that suffered in the earthquake of 1933 at Long Beach, Calif. That schools and other buildings are still being topped out with unstable masonry is cause for anxiety as is the realization that earthquakes sufficiently strong to throw down parapets and cornices have occurred and may occur again. Such might take place when school is in session and children might be crushed by falling masonry.

If parapets are used they should be anchored. Reasonable resistance to horizontal forces in foundations, frames, floors and walls should be provided. *Engineering News-Record* points out that earthquakes have emphasized this lesson and that engineers and architects should not wait for a tragedy in order to change designs which would, at no additional cost, make structures reasonably resistant to earthquakes.

HOW CAN WE IMPROVE ENGINEERING EDUCATION?

GEO. B. LANGFORD, PH.D., F.R.S.C., M.C.I.M.
Professor of Mining Geology, University of Toronto (on leave of absence)
Director, Department of Planning and Development, Province of Ontario.

An address delivered at a joint meeting of the Association of Professional Engineers of Ontario and the Toronto Branch of The Engineering Institute of Canada, on December 3rd, 1943.

The new world that we are all seeking cannot create itself. The foundation of the future is being built in our schools and if the foundation of our new world is to be stronger than the old, our educational systems in Canada from the primary schools to the universities must be revised and improved. The needed changes cannot be brought about solely by the actions of the teachers; active and sympathetic co-operation by the educated men and women of the country must be enlisted before any great measure of improvement is possible.

Among the many problems in the sphere of university education is the needed reorganization of the faculties of engineering, for the prime functions of engineering schools have been changing markedly during recent years. Virtually all the graduates of such schools used to become engineers, but today it is doubtful if 50 per cent of the graduates practise professional engineering. The engineering schools today, in addition to training professional men, are now important units for general education. Enrolment in all Canadian universities for the ten years before the war showed an increase in engineering registration much greater than in other courses. From 1931 to 1940 the number of graduating engineers increased by 71 per cent (418 to 715) while the number graduating in all other courses increased by only 29 per cent (4,423 to 5,691). (1)

I interpret this to mean that many young men who are not interested in the humanities or pure sciences, study engineering as a means of getting a higher education. Such people are forced to take specialized training in some particular field of engineering in which they are often only slightly interested. They cause crowding of the laboratories and classrooms and, in general, are a retarding influence on class progress, even though they, as individuals, may be brilliant. These men should be separated from the professional groups and given courses better adapted to their needs.

There is another group which should not be kept with the professional group: the men who want technical training and who would be more at home in a technical institute than a university.

Proposed Reorganization

These groups, the general and the professional, should be segregated and not all carried along simultaneously as is currently done. An engineering school organized for this purpose would have:

1. A general educational course based on engineering principles but not leading to a professional degree, although graduates should be able to obtain professional status by post-graduate work. Graduates from such a course would be admirably suited for many positions now filled by so-called professional engineers, such as operators, sales engineers, managers, industrial engineers, labour relations officers, etc. These graduates should also be acceptable for training as teachers or lawyers.

(1) Canada Year Book 1942, pp. 883-885.

The principle of a general education in an engineering school is just as sound as the principle of a general education in an arts college. Such a course would fill the long-felt need of many engineers who wish they had been given a more liberal training at university. The cultural value of engineering courses should be emphasized, for many engineering graduates have failed to appreciate the cultural value of the courses they have studied. Such a value cannot be judged by ordinary standards for it depends almost entirely on the background, scholarship, and ability of the teacher and of the student. Calculus is a case in point. How often have we heard criticisms of the alleged wasted efforts of hundreds of students on this subject? People who have that attitude never derived much culture or liberalization from the study of calculus. On the other hand, anyone who developed an appreciation of rigorous logic, or who took pleasure in a perfect demonstration of mathematical precision, derived as much culture as though he had learned to eulogize an old master. This much sought after virtue is not something we can put on in an evening when we attend a symphony concert, and take off the next day when we are dealing with engineering details and problems, nor does it mean an ability to discuss the Greek poets. It is an intellectual development which affects all our mental processes and is as much a part of us and characteristic of us as is the colour of our eyes or the length of our noses.

When our engineering schools reduce the hours spent in purely mechanical work; when they break, as far as is practicable, with the deadly lecture system; when they teach students the methods and practices of self-education; when they give the students some time for mental development, then students will be capable of deriving some cultural value either from the engineering subjects, or from the liberal courses that are now being added to some engineering curricula.

2. Professional courses of honour standing whose graduates should receive professional engineering degrees. These graduates, because of a more adequate scientific training than is possible under present conditions, will become industrial research engineers, professional engineers, and university teachers.

Almost invariably we call our schools faculties of applied science and engineering. The emphasis both in and out of the classroom on the term "applied" has fostered the idea that science can be divided into sections, one of which can be readily "applied" and is therefore practical and useful, and the other which is only theoretical and therefore useless. Our teaching has a tendency to produce students more interested in the proven fact than in the proof. Their training gives them a certain appreciation of the applicability of science in general, rather than a working knowledge of fundamental science. Training of this sort falls short of the needs of the professional and research engineer. They need the same knowledge of, and ability to work with, the basic sciences as do the pure scientists. However, present-day teaching methods, facilities, and staff are not organized to do this. With the potential professional engineers forming a minority of the classes, their particular needs must of necessity receive secondary consideration.

Post-Graduate Studies and Research

An engineering course organized on the basis of creating an honours group with a high degree of scholarship and capacity, will do much to correct the great weaknesses which exist in Canadian engineering schools. There is a serious lack of research and post-graduate work in our engineering schools. They have been teaching applied science and neglecting post-graduate work for years and today we have a generation who are becoming teachers in these schools, many of whom have neither a broad and sound scientific training, nor an active interest in post-graduate work and research. In some engineering schools in Canada the number of professors with post-graduate degrees is only 40 per cent of the total. If one compares the staffs in applied science and pure science in any Canadian university, one finds almost invariably that the pure science staff has done far more post-graduate work than the applied science staff, and their scientific publications greatly outnumber those of their colleagues. A scientist requires four years of undergraduate study and three or four years of post-graduate study before he is adequately trained, yet we consider an engineer to be adequately trained with only four years of undergraduate study. It may be sufficient for a general education but is entirely inadequate if we want to produce top-flight professional and research engineers, and professors. Engineering schools elsewhere realize this. At the Massachusetts Institute of Technology, 20 to 25 per cent of the student body are post-graduate students compared to less than five per cent at most Canadian universities.

Canadian engineering schools have not established reputations as research centres. This is apparent from the fact that comparatively little of the government-sponsored war research has been done in our faculties of applied science. I am of the opinion that lack of scholarship is an important factor contributing to the lack of research and post-graduate work in our engineering schools.

How shall we stimulate more research and post-graduate activity in engineering schools?

1. Build up staffs who are interested in such work, and capable of inspiring students. The staff must be given time and facilities for this. This means more money—a lot more. A faculty which establishes a reputation for sound research work attracts post-graduate students.

2. Provide greater financial aid to post-graduate students. A great many of our most earnest students cannot afford post-graduate work.

3. Create schools of engineering research that will be more than just organizations within the existing undergraduate schools. The Ontario Research Foundation might be to the engineering schools of Ontario what the Banting Institute is to the medical schools—both an inspiration and a medium for doing research.

Staff Personnel

We hear much, from time to time, about inbreeding in university staffs. This can be a very serious criticism of a university. On the other hand, why should any institution deprive itself of the service of some brilliant graduate, just because he graduated from that institution? There is no objection whatsoever to any man teaching at his *alma mater*, if he has, following graduation, spent several years in post-graduate work at other universities. The experience of learning in several different schools of thought and of knowing how classes and laboratories are conducted at other universities is most stimulating, and absolutely essential if one is to be a teacher.

It is only by this means that one gets the training and experience in teaching methods that are so necessary. Teaching, just like any other profession, requires that those who practise it should be especially trained. How can young men get such training if, following graduation, they are given teaching assignments in the very school from which they graduate? Altogether insufficient thought is given to the training of university teachers.

I have mentioned the training, but how about the selection of teachers? For many years we have all seen the large industrial firms picking up the top students in the final year. I am not criticizing this practice, but the disturbing feature is, how often has the university been able to attract these bright students into the teaching profession? Unless we choose our teachers from the very best students, we will soon have a mediocre staff.

Canada can ill afford anything but the best in her engineering schools. So much now depends on our scientific developments, that if we are to keep up with the vanguard we must turn out ever increasing numbers of men capable of engineering research. Our engineering schools, while continuing to turn out men to perform the operational duties, which are customarily thought of as engineering, must turn out an ever increasing number of research engineers. That, in my mind, is the side of engineering education which should be vigorously developed following the war.

Engineering Schools of the Future

President Compton, of M.I.T., has given us his vision of the engineering school of the future:

"Let me describe this institution of tomorrow as a 'super institute of technology' and suggest some of its features, as drawn from the lessons of past and present. It should possess an operating organization flexible enough to meet emergency conditions, alert enough to provide the *modus operandi* for meeting unusual needs in normal times and farsighted enough to provide the means of dealing with new needs or opportunities in advance of their urgent demands. The institution must be organized quickly and effectively to assist industry and government in the solution of both normal and emergency problems and in obtaining highly qualified men. Through the possession of advanced and specialized equipment and laboratories it must have investigatory resources anticipating future needs and not available elsewhere. Of major importance, it must have a staff of outstanding experts marked not alone by individual brilliancies, but by a homogeneous strength that ensures co-operative, creative work, capable of developing a body of advanced thought and applying it to new problems. And finally, it must have a student body of the highest possible calibre—graduate students of distinction and undergraduates of honours calibre and treated as honours students."

We should have such an engineering school in Canada. If we can have more than one, so much the better, but let us have at least one. It would be the fountain head from which would come the inspiration for all other schools. It would be a centre for industrial research on all our Canadian problems.

The industrial life of Canada would be crippled if all the engineers were suddenly removed. It will be seriously affected if we do not keep up the supply of well-trained men. Industry is calling for better trained men year by year. If we cannot improve the training given our young engineers, the development of Canada will be seriously retarded.

I have attempted to set out some of the fundamental reasons why we are not turning out better engineers than we do. A close examination will show that the reason for the existing situation in nearly every instance boils down to one thing—lack of money. If our universities in Canada are to attract and hold good staffs, if they are to have post-graduate students, if they are to be noted for their research activities, they will need vastly increased budgets.

DISCUSSION

The Editor,
The Engineering Journal.
Sir:

While Dr. George B. Langford is to be commended for bringing to the attention of Canadian engineers and educators certain conditions in engineering education that require remedy, the matters to which he refers are by no means new or unrealized in academic circles. Indeed, most of them have already received close study on more than one campus. Academic bodies, in common with Dr. Langford, long ago reached the conclusion that impressive advances could be made, and made quickly, if salaries were made commensurate with the qualifications and attainments desired in members of the teaching staff, if some senior professors could give all of their time to research and graduate study, if funds for equipment of a standard that governmentally-supported research organizations can obtain were provided, and if generous fellowships, scholarships, and bursaries could be made available to brilliant students who otherwise could not attend a university.

Dr. Langford has performed a useful service in pointing out the value in a general educational and non-technical sense of the training available in the engineering colleges. Engineering education as a basis for employment that is essentially executive, administrative or commercial and only incidentally technological has been the subject of a close study in the University of Toronto during the past year. At twenty years out of college considerably less than half of the engineering graduates of this university are in predominantly technological work, while for graduates of all ages in engineering, it is slightly over one-half. That circumstance suggests the need for serious consideration of some curricular adjustment. It may involve for some selected men a type of undergraduate course that, while being predominantly scientific-technological, would contain a substantial body of business and administrative material. A course of this kind should be so devised as to warrant professional licensure and at the same time to give the most appropriate scholastic training to a growing proportion of engineering graduates who attain posts of executive responsibility and influence in corporate and public affairs.

The offering of work of a type that would be appropriate to a "super institute of technology", to use President Karl T. Compton's term, will need, so far as Canada is concerned, to be largely confined to the graduate level. A few particularly exacting undergraduate courses already existing in this country represent a start in the direction of the new trend for courses that would fit men for unusual scientific and creative accomplishments to which reference is made in the Report of the Committee on Engineering Education After the War recently issued by the Society for the Promotion of Engineering Education.* Those enrolled in these courses will, unless registration in engineering colleges is closely restricted, be very much in the minority.

The extension of research in the engineering schools is largely dependent upon the availability of senior and full-time staff for original work and the direction of graduate study. Although full-time research professors are to be found in faculties of arts and medicine in Canada, there are none in engineering. Like every other worthwhile academic activity, research must be headed up by a specially designated experienced staff. Exceedingly heavy teaching loads; demands for technical assistance of war industry, of government departments, and government-sponsored research organizations; and inability to obtain postponement of military training for workers on any research problem of long-range significance has seriously hampered research in the engineering colleges during the war. Given reasonable financial encouragement, much will be heard from them in the way of original investigation and advanced study when hostilities have ceased.

It is scarcely fair to compare the proportion of graduate students in the Canadian engineering colleges with the proportion in that institution in the United States which, because of its huge endowment and industrial backing, bulks largest in graduate work. In times of peace when research assistants could be employed, the proportion of graduate to total enrolment in engineering in at least one Canadian university was not very different from the corresponding average proportion for all the engineering colleges of the United States.

The members of the teaching staff of the Faculty of Applied Science and Engineering of this university are in general accord with the views expressed herein.

C. R. Young, M.E.I.C.,
Dean of the Faculty of Applied Science and Engineering.

University of Toronto,
October 26, 1944.

*See *Engineering Journal*, May 1944, p. 314.

NUTRITION IN RELATION TO EFFICIENCY

K. E. DOWD, M.D., F.A.C.S.
Chief Medical Officer, Canadian National Railways, Montreal

An article prepared at the request of the Institute Committee on Industrial Relations, being one of a series written for the *Journal*

NOTE—Although its subject is not directly related to engineering, it is thought that the following paper will be of assistance to many engineers engaged in industrial relations work. It contains much information of interest to all our members.—*Ed.*

A balanced diet and good nutrition together with proper knowledge as to the best foods to eat are necessities for maximum national health and production. A balanced diet requires that not only will the food consumed have definite caloric value, but also that it will have a proper vitamin and mineral content. Much investigational work in regard to nutrition has been done recently by the Medical Services of the Royal Canadian Air Force, particularly by Air Commodore J. W. Tice, Director of Medical Services R.C.A.F., and Group Captain F. F. Tisdall. It is felt that a knowledge of some of the general results of this work would be of as much value to the general public as to the flight crews and other personnel of the R.C.A.F.

The main food requirements of life are made up of five fundamental groups, namely, proteins, fats, carbohydrates, minerals and vitamins. Of these five, the proteins, fats and carbohydrates supply our heat and energy. These groups contain some thirty-three different food substances, ten of which come from proteins, thirteen are minerals, eight are vitamins. Fats and carbohydrates make up the total to thirty-three.

The following facts concerning the food constituents listed above are of interest:

Proteins

Proteins are indispensable for the building of new tissue. They are obtained from both animal and vegetable sources. It is considered that about 12 to 15 per cent of the total caloric intake should be in the form of proteins. Meats, fish, cheese, eggs and milk are the main sources of protein.

Fats

Fat should constitute about 30 per cent of the total calories of the daily food intake. Our best sources of fat are butter and the fat of milk for they contain some of the fat-soluble vitamins. The next most valuable source is animal fat such as lard. The cheapest fats are vegetable oils which are usually devoid of vitamins. In most cases about three ounces of fat a day will satisfy the ordinary needs of the body.

Carbohydrates

The chief sources of carbohydrates usually consumed are purified flours and purified sugars. In this purification many essential food elements are removed. Approximately 50 per cent of the average Canadian diet is obtained from two purified foods—white flour and sugar. If one adds to these two foods glucose, corn syrup and processed fats, we find that no less than 66 per cent of the calories consumed are devoid of, or very low in, minerals and vitamins. One does not perhaps realize the large number of calories which are consumed in our common articles cf food made from these purified food products. For example, one average helping of pie made with the usual amount of sugar and pastry will furnish no less than 500 to 700 calories. To get 500 calories in the form of milk would require 1¼ pints; as meat, slightly under one pound; as potatoes, no less than six cupfuls; and as cabbage, ten cupfuls. With these facts in mind, our chief worry is to see that we do not get too much carbohydrate and thus crowd out the other essential articles of food.

Through the efforts of the Dominion Government, a new flour known as "Canada Approved" flour is now available. Ordinary white flour, the kind usually purchased for home baking, contains about 100 units of Vitamin B_1 per pound; baker's, 150 units per pound; and the new Canada Approved white flour 400 units per pound. But Canadian whole wheat flour contains approximately 650 units per pound. Therefore, eat whole wheat bread preferably all the time.

White bread made from Canada Approved flour and 4 per cent skim milk solids is known as Canada Approved white bread. If you must have white bread, make certain it is made with Canada Approved white flour. It is of interest to note that the only type of white bread now used in the R.C.A.F. and the Canadian Army is Canada Approved white bread. Find out what kind of flour your baker is using for the bread you get.

Minerals

Of the thirteen minerals mentioned above, there are only four which we have to watch carefully, namely, calcium, iron, iodine and phosphorus.

Our chief source of calcium is milk and cheese. In fact, without milk and cheese it is impossible to outline a diet which would supply the proper amount of calcium. The calcium necessary for the adult is 800 milligrams daily, and unless some milk is included in the diet it will be found that the average intake of calcium is only 300 to 400 milligrams. Everyone should therefore consume at least one pint of milk daily. Due to our custom of drinking tea or coffee at every meal, it is obvious that many adults do not receive the optimum amount of milk. As regards calcium requirements it does not matter whether the necessary milk is taken as a beverage or is used in the cooking. One ounce of cheese contains as much calcium as eight ounces of milk.

With reference to iron, the average adult has a total of 4.3 grams of iron in the body. Of this amount 2.7 grams are present in the circulation, most of which is in hemoglobin carried by the red blood cells. Under ordinary conditions of good health the iron is retained in the system. Our best sources of iron are vegetables such as potatoes, peas and beans, fruits such as prunes or apricots, and egg yolk, liver and kidney.

Iodine is best maintained through the use of easily available iodized salt. Its importance in the metabolism of the body is chiefly related to the function of the thyroid gland. Sea foods contain this mineral.

Phosphorus is abundantly present in a variety of foods. Dairy products of all types are the best sources as in the case of calcium. An adult male requires about 0.9 grams daily and this amount is present in one quart of milk. Eggs, liver, whole wheat and oatmeal also contain phosphorus. There are many vital functions of phosphorus in connection with bone, muscle and nerve tissue.

In general it may be stated that if the adult diet contains each day one pint of milk, two average servings of vegetables besides potato, and some animal source of iron such as egg yolk, liver or kidney, plus the use of iodized salt, there will be an adequate supply of calcium, iron, iodine and phosphorus.

Vitamins

A vitamin is a specific chemical substance which is necessary in small amounts for the proper functioning of the complete organism. It must be obtained from outside the body. The chemical composition of fourteen vitamins has been determined. There is evidence that these are not all the vitamins necessary for health and no doubt more will be discovered. Of the fourteen known vitamins, eight have been shown to be necessary for human nutrition.

Dietary surveys and nutritional studies indicate that a large proportion of the population are not receiving a proper supply of vitamins. Vitamins must be supplied in adequate amounts each day and fairly definite daily allowances have been established for several of the most important ones.

The amount of a vitamin present in a food or medicament is usually stated either in milligrams or in 'international units'. The values of these international units however are different for different vitamins. The generally accepted values of these vitamin-unit equivalents are given in a table at the end of this paper, the figures being taken from the most recent issue of Eddy and Dalldorf's textbook on 'The Avitaminoses'.

In practice it is convenient to know the amount of the various vitamins present in an average serving of some ordinary foods, for example, in three-quarters of a cupful of vegetables or fruit juices, or four slices of bread, or a quarter of a pound of meat. Such information, together with other data, is given in the following notes on a number of the most important vitamins.

Vitamin A

Vitamin A is essential for growth and bodily vigour from childhood to old age. It promotes normal vision, assists in maintenance of normal growth and general health, stimulates secretions which lubricate mucous membranes, heightens resistance to infection and prevents certain inflammations of the eye. One of the results of Vitamin A deficiency is known as hemeralopia, or night blindness, which is a subnormal vision during twilight. It must be pointed out, however, that there are at least ten other known causes which can result in this condition of night blindness. When night blindness is due to Vitamin A deficiency, vision becomes practically normal after seven to fourteen days of Vitamin A therapy.

As a result of the relation between Vitamin A deficiency and adequate vision, attempts have been made to use measurements of light perception after a period of dark adaptation as a measurement of the state of Vitamin A nutrition. Some observers have diagnosed from twenty to sixty per cent of the population groups as suffering from a Vitamin A deficiency.

Vitamin A is only slightly destroyed by ordinary cooking. Ninety-five per cent of this vitamin is retained in cooked liver. It is found in milk, cream, butter, cheese, egg yolk, liver and liver oils, especially cod and halibut liver oils. It is also abundant as carotene (or Pro-Vitamin A), in green or yellow vegetables such as beet greens, spinach, carrots, peas or in fruits such as peaches, prunes, apricots, etc. It does not occur to any extent in lard, olive oil, or any fat or oil of vegetable origin.

At least 5,000 units per day are necessary for adults. The following figures indicate the amount of Vitamin A in various foods:

1 whole cup cooked spinach	=2,500	units
7/8 cup cooked broccoli	=9,000	"
1/4 cup beef liver	=7,000	"
1/4 cup calves liver	=7,000	"
3 average size apricots	= 900	"
12 medium prunes	=2,500	"
3/4 cup carrots	=2,100	"
1/2 cup peas	=1,200	"
1 tomato 2½" diameter	=1,000	"
1 cup milk	= 220	"
1 square butter	= 240	"
1 small orange	= 225	"

In the past, Vitamin A has been spoken of as the anti-infective vitamin. As is the case with all other necessary dietary constituents, resistance to infection is lowered when the bodily content of Vitamin A is below normal. However, there is no evidence that the ingestion of amounts above the optimum requirements will further increase resistance to disease. Adequate amounts of Vitamin A are necessary for normal weight, but again, additional amounts will not procure added weight gain. In therapy fish liver oils of high potency, such as halibut oil or cod liver oil are used. No toxic effects have been observed through the administration of this vitamin.

Vitamin B Complex

Vitamin B Complex contains several important vitamins. Four members of this group have been shown to be essential for human nutrition, namely, thiamine (Vitamin B_1); riboflavin (Vitamin B_2); nicotinic acid and biotin. These vitamins are water-soluble, as is also Vitamin C. To retain them in cooking it is essential that very little water be used in the cooking, and that the vegetables are not over-cooked. The cooking water should be retained and used for soups or some other food purpose. The body does not store these vitamins to any appreciable extent. A marked lack of thiamine results in the disease beri-beri, and a deficiency of nicotinic acid results in pellagra.

A lack of any one member of the B Complex is almost invariably accompanied by a lack of the other members. It is, therefore, advisable in the treatment of conditions resulting from lack of Vitamin B to give some form of the whole B Complex, such as brewer's yeast or wheat germ, as well as larger amounts of the particular vitamin involved. The taste of yeast, if unpleasant, may be concealed by blending it up to 25 per cent with peanut butter, also rich in Vitamin B_1. Foods showing a high content of this vitamin are lean pork, liver and other edible organs, egg yolk, oysters, milk, whole grains, beans, peas and other legumes, nuts and fruits. A brief note follows regarding each of the above mentioned four Vitamin B Complex components.

thiamine

Thiamine or Vitamin B_1 is intimately concerned with the metabolism of carbohydrates. A lack of thiamine appears to produce degenerative changes in the nerve cells; cellular degeneration may also occur in other parts of the body, particularly the gastro-intestinal lining, the pancreas, salivary glands and the liver. A prominent symptom is lack of appetite, and either through this or the direct effect of the lack of this vitamin, the rate of growth is diminished. There may also be changes in the mental outlook of the individual. Many of the symptoms which were formerly described as "neurasthenia" have been duplicated in patients receiving an insufficient amount of this vitamin. The patient may suffer from fatigue, disturbance of sleep, or constipation.

The daily dietary requirement for an average healthy adult is 500 international units. The following values of some foods are given:

6 teaspoonfuls wheat-germ........	=	1,350 units
¼ lb. pork........................	=	400 "
½ cup soy beans..................	=	400 "
¼ lb. beef or lamb heart..........	=	200 "
½ cup cubed pork kidneys.........	=	150 "
¾ cup peas........................	=	140 "
4 to 5 slices bread (whole wheat)..	=	100 "
4 large oysters...................	=	130 "

A single pork chop, even after frying, will supply nearly the entire thiamine requirements for a day. Canada Approved white bread contains three times as much thiamine as ordinary white bread. A dietary survey of Canadians showed that 40 per cent of the population were not obtaining the suggested requirement of one serving of whole grain cereal and four to six slices of Canada Approved bread daily.

RIBOFLAVIN (VITAMIN B_2)

This vitamin is widely distributed in both animal and plant foods. It is not stored in the body in any appreciable quantity. It is soluble in water but not in fat. It is not easily destroyed by heat or oxidation. It is necessary for the metabolism of practically all living cells. It promotes growth and bodily vigour, preserves a healthy condition of the skin and hair. Its definite value in human nutrition was not discovered until 1938. The lack of this vitamin may result in evidences of abnormal metabolism, such as loss of weight or retarded growth.

Riboflavin is essential for normal vision. An insufficient intake over many months results in such eye symptoms as intolerance to light, lacrimation, headaches, eye fatigue and loss of visual acuity. In treatment one can administer pure riboflavin. Of prime importance is the correction of the diet, which should be built around 20 to 30 ounces of milk per day, cheese, some meat, particularly liver, an egg, two liberal helpings of vegetables besides potatoes, fruits and vitamin-rich cereals and bread. Milk, cheese and liver contain comparatively large amounts of riboflavin.

In an interesting study of R.C.A.F. aircrew, as published recently by Air Commodore Tice and Group Captain Tisdall of the R.C.A.F., it was found that under ordinary dietary conditions there were only 18 normal eye findings in 198 of the crew members tested. These men, like all pilot personnel were more exposed to glare and sunlight than normally obtains in other occupations. Only 12 of these 198 men wore coloured glasses or goggles constantly while in the air. The wearing of these coloured goggles reduces the amount of light which strikes the eye, with resultant definite reduction of eyestrain. Of the group studied, 66 men showing more advanced eyestrain were treated by increased riboflavin intake and within two months' time 95 per cent showed definite photographic improvement in the eye examinations and also showed improvement in their subjective symptoms such as headache or decreased visual acuity.

Now, how prevalent is the lack of this particular vitamin in our Canadian population ? In answer to this enquiry Air Commodore Tice and his co-workers have found that in approximately 500 R.C.A.F. aircrew admitted for training, 66.3 per cent showed a definite lack of riboflavin as evidenced by well-controlled photographic eye studies. In a study of the general population it has been found that 40 per cent of the Canadian people consume practically no milk at all as part of their daily diet, and 25 per cent of the population do not take either milk or cheese in some form daily.

The recommended allowance of riboflavin for adult males is 2.2 to 3.3 milligrams or 650 to 1,000 units daily. The following riboflavin values in certain foods are given:

½ cup cubed kidney, beef or veal....	=	700 units
¼ lb. beef, pig or calves liver.......	=	600 "
1 cup fresh milk.................	=	150 "
1 inch cube cheese................	=	250 "
½ cup peas......................	=	100 "
2 medium eggs....................	=	110 "

Generally speaking, liver, milk and vegetables may be considered the best and most reliable sources of this vitamin. Seeds, such as wheat, oats, etc., which are so important as a source of thiamine or Vitamin B_1, are poor sources of riboflavin. One serving of liver will adequately meet the daily allowance. One quart of milk will supply the minimum requirement and one serving of cheese or two eggs will supply one-quarter of the daily requirements. White bread made without milk contains practically no riboflavin. However, Canada Approved white bread supplies an appreciable amount of riboflavin, chiefly due to the fact that it contains 4 per cent milk solids.

NICOTINIC ACID OR NIACIN

Nicotinic acid or niacin is the B Vitamin factor of definite importance in the prevention of pellagra. Deficiency results in profound alterations in the body chemistry, particularly involving the nervous system and the digestive tract. There is also loss of appetite and loss of weight.

Meats are our most important source of this vitamin and should, of course, be included in all well-balanced diets. Whole wheat products are also of value. Liver, pork, salmon, poultry and beef contain the highest quantities of this vitamin in the order named. Milk and milk products are poor sources of this vitamin. The body does not store nicotinic acid. This product, like other members of the Vitamin B Complex, is slightly soluble in water and is not soluble in fat. It can be obtained in pure crystalline form. No definite unit dosage has been worked out for this vitamin, which, it may be noted, has no relation to tobacco.

The values for certain foods containing nicotinic acid are as follows:

2 slices chicken 4″ x 4″ x ⅛″	=	10 milligrams
1 piece haddock 3″ x 1½″ x 1″	=	5 "
3 slices liver 2″ x 1″ x ¼″...	=	15 to 20 "
1 cup whole milk...........	=	2.2 "
¾ cup salmon................	=	6 "
1 slice fresh beef 2½″ x 2½″ x 1″...............	=	4 "
1 pork chop (large).........	=	4 "

The Food and Nutrition Committee[1] has suggested 15 to 20 milligrams as the daily requirement. Briefly, one serving of liver will supply the daily allowance and one serving of lean meat will supply about one-half of the daily requirement. Since nicotinic acid is a very stable compound, there is little destruction duringcook-

[1] The Committee on Food and Nutrition of the National Research Council, Washington, D.C., which issued a table of recommended dietary allowances in May, 1941.

ing and the loss is negligible unless the cooking water is discarded.

BIOTIN

Biotin is the fourth member of the Vitamin B group which is known to be essential for human nutrition. Two others, pyridoxine and pantothenic acid, are also probably necessary, but a complete discussion of these and other more obscure vitamins need not be undertaken here. The full value of these vitamins to human nutrition is not yet well known.

Vitamin C

Vitamin C or ascorbic acid belongs to the water-soluble group of vitamins. It is the factor needed in the prevention of scurvy. A lack of this vitamin results in a general lack of vitality, and may cause serious disability.

The average adult requires 1,200 international units or 60 milligrams per day. It can be purchased in pure state as tablets (ascorbic acid). It is very soluble in water, and 30 to 40 per cent may be dissolved in the water in which foods are cooked. The addition of soda in cooking increases the loss of this vitamin. Only a little Vitamin C is lost in commercially canned fruits and vegetables.

The best sources of Vitamin C are fresh or green citrus fruits and citrus fruit juices (orange, grapefruit, lemon); fresh or canned tomatoes; and the vegetables used throughout the year, cabbage, turnips and potatoes. Orange juice is highest in Vitamin C content immediately after it is squeezed, but it will retain its value as long as twenty-four hours if kept in a closed container in the refrigerator. Potatoes, even though boiled or baked, contain sufficient quantities of Vitamin C, but if mashed they contain much less. The whipping of potatoes may result in complete destruction of the ascorbic acid because of the oxidation of this vitamin by the air. If cabbage, turnips, potatoes or other vegetables are cooked too long or in more than the minimum amount of water, as much as 20 per cent of the Vitamin C originally present may be lost. Also if allowed to stand after cooking for as long as one hour, a further significant loss may occur. The value of serving vegetables uncooked as salads is obvious.

Vegetables and fruits kept under ordinary home conditions, or even in cold storage, gradually lose their Vitamin C. Wilted vegetables usually contain practically none. Five ounces of grapefruit juice or a serving of raw cabbage will produce two-thirds or more of the daily requirement of this vitamin.

Expressed in units, the following items are of interest:

½ cup orange juice, grapefruit juice	= 900	units
½ cup beet greens	=1,200	"
1 cup cauliflower	=1,500	"
7 only Brussel sprouts	=1,500	"
½ cup spinach	=1,500	"
¼ lb. beef liver	= 750	"
½ cup tomato juice	= 375	"
1 potato 2¼″ diameter	=. 250	"
¾ cup strawberries	=1,000	"
1 medium tomato	= 450	"

The body does not store this vitamin beyond the amount necessary, hence a daily supply is of the greatest importance. In a recent dietary survey of Canadians it was found that 83 per cent of the population did not obtain the suggested requirement of tomato or citrus fruit juices and one serving of some other fruit as part of the daily diet. It was found, however, that 70 per cent used either one or the other of these items of diet.

Vitamin D

Vitamin D is essential for the prevention of rickets, a disease of infancy and early childhood characterized by a lack of deposition of calcium salts in the bones, with many other symptoms associated therewith. This vitamin is not present in appreciable amounts in ordinary foods. For instance, it would take over 1,500 servings of spinach or 14 egg yolks to give the Vitamin D equivalent of one teaspoon of cod liver oil. Contrary to a popular misconception, butter contains only a very small amount of Vitamin D.

About 1920 it was shown that exposure to summer sunshine produced the same beneficial effect as the oral intake of fish liver oils. This has later been shown to be the result of activation by the ultra-violet rays of the sun on traces of cholesterol in the skin. In Canada we can only depend on summer sunshine as a source of Vitamin D for three months, namely, from the middle of June to the middle of September. For the other nine months in Canada it is usually impossible to get enough sunshine to produce the desired Vitamin D effects. When the substance ergosterol found in the skin is exposed to ultra-violet rays from a mercury vapour lamp, it is changed into Vitamin D, hence the use of a mercury vapour lamp during the winter months is of definite value. Excessive exposure of the skin to ultra-violet rays should be avoided, however. Certain foods are now irradiated or exposed to ultra-violet rays, as a result of which they contain Vitamin D. The most widely available irradiated food is irradiated evaporated milk.

There are available on the market many cod liver oils and other fish liver oil preparations, as well as other pharmaceutical products which supply Vitamin D. It is essential that all children be given at least one teaspoonful of cod liver oil daily during at least nine months of the year, and it would also be of definite value if all adults would take a similar amount. About 400 international units are required daily.

Diet Suggestions

Summarizing the above discussions of the more important vitamins, it is necessary to say that if one's daily diet is built up around milk, meat, eggs, leafy green or yellow vegetables, and either whole wheat or special vitamin-containing cereals and bread such as Canada Approved bread, there is no reason to take doses of prepared vitamins as supplied by various pharmaceutical houses. But it must be remembered that it is not sufficient just to know about the necessary food factors, but such food factors must be eaten before any good will result. Under conditions where such a balanced diet is not obtainable, the daily use of a combined vitamin preparation may be indicated. Such preparations are prescribed by physicians in cases of fatigue and debility, certain nervous manifestations, etc., with very beneficial results. Your physician will be able to advise you fully as to some of the more satisfactory preparations now available if, on examination, the use of such additional food factors appears necessary. It must be added, however, that based on our present medical knowledge, vitamins in tablet or capsule form are not a cure-all and their use must not be regarded as the answer to all our ills.

A well balanced diet will be obtained if the following seven rules based on careful scientific research are utilized:

1. At least one pint of milk a day for every adult and a quart for every child. One half this amount of evaporated milk

may be used, or ten tablespoons of dried milk may be substituted for one pint of fresh milk.

2. A serving of lean meat daily for every adult and every child over eight years of age; from two to four servings a week for children under eight.
3. One egg daily for every adult and child over three years of age; four a week for children under three.
4. One serving of fresh or canned tomato or citrus fruit daily for both adults and children (for young children at least six ounces of tomato juice or two ounces of orange juice).
5. One serving of potato every day for adults and children; two servings of other vegetables for adults and one serving for children under eight.
6. One serving of whole grain cereal a day for adults and children, together with three slices of whole wheat or Canada Approved bread for young children and six slices a day for older children and adults.
7. Guard against loss of vitamins and minerals in cooking by the following six rules:
   Do not peel or cut up vegetables or fruits and then let them stand before cooking. If possible cook them whole with skins on.
   In cooking vegetables and fruits use as little water as possible and cook them as quickly as possible. Never add soda to vegetables.
   Whenever possible steam foods rather than boil or stew them.
   Do not fry foods if it can be avoided.
   Do not chop or crush fresh vegetables or fruits and allow them to stand for long periods before serving.
   Frozen foods should be put on to cook while they are still frozen. If used raw they should be eaten immediately after thawing.

Vitamin Unit Equivalents

Owing to different usages in the past, the following table of equivalents may be of value in translating unitage into International unit equivalents for vitamins A, B_1, C, and D.

Vitamin A

1 Int. unit = 0.0006 mgm. Beta-carotene.
1 Int. unit = 0.7 Sherman Munsell units.

Vitamin B_1

1 Int. unit = 0.003 mgm. thiamin.
1 Int. unit = 2 Sherman-Chase units.
1 Int. unit = 0.5 Smith curative units.
1 Int. unit = 1.0 Chick-Roscoe units.
1 Int. unit = 20.0 Cowgill mgm.-equivalents.

Vitamin C

1 Int. unit = 0.05 mgm. ascorbic acid.
1 Int. unit = 0.1 Sherman-LaMer unit.

Vitamin D

1 Int. unit = 0.000025 mgm. calciferol.
1 Int. unit = 1 U.S.P. unit.
1 Int. unit = 0.37 Steenbock units.
1 Int. unit = 1 A.D.M.A. unit.
1 Int. unit = 1 Oslo or Poulsson unit.

N.B.—Viosterol is frequently labelled 250 or 150 D. This means containing 250 to 150 times the content of cod liver oil. All Viosterol preparations must contain at least 10,000 Int. units of D per gram.

ROYAL CANADIAN ENGINEERS IN HOLLAND

Army crane swings pontoon out into the water as Royal Canadian Engineers prepare for an embarkation across the Scheldt. Operations later included many types of vehicles and smoke screen equipment *(Canadian Army Overseas Photo.)*

"PORTABLE" INVASION HARBOUR

How the Allies built two "portable" harbours capable of handling the millions of tons of cargo and the vast armies of men needed in the invasion of Europe has only recently been told. Scores of merchant ships were sunk off the coast of Normandy to form breakwaters behind which concrete pontoon jetties, pre-fabricated in England and towed across the Channel, were strung together. Ships of the Royal Canadian Navy helped in the tedious job of protecting the pontoon jetties on their way across the English Channel towed by tugs at a top speed of three knots.

Once the breakwaters were formed, the jetty sections were towed into place. In the picture at the top one of these sections can be seen in the left foreground. It will be moved around behind the sunken freighters and moored there in such a way that it will rise and fall with the 20-ft. Channel tide.

At their destination the various sections of the jetty are joined together as links in the chain of jetties stretching from the beach to the breakwater. On one occasion a towing barge broke down and the Canadian corvette, H.M.C.S. Mayflower, took over the job of towing the pontoon jetty for the remainder of the journey, thereby averting what might have been serious delay in putting the harbour together.

In the picture at left, trucks are seen hauling supplies from ships alongside the line of pontoon jetties stretching from the breakwater to the beach.

Establishment of the "portable" harbours meant that Allied troops no longer had to plunge into the surf to make the last few yards to shore. In the bottom picture, assault landing craft from the infantry landing ship, H.M.C.S. Prince Henry, are seen streaming toward one of the new harbours. (*Royal Canadian Navy Photos.*)

From Month to Month

News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

CO-OPERATION IN QUEBEC

Negotiations which have been carried on for some time between representatives of the Corporation of Professional Engineers of Quebec and a special committee of the Institute have resulted in a draft of a proposed co-operative agreement which appears on page 585 of this *Journal.*

The text of the agreement was approved by the Institute Committee on Professional Interests and by the councils of the Corporation and the Institute. It will now be submitted to ballot of the members of the Corporation and, in accordance with Institute By-Law No. 78, to all councillors of the Institute and to corporate members in the province.

This will be the sixth agreement to be negotiated with the provincial associations, and it is hoped that it will receive the same enthusiastic support by ballot as was accorded those in other provinces. The successful result of the agreements already in operation is a convincing proof of the value of such understandings and arrangements between engineers.

The acceptance of this proposed agreement by the councils of the Corporation and the Institute is a further evidence of the desire to extend the programme of practical co-operation between professional bodies.

UNRRA NEWS

Immediate response followed the announcement, in the September supplement of the *Journal,* of vacancies for engineers for important duties with UNRRA. Several hundred requests for application forms were received at Institute headquarters and, to date, over one hundred completed applications have been returned. These have been turned over to UNRRA officials who have made a preliminary selection and already interviewed a number of candidates in Ottawa, Montreal and Toronto. Applicants from other parts of the country will be notified in due course of the time and place of interview. Eventually, UNRRA will communicate its decision to all applicants.

The need for personnel is dependent upon the fortunes of the war and varies accordingly almost from day to day. The slowing up of the last few weeks in the progress of military operations has made the immediate requirements for assistance less imperative, thus enabling UNRRA to search the field thoroughly for highly skilled personnel before making appointments. Applicants are reminded that well qualified specialists are needed for the various positions which are now offered, and that the less experienced help will be easily found in the countries where the relief and rehabilitation is to be carried out.

Some doubt has arisen in the minds of several applicants as to the proper interpretation of the UNRRA regulation which does not permit employees to take their wives or other members of their family to the field. Officials advise that, in this case, "the field" means abroad.

Mining Engineers Wanted

As we go to press we are informed that there is at present need for mining engineers experienced in the operation and maintenance of coal mines. Application forms can be secured at Institute headquarters along with additional information.

Applicants are asked to be patient and may rest assured that in due course they will be notified individually of the result of their applications. UNRRA officials who visited Montreal a few days ago have expressed their appreciation of the ready response from Canadian engineers and their hope that it will be possible to take full advantage of the many talents uncovered.

E.C.P.D. ANNUAL MEETING

On October 20-21, the Engineers' Council for Professional Development held its customary annual meeting in New York City. Representatives of The Engineering Institute of Canada were: Dr. J. B. Challies, Dr. Arthur Surveyer, Messrs. J. B. Stirling and J. A. Vance, and Dean C. R. Young, of the University of Toronto. Due to their absence in the West, the president and general secretary of the Institute were not able to attend.

In reporting for the E.C.P.D. Committee on Student Selection and Guidance, President A. R. Cullimore, of the Newark College of Engineering, pointed out that twenty-three institutions are now participating in the Measurement and Guidance Project in Engineering Education, including the University of Toronto, and that about 4,500 students are being given the Pre-Engineering Inventory tests. Reports indicate that these tests are proving of great value in dealing with cases of ex-service men who wish to enter the engineering colleges without academic credentials that are in strict conformity with the standards heretofore exacted.

Mr. John T. Sherman, reporting for the Committee on Professional Training, stated that President W. E. Wickenden, of the Case School of Applied Science, had made good progress in preparing the Manual for Junior Engineers. About two-thirds of the necessary material has been collected and about one-quarter of the manuscript is finished. The decision was reached that the reading list issued some time ago under the auspices of the committee would now be published in the annual report of E.C.P.D.

President D. B. Prentice, of Rose Polytechnic Institute, reporting for the Committee on Engineering Schools, stated that curricula in 143 of the 167 engineering degree-granting institutions in the United States had been inspected up to the present. Due to the disturbing influence of the war, the committee has held its inspections to a minimum during the past two years, since it believes that engineering colleges cannot be fairly judged while operating under war conditions.

At the time of the meeting seven of the eight organizations participating in E.C.P.D. had approved of the report of the Sub-Committee on Technical Institutes providing for an accrediting mechanism. The eighth organization had not held its annual meeting, but it was confidently predicted that it too would approve of the report.

Dr. Charles F. Scott presented the report of the Committee on Professional Recognition and outlined the efforts that have been made to enlist the teachers of engineering in the work of promoting the professional ideal amongst engineers-in-training. Dean N. W. Dougherty of the University of Tennessee, the newly elected chairman of the committee, presented an appraisal of the concepts underlying professional recognition and forecasted vigorous activity of the committee for the ensuing year.

Reporting on behalf of The Engineering Institute of Canada, Dean C. R. Young mentioned the activities of the Institute's Committee on the Training and Welfare of the Young Engineer and indicated the manner in which this is promoting one of the most important objectives of E.C.P.D. Council was particularly interested in the counselling activities of the Institute's committee in respect of men who are being discharged from the active service forces and the incidental close collaboration with the District Rehabilitation Boards. Interest was also expressed in the proposed consolidation of the counselling activities of the Institute, the Canadian Institute of Mining and Metallurgy, and the Canadian Institute of Chemistry.

At the annual dinner, Dr. George Granger Brown, president of the American Institute of Chemical Engineers, and chairman of the Department of Chemical and Metallurgical Engineering of the University of Michigan, delivered a strong and thoughtful address on "What is Ahead in Engineering Education?" Shorter addresses on special aspects of the subject were given by three others. Dean C. R. Young spoke on "The Canadian Viewpoint," Mr. George W. Burpee, of Coverdale and Colpitts, presented "Industry's Viewpoint," and Colonel C. E. Davies, Secretary of The American Society of Mechanical Engineers, dealt with "The Societies' Viewpoint."

Mr. Everett S. Lee of Schenectady, director of the general engineering laboratory of the General Electric Company, was re-elected chairman for the ensuing year and Dr. J. W. Parker of Detroit, a past-president of The American Society of Mechanical Engineers, was re-elected vice-chairman. In accordance with the commendable custom of rotating the secretaryship among New York secretariats of the constituent bodies, the secretaryship would have been assumed by Colonel C. E. Davies of The American Society of Mechanical Engineers. He being on war duty in Washington, the venerable and greatly beloved Dr. R. L. Sackett, dean emeritus of engineering of the Pennsylvania State College was elected secretary. The assistant secretary will be George Seabury, secretary of the American Society of Civil Engineers.

The Engineering Institute of Canada representation upon the E.C.P.D. Council now consists of Past-President Dr. C. R. Young of Toronto, Past-President Dr. A. Surveyer, consulting engineer of Montreal and Past-President Dr. C. J. Mackenzie of Ottawa, with Dr. Young sitting on the Executive Committee. Dr. Challies of Montreal, who has represented the Institute on the E.C.P.D. Council since it was admitted in 1940 was not eligible for election. During the meeting, word was received from the E.I.C. Council at Edmonton that R. E. Heartz of Montreal had been appointed the Institute representative upon E.C.P.D.'s special Committee on Employment Conditions for Engineers. One of the duties of this committee is to study, for the Council, the relation of engineers to collective bargaining.

COLLECTIVE BARGAINING

There is little more that can be reported at present about the engineer's position in relationship to collective bargaining. There was another meeting of the "fourteen societies" at Ottawa on October 3rd, to receive the report of the sub-committee on legislation, which had been appointed at the August meeting.

In view of the almost unanimous opinion expressed by all organizations the sub-committee had a strong mandate to proceed along definite lines, i.e., to secure a new order whereby the professional worker could have and control collective bargaining for himself. The sub-committee reported in great detail and, with very few suggested amendments, had its report approved unanimously.

An innovation at the meeting was the presence of representatives of a very small group of scientists centred in Ottawa. This group had previously expressed itself as favouring a policy quite contrary to that agreed upon by the larger group, and the representatives had been invited to the meeting to see if some common ground could be discovered whereby it would not be necessary for the two groups to oppose each other. Considerable progress was made and it is hoped and believed that a solution of the situation has been found.

The proposed legislation will be found to meet the needs of the professional worker. It does not infringe on the field of the trade union, nor should it be offensive to those who have been so concerned about professional status. It preserves the advantages of Order-in-Council 1003 without the features that were unsuitable to a professional group.

The situation now is that the desires of the professional worker have been resolved into a draft of an order. The next step is to secure support and approval for it. To do this a new sub-committee of three has been established, with instructions to take whatever steps are necessary. The members of the sub-committee are Alex. E. MacRae of the Mining Institute, W. P. Dobson of the Dominion Council and R. E. Heartz of The Engineering Institute.

FRANCO-CANADIAN SCIENTIFIC AND TECHNICAL ASSOCIATION

Under the above name, an association was formed in Montreal, last September, whose object, among others, is to maintain "friendly and intellectual intercourse with similar associations of all United Nations, and more particularly with the 'Union des Ingénieurs et Techniciens Français' whose head office is to be established in Paris, thus assuring and strengthening the ties of friendship between Canada, France and the United Nations through the development of mutual comprehension and appreciation."

The new Association has requested the assistance of the Institute in supplying the departments of the French Government with the technical literature describing engineering developments in Canada since 1940, when the interchange of information was interrupted. Ever since those dark days when mail service with the various European countries gradually ceased, the Institute has put aside several sets of the *Journal* and other Institute publications for the purpose of filling the gap in the interchange of information with the occupied countries. It has thus been possible to comply with the request from the Franco-Canadian Association, and we are now looking forward to the time when we may send to other liberated countries, including a purified Germany, the story of Canada's tremendous industrial expansion and of her material contribution to the cause of liberty.

Persons interested in the objects of the new association may obtain additional information from its headquarters at 1111 Beaver Hall Hill, Montreal 1.

COMPULSORY MILITARY TRAINING SHOULD NOT BE PART OF GENERAL EDUCATION PROGRAMME

Recognizing the "absolute necessity of universal military training for some time to come as insurance against possible disaster", Dr. Harvey N. Davis, president of Stevens Institute of Technology, addressing the annual meeting of the New Jersey Association of Colleges and Universities at Seton Hall College last month, advocated that it be sharply limited to training for national defense in an emergency and not become part of a Federal system for general education.

Dr. Davis urged his fellow educators to consider the problems presented by universal military training both from the standpoint of their responsibilities as citizens and as educational administrators. He carefully distinguished between training for military purposes and such objectives as CCC and relief. The speaker added that the country would expect of the military organizers of universal training an efficiency comparable to the present wartime training of soldiers and sailors, and referred to the fact that the Navy now seems to be able to train men for sea duty in ten weeks. He said that universal training should be for young women as well as young men.

Leave Education to Educators

"I believe," said Dr. Davis, "in leaving education to the educators, just as I believe in leaving military training to military men."

He advocated that "any period that may be demanded by law of every young man for universal military training be devoted, with singleness of purpose, to that training and to that training only; that that military training be given as intensively and as expeditiously as possible, and that the young men be returned to civil life with as little delay as possible as soon as the minimum requirements of national security are accomplished. Let us not countenance the mixing of a lot of federal dispensing of sweetness and light with the stern job of preparing to defend ourselves if and when we have to."

Dr. Davis said that he had no sympathy with the suggestion that perhaps a period of "national service —whatever that may mean", should be combined with the proposed military training. He agreed that the CCC camps had been an admirable form of relief in the depression, but the young men of the nation should not be compelled by law to go to such a type of camp for all or part of their military training for national defense, "just so that some of the trainees may learn some forestry on the side."

He declared that it was important to distinguish between three different kinds of military training—training of the rank and file, of non-commissioned specialists, and of commissioned officers.

"The training of the rank and file will necessarily be the major job," he declared, "and I, personally, think should be the sole job of any scheme of compulsory universal training."

AN INSTITUTE COMMITTEE ON QUALITY CONTROL

At the suggestion of Past-President Cameron, Council recently appointed a Committee on Quality Control. H. E. McCrudden, M.E.I.C., Staff Engineer of The Bell Telephone Company of Canada, in Montreal, is chairman.

High quality and uniformity of product has been obtained and maintained at reasonable cost by the application of statistical procedures in many American, British and Canadian factories, both before and since the outbreak of war.

The Institute committee has been organized to promote the study and use of this powerful and valuable tool by Canadian engineers and production executives.

Invitations are being extended to qualified non-members of the Institute to participate in this project and contribute to its effectiveness.

Mr. McCrudden will welcome enquiries, suggestions and comments for the consideration of his committee.

LEDA CLAYS TO BE INVESTIGATED

Dr. Karl Terzaghi of Boston, world authority in the relatively new science of soil mechanics, was the speaker at the weekly meeting of the Montreal Branch, on October 12th.

At the time when the arrangements were being made for his visit to Montreal, Dr. Terzaghi indicated his interest in what are known as the Leda clays of the province of Quebec. In some localities, such as Nicolet and St. Casimir, a very soft variety is encountered at a depth of not more than four feet below the surface of the ground. It is so soft that a steel rod can be pushed into it, without the use of a hammer, to a depth of one hundred feet. Dr. Terzaghi offered to co-operate with a committee of the Institute in the investigation of this material, and undertook to publish the results of such work in *The Engineering Journal.*

This kind offer was accepted and a Temporary Committee, under the chairmanship of R. E. Chadwick, president of The Foundation Company of Canada, was appointed to assist Dr. Terzaghi in taking some undisturbed samples of Leda clay during his visit in the province.

It was not possible, during Dr. Terzaghi's short visit to Montreal, to proceed to Nicolet or St. Casimir for sampling the clays of that district; but a visit was arranged to nearby Beauharnois, where soft clay is found. Accompanying Dr. Terzaghi were the following members of the Institute: S. R. Banks, L. H. Burpee, D. G. Elliot, B. A. Evans, C. G. Kingsmill, I. D. Mackenzie, J. W. McCammon, E. Nenniger, M. V. Sauer and W. U. Smick.

The taking of proper samples for testing purposes is a very delicate operation requiring extreme care and strict adherence to specifications. The undisturbed samples obtained at Beauharnois were not representative of the true soft Leda clay, but careful note was taken of Dr. Terzaghi's technique of sampling. The knowledge thus acquired will render it possible to take acceptable samples from Nicolet and St. Casimir without Dr. Terzaghi's personal supervision.

The committee expects to obtain such samples in the near future and it is hoped that results of the investigation may be published in the course of the next few months. In the meantime, the paper presented at Montreal by Dr. Terzaghi will appear in the December issue of the *Journal.*

PROPOSED AGREEMENT BETWEEN THE ENGINEERING INSTITUTE OF CANADA AND THE CORPORATION OF PROFESSIONAL ENGINEERS OF QUEBEC

MEMORANDUM OF AGREEMENT made in duplicate at the City of Montreal, in the Province of Quebec, this.............

day of..............................194.....

BY AND BETWEEN:

THE ENGINEERING INSTITUTE OF CANADA, a corporation duly incorporated under the laws of the Dominion of Canada, having its head office in the City of Montreal, in the Province of Quebec, herein acting by its President and General Secretary, duly authorized for the purposes hereof by a resolution of its Council passed at a meeting duly called and held on the

..................day of..................194..., hereinafter called the Institute;

Party of the First Part.

AND

THE CORPORATION OF PROFESSIONAL ENGINEERS OF QUEBEC, a corporation duly incorporated under the laws of the Province of Quebec, having its head office at the City of Montreal, in the Province of Quebec, herein acting by its President and its Secretary, hereinafter called the Corporation.

Party of the Second Part.

WHEREAS it is desirable in the interest of the engineering profession that there be close co-operation between the Institute and the Corporation, and

WHEREAS such close co-operation will be promoted if, so far as it is practicable, there be effected:

(a) A common membership in the Province of Quebec of the Institute and the Corporation for the purpose of more effectively promoting the interests of the engineering profession.

(b) A liaison between the Councils of the Institute and the Corporation.

(c) A simplification of the procedure whereby members of either body qualified for membership in the other body may secure such membership.

(d) A simplification of existing arrangements for the collection of fees.

(e) The elimination of entrance fees hereto exigible when members of either body are elected to membership in the other.

NOW, THEREFORE, the parties hereto agree with each other as follows:—

1. Each Member of the Corporation who on the date of this agreement is registered as a professional engineer under the provisions of Chapter 270 of the revised statutes of the Province of Quebec for the year 1941 and subsequent amendments thereto, and who on such date is not a Corporate Member of the Institute, shall have the right, under the provisions of this agreement, to become a Corporate Member of the Institute. In order to exercise such right such Member of the Corporation shall notify the registrar of the Corporation in writing within 90 days of the effective date of this agreement of his desire to become a Corporate Member of the Institute under the conditions of this agreement.

2. Each person registering as a professional engineer and becoming a Member of the Corporation subsequent to the date of this agreement who does not hold membership in the Institute, shall have the right, under the provisions of this agreement, to membership in the Institute. In order to exercise such right such Member of the Corporation shall, within 90 days of the date of such registration, make application to the Institute for membership in the Institute. Such applicant shall be granted the class of membership in the Institute warranted by age, experience, and professional qualifications of such applicant according to the by-laws of the Institute.

3. Members of the Corporation who become Corporate Members of the Institute under the provisions of paragraph 1 of this agreement, and Members of the Corporation who become Cor-

PROJET D'ENTENTE ENTRE L'ENGINEERING INSTITUTE OF CANADA ET LA CORPORATION DES INGENIEURS PROFESSIONNELS DE QUEBEC

MEMOIRE DE CONVENTION fait en double en la cité de Montréal, dans la province de Québec, ce....................

jour d.........................194.....

PAR ET ENTRE:

L'ENGINEERING INSTITUTE OF CANADA, corporation dûment constituée conformément aux lois du Dominion du Canada, ayant sa principale place d'affaires dans la cité de Montréal, province de Québec, représentée aux présentes par son président et son secrétaire général, dûment autorisés aux fins des présentes par une résolution de son conseil passée à une assemblée dûment convoquée et tenue le....................

jour de..........194..., ci-après désignée comme l'Institut,

Partie de première part,

ET:—

LA CORPORATION DES INGENIEURS PROFESSIONNELS DE QUEBEC, corporation dûment constituée conformément aux lois de la province de Québec, ayant sa principale place d'affaires en la cité de Montréal, province de Québec, agissant aux présentes par son président et son secrétaire, ci-après désignée comme la Corporation,

Partie de seconde part.

ATTENDU qu'il est désirable, dans l'intérêt de la profession d'ingénieur, qu'il existe une coopération étroite entre l'Institut et la Corporation, et

ATTENDU qu'on encouragera une telle coopération si on réussit à établir, en autant qu'il est possible:

(a) Un ensemble de membres dans la province de Québec qui soit commun à l'Institut et à la Corporation, dans le but de promouvoir plus efficacement les intérêts de la profession d'ingénieur.

(b) Une liaison entre les conseils de l'Institut et de la Corporation.

(c) Une simplification de la procédure par laquelle les membres de l'une des associations possédant les titres à l'admission dans l'autre association peuvent en devenir membres.

(d) Une simplification des modes actuels de perception des cotisations.

(e) L'abolition des droits d'entrée jusqu'ici exigibles lorsqu'un membre de l'une de ces associations est admis comme membre de l'autre.

EN CONSÉQUENCE, les parties aux présentes conviennent entre elles comme suit:

1. Tout membre de la Corporation qui, à la date de la présente convention, est inscrit comme ingénieur professionnel conformément aux dispositions du chapitre 270 des Statuts Refondus de la Province de Québec pour l'année 1941 et à tous amendements subséquents au dit chapitre, et qui, à cette date, n'est pas membre régulier (Corporate Member) de l'Institut, aura le droit, en vertu des présentes, de devenir un membre régulier de l'Institut. Pour exercer ce droit, tel membre de la Corporation devra, dans les 90 jours de la date d'entrée en vigueur de la présente convention, donner avis par écrit au régistraire de la Corporation de son désir de devenir membre régulier de l'Institut, aux termes de la présente convention.

2. Toute personne s'inscrivant comme ingénieur professionnel et devenant membre de la Corporation après la date des présentes et qui n'est pas membre de l'Institut, aura le droit, conformément aux dispositions de la présente convention, de devenir membre de l'Institut. Pour exercer ce droit, tel membre de la Corporation devra, dans les 90 jours suivant la date de son inscription, demander à l'Institut son admission comme membre. Tel candidat sera admis dans la classe de membre à laquelle, d'après les règlements de l'Institut, il est

porate Members or Juniors of the Institute under the provisions of paragraph 2 of this agreement, shall not be required to pay the entrance or the transfer fee of the Institute otherwise payable.

4. Each Corporate Member or Junior of the Institute who on the date of this agreement is a resident of the Province of Quebec and who is not on such date a Member of the Corporation, shall have the right, under the provisions of this agreement, to become a Member of the Corporation if qualified for such membership. In order to exercise such right he shall make application for membership in the Corporation within 90 days of the effective date of this agreement.

5. Each Corporate Member or Junior of the Institute who subsequent to the date of this agreement becomes a resident of the Province of Quebec, and who is not on such date a Member of the Corporation, shall have the right, under the provisions of this agreement, to become a Member of the Corporation if qualified for such membership. In order to exercise such right he shall make application for membership in the Corporation within 90 days of the date on which he becomes a resident of the Province of Quebec.

6. Each resident of the Province of Quebec who subsequent to the date of this agreement becomes a Corporate Member or Junior of the Institute, and who is not a Member of the Corporation, shall have the right, under the provisions of this agreement, to become a Member of the Corporation if qualified for such membership. In order to exercise such right he shall make application for membership in the Corporation within 90 days of the date on which he becomes a Corporate Member or Junior of the Institute.

7. Corporate Members and Juniors of the Institute who become Members of the Corporation under the provisions of paragraphs 4, 5 and 6 of this agreement shall not be required to pay the entrance fee of the Corporation otherwise payable.

8. Each person who is enrolled as a Student with the Corporation shall have the right, upon application to the Institute, to become a Student of the Institute.

9. Within 60 days after the effective date of this agreement a joint committee composed of three members appointed by the Council of the Institute and three members appointed by the Council of the Corporation shall be constituted to explore the possibilities of simplification of existing arrangements for the collection of fees and the possibilities of reduction of total fees payable by those who hold membership in both the Institute and the Corporation. The report and recommendation of this joint committee shall be transmitted to the Council of the Institute and of the Corporation at the earliest feasible date for action by the respective parties.

10. The Council of the Corporation shall have the right to appoint to the Council of the Institute, as a representative of the Corporation, a Councillor of the Corporation who is also a member of the Institute.

11. Nothing in this agreement shall be so interpreted as in any way to limit the autonomy of each of the parties hereto, but should one of the parties deem it necessary, in accordance with its charter and by-laws, to discipline, suspend, or expel, any person or persons holding membership in both the Institute and the Corporation, it will, before taking final action, furnish the other party with sufficient information to enable such other party to determine whether the circumstances warrant action by such other party. Neither party shall be affected by action or lack of action by the other party.

12. This agreement is intended to apply to residents of the Province of Quebec only. A person who is not, or who has ceased to be, a resident of the Province of Quebec shall not, by virtue of this agreement, share in any of the benefits arising under this agreement.

13. The terms and conditions of this agreement may be amended by mutual consent in writing between the Councils of the parties hereto, duly authorized, where necessary, by the parties hereto and executed by their accredited officers.

14. The term of this agreement shall be the period commencing on the first day of .... and ending on the thirty-first day of December but unless either one of the parties hereto has given notice to the other party hereto at least six months prior to the said thirty-first day of December ...., that this agreement shall be terminated, it shall continue in full

éligible eu égard à son âge, son expérience et ses titres professionnels.

3. Les membres de la Corporation qui deviennent membres réguliers de l'Institut, selon les dispositions du paragraphe 1 de la présente convention, et les membres de la Corporation qui deviennent membres réguliers ou membres juniors de l'Institut selon les dispositions du paragraphe 2 de la présente convention, n'auront pas à payer les droits d'entrée ou de changement de classe imposés par l'Institut, qui seraient autrement exigibles.

4. Tout membre régulier ou membre junior de l'Institut qui, à la date de la présente convention, réside dans la province de Québec et qui n'est pas à cette date un membre de la Corporation, aura le droit, conformément aux dispositions de la présente convention, de devenir membre de la dite Corporation pourvu qu'il possède les titres à l'admission. Pour exercer ce droit, il devra demander à la Corporation son admission comme membre dans les 90 jours de la date d'entrée en vigueur de la présente convention.

5. Tout membre régulier ou membre junior de l'Institut qui, après la date des présentes, établit résidence dans la province de Québec, et qui n'est pas à cette date membre de la Corporation, aura le droit, conformément aux dispositions de la présente convention, de devenir membre de la Corporation pourvu qu'il possède les titres à l'admission. Pour exercer ce droit, il devra demander à la Corporation son admission comme membre dans les 90 jours de la date à laquelle il a établi résidence dans la province de Québec.

6. Toute personne résidant dans la province de Québec qui, après la date des présentes, devient membre régulier ou membre junior de l'Institut, et qui n'est pas membre de la Corporation, aura le droit, conformément aux dispositions de la présente convention, de devenir membre de la Corporation pourvu qu'elle possède les titres à l'admission. Pour exercer ce droit, elle devra demander à la Corporation son admission comme membre dans les 90 jours de la date à laquelle elle est devenue membre régulier ou membre junior de l'Institut.

7. Les membres réguliers et membres juniors de l'Institut qui deviendront membres de la Corporation selon les dispositions des paragraphes 4, 5 et 6 de la présente convention, n'auront pas à payer les droits d'entrée imposés par la Corporation, qui seraient autrement exigibles.

8. Toute personne inscrite à la Corporation comme Etudiant aura le droit, en en faisant la demande à l'Institut, de devenir membre étudiant de l'Institut.

9. Dans les 60 jours de la date d'entrée en vigueur de la présente convention, un comité conjoint composé de trois membres désignés par le conseil de l'Institut et de trois membres désignés par le conseil de la Corporation, sera constitué pour étudier la possibilité de simplifier les modes actuels de perception des cotisations et de réduire les cotisations totales exigibles de ceux qui sont membres à la fois de l'Institut et de la Corporation. Le rapport et les recommandations de ce comité conjoint seront transmis au conseil de l'Institut et au conseil de la Corporation dans le plus court délai possible afin que les parties concernées puissent prendre une décision.

10. Le conseil de la Corporation aura le droit de désigner auprès du conseil de l'Institut, comme représentant de la dite Corration, un conseiller de la Corporation qui soit en même temps membre de l'Institut.

11. Rien dans la présente convention ne devra être interprété comme devant limiter en aucune façon l'autonomie de chacune des parties contractantes; toutefois, si l'une des parties contractantes juge nécessaire, conformément à sa charte et à ses règlements, de réprimander, suspendre ou expulser toute personne qui est membre à la fois de l'Institut et de la Corporation, cette partie, avant de prendre une décision finale, devra fournir à l'autre partie les renseignements suffisants pour permettre à cette dernière de déterminer si les circonstances la justifient d'agir en conséquence. Nulle partie ne sera liée par les mesures prises par l'autre partie ou par son inaction.

12. La présente convention, selon l'intention des parties contractantes, ne s'applique qu'aux personnes résidant dans la province de Québec. Une personne qui ne réside pas ou qui a cessé de résider dans la province de Québec n'aura droit, en vertu de cette convention, à aucun des avantages prévus par les présentes.

13. Les termes et conditions de la présente convention pourront être amendés par le consentement mutuel intervenant par écrit entre les conseils des parties aux présentes, dûment autorisés, si nécessaire, par les parties aux présentes, et signé par leurs officiers accrédités.

force and effect from year to year subject to termination at the end of any such subsequent year by either one of the parties hereto giving six months prior notice to the other party hereto of intention to terminate. Notice of intention to terminate this agreement shall be given by delivery by one party to the other party of a certified copy of a resolution of the Council of the one party to that effect.

In Witness Whereof these presents have been duly executed on behalf of the parties hereto on the date and at the place above written.

THE ENGINEERING INSTITUTE OF CANADA

IN THE PRESENCE OF

.... *President.*

.... *General Secretary.*

THE CORPORATION OF PROFESSIONAL ENGINEERS OF QUEBEC

.... *President.*

.... *Secretary.*

14. La présente convention entrera en vigueur le premier jour de ....et expirera le trente-et-unième jour de décembre 194..., mais à moins que l'une des parties n'ait, au moins six mois avant le dit trente-et-un décembre 194..., donné avis à l'autre partie que la présente convention doit se terminer, la convention demeurera en vigueur d'année en année sujet, cependant, à terminaison à la fin de n'importe quelle année subséquente en par l'une des parties signifiant, par un avis d'au moins six mois, à l'autre partie son intention de terminer la dite convention. L'avis de l'intention de terminer la présente convention sera donné par la remise par une partie à l'autre d'une copie certifiée de la résolution à cet effet du conseil de la première.

En Foi de Quoi les présentes ont été signées au nom des parties contractantes à la date et à l'endroit mentionnés plus haut.

L'ENGINEERING INSTITUTE OF CANADA

EN PRÉSENCE DE

par Le président

.... *Le secrétaire général*

....

LA CORPORATION DES INGENIEURS PROFESSIONNELS DE QUEBEC

par Le président

.... *Le secrétaire*

....

WASHINGTON LETTER

In the early days of the war, Dr. Vannevar Bush, then president of the Carnegie Institute, foresaw the need of a coordinating body to handle and initiate the vast amount of scientific research and development which is involved in modern warfare. Under presidential direction, therefore, the Office of Scientific Research and Development was set up with Dr. Bush at the head and with Dr. James B. Conant, president of Harvard, and Dr. Karl T. Compton, president of M.I.T. as two of his chief aides. Through our Scientific Liaison we have been keeping in touch with the work of O.S.R.D. They actually have offices and a staff in Australia where one of their main preoccupations is tropic proofing and the study of the behaviour of weapons and instruments under tropical conditions. Every week Dr. Bush has a meeting of his key officers and it was my privilege last week to be invited to one of these meetings. They are interesting and informal affairs at which tea is served. I had an interesting chat with Dr. Bush and also with Dean Moreland, who is executive director of the National Defense Research Committee and dean of engineering at M.I.T. Dr. Klopsteg, who is dean of Northwestern, had just returned from a mission in Australia and told me of the work being carried out there. Also present were General Borden, director of the Army Research Division, Dr. Baxter, president of Williams, who is O.S.R.D. historian and twenty or so others.

Civil Aviation Conference

By the time this letter appears, the International Conference on Civil Aviation will be well under way. As this is written, a strong Australian delegation, headed by Air Minister Drakeford, is arriving in Montreal for preconference conversations. We here in Washington have been busy during recent months briefing our people and keeping in touch with developments leading up to the conference. The American delegation, the names of which were sent for White House approval the other day, includes Assistant Secretary of State Adolf Berle, CAB Chairman L. Welsh Pogue, and Vice-Chairman Edward P. Warner, to all of whom I have talked in recent weeks. In addition to two representatives from both the House and the Senate, the delegation also includes Mayor LaGuardia and Assistant Secretary of State William A. Burden. Among the advisers to the U.S. delegation are the very highly regarded Robert Lovett and Artemus Gates, Assistant Secretary of War for Air and for Navy respectively.

The conference will tackle extremely difficult problems. The Australian view was embodied in the Australian-New Zealand Pact which agreed, *inter alia*, that world aviation should be controlled and operated by an international authority. The Americans have put forward a four point proposal to be regarded as an interim solution and as a compromise position to enable a start to be made. On the basis of several years' experience, it is contended, a final plan could more easily be worked out. Canada has made some revisions to her now well known Draft Convention and, within the last two days, the United Kingdom has set forth its views in a White Paper which proposes a new convention to replace the Paris and Havana Conventions. This convention would confirm the right of innocent passage and the right to land for non-traffic purposes and to disembark; it would define routes and frequencies and rates; it would provide for licensing, inspection, safety regulations, etc. The convention would be administered by an international authority with operational and executive subsidiary regional panels and sub-commissions.

The Canadian delegation will include the Hon. C. D. Howe and members of the newly formed Air Transport Board. The British delegation is being headed by Lord Swinton.

"De-control" Policies Considered

It is a source of regret that it is not possible for me to take a more active part in these discussions but other things have crowded in and made this impossible. While procurement work is easing somewhat and while purchasing will increasingly return to normal channels, policy considerations these days demand more attention than ever. A revamping of all policies and procedures has been made necessary by the U.S. decisions to institute de-control, (as a return to "normal" is being called) and a re-alignment of both the requirements and the sources of supply for Stage II of the war has been a matter of close study in recent months. The tempo of these discussions has been increasing and much of our time has been spent in pursuance of these negotiations and in preparing the ground for Australian officials who have either arrived or are on their way to take part in these negotiations. It would be brash to attempt to predict American policy a few weeks before the election. It seems safe to say, however, that the principle of de-control has been so far established that it will be very difficult to reverse the process. In fact, there will continue to be exerted very considerable pressure from many quarters for a return to civilian production, for the elimination of Government controls and for the handing back to private industry of both the initiative and the responsibility for ensuring full employment. There are some who say too much has been promised in the way of de-control and there is certainly no doubt that the reports of the W.P.B. Task Group appointed to implement the Krug and Byrnes Reports are more cautious than the original announcements might seem to justify. It is also being pointed out that the real test will come at the end of the Pacific War and that an experiment would be easier to handle now than later with some reversal of policy if such a reversal could be shown to be necessary. The last controls to go will probably be, in order, manpower, price control and currency control. Currency control will probably be with us, in one form or another, for a long time.

Bretton Woods and Dumbarton Oaks Recommendations Discussed

Controversy still continues round the recommendations of the Bretton Woods Conference and also round the more recently completed Dumbarton Oaks Security Conference. The Oaks recommendations covered more ground and represented a greater measure of agreement and accord than had been anticipated. The controversy, however, centres on the possibilities of giving effect to principles which, without adequate sanctions and Congressional powers granted *in advance of the event*, may well suffer the fate of the similar principles embodied in the old League. Both the Bretton Woods and the Oaks recommendations were received somewhat coolly by the recent National Foreign Trade Council Conference at New York. Canada has also raised a number of pertinent questions with respect to the Oaks recommendations. All this, however, is a healthy sign. It is highly desirable to get all the problems and points of view out into the open as early as possible.

There is certainly variety in a Washington job these days. From a conference on aviation one may attend a meeting on fiscal policy and then make a visit to the Department of Agriculture to discuss sheep dips. Then may follow a trip to New York to attend a lunch for some visiting Australian at which may be present such people as the presidents of General Motors Export, International Business Machine, Chase National Bank, International Nickel, and Air Reduction Corporation. I spent an interesting hour recently with officials of the New York Museum of Natural History who were interested in Australia and were contemplating an excursion to the South West Pacific and who were also hoping to add an Australian room in the Museum. All these incidents have been crowded into our ordinary work in the last several weeks. One of the most unusual experiences, however, was being shown the fine points of the Australian crawl by a Knight and an ex-Lord Mayor of Melbourne. Sir Frank Beaurepaire is head of one of Australia's large rubber companies and, after a gruelling session with him on the problems of converting Australia's industry from crude to synthetic rubber, I invited him for a swim at the Club. Not so many years ago he was an Olympic swimmer and holder of no fewer than fourteen world swimming records.

E. R. Jacobsen, m.e.i.c.

October, 1944.

CORRESPONDENCE

Would Close The Profession

Toronto, Ont., September 21st, 1944.

The Editor,
The Engineering Journal.

Dear Sir:

I have followed with great interest in the *Journal* your letters to Colonel Ralston, as I was one of the unfortunate graduate engineers, and a Junior member of the Institute, who was unable to obtain a commission, and joined up as an AC2 (Standard) in the R.C.A.F. I have, therefore, been interested in finding out just what, if anything, was being done. (I might say here that I would be very happy to remuster to the R.C.E.M.E.) In reading the letters, I thought they were very good but felt that more pressure would have to be brought to bear, and in later issues, I find that you have also come to that conclusion.

In thinking over the engineers' status in peace and in war, I feel that drastic changes must be made. At present, if a lad is an office boy in an engineering office for a few years, and then starts to check blue prints, he calls himself a mechanical engineer; in fact it seems that anyone who does anything concerned with some engineering place calls himself an "engineer".

When we consider the position and prestige of an engineer, I believe we must start with ourselves to make a change. The Engineering Institute will accept non-graduates as affiliates which turns down that which we would like to see built up. Lawyers, doctors, pharmacists, etc., are not as tolerant as we are, and as a result, a doctor joins the forces as a captain. Our own graduate engineers lower the level of the graduate by tutoring a non-graduate until he can do some phase of engineering work. He also lowers the prestige of an engineer by his actions in other ways than the above. I have been hired by engineers, and none have asked for proof of my education. On at least three occasions, I have been offered between \$20 and \$25 per week. Now let us look at that. The professional engineer advertises for a graduate engineer but doesn't give a darn whether he is or not, as he doesn't want proof nor does he intend to pay him for being one.

Therefore, Sir, I say let us start with ourselves to raise the prestige of the engineer. Let every professional engineer obtain proof that a man is a graduate before he accepts him in an engineering position. Let him also see that graduate engineers fill all available engineering positions, and offer that man a salary in keeping with his education.

When we raise the prestige of the engineer among ourselves and close the profession to all except those educated for it, we won't have very much difficulty in building it up outside.

I feel we must have an association or union similar to the Medical Association whereby no graduate engineer may practise engineering without belonging to this organization, and, of course, no non-graduate can be a member without writing examinations equivalent to those passed by a graduate. This, of course, seems very drastic, but if something like this is not done, then I think that it is the duty of the Institute to inform all prospective engineering students that they are intending to take a course of little practical value.

Yours truly,

(Signed) G. L. T. Ellis, Jr.E.I.C.

Salmon Fishing and Industrial Pollution

Oakville, Ont., October 20th, 1944.

Dear Sir:

In the August *Journal*, in the interesting article "The Ganaraska Survey", by Mr. A. H. Richardson occurs the following. On page 463 "Settlement commenced as early as 1793. Different Indian tribes congregated at the mouth of the river attracted by the fresh water salmon". Also on page 466 "fresh water salmon were abundant". Is there any confusion here about the species of salmon ?

We are prone to forget nowadays that the wonderfully game and tasty fish, the Atlantic salmon, made yearly runs in countless numbers up the St. Lawrence river, Lake Ontario and their tributaries as far as Niagara Falls. These runs continued until the 1860's when they gradually ceased because of the increasing pollution of the Great Lakes Waterway. There were not then, and are not now, any engineering works that would stop the runs. By 1870 there was an end to Atlantic salmon fly fishing, "the king of sports"; an end to the huge catches by commercial fishermen; an end to the yearly gatherings of the Indians to catch and cure the salmon for their own use. Fresh salmon, smoke-cured salmon —which is the more delicious ?.

There is a critical degree of pollution which the salmon will not tolerate. It is like a wall past which they will not go. The tidal waters at the mouth of the St. Lawrence dilute the pollution so that there are still salmon runs on tributaries on the North Shore and also on the Gaspé coast some distance up from the Gulf.

On the south side of the Gaspé peninsula, on rivers tributary to the Baie des Chaleurs, is still some of the finest salmon fishing. When the International Paper Company started to build a pulp mill on tidewater at Dalhousie, N.B., about 1925, the salmon fishing clubs retained an expert to report whether the industrial waste from the mill would stop the salmon runs. By the way, the membership lists of the clubs, the owners of the valued "free hold rights" on the salmon streams are a rather full roster of United States millionaires. A few Canadians are in on it and also on the "lease hold rights". Of recent years the New Brunswick government has kept a few miles of these latter open on which Mr. John Public may buy a license to cast an Atlantic salmon fly like the best of them. There is not yet sufficient population density in these parts to produce the critical degree of pollution of the salmon streams.

Yours truly,

(Signed) L. H. Robinson, M.E.I.C.

Short Course in Soil Mechanics

Dear Sir:

It was a great pleasure for me, as an old member of the Montreal Branch, to attend the recent meeting of that branch at which Dr. Terzaghi gave his interesting address on Soil Classification. I regretted having to leave the meeting (in order to catch a train) before having the opportunity of contributing to the discussion.

As Mr. R. E. Chadwick then indicated and as was evident from Dr. Terzaghi's address, a great deal of information regarding soils has been accumulated during the last two decades which can be usefully applied to the practice of foundation engineering. Since so many engineers concerned with foundation work took their formal engineering training before soil mechanics was recognized, and since it is extremely difficult to keep in touch with current developments in this field, there appears to be a real need for some means of introducing this information on soils to practising engineers.

With the cordial approval of Dean C. R. Young, I therefore write to you to ask if you could publicize through the pages of the *Journal* the fact that the University of Toronto would be glad to arrange for a short course in Soil Mechanics as applied to foundation engineering if sufficient interest is indicated in such a project. If arranged, the course would take place towards the end of May 1945; it would last for not more than one week; a fee would be necessary to cover expenses; and the entire proceedings will be designed especially for practising engineers, and architects.

If those who would plan to attend such a course would be good enough to communicate with me as soon as possible, we shall be glad to determine whether the demand is sufficient and if so, to proceed with the necessary arrangements during the winter.

It should be added that it is necessary for the course to be held after the academic session has closed in view of the heavy pressure upon university staffs and facilities in engineering. Correspondingly, it appears that if such a course is given it should be held early in 1945, before the universities are faced with the great problems of catering adequately to those who will shortly (we hope) be discharged from the Armed Forces.

Yours faithfully,

Robert F. Legget, M.E.I.C.

Associate Professor of Civil Engineering.

COMING MEETINGS

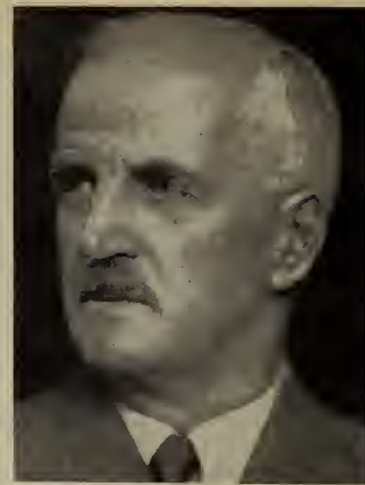
The American Society of Mechanical Engineers—Annual Meeting, Hotel Pennsylvania, New York, N.Y., November 27-December 1, 1944. Secretary: C. E. Davies, 29 West 39th Street, New York 18, N.Y.

Canadian Construction Association—Annual Meeting, Chateau Frontenac, Quebec, Que., January 17-19, 1945. General Manager, J. Clark Reilly, Ottawa Electric Bldg., Ottawa, Ont.

The Engineering Institute of Canada—Fifty-Ninth Annual Meeting, Royal Alexandra Hotel, Winnipeg, Man., February 7-8, 1945. General Secretary: Dr. L. Austin Wright, 2050 Mansfield Street, Montreal 2, Que.

Hon. C. D. Howe, Hon.M.E.I.C.

(*Associated Screen News Limited*)
R. A. C. Henry, M.E.I.C.



C. J. Mackenzie, M.E.I.C.

ENGINEERS IN RECONSTRUCTION

A fine tribute to their ability as administrators was paid engineers by the Government last month. Three of the most important appointments in the huge task of reconstruction went to members of the Institute.

Honourable C. D. Howe, Hon.M.E.I.C., Minister of Munitions and Supply, has been given the additional task of directing the activities of the new Department of Reconstruction. No great effort of imagination is necessary to realize the amount of work and the great difficulties which lie ahead in the reorganization of national economy on a peace time basis. But the minister is in the class of giants, and ever since coming into public life his tasks seem to have been the herculean ones in the government of the nation. His remarkable achievements of the last five years in mobilizing the industrial resources of the country were preceded by four years during which he united under one department all governmental transportation agencies; established the National Harbours Board and set up the Board of Transport Commissioners; developed the Canadian Broadcasting Corporation from the former Canadian Radio Commission, and organized Trans-Canada Airlines.

The *Ottawa Journal* spoke as follows on Mr. Howe's appointment:

"Measured by the ordinary standards of politics Mr. Howe has been a different sort of Minister. Not a parliamentarian, often seemingly unaware of what Parliament is about, he has been a great administrator; restless, tireless, unimpeded by fetishes and formulas, and with a genius for getting things done. There were dark days during the past five years when certain war supply problems in this country seemed insoluble, when the utmost in courage and optimism was required to surmount them. Mr. Howe had the utmost in both qualities. Never cast down, he had the gift of overcoming trouble by the unique process of denying its existence, a talent which, extraordinarily helpful, is possessed by a few of us.

"That talent will stand him in good stead in the task of reconstruction—certain to be a tremendous one, calling for both courage and optimism. It is characteristic of Mr. Howe that, facing up to it, he keeps as well his present supply job and takes on in addition a number of other duties, including the direction of civil aviation."

In the work of reconstruction, Mr. Howe will be seconded by R. A. C. Henry, M.E.I.C., of Montreal, who has been appointed deputy-minister of the new department. Like his minister, Mr. Henry has had a sound background of engineering experience which culminated in administrative positions such as those of vice-president and general manager of Beauharnois Light, Heat and Power Company and Montreal Light, Heat and Power Consolidated. His experience in government work includes service as an engineer in the former Department of Railways and Canals of which he was, at one time, deputy-minister. For six years he was director of the Bureau of Economics of Canadian National Railways. Since the beginning of this war Mr. Henry has served as executive assistant to the Minister of Transport and later as economics advisor to the Department of Munitions and Supply. Last year, he was appointed president of Defence Communications Limited, a crown company established to co-ordinate certain telegraph, telephone and other communications systems in Canada on behalf of the armed forces. Lately he was made chairman for ten years of the new Air Transport Board.

The importance of organized research in the post-war period is beyond question. The appointment of C. J. Mackenzie, M.E.I.C., a past-president of the Institute, to the presidency of the National Research Council comes as a fitting tribute to the admirable qualities which he has displayed during the last five years as acting-president of the Council. It is significant that this appointment was followed by another a few weeks later when Dean Mackenzie accepted in addition to his duties as National Research Council head, the post of director of industrial research and development in the Department of Reconstruction.

Consultant, teacher, dean of engineering, Dr. Mackenzie had been for 30 years a strong figure in western Canada before coming to Ottawa at the outbreak of war when General McNaughton, the president of the National Research Council, was given charge of the Canadian Army overseas.

It is appropriate to recall here the tribute paid Dr. Mackenzie by General McNaughton himself at the Annual Meeting of the Institute in Montreal in 1942:

"Actually I made Dean Mackenzie's appointment one of two conditions that were attached to my accepting office as a soldier again. And all the time, through the long months that we have been away, he has been good enough to send me each month a running account of what was going on. In each of his letters one could see the seed of the purpose which we had held in our mind before in the Research Council growing, coming to flower and bearing fruit, not only in implementing the war effort of the Dominion of Canada, and contributing to the war effort of Great Britain and of the sister Dominions, but also in the constant thought that the organization which was growing would be of service in the years that are to come, beyond the war.

"Standing here tonight, with a very considerable knowledge of the situation, I can say that one of the happiest thoughts in my mind is the feeling that the National Research Council, and all it stands for under Mackenzie's leadership, is performing that duty of scientific leadership and helpfulness in the way in which it is being carried out to-day."

Further recognition was given Dr. Mackenzie's outstanding achievements in the field of research when last month he received honorary doctor's degrees from Queen's University at Kingston and the University of Algiers. This latter was presented to him by the French Consul at Montreal.

Members of the Institute rejoice in the recognition given their fellow-engineers, and with their best wishes goes the assurance of their earnest co-operation in the formidable tasks of to-morrow.

Personals

Relatives and friends of members in the active forces are invited to inform the Institute of news items, such as locations, promotions, transfers, etc., which would be of interest to other members of the Institute and which should be entered on the member's personal record kept at Headquarters. These would form a basis of personal items in the *Journal*.

H. W. Lea, M.E.I.C.

H. W. Lea, M.E.I.C., director of the Wartime Bureau of Technical Personnel, Department of Labour, Ottawa, has been named general manager and secretary of the new Chemical Institute of Canada. Arrangements have been completed with government authorities which enable him to undertake his new duties immediately in addition to the direction of the activities of the Bureau.

The Chemical Institute of Canada is a consolidation of the interests and membership of the Society of Chemical Industry, the Canadian Institute of Chemistry and the Canadian Chemical Association. The Society of Chemical Industry as a British Empire and international organization will retain a Canadian section. It is anticipated that the headquarters of the Chemical Institute will be established at Ottawa on the cessation of hostilities. The new body will represent the interests of the six thousand professionally trained chemists and chemical engineers in Canada and will attract as non-professional members a considerable number of persons interested in the application of chemical engineering and all branches of chemistry.

Mr. Lea's early experience in organizational activities among junior engineers and his intimate contacts with technical personnel in the Armed Forces, in civilian employment and at universities during this war have qualified him especially for this new task.

News of the Personal Activities of members of the Institute

C. H. McL. Burns, M.E.I.C., who since early 1941 has been connected with the Otis-Fensom management of their anti-aircraft Ordnance Division at Hamilton as control manager and sub-contract manager, and lately in charge of that company's post war planning and industrial survey of Canada, has accepted a temporary position as industrial engineer with the Ontario Department of Planning and Development.

Major-General G. R. Turner, C.B., M.C., D.C.M., M.E.I.C., has been appointed special assistant in the Department of Pensions and National Health at Ottawa. General Turner returned from overseas in September 1944.

Hector S. Philips, M.E.I.C., has recently resigned his position as designing engineer for sewerage and waterworks for the City of Hamilton, Ont., after 23 years service, in order to engage in private practice as consulting engineer.

Before going to Hamilton he was employed as assistant engineer at Toronto and London in the design of sewerage and sewage disposal works. In 1915 he was temporarily released from his Toronto appointment to become assistant district engineer on the staff of Professor E. B. Phelps, consulting sanitary engineer of the International Joint Commission in connection with the Pollution of Boundary Waters.

In March 1916 he left the employ of the City of Toronto to become designing engineer for the Canada Nitro Products Co. Limited of Toronto, in which capacity he supervised the design of a shrapnel loading plant and also guncotton and cordite plants. For two years following this he held a commission as lieutenant in the Royal Canadian Engineers.

Prior to coming to this continent Mr. Philips was employed as assistant engineer on construction of various water works in Scotland.

Major-General J. P. Mackenzie, C.B., D.S.O., M.E.I.C., has been appointed controller of construction in the Department of Munitions and Supply at Ottawa, succeeding John Schofield of Montreal. General Mackenzie had been associate controller for the past few months.

E. C. Perley, M.E.I.C., has recently been promoted to Assistant Director General, Automotive and Tank Production Branch, Department of Munitions and Supply, Ottawa. He has also been appointed Deputy Canadian Member, Transportation Equipment Committee, Combined Production and Resources Board, Washington.

W. A. Dawson, M.E.I.C., has been elected director of the American Society of Tool Engineers of Regina No. 20, comprising that section of Ontario lying west of Toronto, in which the following chapters of the Society are located: Hamilton, Windsor, Lakehead, Niagara District, representing a total enrolment of approximately 600 tool engineers. He organized the Hamilton Chapter of the A.S.T.E. in 1941 and became its first chairman. For three years following 1940, Mr. Dawson was chief planning engineer, while at present he occupies the position of chief inspector of the Ordnance Division of the Otis-Fensom Elevator Company Limited, Hamilton, Ont.

C. James Gardner, M.E.I.C., has recently been appointed commodity officer (machinery and tools), Commercial Intelligence Service, Department of Trade and Commerce, Ottawa, Ont.

George M. Hudson, M.E.I.C., who held the position of outside plant standards engineer with the Bell Telephone Company at Montreal, has retired after 33 years service. Mr. Hudson joined the Institute as Junior in 1912.

Francis Bernard Connors, M.E.I.C., captain in the Royal Canadian Engineers, has now been retired from the Canadian Army and has resumed his work with the Department of Public Works of Alberta, Roads Branch, as district engineer at Calgary, Alta.

Lindsay Miller, M.E.I.C., formerly with the engineering department of Defence Industries Limited, has now joined the staff of Johnson & Johnson Limited, Montreal, Que., as plant engineer.

R. L. Dunsmore, M.E.I.C., of Imperial Oil Limited has been appointed manager of the Montreal refinery of the company. For the past two years he had served as Commander with the R.C.N.V.R. at Naval Service Headquarters, Ottawa, where he was director of fuel and assistant director of plans. Before that Mr. Dunsmore was manager of the Imperial Oil refinery at Halifax. He is a former vice-president of the Institute.

Lieutenant (E) A. Meade Wright, Jr.E.I.C., took part in his third invasion in five months as a member of the Canadian landing craft *H.M.C.S. Prince David* when he landed at Kithera Island off the coast of Greece last month. He was in the invasion of Normandy in June and, a few weeks later, participated in the invasion of the South of France. Last year he landed troops for the invasion of Sicily. Lieutenant Wright, who graduated in electrical engineering from McGill University in 1941, is the son of Dr. L. Austin Wright, general secretary of the Institute.

C. A. Miller, Jr.E.I.C., of Defence Industries Limited, has been transferred from Winnipeg, Man., to Nobel, Ont., as superintendent of the guncotton department.

Major Jacques Déry, Jr.E.I.C., was severely injured and received multiple shrapnel wounds while on duty at Caen, France, on August 8th. He was transferred to England where he is now convalescing. Major Déry was formerly with the Department of Public Works of Canada as a junior engineer at Montreal.

W. C. Murray Luscombe, Jr.E.I.C., of the Aluminum Company of Canada Limited has been transferred from Arvida to Montreal, Que., where he is electrical purchasing agent. While at Arvida he was chairman of the Junior Section of the Saguenay Branch of the Institute.

D. W. MacLean, Jr.E.I.C., formerly with the Forest Products Laboratories, Ottawa, is now with the Forest Engineering Department, New Brunswick International Paper Company, Campbellton, N.B., as forest engineer.

Conrad Laverdure, S.E.I.C., has joined the staff of Commonwealth Plywood Limited at Ste. Thérèse, Que. A graduate of the Ecole Polytechnique in the class of 1943, he was previously employed with Anglo-Canadian Shipbuilding at Quebec.

Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Norman Short Braden, M.E.I.C., widely known Canadian industrialist, died suddenly at his home in Hamilton, Ont., on September 27th, 1944. Born at Indianapolis, Indiana, on June 15th, 1869, he came to Canada in 1904 and later became a Canadian citizen.

He received his education at Whitman College, Walla Walla, Washington and Oberton College, Ohio, becoming associated in 1899 with the Westinghouse Electric & Manufacturing Company, Cleveland. By 1902 Mr. Braden had advanced to the post of district manager and two years later he was appointed sales manager of the Canadian Westinghouse Company. In 1919 he was elected vice-president, becoming a member of the Board of Directors seven years later. In 1939 he was elected vice-chairman of the Board which post he relinquished this past year upon retiring. However, he retained his directorship.

For the past 40 years Mr. Braden was one of the leading figures in the electrical and industrial life of Canada. In 1913 he was instrumental in establishing the first complete electrification of a steel plant in the world for the Steel Company of Canada. Six years later he contracted for the first generator to be installed by the Ontario Hydro Power Commission at Queenston—at that time the largest electrical machine on the continent. He successfully pioneered many other electrical projects, including hydro-electric developments throughout Canada, railway equipment, application of electricity for rubber and paper production, and the early introduction of radio into Canadian homes.

In addition to his activities with Canadian Westinghouse Company Limited, Mr. Braden was a director of the B. Greening Wire Company, a former president and director of Thermionics Limited, Canadian Radio Patents Limited, Sea, Land & Air Patents Limited. He was active in such groups as the Radio Manufacturers Association of Canada, The Canadian Manufacturers Association, and many other commercial and technical associations.

After a long period of association with the Hamilton Branch as an affiliate, Mr. Braden joined The Engineering Institute of Canada as a Member in 1943.

Sydney Edwin Junkins, M.E.I.C., died on October 3rd, 1944, at his home in Hanover, New Hampshire. Born at Wakefield, N.H., on January 16th, 1867, he received his education at Dartmouth College where he had taken his B.A. degree in 1887 and his M.A. degree in 1890. In 1927 he received the degree of Doctor of Engineering.

Following graduation he was employed as general manager of the Morley Button Sewing Machine Company, Boston, until 1898 when he went with the Westinghouse, Church, Kerr & Company. With the latter company he served successively as engineer, manager, secretary and vice-president. Mr. Junkins participated in the complete electrification of 108 miles of the Long Island railroad tracks and in the design of railway terminals, shops and power plants of the Pennsylvania Railroad System, including the Pennsylvania Station in New York City. He was also active in numerous other undertakings including investigations, reports, designs and construction of industrial, hydraulic and railway projects.

After forming his own company in Winnipeg in 1917 Mr. Junkins served as a consulting engineer for the Canadian Pacific Railway, much of his work being done in Vancouver and Winnipeg. For that company he was for five years in charge of lining the Connaught tunnel. He was also consultant for the Department of Public Works of the Dominion of Canada and for the same department in the Province of British Columbia. He retired in 1932.

Mr. Junkins joined the Institute as a Member in 1913.

Samuel Robert Newton, M.E.I.C.

Samuel Robert Newton, M.E.I.C., died on October 11, 1944, at the Sherbrooke Hospital, Sherbrooke, Que., after a short illness. Born at Drummondville, Que., on November 23, 1881, the son of Samuel and Margaret Newton, he received his early education in the public school at Actonvale and Dufferin grammar school at Brigham. He graduated from McGill University in 1902 with the degree of B.Sc., receiving his degree of M.Sc. in the following year. In June of the same year he joined the Canadian Rand Drill Company at Sherbrooke, Que., as a draughtsman. In 1910 he was appointed chief draughtsman of the Canadian Rand Company Limited and continued in this position until 1915, when he was appointed chief engineer of munitions manufacture for the Canadian Ingersoll-Rand Company Limited.

After the Great War he served successively as superintendent of the company's Jenckes plant, engineer in charge of manufacturing at the Rand plant, and in 1929 was appointed chief engineer of the Canadian Ingersoll-Rand Company Limited, which position he held until the time of his death. In 1934 he was elected a director and vice-president of the company.

Mr. Newton was also vice-president of the Newton Construction Company Limited, a director of the Brompton Pulp and Paper Company.

One of the Eastern Townships' most prominent citizens, Mr. Newton served on the city council of Sherbrooke for ten years and played an important part in building up the city, acting as chairman of the Parks Committee and chairman of the Electric and Gas Committee.

At the time of his death Mr. Newton was a member of corporation and treasurer of King's Hall School, Compton; vice-chairman of the executive committee of Corporation of Bishop's University; and a member of the Senior Council of Technical Education of the Province of Quebec. He was also a member of the Sherbrooke Country Club, a member of the St. George's Club and past president of the Sherbrooke Y.M.C.A.

Taking a very active interest in hockey, baseball, badminton and other sports, Mr. Newton was one of the leading trap shooters in the Dominion and a member of the Canadian team which finished second in the Olympic Games at Paris in 1924, and also a member of the team which finished third in the British Trap Shooting Championships in the same year.

Mr. Newton joined the Institute as a Student in 1902, transferring to Associate Member in 1913. He became a Member in 1940. He was also a member of the Corporation of Professional Engineers of Quebec.

William B. Russell, M.E.I.C., died suddenly on September 20th, 1944, at his summer home at Elk Lake, Ont. Born at Pembroke, Ont., on March 22nd, 1868, he graduated in civil engineering from the School of Practical Science, University of Toronto, in 1891.

Upon graduating Mr. Russel began a long career in railway and highway construction. For the two years following graduation he worked on the engineering staff of the Newfoundland Railway. He returned to Canada in 1893 where he was employed as follows: 1893-1896, in charge of construction, Ottawa, Arnprior & Parry Sound Railway; 1896-1898, chief engineer of construction, Pembroke Southern; 1898-1899, constructing sewerage system of Town of Pembroke; 1899-1901, in charge of construction, Algoma Central Railway. In 1901 he took charge of location of Temiskaming and Northern Ontario Railway and the following year was appointed chief engineer of that railway then under construction. Mr. Russel resigned this latter position in 1905 and was later identified with the Trent Valley Waterway; the filtration plant, Toronto; the Canadian Northern Railway; the Welland Canal and the Ferguson Highway in Ontario. For the past ten years he had been associated with the Ontario Department of Highways.

Mr. Russel joined the Institute as a Student in 1888, transferring to Associate Member in 1899 and to Member in 1903. In 1933 he was made a Life Member.

News of the Branches

Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

HALIFAX BRANCH

S. W. Gray, m.e.i.c. - - *Secretary-Treasurer*
C. D. Martin, m.e.i.c. - *Branch News Editor*

The first dinner meeting for the season was held at the Nova Scotian Hotel on Thursday, October 19th.

The attendance at this meeting was 105, and if this is an indication of what can be expected for the rest of the meetings, it looks as if we will have a very successful season.

The speaker for the evening was Captain Berton E. Robinson, Associate Editor of the *Halifax Chronicle and Star*. The title of his address was **The Gateway to the North.** Captain Robinson recently made an extensive trip which included the Alaska Highway, the Northwest Staging Route and the Canol Project. With all this first-hand information available, Captain Robinson presented a highly interesting address, which held the complete attention of the audience throughout.

Following Captain Robinson's talk, a sound film, covering the construction of the Alaska Highway, was shown through the courtesy of Wm. Stairs Son & Morrow. Mr. H. R. Robson, of the Caterpillar Tractor Company, who had also covered these northern projects, was present at this meeting and, as did Captain Robinson, very kindly answered the various questions that were asked relative to the address and the film.

As has been the custom in recent years, several of the Senior students of the Nova Scotia Technical College attended this meeting as guests of the Halifax Branch.

It is hoped that the interest shown in this meeting will be maintained for those following.

HAMILTON BRANCH

W. E. Brown, m.e.i.c. - *Secretary-Treasurer*
L. C. Sentance, m.e.i.c. - *Branch News Editor*

On Thursday, September 28th, seventy-five members and guests of the Hamilton Branch of the Institute attended the initial meeting of the season, held at McMaster University; H. A. Cooch, branch chairman, presided.

The speaker of the evening was V. A. M. Kemp, assistant commissioner and director of criminal investigation, Royal Canadian Mounted Police. Commissioner Kemp chose for his subject, **The Progress of Science in Criminal Investigation.**

As science progressed, said Commissioner Kemp, the criminal lost no time in availing himself of such new aids to crime. The police have perforce followed closely this trend, and have used science and scientific developments in combating the scientific criminal.

While the average policeman is not trained as a scientist, he is trained to quickly recognize the potentialities of the application of scientific methods to the solution of his case. The Royal Canadian Mounted Police maintain two large and very well equipped scientific laboratories, and in addition, work in close co-operation with various state scientific groups.

In a recapitulation of specific scientific aids now available to the police forces, Commissioner Kemp cited the importance of scientific examination and analysis of blood in the solution of a crime. The presence of blood at the scene of a crime may be made to tell the position of the victim, the time that has elapsed since commission of the crime, and provide clues and identification by its grouping.

The analysis of dust particles and fibres, and microscopic examinations thereof, often provide important means of identification.

Commissioner Kemp dealt at some length with the use and training of dogs for tracking down escaped convicts and for locating missing persons. A number of these highly trained animals are kept at stations throughout the country and their services are available, free of charge, to any other police organization.

In the field of qualitative analysis, the most modern spectrographic equipment is available in police laboratories and has proved invaluable in identification of many substances.

The study of ballistics and fire-arms has been aided by modern scientific methods and positive identification of bullets and fire-arms is easily accomplished.

Modern chemical and optical developments have anabled police forces to successfully solve many cases of forgery and counterfeiting.

The speaker was introduced by H. Chambers, chairman of the papers committee, and a vote of thanks was tendered by Col. E. G. MacKay.

LAKEHEAD BRANCH

J. I. Carmichael, m.e.i.c. - *Secretary-Treasurer*
R. B. Chandler, m.e.i.c. - *Branch News Editor*

The Lakehead Branch met in the Prince Arthur Hotel, Port Arthur, Thursday evening, October 12th, to welcome Mr. de Gaspé Beaubien, president of the Institute, and Dr. L. Austin Wright, general secretary, both of Montreal. S. T. McCavour, chairman of the branch, presided.

Murray J. Fleming, vice-president of the Institute for Ontario, introduced Mr. Beaubien as one of Canada's outstanding engineers, whose service to the Dominion since the outbreak of war had been such as to earn for him an honour from His Majesty, the King.

Mr. Beaubien expressed his pleasure at having been chosen as the Institute's president, and said his present trip across Canada was bringing him in contact with the important men of the country. He said Ontario and Quebec had much in common. There was very little difference in the viewpoint of the average citizen concerning national affairs. Canada, he declared, was the link between the United States and Europe.

Canada has made a great contribution to the war effort. It had developed an industry much greater than the population required, and now was sufficient to take care of a major part of world requirements. Short handed as this country was, it had made a worthwhile achievement in the industrial world in developing new processes.

He spoke of magnesium, produced in Canada, by a new process, which was now being used in many allied countries. Canada, he said, had developed a type of glass that provided lenses equal to or better than the finest produced in Germany before the war.

Skilled mechanics trained in Canadian industry were equal to any in the world. Refractory materials had been developed in Canada for use in the iron and steel industry that were revolutionizing the smelting of iron ore. Steel for gun barrels was also being produced, Mr. Beaubien said, which enabled their production in a shorter time than heretofore and with much longer life in action. New plastics and a new industrial glue were two other important developments. In Canada there had been an industrial machine built up which was capable of producing anything the world would require.

Mr. Beaubien said labour was tired after five years of a great war effort and production individually appeared to be falling off at a serious rate. Unless the slackening could be halted, Canada might lose the fruits of the wonderful effort industry has made.

Canada, he said, would have to continue to supply machinery and food to Europe. This country could have its share of the market available now and if we do this we can retain it in after years. The engineer, he added, was capable of directing this effort, since labour had confidence in the engineer. The engineer must broaden his viewpoint. He must take an interest in public affairs. He should strive to keep labour producing, to keep industry going, and the standard of living on the up grade.

Unless we take steps now while the opportunity presents itself, at the end of the war we may lose the place in world industry that Canada should rightly enjoy.

Dr. L. Austin Wright, general secretary, spoke on the work and growth of the Institute. He outlined the work being done by the standing and special committees and presented a most comprehensive survey of institute matters. He was introduced by R. B. Chandler, past chairman of the branch.

The speakers were thanked by Messrs. H. G. O'Leary and J. A. Antonisen.

The president and general secretary were met on arrival in Port Arthur by members of the branch executive on Thursday morning. Following a luncheon when they were entertained by the chairman and branch executive, the visitors were taken through the plant of the Port Arthur Shipbuilding Company, now working on naval craft.

On Friday morning they visited the new iron ore dock under construction in Port Arthur and in the afternoon paid a visit to the aircraft plant of the Canadian Car and Foundry Company in Fort William.

At 5 p.m. Friday, accompanied by some forty Lakehead engineers, and heads of Port Arthur civic bodies the visitors left for Atikokan, Ont., to visit the Steep Rock Iron Mines development.

On Saturday, October 14th, the party was met by Mr. M. S. Fotheringham, mine manager, and had breakfast at the mine. An inspection tour by bus and motor car was made of the great diversion works undertaken to change the flow of the Seine river and lower the levels of Finlayson and Marmion lakes. The pumping plant for de-watering Steep Rock lake was inspected and a visit made to see the open cut mining operations under way on the "B" ore body formerly under the waters of Steep Rock lake.

President Beaubien spoke at the noon luncheon on the mining property, expressing his thanks for the opportunity of being present. He also congratulated the officials on the scope of the development work completed. It was an indication of what could be accomplished by a spirit of adventure, backed by sound engineering. Mayor C. W. Cox of Port Arthur and Sam McCavour, chairman of the branch, spoke briefly expressing their appreciation to Steep Rock officials.

The Steep Rock visit concluded by a dinner at the mine on Saturday evening which was followed by an impromptu programme of song, speeches and tall stories.

CONFERENCE ON RIVER POWER DEVELOPMENT IN SOUTHERN ONTARIO

London, Ontario—October 13th and 14th, 1944

W. R. Smith, m.e.i.c., County Engineer, Middlesex County, Ontario, provided one of the high lights of the Conference on River Valley Development in Southern Ontario, by his paper "A Reconnaissance Survey of the Upper Thames Watershed."

The paper dealt largely with the nature of the watershed in the upper 1,200 sq. mi. above the city of London. At least 10,000 acres of submarginal lands are available for reforestation and improvement of the ground water supply. Excessive run-off must be stopped as this means more than the prevention of flooding houses in the urban centres, and represents the right to live of thousands of our most virile Canadians, and their children.

Great dams will not alone stop the waste of valuable water. The rainfall and snow must be held farther upstream before it has a chance to become a torrent.

The facts presented by Mr. Smith were gathered by a committee of the London Branch of The Engineering Institute of Canada, made of members resident in the countries through which the Thames river flows.

Papers on River Development in the United States, the Value of Reforestation, Underground Water Supply, Stream Sanitation, The Ganaraska Report, The Experience with Stream Control on the Grand River, and Erosion Control, gave the conference a very broad background.

The conference was called by the Honourable Dana H. Porter, Ontario Minister of Planning and Development, and over 300 persons attended from all parts of southern and eastern Ontario, and the United States. The details were arranged by Dr. George B. Langford, director of the department, and a regional committee of which J. A. Vance, m.e.i.c., W. H. Riehl, m.e.i.c., W. R. Smith, m.e.i.c.. and Lt.-Col. Wm. Veitch, m.e.i.c., were members.

Engineers, especially, will be interested in the resolutions presented by R. F. Leggett, m.e.i.c., and unanimously adopted by the conference; first, "that the Government of Ontario be urged to establish a conservation authority for Ontario, responsible to the Government, having as its principal function the bringing about of co-ordination and co-operation amongst all agencies in Ontario carrying on or promoting conservation projects, with the object of formulating a unified programme for the rehabilitation of all our renewable natural resources;"

and second, "that the Government of Ontario be urged to arrange for an early start on an inventory of ground water supplies in Ontario, in conjunction with the Geological Survey of Canada."

A more detailed report of the conference prepared by Professor R. F. Legget, will appear in the December *Journal.*

TORONTO BRANCH

S. H. de Jong, m.e.i.c. - *Secretary-Treasurer*
G. L. White, affil.e.i.c. - *Branch News Editor*

The opening meeting for the season of the Toronto Branch was held at Hart House on October 5th. S. R. Frost, chairman, presided over the business part of the meeting when reports were presented on the programme for the season, on the activities of the Junior Group, and on the work of the membership and policy committees.

The speaker of the evening, Charles E. de Leuw, consulting engineer, Chicago, who has spent most of his professional career on traffic and transportation problems, including work in Baltimore, Chicago, Los Angeles, Montreal, St. Louis and Washington, and who spoke on the subject **Transportation Subways** was introduced by H. W. Tate, Toronto Transportation Commission.

Mr. de Leuw pointed out that subways have two principal functions. The first of these is to provide rapid transit for large numbers of people, a function that is an absolute necessity in large cities. Elevated railroads can do this job but they blight the adjacent areas, and are noisy and darken the street beneath. As a result, the trend is toward the replacement of elevated railroads by sub-surface lines.

The second important function of the subway is to provide a separate street level for fixed wheel and free wheel vehicles. This separation speeds up free wheel vehicular traffic, and as a result there are moves being made in cities down to 300,000 or 400,000 to separate various types of traffic by subways or other means.

Mr. de Leuw outlined a system being adopted in a number of cities whereby a few strong trunk subway lines are fed by street cars and buses at points beyond the congested downtown area. The subway often cuts in half the time required to travel from these transfer points to the centre of the city.

The speaker described, with the aid of lantern slides and motion pictures, the construction of the State Street subway in Chicago. He outlined the methods of construction involved in lining the tube tunnels and in the provision of stations and various auxiliary equipment.

In the tunnel work, semi-bench mining methods could be used in more outlying districts while the shield method had to be employed in the downtown area because of the heavy buildings on floating foundations.

Special care was taken in the construction of the system to provide every possible convenience for passengers—escalators from subway level to street level being important factors in this part of the programme. Better lighting than has generally been used in subway stations and platforms was installed and the ventilating system was designed to keep the air conditions good. Original plans called for the use of large quantities of stainless steel and other metals in the stations but the war made it necessary to utilize substitutes. However, very attractive results have been obtained in keeping with the general plan of attracting as many people as possible into the subway, speeding their transportation and relieving surface congestion.

* * *

Junior Section

The Junior Section got away to a good start this fall with a general meeting in the Debates room, Hart House, on October 2nd. Allan Davis our new chairman presided and the guest speaker was Lieut. Col. T. M. Medland, the recently appointed Director of Public Relations of the Association of Professional Engineers of the Province of Ontario.

Col. Medland spoke on the work of the Association in connection with the current Dominion labour legislation P.C. 1003. It was his opinion that all employee engineers should band themselves together into an organization to negotiate employment agreements with their employers.

The meeting was attended by more than 125 young engineers who showed themselves keenly interested in this problem facing the young engineer by the enthusiastic discussion which followed Col. Medland's address.

After business announcements and the distribution of forms for this year's salary survey, the meeting was declared adjourned.

OTTAWA BRANCH

A. A. Swinnerton, m.e.i.c. - *Secretary-Treasurer*
R. C. Purser, m.e.i.c. - - *Branch News Editor*

The first noon luncheon of the fall and winter season of the Ottawa Branch held at the Chateau Laurier, was addressed by Assistant Commissioner V. A. M. Kemp, R.C.M.P., on the subject **The Application of Science to Criminal Investigation.**

Behind the application of science to crime detection there is a tremendous amount of hard plodding and routine police work, stated the speaker. The number of false leads that may arise is truly amazing. The Royal Canadian Mounted Police maintain laboratories and train expert investigators along certain scientific lines but rely to a large extent on common sense and routine methods of police work. They have endeavoured to keep abreast of the times both in these laboratories and in the training given their detectives and investigators. Regular members of the force are given elementary training particularly so they may be able to safeguard evidence that may later be turned over to the technical expert.

All police forces in Canada are at liberty to avail themselves of the R.C.M.P. laboratory and Police College facilities, free of charge except for out-of-pocket overhead. Many forces have made use of them.

Assistant Commissioner Kemp briefly reviewed some of the scientific types of investigation undertaken. The examination of questioned documents, for instance, entailed the identification of handwriting and allied subjects including inks, altered documents, deciphering of messages, writing with invisible ink or in code, the identification of paper to manufacturers, and of typewriting. It is possible to determine with precision the exact machine which may have typed a forged document or perhaps a threatening letter.

Cases have come up, for instance, relating to the identification of counterfeit ration coupons. Such identification is an involved process, including the examination of paper under various lights, the microscopical examination and measurement of paper, perforations and printed matter, also the chemical treatment and raising of license numbers which have been purposely obliterated.

Scientific aids to the criminal investigator are many and varied. They may relate to the use of photography, of the microscope, of blood analysis, of chemical analysis as in the case of poisoning, of the analysis of dust particles, metal filings, of the material under the fingernails, the use of the spectroscope in connection with paints, of hair and fibre analysis, of soil analysis, the examination of grain kernels, and many others.

The assistant commissioner illustrated the various types of investigation with actual examples that came up during the course of the police work. He told of one case where two witnesses to a will in which some $16,000 was involved swore at the trial that the signatures on the document were not their own but were forgeries; and of how the police expert after making photographic enlargements and conducting other investigations was able to prove that the signatures actually were genuine.

WINNIPEG BRANCH

T. E. Storey, m.e.i.c. - *Secretary-Treasurer*
V. W. Dick, m.e.i.c. - *Branch News Editor*

The first joint general meeting this season of the Winnipeg Branch and the Manitoba Association of Professional Engineers was held Thursday, September 28th 1944, under the chairmanship of H. S. Rimmington, assistant engineer, Canadian National Railways Bridge Department, president of the A.P.E.M.

Preliminary announcements of events to come included arrangements for the visit of President Beaubien and General Secretary Dr. L. A. Wright, October 15th to 17th, the main feature being a luncheon meeting to be held on October 17th. Advance notice was also given of the Fifty-Ninth Annual General and Professional Meeting of The Engineering Institute of Canada, to be held in Winnipeg on February 7th and 8th, 1945. It was noted that the last Annual General Meeting of the Institute to be held in Winnipeg was in 1911.

The chairman then called on Mr. D. M. Stephens, Deputy Minister of Mines and Resources of the Manitoba Government, to introduce the speaker, Mr. G. R. Pritchard, illumination engineer for Canadian General Electric Company, Winnipeg. Mr. Pritchard gave a descriptive address on **The Magic of the Spectrum.** Practical demonstrations of many aspects of illumination were shown, including cold light produced with chemicals, fluorescent light produced with ultra violet rays, and monochromatic light produced by sodium and mercury vapour lamps. Other demonstrations were given of different types of heat lamps, infra red and black light lamps.

An interesting discussion followed with many asking questions regarding the various uses of the different types of lights.

The discussion period was closed by Mr. J. W. Tomlinson, assistant general superintendent, Manitoba Power Commission, who thanked the speaker for his interesting and instructive address. Many stayed on after the meeting was adjourned to examine the different exhibits which were used in the demonstrations.

Library Notes

Book notes, Additions to the Library of The Engineering Institute, Reviews of New Books and Publications

GAS PRODUCERS FOR MOTOR VEHICLES

E. A. Allcut, m.e.i.c., and R. H. Patten

The shortage of petroleum products resulting from the war has stirred research work in several countries towards the discovery of substitute fuels for internal combustion engines.

In Canada, a conference of experts to examine the position respecting fuel supplies for motor vehicles was held in the National Research Council Laboratories on December 1, 1941, and, as a result of that discussion, a committee was appointed to investigate the possibilities of fuels other than petroleum products for use in mobile internal combustion engines. This committee reported that the most promising substitutes were producer gas, alcohol, and methane or propane (in some localities). Accordingly, a subcommittee on producer gas was appointed on February 7, 1942, consisting of E. A. Allcut, m.e.i.c. (Chairman), Head of the Department of Mechanical Engineering, University of Toronto; J. H. Parkin, m.e.i.c., Director, Division of Mechanical Engineering, National Research Council, Ottawa, Ontario; C. Greaves, Forest Products Research Laboratory, Ottawa, Ontario; G. Godwin, Quebec North Shore Paper Company, Montreal, Quebec; E. S. Malloch, Department of Mines, Ottawa, Ontario. R. H. Patten, Assistant Professor of Mechanical Engineering, McGill University, Montreal, was the engineer in charge of the testing programme.

The First General Report of this Subcommittee on Producer Gas, which was presented last November, has recently been printed as N.R.C. Publication No. 1220 under the title "Gas Producers for Motor Vehicles." A synopsis of the report follows:

The Subcommittee on Producer Gas was appointed by the Associate Committee on Substitute Fuels to investigate the possibility of replacing gasoline by gas made from charcoal or wood, as a wartime emergency measure. A testing programme was devised and carried out to determine the kind of gas producer that is necessary to meet Canadian conditions and that could be made with the materials, labour, and machinery available.

Stationary and road tests were made to measure power, economy, ease of handling, durability and other characteristics under different conditions, and, as a result, it was decided that Producer "M" embodied most of the desirable features and that Producer "L" was next in order of desirability. It is recommended that at least 25 of Producer "M" and 12 of Producer "L" be purchased and tested on trucks under practical conditions by potential users, and that the manufacturing rights for Producer "M" be acquired for Canada.

A standard specification for charcoal fuel is also included in the Report.

It is further suggested that, in view of the probable shortage of petroleum products in the post-war period, more particularly if the aircraft programme is maintained or accelerated, there will be an increasing need for substitute fuels of all kinds. Indeed, such a provision may well be necessary for national safety. If the practical tests outlined above are satisfactory, the installation of gas producers on 10,000 trucks would give an annual saving of 20 million gallons of gasoline. It should be remarked that there are already more than 500,000 of these plants operating in Europe. The provision of the fuel necessary for these gas producers could form part of a post-war reafforestation programme.

Copies of the Report are available at 75 cents each from the King's Printer, Ottawa.

TECHNICAL BOOKS

Calculus Refresher for Technical Men:

A. Albert Klaf. N.Y., McGraw-Hill Book Company Inc., c. 1944. 5¼ x 8½ in. $3.00.

Centrifugal Pumps and Blowers:

Austin H. Church. N.Y., John Wiley and Sons, Inc., c. 1944. 5½ x 8½ in. $4.50.

Technologists' Stake in the Wagner Act:

The National Labour Relations Act in operation as it affects engineers, chemists and architects. Prepared and edited by M. E. McIver, H. A. Wagner and M. P. McGirr. Chicago, American Association of Engineers, 1944. 5¾ x 9 in. $2.00.

Gas Producers for Motor Vehicles:

First general report of the Subcommittee on Producer Gas of the Associate Committee on Substitute Fuels for Mobile Internal Combustion Engines by E. A. Allcut and R. H. Patten. Ottawa, National Research Council, 1944 (N.R.C. No. 1220). 6½ x 10 in. 162 pp. $0.75.

Canada Year Book 1943-1944:

Dominion Bureau of Statistics. Ottawa, King's Printer, 1944. 6¼ x 9 in. $2.00.

TRANSACTIONS, PROCEEDINGS

Canadian Electrical Association:

Proceedings of the fifty-fourth annual meeting, 1944.

U.S. National Research Council—Highway Research Board:

Proceedings of the twenty-third annual meeting held in Chicago, November 27-30, 1943.

Toronto—The City Planning Board:

Second annual report, December 31st, 1943.

REPORTS

The Iron and Steel Institute (London)—Special report No. 29:

Review of the work of the joint research committees, 1942-1943.

Kenya and Uganda Railways and Harbours:

Report of the general manager on the administration of the railways and harbours for the year ended 31st December, 1943.

Harvard University—Graduate School of Engineering Publications:

No. 391: Signs of voltages and currents in vacuum tube circuits, by Harry Stockman; No. 392: Mechanical models of frequency converters, by Harry Stockman; No. 393: Mutual and self-impedance for coupled antennas, by Ronald King and Charles W. Harrison, Jr.

University of California—Publications in Mathematics—New Series:

Vol. 1, No. 1: Multiple integral problems in the calculus of variations and related topics; No. 2: Bounded analytic functions; No. 3: Natural orderings. Vol. 2, No. 1: Seminar reports in mathematics.

U.S. Bureau of Mines—Technical Paper:

No. 652: Analyses of Kentucky coals; No. 669: Rare and uncommon chemical elements in coal.

Electrochemical Society—Preprint:

No. 86-4: Electrical hazards in electrolytic cell rooms; No. 86-5: Effects of oxygen exhaustion from corrosive solutions on high nickel-chromium-molybdenum alloy steels; No. 86-6: Cathode potential efficiency and throwing power of nickel plating solutions; No. 86-7: Functions of chloride in copper-refining electrolyte; No. 86-8: Electrodeposition on the inside of eccentric cylinders; No. 86-9: Graphite anodes in brine electrolysis; No. 86-10: The effect of certain variables on the electrodeposition of manganese; No. 86-11: Aspects of the operation of mercury arc rectifier stations; No. 86-12: A rotating cathode cell for strip plating evaluation.

BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet all of these books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

AIRCRAFT SHEET METAL BLUEPRINT READING

By H. H. Coxen, G. E. Jackson and G. D. Masters. American Technical Society, Chicago, 1944. 132 pp., illus., diagrs., charts, tables, blueprints, 11 x 8½ in., stiff paper, $2.50.

The material in this workbook is devoted solely to instruction in the actual reading of blueprints without introducing a background of mechanical drawing practice. Beginning with the most elementary aspects it develops the subject to the point of interpreting fairly complicated drawings mainly in question and answer form. Common forms and abbreviations are defined for the beginner.

BASIC STRUCTURES

By F. R. Shanley. John Wiley & Sons, New York; Chapman & Hall, London, 1944. 392 pp., illus., diagrs., charts, tables, 8¼ x 5½ in., cloth, $4.50.

The beginning chapters describe simple kinds of forces and force systems and develop the methods of transmitting these forces through space. From this point on, the arrangement has been dictated by the actual development and analysis of the structure as a means of force transmission with particular emphasis on the physical action involved. The mathematical treatment has been kept as simple as possible. Special application is made to the design and analysis of aircraft structures.

CENTRIFUGAL PUMPS AND BLOWERS

By A. H. Church, John Wiley & Sons, New York; Chapman & Hall, London, 1944. 308 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $4.50.

This discussion of centrifugal pumps and blowers is a welcome addition to the scanty literature on modern practice. The work covers the basic principles of design in sufficient detail for practical purposes and discusses accepted practice in the construction of details and in materials. The selection of pumps and blowers and their installation, operation and testing are also treated.

(The) CHEMICAL INDUSTRY (America at Work)

By J. Perry. Longmans, Green and Co., New York and Toronto, 1944. 128 pp., illus., diagrs., 8½ x 6 in., cloth, $1.75.

Beginning with a brief survey of the history of chemistry in ancient times, this small book continues with the growth of the chemical industry in the United States from early times to the present. Important products and processes are discussed in a simple, concise manner, including a chapter on synthetic products. The volume is one of a series covering the important industries of this country.

DIRECT-CURRENT CIRCUITS (Rochester Technical Series)

By E. M. Morecock. Harper & Brothers, New York and London, 1944. 387 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $3.25.

Designed as a basic course for elementary study, this text provides selected laboratory experiments and a variety of problems for review purposes. A working knowledge of algebra and logarithms is required, but not calculus. The separate chapters deal with elementary electric circuits, magnetism and electromagnetism, instruments and measurement methods, power and energy, conductors and insulation, batteries, the magnetic circuit, electromagnetic induction, capacitance and electrostatics.

ELECTRONICS; To-day and Tomorrow

By J. Mills. D. Van Nostrand Co., New York, 1944. 178 pp., illus., 8 x 5 in., cloth, $2.25.

The simple characteristics of electrons, both in nature and as used by science, are discussed in the introductory chapters. The following section describes the evolution and operation of the more important kinds of electron tubes, vacuum or gas-filled. The last section is devoted to explanation of various electronic devices for television, electron microscopy, ultra-high-frequency apparatus and the cyclotron. The book is designed for the "intelligent layman".

Life and Works of The Honourable ROBERT BOYLE

By L. T. More. Oxford University Press, New York, London, Toronto, 1944. 313 pp., illus., 9½ x 6 in., cloth, $4.50.

The many-sided character that was Robert Boyle is ably depicted in this book. The first half portrays his life against its contemporary background, indicating the results of the impact of his world upon Boyle, and of Boyle upon his world. The later chapters consider Boyle successively as theologien, alchemist, sceptical scientist, and creative natural philosopher, with some emphasis upon his leading role in the swing from alchemy to modern chemistry. *(Continued on page 602)*

PRELIMINARY NOTICE

of Applications for Admission and for Transfer

Oct. 27, 1944.

The By-laws provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described at the December meeting.

L. Austin Wright, General Secretary.

*The professional requirements are as follows:—

A Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science or engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examination of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; be shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainment or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

BISSETT—ERNEST EUGENE, of Vancouver, B.C. Born at Victoria, B.C., June 25th, 1896. Educ.: B.Sc. (Mech.Eng.), Univ. of Washington (accredited by E.C.P.D.), 1919; 1917-18, U.S. Navy; 1919-21, Washington Salvage Corp.; 1921-23, Vancouver Dredging & Salvage Co. Ltd.; 1923-24, Pacific Salvage Co. Ltd.; Consltg. engr. for the following firms: 1924-25, Giant Salvage Co. Ltd., 1925-26, Anglo Canadian Transport Ltd., 1926-27, Washington Tug & Barge Corp., 1934-35, Puget Sound Bridge & Dredging Corp., 1934-37, Kelley Logging Co. Ltd., and at various times to Coast Quarries, Ltd.; 1942-43, asst. to chief engr., Port Edward Divn., B.C. Bridge & Dredging Co. Ltd., U.S. Army Eng.; at present, in private practice.

References: C. T. Hamilton, W. N. Kelly, W. H. Powell, W. O. Scott, P. B. Stroyan.

BONFONT—HUBERT LEOPOLD, of Shawinigan Falls, Que. Born at Montreal, Que., Sept. 13th, 1913. Educ.: 1935-38, Ecole Polytechnique (completed third year), course in radio engrg., Sir George Williams College; 1937 (summer), road surveying, levelman; 1938-40, designing dftsman., installns. of oil burners for domestic and industrial furnaces, design of oil burners, boiler setting, etc., E. J. Raskin, Inc.; 1940-41, layout man, design of tools and templates for aircraft sheet metal work, Fairchild Aircraft; 1941-42, mech. dftsman., boiler and marine engine drawing, valve design, Canadian Vickers; 1942-43, designing dftsman., piping and plant layout, design of dust exhausting system, etc., genl. engrg. dept., Montreal, and at present, designing dftsman. (classified as intermediate engr.), Aluminum Co. of Canada, Ltd., Shawinigan Falls, Que.

References: M. E. Hornback, S. R. Banks, F. Smallwood, A. C. Fleischmann.

GIFFEN—SPENCER HARRINGTON, of Westmount, Que. Born at Isaac's Harbour, N.S., July 18th, 1898. Educ.: 1919-20, Nova Scotia Tech. Coll.; 1921, timber surveying, Brown Corp., La Tuque, Que.; 1922-27, dfting., mech. engrg. dept., Hollinger Gold Mines, Ont., 1927 (6 mos.), plant layout and design, Tennessee Copper Co., Copper Hill, Tennessee; 1927 (6 mos.), reinforced concrete design and plant layout, Sherwin-Williams Co., Chicago; 1928-29, layout and design, Elgin Street Sweeper Co., Elgin, Ill.; 1929-32, application and design of industrial gas engines, Continental Motors, Detroit, Mich.; 1933 (6 mos.), asst. mgr., Lakeland Gold Mines; 1933-37, pres. and genl. mgr., Giffin Gold Mine Ltd.; 1938-39, mill operator, Seal Harbour Gold Mine; 1940 to date, senior dftsman., plant layout and design, D.I.L. and C.I.L., Montreal.

References: D. A. Magnant, S. I. Gislason, A. B. McEwen, W. C. Tatham.

GRENIER—RAYMOND, of Port Alfred, Que. Born at Port Alfred, June 9th, 1923. Educ.: Diploma in Machine Dfting., Chicago Technical School, 1944 (corres. course); 1942 to date, mech. dftsman, with a certain amount of supervision in various small works, Aluminum Co. of Canada, Ltd., Arvida, Que.

References: M. G. Saunders, J. H. Jette, R. Saintonge.

HEWITT—HARRY NAYLOR, of Jean Brillant, Que. Born at Leedale, Alta., March 14th, 1916. Educ.: B.Sc. (Chem.Eng.), Univ. of Alberta, 1940; 1940-42, lab., development and experimental, and 1942-44, lab. supervision, C.I.L., Brownsburg, Que. At present, asst. chief chemist, D.I.L. Bouchard Works.

References: R. S. L. Wilson, J. W. Porteous, I. F. Morrison, C. A. Robb.

HEYS—CHARLES HORACE, of Montreal, Que. Born at Toronto, Ont., April 5th, 1919. Educ.: B.A.Sc. (Chem.Eng.), Univ. of Toronto, 1943; 1940 (6 mos.), glycerine mfg., oil refining dept., Colgate-Palmolive-Peet, Toronto; 1941 (6 mos.), asst., erection of lactic refinery, Beamish Sugar Refinery, Toronto; 1942 (6 mos.), gen. engrg., proof yard, Scarboro, Ont.; at present, mfg. engr., electronics divn., Northern Electric Co., Montreal, Que.

References: C. A. Peachey, S. Sillitoe, C. P. Wright.

HUECK—BARON BORIS DE, of Cornwall, Ont. Born at St. Petersburg, Russia, Oct. 11th, 1889. Educ.: B.Sc., Polytechnic Inst. of Riga, Russia, 1913; R.P.E. Que.; R.P.E. Ont.; 1907-13 (summers), practical engrg. work in Germany, France, Sweden, Russia; 1913-15, responsible for design and erection of bldgs. and consltg. practice for various industries in St. Petersburg, and for the produc'n. of shells, military supplies, Imperial Govt. Explosive Mills; 1915-17, Major, Imperial Engrg. Corps, with 1st and 5th Russian Armies, and, 1919, with British Expeditionary Forces in Murmansk; 1919-21, tech. advisor, Russian Embassy, London, England; 1921-23, engr., Toronto Carpet Co. and Barrymore Cloth Co., Toronto; 1923-26, own office, consltg. engrg. for various firms in Canada and U.S.; 1926-28, engr., New York, and 1928-30, mgr. for Canada, Stuart James & Cook, Inc., Montreal; 1930-33, engr., Canadian National Rlys.; 1934 to date, chief engr., Canadian Cottons, Ltd., Montreal, Que.

References: J. G. Hall, C. B. Brown, R. C. Flitton, R. M. Prendergast, C. A. Morrison.

ISBESTER—JAMES EMERY, of Port Arthur, Ont. Born at Port Arthur, Ont., Nov. 4th, 1914. Educ.: B.A.Sc., Univ. of Toronto, 1940; 1930-34 (summers), chainman and rodman, highway constrn. and location, Ont. Dept. of Northern Development; 1935 (summer), instru'mn., Hewitson Constrn. Co. Ltd., Port Arthur, Ont.; 1937 (summer), instru'mn., Carter-Halls-Aldinger Co. Ltd., Winnipeg; 1939 (summer), instru'mn., Chambers, McQuigge & McCaffery Co. Ltd., Port Arthur; 1940 (May to Dec.), junior engr., Provincial Paper Co. Ltd., Port Arthur divn.; with the R.C.E. as follows: 1941-42, Lieut., Petawawa and overseas; 1942-44, Lieut. and Capt., Wks. Officer, Petawawa Military Camp; at present, Capt., R.C.E., Directorate of Wks. and Constrn., N.D.H.Q., Ottawa, Ont.

References: R. B. Chandler, E. L. Goodall, O. J. Koreen, E. J. Davies, H. G. O'Leary, H. H. Minshall, W. J. Foley.

JENSEN—LOUIS, of London, Ont. Born at Hjorring, Denmark, May 2nd, 1908. Educ.: 1926-27 (evening classes) and 1927-28 (day classes), Tech. Engrg. School, Aalborg, Denmark; 1922-27, tool and diemaker ap'ticeship, Petershope Industries; 1928-29, tool making, Motors & Coach Ltd., Chatham; 1929-33, tool design and plant engrg., Hayes Wheel & Forgings Ltd., Chatham; 1934-36, genl. engrg. and designing; 1937-42, genl. plant engr., Forest City L'ndry.; 1942 to date, wks. mgr. and designer, and at present, genl. mgr. and vice-pres., Kelco Engineering Ltd., London, Ont. (Asks for admission as an Affiliate.)

References: E. V. Buchanan, V. A. McKillop, W. M. Veitch, R. W. Garrett, H. G. Stead.

KELLY—ERNEST A., of 168 Simpson St., Sault Ste. Marie, Ont. Born at Albany, N.Y., Feb. 11th, 1889. With the Dominion Bridge Co. and subsidiaries for 38 years—erection, office, shop and sales; at present, mgr., Sault Structural Steel Co. Ltd., Sault Ste. Marie, Ont. (Asks for admission as an Affiliate.)

References: C. Stenbol, J. L. Lang, W. H. M. Laughlin, G. P. Wilbur, C. S. Kane.

LANCASTER—JOHN TOGO, of 987 Main St. East, Hamilton, Ont. Born at Edenfield, England, May 10th, 1905. Educ.: 1920-24, Elton & Bury Tech. Coll.; 1919-26, ap'ticeship. as machinist and fitter to Messrs. Hackings, textile mach. makers, Bury, England; 1927-28, Greenhalgh's, gas engine makers; with Elton

Cop Dyeing Co. Ltd., Bury, as follows: 1928-34, mtce. foreman, textile dyeing mach., pumps, air compressors, etc., 1934-39, invented and patented two machines approved and published in "The Dyer" and produced at Sun Street Works, Clitheroe, Lancs., 1939-41, mtce. supervisor, Lima Office, Peru; 1941-44, tech. advisor, methods of machining, operational sequence, etc. (ordnance section), Otis Fensom Elevator Co. Ltd.; at present, mach. shop supt., Hamilton Bridge Co. Ltd.

References: W. J. W. Reid, W. A. Dawson, H. J. A. Chambers, A. Love, W. B. Nicol.

LEBLANC—RAYMOND FORTE, of 3445 Papineau Ave., Montreal, Que. Born at Montreal, Que., June 3rd, 1911. Educ.: B.A.Sc., M.E., Ecole Polytechnique, 1937; B.Eng. and M.Eng., McGill Univ., 1939 and 1940; M.Sc., Univ. of Montreal, 1941; R.P.E. Que.; 1932 (summer), Municipal Roads Dept., Montreal; 1933 (summer), lab. asst., Municipal Testing Lab.; 1934-36 (summers), surveyor's asst.; 1937 (6 mos.), res. engr., LeRoy Mines Ltd.; 1938-40 (summers), asst. engr., Bell Asbestos Mines, Noranda Mines, Ltd., Francoeur Gold Mines; 1940-41, prof. of mining engrg., Laval Univ.; 1941 to date, asst. prof. of mining engrg., Ecole Polytechnique, Montreal, Que.

References: A. Circe, H. Gaudefroy, T. J. Lafreniere, G. W. Waddington.

LEFEBVRE—JEAN JULES, of Montreal, Que. Born at Lachute, Que., March 14th, 1913. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1938; R.P.E. Que.; 1938-43, fire protection, Canadian Underwriters Assoc.; 1944 (summer), weight and balance, aircraft constrn., Canadian Car & Foundry Co. Ltd.; 1943 to date, instructor, dept. of hydraulics, Ecole Polytechnique, Montreal.

References: A. Circe, R. Boucher, H. Gaudefroy, L. Trudel, R. A. Robert.

MORRISON—DAVID, of 23 Knappen Ave., Winnipeg, Man. Born at London, England, Nov. 2, 1887. Educ.: 1903-07, Borough Polytechnical Institute, London (evening classes), during this time ap'ticed to Dolby & Williamson, consltg. engrs., London; 1907, received City & Guilds Certificate; R.P.E. Man.; 1908-10, Shawinigan Water & Power Co.; 1910-13, contractor, Shipman Electric Co., Winnipeg; 1913-14, Winnipeg Elec. Co.; 1914:19, on active service, Cdn. Engrs.; 1920-24, mechanics services, office of the engr., Prov. Govt. of Manitoba; 1924-30, asst. engr., and 1930 to date, chief engr., Kipp-Kelly Ltd., and consltg. engr., Ogilvie Flour Mills Co., western divn.

References: T. H. Kirby, J. W. Sanger, N. M. Hall, E. V. Caton, D. Hunter.

PECK—WILLIAM ROMAINE, of 404 Queen St., Ottawa, Ont. Born at Fort George, Que., Sept. 5th, 1891. 1909-10, Univ. of Toronto; 1911-13, chainman, rodman, transitman and dftsman.; 1914-16, junior dftsman., Wm. & J. Greey, Toronto; 1916-19, dftsman., Imp. Min. of Munitions, Ottawa; 1919, dftsman., Consldt. Mining & Smelting Co., Trail, B.C.; with the Ottawa Car & Aircraft Ltd. (formerly Ottawa Car Mfg. Co. Ltd.) as follows: 1919-22, dftsman., and 1922 to date, chief dftsman., responsible for design, including calculations of weights and stresses, preparation of drawings and specifications, for electric rly. cars, motor buses, etc., and since the war, for plans of new bldgs., design of special machines for produc'n. of aircraft parts, etc.

References: W. H. G. Flay, E. G. Patterson, S. H. Wilson, T. E. McGrail, R. F. Howard, D. Blair, R. M. Prendergast.

PICKARD—NORMAN STANLEY, Major, of 4400 Beaconsfield Ave., Montreal, Que. Born at Manchester, England, July 16th, 1883. Educ.: 1902-06, Manchester College of Technology; Articled pupil to Manchester Architect (3 years); with the Winchester Repeating Arms Co., New Haven, Conn., as follows: 1907-13, constrn. dftsman., 1913-15, chief bldg. supervisor, $5,000,000 addition to plant, and 1915-17, chief dftsman., constrn. dept.; 1917-18, engr., responsible for figuring loads, strength of materials, concrete, steel and wood design, etc., Military Hospitals Comm. & Public Works Dept., Ottawa; 1918-19, Lieut., Cdn. Engrs., C.E.F., St. Johns, Que.; 1919 (Mar. to Nov.), chief dftsman., plant dept., Bell Telephone Co. of Canada; 1919-21, squad chief and asst. to chief dftsman., Riordan Co. Ltd., Mattawa, Ont.; 1922-30, dftsman. and constrn. engr., bank premises dept., Bank of Montreal (Head Office); 1930-40, in business for self; 1941 and 1942-43, res. engr., 1st and 2nd stage, respectively, Noorduyn Aircraft Plant, Cartierville, Que.; 1942, asst. res. engr., Cdn. Vickers Aircraft Plant, Cartierville, Que.; 1943 (Aug. to Dec.), res. engr., Boys Farm & Training School, Shawbridge, Que. At present, constrn. engr., and asst. to Major R. B. Jennings, Dept. of Munitions & Supply, Montreal.

References: L. S. Dixon, G. M. Wynn, G. L. Wiggs, L. A. Amos, C. C. Lindsay, R. B. Jennings, B. P. Richardson, G. L. Freeman.

STANN—DANIEL ALEXANDER, Elect. Lieut., R.C.N.V.R., of London, England. Born at Markinch, Sask., Nov. 14th, 1920. Educ.: B.Sc. (E.E.), Univ. of Man., 1943; R.P.E. Ont.; 1938-39 (summers), Sask. Govt. Telephones; 1942 (summer), International Nickel Co., Sudbury, Ont.; 1943 to date, Elect. Lieut., R.C.N.V.R., on Cdn. cruiser overseas.

References: E. P. Fetherstonhaugh, W. F. Riddell, W. E. Lovell, G. V. Ross, M. A. P. Harrigan.

TALLMAN—ESLEY GORDON, of 148 Madison Ave., Toronto, Ont. Born at Kandahar, Sask., April 6th, 1912. Educ.: B.Sc. (Civil Eng.), Univ. of Sask., 1936; R.P.E. Ont.; 1935, geol. survey, Athabaska; 1936-37, mining engrg. and survey, Patricia Gold Mine; 1937 (summer), airport constrn. (Sea Island), Vancouver, B.C.; 1937 to date, design engr., layout and detailing of hydraulic structures, field surveys, stream gaugings, etc., Hydro-Electric Power Commission of Ontario, Toronto, Ont.

References: C. J. Mackenzie, O. Holden, J. R. Montague, S. W. B. Black, E. B. Hubbard, S. H. deJong.

TURNER—WILLIAM ELLIOTT, of 136 Clifton Road, Toronto, Ont. Born at Markdale, Ont., March 21st, 1884. Educ.: B.A.Sc., Univ. of Toronto, 1905; R.P.E. Ont.; 1906-07, sewer work, Saskatoon, and switchbd. tending at Leadville, Colorado; 1907-15, dftsman. and i/c underground conduit constrn., Utah Light & Rly. Co., Salt Lake City, Utah; 1915-21, asst. engr., costs, estimates and contracts, Villadsen Bros., Inc., engrs. and contractors, Salt Lake City; 1921-23, estimating engr., 1923-24, asst. cost engr., and 1924 to date, cost engr. Toronto Transportation Commission, Toronto, Ont.

References: H. W. Tate, W. E. P. Duncan, J. A. McNicol, C. R. Kinnear, M. C. Hendry, J. J. Traill.

VINCE—D. M. RABAN, Capt., R.C.E., of Halifax, N.S. Born at Halifax, N.S., Oct. 15th, 1922. Educ.: B.Sc. (Chem. and Chem.Eng.), Dalhousie Univ., 1941; 1940, summer surveys; 1941-42, junior engr., Standard Constrn. Co.; 1942, 2nd i/c Administration, Teg. Coy., R.C.E., Petawawa; 1942-43, Wks. Officer and i/c Administration, 3rd Fort. Coy., R.C.E., Sydney, N.S.; 1942 to date, military member, Manoeuvre Boards; 1943 to date, Adjutant, District Engrs., M.D. No. 6, R.C.E., Halifax, N.S.

References: H. S. Dunn, D. H. Sutherland, D. W. Laird, W. H. Noonan, C. A. D. Fowler, S. Ball.

WALSH—JOHN STANLEY, of 1112 Elgin Terrace, Montreal, Que. Born at Brighton, England, Aug. 16th, 1907. Educ.: B.Sc. (Eng.), Brighton Technical College, 1929; City & Guilds Diplomas in elec. technology and engrg.; 1929-32, student ap'ticeship., and 1932-34, tech. publicity dept., Thomson-Houston Co. Ltd., Rugby; 1934-39, publicity mgr. and later sales development mgr., Browett-Lindley Ltd., Letchworth, Herts., England; 1939-44, Production Officer, responsible for assessment of capacity of firms for mfg. of armaments and stimulation of producn. by tech. assistance on tooling, materials, etc., Armament Supply Dept., Admiralty (attached to H.Q., England, and B.A. T.M., Ottawa); at present, Naval Ordnance Inspecting Officer, B.A.T.M., Montreal area (Kingston to Maritimes), i/c inspection of guns, ammunition and filling in this area.

References: E. G. Wyckoff, J. L. Bieler, F. W. Taylor-Bailey, F. T. Peacock, A. S. Gentles, I. F. McRae, H. V. Anderson.

FOR TRANSFER FROM JUNIOR

BYERS—WILLIAM CARYL, of 103 St. George's Manor, Port Arthur, Ont. Born at Rouleau, Sask., Sept. 1st, 1912; Educ.: B.Sc. (Elec.), 1934, B.Sc. (Civil), 1935, Univ. of Man.; 1935 (summer), dftsman., Ontario Dept. of Northern Development; 1935-36, 1937 (4 mos), 1938 (5 mos.), instr'man., Ontario Dept. of Highways; 1937 (3 mos.), instr'man., Dept. of Public Works, Canada; 1937-38, field engr., Lake Sulphite Pulp Co.; 1938-39 (4 mos.), inspr., Dept. of Public Works, Canada; 1939 (6 mos.), dftsman., Dominion Bridge Co. Ltd., Winnipeg; 1939 (4 mos.), foreman and inspr., Dept. of Transport; 1939 to date, designing engr., C. D. Howe Co. Ltd., Port Arthur, Ont. (Jr. 1937.)

References: J. M. Fleming, B. A. Culpeper, A. T. Hurter, E. A. Kelly, P. E. Doncaster, W. E. Maclennan, A. H. Rabb, H. M. Olsson.

KERRY—FRANK GEORGE, of Montreal, Que. Born at Montreal, Sept. 27th, 1911. Educ.: B.Eng., McGill Univ., 1935; 1935-36, Institute of Welding Research, Paris; Ing.E.S.S.A., Paris; summers—1929-30, dftsman., Dominion Bridge Co. Ltd.; 1933-34, leveller, mapping, Quebec Streams Commn.; with Canadian Liquid Air Co. Ltd., as follows: 1935 (summer), welder, 1936-37, welding electrode research, 1937-41, head of welding electrode development and electric welding divn., 1941-43, head of engrg. sales dept., 1943 to date, mgr. of development and engrg. dept. (Jr. 1937.)

References: R. E. Jamieson, R. DeL. French, J. G. Dodd, J. R. Stewart, C. S. Kane.

MOTHERWELL—JAMES SHEARER, Sqdn.-Ldr., R.C.A F., of Montreal, Que. Born at New Westminster, B.C., Jan. 10th, 1914. Educ.: B.A.Sc. (Mech.), Univ. of B.C., 1936; 1937-40, dfting office, design of paper mchy., Dominion Engrg. Co. Ltd.; 1940 to date, aeronautical engr., R.C.A.F., 1940-41, Montreal and Vancouver, 1941-42, Commanding Officer, No. 17 A.I. District, Moncton, 1942 to date, Chief Engrg. Officer, No. 11 A.I. District, Montreal. (Jr. 1939.)

References: A. Ferrier, H. G. Welsford, P. R. Sandwell, W. G. Swan, J. McHugh.

FOR TRANSFER FROM STUDENT

BAXTER—JOHN FREDERICK, of Barranca-Bermeja, Colombia, South America. Born at Saint John, N.B., Feb. 27th, 1919. Educ.: B.Eng., McGill Univ., 1942; 1942-43, junior engr., Halifax refinery, Imperial Oil Limited; 1943 to date, junior engr., Barranca Refinery, International Petroleum Co. Ltd. (St. 1941.)

References: G. L. Colpitts, C. J. Bullick, L. E. Mitchell, C. Scrymgeour, R. G. Shatford, H. W. McKiel.

BOGLE—ROY THOMAS, Major, R.C.E.M.E., of Ottawa, Ont. Born at Vancouver, B.C., Feb. 14th, 1916. Educ.: B.A.Sc. (Mech.), Univ. of B.C., 1940; 1940, student test course, 1941, plant layout engr., C.G.E., Peterborough; 1942, 2nd i/c R.C.O.C. Workshops, Vancouver; 1942, i/c R.C.O.C. Workshops, Terrace, B.C.; 1943, i/c armament section cold tests, Shilo, Man.; 1943, mechanical specialist on anti-aircraft artillery, D. of M.M., N.D.H.Q.; 1944, Sr. Ordnance Mechanical Engineer, Petawawa Military Camp, and at present Coordinating Officer for R.C.E.M.E. workshop layout, tire maintenance programme and maintenance control system, Directorate of Mechanical Engineering, Ottawa, Ont. (St. 1941.)

References: H. J. MacLeod, J. N. Finlayson, G. R. Langley, I. F. McRae, LeS. Brodie, H. G. Thompson.

BROWNE—JACK WILKINSON, of Jean Brillant, Que. Born at Winnipeg, Man., Feb. 18th, 1920. Educ.: B.Sc. (Elec.), Univ. of Man., 1941; summers—1938-39, rodman and instr'man., Manitoba Good Roads Board; 1940, dftsman. and inspr. on constrn., Winnipeg Electric Co., substation at St. Boniface; 1941 to date, with Defence Industries Limited as foreman, shift supervisor, general supervisor, job instructor trainer, and at present asst. supt. of small arms ammunition group. (St. 1939.)

References: E. P. Fetherstonhaugh, N. M. Hall, H. G. Herriot, E. V. Caton, L. M. Hovey, C. P. Haltalin.

BUCHANAN—JAMES CHARLES, of 76 East Avenue North, Hamilton, Ont. Born at Saskatoon, Sask., Sept. 6th, 1918. Educ.: B.Sc. (Mech.Eng.), Univ. of Sask., 1942; 1936-38, practical experience at Saskatoon Tech. Collegiate Inst., acting as asst. instructor in armature winding night class for course of 1937-38; 1939-41 (summers), operating steel saw, drilling, arc welding, assembling road mach., layout, etc., Richardson Road Mach. Co., Saskatoon, also repairing of electl. apparatus, Saskatoon Municipal Rly.; 1942-44, engineering training course, Canadian Westinghouse Co. Ltd., including inspecn. of anti-aircraft gun parts on the machines, metallurgical study and research of welds and metals, pattern making and foundry practice, estimates of cost of war contracts, etc. At present, tool engr., designing and dfting. tools, jigs, and fixtures for a special naval internal combustion engine and air brake equipm't., W. Duckworth, air brake engr. (Student 1941.)

References: H. Thomasson, H. A. Cooch, W. E. Brown, L. C. Sentance, H. O. Peeling, I. M. Fraser, N. B. Hutcheon.

COUTTS—ERSKINE, of 3469 Montclair Ave., Montreal, Que. Born at Montreal, Jan. 19th, 1915. Educ.: B.Eng., McGill Univ., 1938; 1934-35-36 (summers), and 1938-39, carpentry, J. Thom & Co. Ltd.; 1939-41, design and detail, structl. steel and reinforced concrete, Dominion Structural Steel Co. Ltd.; 1941-42, field engr., gen. constrn., E. G. M. Cape & Company, Montreal; 1942 to date, field engr., J. L. E. Price & Co. Ltd., Montreal. (St. 1936.)

References: A. H. Milne, O. Kemp, L. B. McCurdy, J. B. Stirling, J. L. E. Price.

DANSEREAU—JOSEPH HERCULE RENE, of 271 Ste. Catherine Road, Outremont, Que. Born at Three Rivers, Que., Nov. 14th, 1917. Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1942; 1940-41 (summers), structl. design, Dominion Bridge Co. Ltd.; 1942 to date, Navigation Instructor, R.C.A.F., Montreal. (St. 1940.)

References: R. S. Eadie, D. B. Armstrong, J. A. Lalonde, A. Circe, J. A. Beauchemin, A. Duperron, T. J. Lafreniere.

DAVIES—RICHARD LLEWELYN, of Whitecourt, Alta. Born at Passburg, Alta., Jan. 12th, 1914. Educ.: B.Sc. (Civil), Univ. of Alta., 1942; 1939-43 (summers), mine survey, irrigation survey, instr'man., Fort St. John Airport, design, power line survey, etc., at Shipshaw power development; 1943 to date, res. engr., Whitecourt Airport, Dept. of Transport, i/c of bldgs., runway, power line and road constrn. (St. 1941.)

References: L. C. Charlesworth, H. P. Keith, R. S. L. Wilson, R. M. Hardy, L. A. Thorssen.

de VILLERS—RAOUL ALBERT, of 5609 Woodbury Ave., Montreal, Que. Born at Victoriaville, Que., Aug. 18th, 1919. Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1942; R.P.E., Que.; summers—1938, chemist, B.A. Oil refinery, Montreal, 1939, instr'man., Quebec Dept. of Roads, 1940, aircraft divn., Canadian Car & Foundry Co., Montreal; 1941 (summer) and 1942 (Mar.-June), Lieut., O.M.E., R.C.O.C., Barriefield Camp, Ont.; March, 1943, to date, mech. engr., Canadian Marconi Company, Montreal. (St. 1940.)

References: R. W. Hamilton, E. W. Farmer, A. Benjamin, A. Circe, E. Mackay, H. Gaudefroy.

DROUIN—JACQUES, of Sorel, Que. Born at Montreal, Feb. 1st, 1915. Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1942; R.P.E., Que.; 1942-43, design for commercial heating system, mech. design for Oxy-acetylene cutting machy., and 1943 to date, i/c Oxy-cutters dept., Marine Industries Ltd., Sorel, Que. (St. 1940.)

References: J. A. Lalonde, P. P. Vinet, A. Circe, H. Gaudefroy, H. Gendron.

DUNBAR—GEORGE G., of 28 Wentworth St., Dartmouth, N.S. Born at New Glasgow, N.S., Dec. 25th, 1920. Educ.: B.Eng. (Chem.), McGill Univ., 1942; 1941 (summer), labs. of Canada Starch Co., Cardinal, Ont.; 1942 to date, asphalt technician and chemist, experimental lab., Imperial Oil Limited, Imperoyal, N.S. (St. 1941)

References: C. Scrymgeour, L. E. Mitchell, G. R. McMillan, S. W. Gray, R. B. Stewart, D. G. Dunbar.

DUNN—SYDNEY MEWBURN SECORD, of Ste. Therese, Que. Born at Toronto, Ont., July 16th, 1917. Educ.: B.A.Sc. (Met.), Univ. of Toronto, 1940; 1937-38-39 (summers), junior assayer, Ontario Refining Co., and International Nickel Co.; 1940, junior physical metallurgist, Anaconda American Brass Co., New Toronto; 1940-41, shell filling training in U.S.A. and U.K., engr., Allied War Supplies Corpn., Montreal; 1941 to date, with Defence Industries Ltd. as follows: 1941 (Mar.-June), engr. on layout and design of cartridge lines, 1941 (June-Nov.), B.L. cartridge and pellet lines supt., 1941-43, planning engr., then supt. of planning dept., Bouchard Works, i/c production planning and records, methods engrg., process development, control labs., standards practices, Sept., 1943, to date, supt. of quality control (incl. tech. dept.), Bouchard Works. Instituted and organized dept., i/c factory inspn., quality control by statistical methods, gauges and standards, specifications, process development, labs. and process manuals. (St. 1940.)

References: J. D. Chisholm, M. S. MacGillivray, A. T. Hurter, C. R. Young, C. G. Williams, H. M. Scott.

FARAGO—WILLIAM JAMES, Lieut., R.C.E.M.E., of Saskatoon, Sask. Born at Plunkett, Sask., July 11th, 1916. Educ.: B.Sc. (Mech.Eng.), Univ. of Sask., 1941; 1935-37, ap'ticed in sheet metal work, Brunt Mfg. Co. Ltd., Toronto; 1939-40 (summers), Ford Motor Co. of Canada, Ltd., Windsor, Ont.; 1941-42 (7 mos.), McKinnon Industries, Ltd., St. Catharines, Ont.; 1942-43, plant engrg. and tool design, also i/c of time study, rate setting, method improvement and plant layout. At present, O.C., 119 L.A.D., R.C.E.M.E. (Student 1941.)

References: I. M. Fraser, N. B. Hutcheon, W. E. Lovell, R. A. Spencer, C. J. Mackenzie, E. K. Phillips.

FINDLAY—ALLAN CAMERON, Flying Officer, R.C.A.F., of Sidney, B.C. Born at Montreal, Sept. 11th, 1917. Educ.: B.Eng., McGill Univ., 1942; 1936-38, ap'tice dftsman., Dominion Bridge Co. Ltd.; 1942-43, plant mtce., Steel Co. of Canada, Ltd., Montreal; 1943 to date, Engineering Officer, Aircraft Maintenance, R.C.A.F., Sidney, B.C. (St. 1937.)

References: E. Brown, C. M. McKergow, A. R. Roberts, H. W. Buzzell, P. G. A. Brault, P. E. Poitras, E. C. Kirkpatrick, J. A. Coote.

GARRETT—CYRIL, Elect. Lieut., R.C.N.V.R., of Halifax, N.S. Born at Sutherland, Sask., May 1st, 1921. Educ.: B.Sc. (Engrg.Physics), 1942; 1941 (summer), and 1942 (May-Dec.), instructor, R.C.A.F. radio course, Univ. of Sask.; 1943 (Jan.-May), senior research asst., National Research Council, Halifax; May, 1943, to date, Elect. Lieut., R.C.N.V.R., Naval Research Establishment, H.M.C.S. Stadacona, Halifax, N.S. (St. 1940.)

References: N. B. Hutcheon, I. M. Fraser, W. E. Lovell, E. K. Phillips, G. W. Parkinson, R. A. Spencer, A. F. Peers.

GLYNN—WALTER S., of 126 St. Helen's Ave., Toronto, Ont. Born at Toronto, Nov. 26th, 1918. Educ.: B.A.Sc., Univ. of Toronto, 1942; 1940-41 (summers), with Speight, Van Nostrand, Ward & Anderson, Toronto, and the Anaconda American Brass Co., New Toronto; 1942 (1 mon.), design research on pre-stressed reinforced concrete for E. P. Muntz, M.E.I.C.; 1942 (3 mos.), field engr. and job office mgr., Preload Company of Canada; 1943 (summer), job engr. and dftsman; 1944 (summer), job engr. and supt. for roofing and sheet metal contractor, also office mgr.; 1942-43, demonstrator, and 1943-44, instructor in engrg. drawing, University of Toronto, Toronto, Ont. (St. 1942.)

References: E. P. Muntz, J. J. Spence, W. B. Dunbar, M. W. Huggins, C. E. Helwig, S. H. deJong.

HAAKONSEN—HAAKON, of 39 Station Ave., Shawinigan Falls, Que. Born at Sarpsborg, Norway, Feb. 26th, 1913. Educ.: B.Sc. (Elec.), Queen's Univ., 1944; 1930-36, lab. and plant, Shawinigan Chemicals Ltd.; 1936-37, Shawinigan Resins Corpn., Springfield; 1938-39-42 (summers), lab., Shawinigan Chemicals Ltd.; 1943 (summer), Aluminum Co. of Canada; 1940-41, and 1944 to date, teacher of maths. and electricity, Shawinigan Technical Institute, Shawinigan Falls, Que. (St. 1943.)

References: D. S. Ellis, R. A. Low, S. D. Lash, A. H. Heatley, H. K. Wyman.

HALL—WILLIAM FRANCIS, of 262 Belfast St., Medicine Hat, Alta. Born at Regina, Sask., March 18th, 1919. Educ.: B.Sc. (Civil), Univ. of Sask., 1942; 1939-40-41 (summers), rodman and instr'man., Dept. of Highways of Sask., and Dept. of Transport; 1942-43, transitman with U.S. Public Roads Administration; at present, junior engr., Prairie Farm Rehabilitation Administration, Medicine Hat, Alta. (St. 1941.)

References: R. A. Spencer, E. K. Phillips, I. M. Fraser, C. R. Forsberg, G. L. MacKenzie, V. E. Thierman.

HARLAND—ROBERT THOMPSON, Flight-Lieut., R.C.A.F., of Winnipeg, Man. Born at Winnipeg, Man., May 25th, 1917. Educ.: B.Sc., Univ. of Man., 1938; S.M., Mass. Inst. Tech., 1940; 1938-39, junior engr., Winnipeg Hydro; 1940, engrg. lab., demonstrator, Univ. of Manitoba; 1940-42, engr. i/c electl. design, Winnipeg Hydro; 1942 to date, Signals Radar Officer, R.C.A.F., Washington, D.C. (St. 1938.)

References: E. P. Fetherstonhaugh, J. W. Sanger, H. L. Briggs, T. E. Storey, C. T. Barnes.

HUOT—JOSEPH ADELARD MARCEL, Flight-Lieut., R.C.A.F., of Montreal, Que. Born at Longueuil, Que., August 20th, 1916. Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1941; summers—1937-41, with Quebec Streams Commn., Quebec Roads Dept., Defence Industries Ltd.; 1941 to date, navigator and navigation instructor, R.C.A.F., No. 9 A.O.S., St. Johns, Que. (St. 1939.)

References: G. Dorais, H. Gaudefroy, A. Circe.

KEYFITZ—IRVING M., of 3454 Addington Ave., Montreal, Que. Born at Montreal, Feb. 19th, 1919. Educ.: B.Eng., McGill Univ., 1941; 1940 (summer), aircraft divn., Canadian Vickers Ltd.; 1941-42, Royal Air Force Ferry Command; Jan., 1942, to date, asst. to chief engr. and sales mgr., Canadian Propellers Ltd., Montreal. (St. 1940.)

References: E. Brown, G. J. Dodd, R. E. Jamieson, C. M. McKergow, J. H. Parkin, A. R. Roberts, F. M. Wood.

KINGSLAND—EDWARD NOTMAN, Flying Officer, R.C.A.F., of Westmount, Que. Born at Montreal, Que., Aug. 3rd, 1913. Educ.: B.Eng., McGill Univ., 1937; 1935-37 (summers), with various machine tool mfg. plants in the U.S. and England, the work involving operations of machines, such as lathes, surface grinders, planers, turret lathes, etc., also time on the erection floor and final inspec'n. of machines; 1938, with the Warner & Swasey Co., Cleveland, Ohio (3 mos.), and later visiting mach. mfg. plants in Ohio, Illinois and Wisconsin, 6 mos. in England with H. W. Kearns Co. Ltd., Manchester, and in visiting machine tool plants in England; 1939-40, Williams & Wilson, Ltd., Montreal; 1940-43, Citadel Merchandising Co. Ltd., Montreal, purchase of mach. tools. At present, Engineering Officer, No. 23 E.F.T.S., R.C.A.F., Davidson, Sask. (Student 1937.)

References: C. M. McKergow, J. G. Dodd, E. Brown.

LABERGE—PAUL X., of La Malbaie, Que. Born at Montreal, May 24th, 1918. Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1942; R.P.E. of Que.; 1938-42 (summers), with Duverny Goldfields Mine, Quebec Streams Commn., Canadian Car & Foundry, Bell Telephone Company; 1942 (7 mos.), junior engr., Brown Corporation, La Tuque, Que.; 1942 to date, plant engr., pulp and paper mill, Donohue Brothers, La Malbaie, Que. (St. 1940.)

References: Y. R. Tasse, A. Circe, H. Gaudefroy, L. Trudel, R. D. Packard, J. Stadler.

LECAVALIER—FERNAND, Flying Officer, R.C.A.F., of 6280 St. Denis St., Montreal, Que. Born at Montreal, Feb. 8th, 1916. Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1939; B.S. in Aero. Engrg., Mass. Inst. Tech., 1941; 1938-39-40 (summers), res. engr., Quebec Dept. of Roads; 1937 (summer), Geol. Survey of Canada; 1941-42, research engr., structures divn., National Research Council of Canada; Dec., 1942, to date, Engineering Officer with the R.C.A.F., now stationed at Debert, N.S. (St. 1939.)

References: J. P. Lecavalier, A. Circe, J. A. Lalonde, L. Buteau, A. Frigon, J. M. Pope.

MACKINNON—DONALD LAUCHLIN, U/T Pilot, R.C.A.F., of Brandon, Man. Born at Stratford, Ont., Oct. 8th, 1916. Educ.: B.Sc. (C.E.) and M.Sc. (C.E.), Univ. of N.B., 1939 and 1944; 1937-38, road and plant inspr., Milton Hersey Co. Ltd., Montreal; 1939-40, constrn. engr., Diamond Construction Co. Ltd., Fredericton, N.B.; 1940-41, asst. to vice-pres., i/c constrn., and 1941-43, asst. to gen. supt., i/c constrn. of Shipshaw Hydro-Electric project, Foundation Co. of Canada, Montreal; 1943, chief engr., Gunite & Waterproofing Ltd., Montreal. At present, U/T Pilot, No. 12 S.F.T.S., R.C.A.F., Brandon, Man. (Student 1938.)

References: E. O. Turner, W. Griesbach, R. F. Leggett, R. A. H. Hayes, M. E. Hornbach, J. Stephens, E. P. Muntz, A. A. Colter, H. E. Barnett, C. Miller.

NORMANDEAU—J. GILLES LAURENT, of Montreal, Que. Born at Montreal, Que., July 6th, 1917. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1942; 1938-40 (summers), genl. surveying; 1940-41, Dept. of Roads (Prov. of Quebec); 1942-43, field engr., Dufresne Engineering Co. Ltd.; 1943 to date, shipbuilding engr., Marine Industries Ltd., Sorel. (Student 1940.)

References: J. A. Lalonde, J. B. D'Aeth, L. P. Cousineau, A. Circe, H. Gaudefroy.

PALMQUIST—DAVID ERNEST, Elect. Sub-Lieut., R.C.N.V.R., of Halifax, N.S. Born at Moose Jaw, Sask., Mar. 28th, 1917. Educ.: B.Sc. (E.E.), Univ. of Sask., 1937; with the C.I.L. as follows: 1937-38, elec. dftsman., 1938-39, power house clerk, 1939-42, checking elec. drawings, 1942-43, res. elec. engr. on constrn. of new plant at Cornwall, Ont.; 1943 to date, Electrical Sub-Lieut., R.C.N.V.R. (Student 1937.)

References: H. C. Karn, J. R. Auld, A. G. Moore, J. T. Howley, K. H. Bjerring.

PEABODY—GERALD S., of Ville La Salle, Que. Born at Fredericton, N.B., Nov. 15th, 1920. Educ.: B.Sc. (E.E.), Univ. of N.B., 1942; with Cdn. Westinghouse Co. as follows: 1941 (summer), dfting. and transformer design, 1942-44, engrg. ap'ticeship. course, 1944 to date, service engr., service dept., Montreal, Que. (Student 1942.)

References: A. F. Baird, E. O. Turner, W. A. Fricker, C. Miller, R. A. Hayes, E. E. Orlando.

PRATT—JAMES CRAWFORD, Elect. Lieut., R.C.N.V.R., of Halifax N.S. Born at Winnipeg, Man., April 5th, 1920. Educ.: B.Sc. (E.E.), Univ. of Man., 1942; 1939 (summer), Man. Bridge & Iron Works; 1941 (summer), radio tech. course (dftsman.); 1942-43, Junior Engr. Officer, H.M.S. "Oribi"; 1943 to date, Elect. Officer, Naval Research Establishment, Halifax, N.S. (Student 1942.)

References: J. W. Sanger, E. P. Fetherstonhaugh, N. M. Hall, G. H. Herriot, A. F. Peers.

PREBOY—JOSEPH WILLIAM, of Port Radium, N.W.T. Born at Fox Valley, Sask., Sept. 23rd, 1919. Educ.: B.Sc. (Mining Eng.), Univ. of Alberta, 1942; 1942 to date, asst. engr., Eldorado Mining & Refining Co., Port Radium, North West Territories. (Student 1942.)

References: I. F. Morrison, R. S. L. Wilson, E. J. Bolger.

PROULX—GILBERT, of Chicoutimi, Que. Born at Montreal, Que., Aug. 2nd, 1918. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1941; R.P.E. Que.; 1939 (summer), student asst. on topographical survey party, Dept. of Mines & Resources; 1940 (summer), instru'mn., Dept. of Roads (Prov. of Que.); 1941-42, dftsman., structl. drawing office, Dominion Bridge Co. Ltd., Lachine; 1942 to date, asst. supt., Saguenay Electric Co., Chicoutimi, Que. (Student 1938.)

References: A. Circe, McNeely Dubose, R. F. Dore, R. Dupuis, R. B. Brosseau, C. Miller, F. L. Lawton.

ROLLAND—LUCIEN GILBERT, of Mont-Rolland, Que. Born at St. Jerome, Que., Dec. 21st, 1916. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1942; R.P.E. Que.; 1936-40 (summers), Rolland Paper Co.; 1940 (summer), Port Royal Pulp & Paper Co.; 1941 (summer), Brown Corp.; 1942 to date, plant engr., Rolland Paper Co., Mont-Rolland, Que. (Student 1941.)

References: A. Circe, P. P. Vinet, R. E. MacAfee, E. MacKay, S. G. MacDermot.

ROUE—JOHN EDWARD, Acting Elect. Lieut.-Cmdr., R.C.N.V.R., of 244 Spring Garden Road, Halifax, N.S. Born at Halifax, N.S., Aug. 25th, 1916. Educ.: B.Sc., B.Eng. (Elec.), Nova Scotia Tech. Coll., 1937 and 1939; 1937 (summer), bituminous paving inspr., Milton Hersey Co.; 1938 (summer), asst. fieldman, inventory of distribution equipm't., N.S. Light & Power Co.; 1939-40, junior engr., gen. engrg. work and i/c dfting. office, Imperial Oil Ltd. (Halifax Refinery); 1940, meter technician, process control dept., mtce. of all recording and control instruments; with the R.C.N.V.R. as follows: 1940, joined the service as Sub-Lieut. (SB), 1941-44, installn., constrn. and mtce. of naval radio equipm't., and at present Acting Elect. Lieut.-Cmdr., Chief Radio Engineering Officer, R.C.N.V.R., H.M.C. Dockyard, St. John's, Nfld. (Student 1939.)

References: R. L. Dunsmore, S. Ball, F. H. Sexton, J. R. Kaye, C. Scrymgeour.

SCOTT—RICHARD, of Toronto, Ont. Born at Toronto, Ont., March 25th, 1919. Educ.: B.A.Sc. (Elec.Eng.), Univ. of Toronto, 1941; R.P.E. Ont.; 1936-37 (summer), assembler, Northern Electric Co. Ltd.; 1939 (summer), lineman, Hydro-Electric Power Commn.; 1940 (summer), Northern Electric Co., Montreal; 1941 (summer), instructor, Westdale Tech. School, Hamilton; with the Canadian Gen. Elec. Co. Ltd., as follows: 1941-42, test engr., Peterborough and Toronto, and 1942-43, asst. engr., aircraft instrument engrg. dept., also demonstrator in elec. engrg. (3rd yr. lab.) and 1943-44, senior demonstrator in elec. engrg. (4th yr. lab.), Univ. of Toronto; 1944 (summer), geophysical asst., Eldorado Mining & Refining, Port Radium, North West Territories. At present, instructor in elec. engrg., Univ. of Toronto, Toronto. (Student 1942.)

References: C. R. Young, R. F. Leggett, G. R. Langley, C. E. Sisson, S. H. deJong, R. L. Dobbin.

SKELTON—ERIC TUDOR, Lieut., R.C.E., of Montreal, Que. Born at Montreal, Dec. 26th, 1918. Educ.: B.Sc. (Civil Eng.), Univ. of N.B., 1942; 1938 (summer), instru'mn. on bush surveys, Price Bros. & Co. Ltd., Matane, Que.; 1939 (summer), foreman in pulp mill, Gulf Pulp & Paper Co., Clarke City, Que.; 1941 (summer), rodman and instru'mn., Cdn. National Rly.; 1942-43, constrn. supt., Demerara Bauxite Co., British Guiana; 1943 to date, platoon and section cmdr., 27th Gen. Pioneer Coy., R.C.E. (Student 1942.)

References: E. O. Turner, A. F. Baird, T. H. Henry, A. C. D. Blanchard, J. Stephens, J. L. Connolly.

STANIFORTH—HAROLD F., Flight-Lieut., R.C.A.F., of St. Genevieve, Que. Born at Montreal, Dec. 18th, 1916. Educ.: B.Eng. (Mech.), McGill Univ., 1939; 1936-38 (summers), concrete and steel constrn., St. Lawrence Allsop Ltd., constrn. and industrial engrg., Staniforth Lumber Co.; 1939-40, industrial engrg., Dominion Wood Heel Co. Ltd., Montreal; 1940 to date, Aeronautical Engineer, R.C.A.F. (St. 1940.)

References: C. K. McLeod, E. Brown, A. R. Roberts, H. D. Chambers, P. H. Morgan, J. A. Coote, R. E. Jamieson.

STEPHENSON—ERIC PAUL, Major, R.C.E.M.E., of Ottawa, Ont. Born at Hazel Hill, N.S., Jan. 5th, 1917. Educ.: B.Eng. (Elec.), Nova Scotia Tech. Coll., 1939; 1935-37 (summers), 2nd Lieut., R.C.C.S.; 1938, plant dept., mtce. data and heating study, etc., Maritime Telephone & Telegraph Co. Ltd., Halifax; 1939-40, testman, test dept., Cdn. Gen. Elec. Co., Toronto and Peterborough; 1940-41, Lieut., 10th Searchlight Bty., R.C.A., and 1941-42, attended qualifying course for Ordnance Mech. Engr. (4th Class); 1942, posted to Directorate Mech. Mtce., Ottawa; 1942-43, Capt., R.C.O.C., experimental wk. on army equipm't.; 1943, Capt., T.S.O.III, mtce. of elec. army equipm't.; 1943 to date, Acting Major, T.S.O.II, in Directorate of Mechanical Engineering, Ottawa. (Student 1939.)

References: G. R. Langley, F. H. Sexton, W. P. Copp, R. L. Franklin, LeS. Brodie, D. S. Nicol, E. C. Mayhew.

ST. JACQUES, MAURICE, of Peterborough, Ont. Born at Montreal, Que., April 6th, 1919. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1942; with the Cdn. Gen. Electric Co. Ltd., as follows: 1942-44, student test course at Peterborough and Toronto, and at present, fractional horsepower motor engr., Peterborough, Ont. (Student 1942.)

References: G. R. Langley, deGaspe Beaubien, A. Circe, H. R. Sills, V. S. Foster, A. L. Dickieson.

SUTTON—ARTHUR LESLIE, of St. Catharines, Ont. Born at Yokohama, Japan, Feb. 14th, 1918. Educ.: B.A.Sc. (E.E.), Univ. of B.C., 1939; 1933-39 (summers), pulp and paper testing, papermaking, Pacific Mills, Ltd., Ocean Falls, B.C.; 1939-40, training in various steam and power plants of Richmond Refinery, Standard Oil of California; 1940-42, water tender and shift engr., power plant of Bahrein Petroleum Co. Refinery, Bahrein Island, Persian Gulf; 1943-44, application engr. (motors and industrial control), English Electric Co. of Canada, St. Catharines. (Student 1939.)

References: H. J. MacLeod, A. D. Creer, J. H. Dyer.

SWAN—ANDREW MUNRO, Elect. Lieut., R.C.N.V.R., of Spryfield, N.S. Born at Winnipeg, Man., June 24th, 1917. Educ.: B.Sc. (E.E.), Univ. of Man., 1939; with the Cdn. Gen. Elec. Co. Ltd., as follows: 1938 (summer), 1939-40, ap'ticeship. test course, Peterborough, Ont., 1941-42, apparatus sales engr., dealing with motors and control equipm't., transformers, switchgear, etc., Toronto, 1942-43, apparatus sales engr., Hamilton, 1943, elec. engr., plant engrg. dept., Peterborough; at present, Electrical Officer, low power section, Torpedo School, H.M.C.S. Stadacona, Halifax, N.S. (Student 1939.)

References: E. P. Fetherstonhaugh, A. E. Macdonald, G. H. Herriot, G. R. Langley, T. S. Glover, C. B. Muir, J. Deane.

TETREAULT—ARMAND JEAN, of Ottawa, Ont. Born at Montreal, Sept. 18th, 1916. Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1940; 1939, with the Quebec Dept. of Roads; 1940 to date, with the Inspection Board of the United Kingdom and Canada as follows: 1940-41, drawing office asst., 1941-42, technical asst., New York office; 1942-43, technical asst., Montreal office, and 1943 to date, inspecting officer (shell), at Ottawa, Ont. (St. 1938.)

References: A. Circe, J. A. Lalonde, L. Trudel, P. P. Vinet, E. MacKay.

TETREAULT—JACQUES, of 1322 Sherbrooke St. East, Montreal, Que. Born at Montreal, Nov. 26th, 1917. Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1942; 1940-41, lab., Quebec Dept. of Roads; 1942-43, drawing room, 1943-44, ship supervisor, Marine Industries Ltd.; at present, welding and hull design, German & Milne, Naval Architects, Montreal, Que. (St. 1938.)

References: A. Circe, J. A. Lalonde, P. P. Vinet, E. MacKay, L. Trudel.

WARD—KENNETH ROY, Major, R.C.E.M.E., of 81 King St., Kingston, Ont. Born at Kingston, Nov. 1st, 1918. Educ.: 1935-39, R.M.C., Kingston. Qualified Mech. Engr., June 1939; Qualified at Ordnance Mechanical Engineers Course, Military College of Science, England, 1940; 1938, gen. shop practice, R.C.O.C. Workshops, Petawawa; June 1939, joined R.C.O.C. (Permanent Force) as Ordnance Mechanical Engineer (4th Class); 1939-40, general O.M.E. duties, Petawawa, Kingston, Halifax; 1940-43, R.C.O.C. Training Centre, Kingston, supervisor of workshops and instructor, and from 1942 chief instructor, Technical Training Wing; 1943-44, i/c of Ordnance workshops, Goose Bay, Labrador; at present attending Canadian War Staff Course, R.M.C., prior to proceeding overseas with the R.C.E.M.E. (St. 1938.)

References: L. F. Grant, R. L. Franklin, E. C. Mayhew, N. C. Sherman, G. W. Beecroft, K. H. McKibbin.

WEBSTER—GEDDES MURRAY, of 515 Victoria St., Kingston, Ont. Born at Yarmouth, N.S., April 30th, 1918. Educ.: B.Sc., Dalhousie Univ., 1939, B.Eng., McGill Univ., 1941; 1938 (summer), instru'mn., Prov. Geol. Survey of Inverness coal fields; 1939 (summer), miner, Frood Mine; 1940 (summer), miner, Pickle Crow Gold Mines; with the D.I.L., Verdun, Que., as follows: 1941-42, in small arms dept. as metallurgist, 1942-44, cartridge produc'n. foreman and later senior foreman; at present, foreman, operating dept., Nylon divn., Cdn. Industries Ltd., Kingston, Ont. (Student 1939.)

References: A. E. Cameron, H. B. Hanna, R. D. Bennett, W. C. Tatham, W. P. Copp, H. K. Theakston.

WILSON—MURRAY EDGAR, of 34 Enterprise St., Moncton, N.B. Born at Moncton, N.B., May 25th, 1916. Educ.: B.Sc. (E.E.), Univ. of N.B., 1937; 1937 (summer), paving inspr., N.B. highways, for Milton Hersey Co. Ltd.; 1938-39, electrical contracting; 1940-41, elec. mtce. worker, Halifax Divn., C.N.R., maintaining transmission lines, substations, switchboards and elec. machy.; 1941 to date, electl. dftsman., Atlantic region, C.N.R., designing power distribution systems, transmission lines, switchboards, etc., for various power and lighting installns., preparing estimates, specifications, inspecting works. (St. 1937.)

References: G. L. Dickson, T. H. Dickson, H. J. Crudge, A. F. Baird, E. O. Turner, V. C. Blackett.

FOR TRANSFER FROM AFFILIATE

ALLWRIGHT—ERNEST GILBERT, of Arvida, Que. Born at Deptford, England, Oct. 15th, 1886. Educ.: 1931-32, Montreal Technical Inst.; I.C.S. course; 1909-10, rodman and chainman, Grand Trunk Rly.; 1926, rodman, and 1927, instru'mn., Cdn. Int. Paper Co. Ltd.; 1927 (April to Dec.), topographer, preliminary and location surveys, C.P.R.; 1928, instru'mn., cutover surveys and road work, Cdn. Int. Paper Co. Ltd.; 1929-31, instru'mn., gas distribution dept., Montreal Light Heat & Power Consldt.; 1931-32, engr., subways and bridges dept., City of Montreal; 1937 to date, dftsman. and asst. field engr. on layout of bldgs., mach. and related process equipm't., inspecn., etc., Aluminum Co. of Canada, Ltd., Arvida. (Affil. 1938.)

References: B. E. Bauman, M. G. Saunders, A. C. Johnson, A. T. Cairncross, P. M. de Chazal.

LIBRARY NOTES *(Continued from page 598)*

MAN'S FIGHT TO FLY, Famous World-Record Flights and a Chronology of Aviation

By J. P. V. Heinmuller, foreword by E. Rickenbacker. Funk & Wagnalls Co., New York and London, 1944. 366 pp., illus., charts, maps, tables, 11 x 8 in., fabrikoid, $6.00.

The author of this book has for many years been observer and chief timer for the National Aeronautic Association, in which capacity he has timed most of the transatlantic and round-the-world flights. He has known nearly all the prominent flyers. His book gives his personal recollections of many world-record flights, illustrated by photographs from his collection. A chronology of aviation from 1483 to 1939 points the outstanding steps in development. An interesting, popular book.

METHODS OF ADVANCED CALCULUS

By P. Franklin. McGraw-Hill Book Company, New York and London, 1944. 486 pp., diagrs., charts, tables, 8½ x 5¼ in., cloth, $4.50.

This textbook is designed for students whose major field of interest is engineering, mathematics, or science, but it may also serve the practicing engineer or applied scientist as an introduction to the more formidable mathematical treatises. The two principal objectives of the book are: first, to refresh and improve the student's technique in applying elementary calculus; and second, to present those methods of advanced calculus most needed in applied mathematics.

(The) SAFE INSTALLATION AND USE OF ABRASIVE WHEELS. (Studies and Reports, Series F, Second Section (Safety), No. 9.)

International Labour Office, 3480 University St., Montreal, Canada, 1944. 175 pp., illus., diagrs., charts, tables, 9¼ x 6¼ in., paper, $1.00.

The six main chapters of this publication deal with the composition and manufacture of abrasive wheels, accidents and injuries, safety precautions against bursting wheels, precautions against other types of accidents, prevention of dust inhalation, and a summary of the main precautions. Two analytical research reports on stresses in rotating disks are appended. Safety regulations in Germany, Great Britain and the United States are given, including the 1943 revision of the "American Standard Safety Code . . . on Abrasive Wheels".

Selected Papers of WILLIAM FREDERICK DURAND, reprinted in Commemoration of the Eighty-fifth Anniversary of his birth

The Durand Reprinting Committee, California Institute of Technology, Pasadena, Calif., 1944. Paged in sections, 11 x 8½ in., fabrikoid, $2.50.

Seventeen selected papers of William F. Durand, from 1896 to 1940, have been reprinted in commemoration of the eighty-fifth anniversary of his birth. The subject matter is varied, ranging from aerodynamics to philosophical considerations of science and engineering. A brief biographical sketch precedes the papers, and a bibliography of published works concludes the book.

Employment Service Bureau

NOTICE

Technical personnel should not reply to any of the advertisements for situations vacant unless—

1. They are registered with the Wartime Bureau of Technical Personnel.
2. Their services are available.

A person's services are considered available only if he is—

(a) unemployed;
(b) engaged in work other than of an engineering or scientific nature;
(c) has given notice as of a definite date; or
(d) has permission from his present employer to negotiate for work elsewhere while still in the service of that employer.

Applicants will help to expedite negotiations by stating in their application whether or not they have complied with the above regulations.

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.

SITUATIONS VACANT

MECHANICAL AND ELECTRICAL ENGINEER WANTED

For the position of assistant superintendent of the Department of Buildings and Grounds, with the ultimate view of assuming the office of superintendent for a large educational institution in the Province of Quebec. Preferred age, 30 to 35 years. The duties involve, among other things, the inspection of buildings and attached services so that an annual budget can be prepared for the operation and maintenance of two light, heat and power plants and some fifty buildings and their adjacent campuses; the consultation with deans of faculties, wardens of dormitories and heads of departments for the provision of such information as they may require. Applicants must give age, nationality, education, training, experience and references; indicate availability, include recent photo and mail before December 15th, 1944 to Box No. 2847-V.

GRADUATE CHEMICAL ENGINEER wauted. See page 53 of the advertising section.

A POST-WAR PROPOSITION—An established manufacturer of steel building products contemplates post-war expansion. The situation will call for the services of a graduate engineer, preferably mechanical with production and executive experience, to act as plant and production superintendent. He must be adaptable and desirous of co-operating in the development of new products and the production of same.

Our purpose is to establish contact now with suitable applicants, on the definite understanding that the position will not be open until after the war. Apply to Box No. 2834-V.

EXPERIENCED MECHANICAL ENGINEER from 30 to 35, preferably a discharged veteran, to act as assistant manager in charge of purchases and stores for a large paper company. The position will involve the purchase of supplies, machinery and parts for five mills and an ability to write specifications and check values in different designs will be helpful. Apply to Box No. 2835-V.

SENIOR TIME STUDY AND/OR LAYOUT MEN

For industrial consulting firm; energetic, bilingual, dependable, excellent salary and permanent prospects to right men. Do not apply unless available under Part III, P.C. 246, administered by the Wartime Bureau of Technical Personnel.

Apply in writing to Dufresne, McLagan & Associates Reg'd., Room 402, Bank of Nova Scotia Building, Montreal.

NATIONAL RESEARCH COUNCIL

Vacancy for Associate Research Biologist Grade, II

The National Research Council announces a vacancy in the Division of Applied Biology for an Associate Research Biologist Grade II to perform the duties of a technical and executive assistant in its Prairie Regional Laboratory. The position has a salary range from $3,840 to $4,200, and is subject to existing regulations. The appointment, which will be on a term basis, may be extended from year to year and is subject to the requirements of the Public Service. The person appointed will be stationed at Ottawa for approximately one year and will subsequently be posted to the Prairie Regional Laboratory in Western Canada.

DUTIES:

To assist the Director in executive and administrative matters and to act for the Director as required; to represent the Director at conferences and on technical committees; to direct the work of the storekeeper, librarian, accountants, clerks and other administrative officers; to carry on correspondence, prepare, review and assess technical and other reports and do other related work as required.

QUALIFICATIONS:

At least the M.Sc. from a university of recognized standing, and preferably a Ph.D. in a branch of Biological or Chemical Sciences of importance to industry. Some diversity of training and experience and a good all-round education in the basic sciences are regarded as the best preparation. A minimum of of at least three years' experience in academic or industrial research is considered essential. In addition, the candidate is required to have five years' experience in a responsible administrative or executive position in the field of research or development and to possess natural tact in meeting and dealing with the public. Ability to supervise administrative staff, to assist in the selection of technical personnel, to make decisions related to the purchase and need for scientific and pilot plant equipment, and do other related work as required. Candidates must be British subjects. Other qualifications being equal, preference will be given those returned from Active Service Overseas.

INSTRUCTIONS TO APPLICANTS:

Applications can only be considered from those who comply with the regulations governing technical personnel as set forth in P.C. 246, in particular Part III thereof. They should be made on the National Research Council application forms. These and additional copies of this announcement are available from the Registrars of the principal Canadian universities and on request from the Secretary-Treasurer, National Research Council, Ottawa. Applications should be addressed to the Director, Division of Applied Biology, National Research Council, Ottawa, and should reach him not later than December 15, 1944.

National Research Council

Vacancy for Director, Prairie Regional Laboratory

The National Research Council announces a vacancy in the Division of Applied Biology for a Director for its Prairie Regional Laboratory. This position has a salary range from $5,400 to $6,000, and is subject to existing regulations. The appointment, which will be made on a term basis, may be extended from year to year and is subject to the requirements of the Public Service.

DUTIES:

To direct and be responsible for the Western branch of the Division located in Western Canada; to select and initiate specific investigations dealing with the general utilization of agricultural products, including laboratory investigations of both fundamental and applied nature leading to the design, construction and operation of pilot plant equipment and processes for industrial development; to assist in the selection of scientific and technical staff for the above duties; to direct their activities in the fields indicated above; and perform other executive duties as required.

QUALIFICATIONS:

A Ph.D. or D.Sc., preferably in Chemistry or Chemical Engineering, with at least ten years' professional research experience, five of which must have included responsibility for the direction of investigational work of major importance, preferably in an industrial laboratory or pilot plant development. The candidate must possess intellectual acumen and a creative faculty of mind; demonstrated ability to perform and direct activities in the field of research and development; sound judgment and good address. Other qualifications being equal, preference will be given those returned from Active Service Overseas. Candidates must be British subjects.

INSTRUCTIONS TO APPLICANTS:

Applications can only be considered from those who comply with the regulations governing technical personnel as set forth in P.C. 246, in particular Part III thereof. They should be made on the National Research Council application forms. These and additional copies of this announcement are available from the Registrars of the principal Canadian universities and on request from the Secretary-Treasurer, National Research Council, Ottawa. Applications should be addressed to the Director, Division of Applied Biology, National Research Council, Ottawa, and should reach him not later than December 15, 1944.

MECHANICAL DRAUGHTSMAN for established and growing firm in western Canada. Preferably experienced in layout of general mechanical equipment for mines and packing plants. Permanent job for right man. In first letter give age, experience and salary desired. Apply to Box No. 2850-V.

CHIEF ENGINEER required by prominent Toronto company. This position requires a thorough background and experience in machine tool design, together with a good knowledge of foundry practice and structural steel design essential. Established post-war future. Graduate engineer or equivalent. Apply to Box No. 2851-V.

STRUCTURAL ENGINEER required by prominent Toronto company. This position requires a thorough knowledge of structural steel design, estimating and fabrication, particularly in the building and related fields. This engineer must be able to satisfactorily deal with owners, architects and contractors in the development of projects and their installation. Permanent post-war employment. Apply to Box No. 2852-V.

SITUATIONS WANTED

MECHANICAL ENGINEER, Canadian graduate, age 45, married, with eighteen years' experience in foundry, machine shop, structural fabrication and assembly work, seeks a responsible position in this field with post-war opportunities. Accustomed to handling executive responsibilities and with a proven ability to secure the co-operation of others. Intimate knowledge of light metal fabrication. Apply to Box No. 251-W.

MECHANICAL ENGINEER, M.E.I.C., English, married, 39, bilingual, presently employed as plant engineer, desires responsible position with Canadian-owned, progressive company. Experienced in engineering of industrial and institutional developments, steam power plants, etc. Available early in 1945. Apply to Box No. 270-W.

CIVIL ENGINEER, graduate, M.E.I.C., age 39, married, 15 years' responsible experience on construction which includes municipal work, high way work, plant construction, installation of various types of machinery and maintenance of equipment; administration and executive duties. Interested in permanent employment with progressive concern. Available on short notice. Apply to Box No. 1815-W.

CHEMICAL ENGINEER, age 27, married. Six years' experience in steel, coal by-products distillation, asphalt and tar products, solvents, heating and ventilating design. Located in Montreal at present. Apply to Box No. 1827-W.

STRUCTURAL ENGINEER, M.E.I.C., R.P.E. (Ont.) desires permanent position of responsibility. Experienced in design, estimates and detail in all types fabricated steel and plate work, also reinforced concrete construction. Apply to Box No. 2208-W.

CIVIL ENGINEER, R.P.E. (Ont.) P.G. III, Toronto Graduate, Age 31, married, seven years' experience including structural engineering, traffic and mass transit study. Experienced in design, maintenance, estimates, preparation of reports and specifications, administration and supervision of construction. Possesses ability to supervise and to co-operate with others. Would consider foreign assignment. Seeks municipal position as assistant city engineer or consultant in charge of town planning and city development. Available immediately. Apply to Box No. 2466-W.

MECHANICAL ENGINEER, McGill Graduate, age 26, with four years, design and executive experience in manufacturing plants, desires position with progressive organization. Highest references from present employer. Alppy to Box No. 2467-W.

FOR SALE

One Buff and Buff transit in first class condition, 3½" needle, erecting telescope, solid silver graduation, full vertical circle. Apply to Box No. 54-S.

A LARGE
PULP AND PAPER MILL REQUIRES
THE SERVICES OF

A Graduate Civil

OR

Mechanical Engineer

WITH THREE OR MORE
YEARS' EXPERIENCE IN

Mechanical Engineering

When applying state age, education, experience, salary, marital status and when available. Include recent snapshot if possible.

Application from graduates in other branches of engineering with mechanical engineering experience will be considered.

Do not apply unless your services are available under regulation P.C. 246, Part III, administered by Wartime Bureau of Technical Personnel. Apply to Box No. 2768-V, The Employment Service Bureau, The Engineering Institute of Canada, 2050 Mansfield Street, Montreal, Que.

FOR SALE

The following used engineering and scientific instruments:
12" sextant with silver scale. Complete with telescopes and wooden case.
Simplex seven-day barograph in glass case.
Fuller spiral slide rule in wooden case.
Set Staedtler drawing instruments consisting of nine instruments and attachments in leatherette case.
Keuffel and Esser 3" Prismatic compass in leather carrying case.
Keuffel and Esser Polar planimeter with 6½" tracer arm with wooden case.
Price rotating vane water current meter in wooden case.
Seven-day recording thermograph.
5" brass hand level in leather case.
Lufkin 50' steel measuring tape graduated in feet and inches.
Lufkin 100' steel measuring tape graduated on one side in links and on the other in feet and inches.
Stanley surveyor's level and tripod in wooden case.
Bronze plumb bob.
Set 34 Vulcanite railroad curves in wooden case.
Brass cross staff head in leather case.
Brass hook water gauge.
Flexible transit rod in metal container.
Portable Zeiss astronomical telescope complete with Zenith prism and tripod.
Chesterman (English) 100' steel measuring tape graduated on one side in links and on the other in feet and inches.
Canvas pack sack.
Chicago rod in canvas case.
These may be inspected in Montreal; for further information, please write Box No. 55-S.

THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 27 MONTREAL, DECEMBER 1944 NUMBER 12

"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

* * *

PUBLISHED MONTHLY BY

THE ENGINEERING INSTITUTE OF CANADA

2050 MANSFIELD STREET - MONTREAL

CONTENTS

ENDS AND MEANS IN SOIL MECHANICS 608
K. Terzaghi, M.Am.Soc.C.E., M.Inst. C.E.

THE CORPS OF ROYAL CANADIAN ELECTRICAL AND MECHANICAL ENGINEERS 616
Lt.-Col. A. O. Monk, B.Sc. and Major R. T. Bogle, B.A.Sc., S.E.I.C.

GAS TURBINES AND JET PROPULSION 622
Dr. Lionel S. Marks

RIVER VALLEY DEVELOPMENT IN SOUTHERN ONTARIO . 624
Robert F. Legget, M.E.I.C.

THE ENGINEER'S NEED OF HUMANITIES 626
R. C. Wallace, C.M.G., LL.D., Hon.M.E.I.C.

PREPARING R.C.A.F. PERSONNEL FOR REHABILITATION . 627
Group Captain S. N. F. Chant

FROM MONTH TO MONTH 630

ANNUAL MEETING PROGRAMME 633

PERSONALS 640

OBITUARIES 641

NEWS OF THE BRANCHES 642

LIBRARY NOTES 650

PRELIMINARY NOTICE 652

EMPLOYMENT SERVICE 655

COVER PICTURE

Firmly battened down, this damaged tank is ready to start its journey to a Royal Canadian Electrical and Mechanical Engineers' workshop. Whenever possible, casualties in equipment are repaired *in situ;* but it may be necessary for lack of facilities or for tactical reasons to take the equipment behind the lines. Tank transporters such as the one shown on the cover are equipped with winches for hauling the damaged tank onto the platform. (*This and other photos appearing on pages 616 to 620 are Canadian Army Photos.*)

Price 50 cents a copy, $3.00 a year: in Canada, British Possessions, United States and Mexico. $4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, $2.00 a year. —Entered at the Post Office, Montreal, as Second Class Matter.

THE ENGINEERING INSTITUTE OF CANADA

MEMBERS OF COUNCIL - 1944

PRESIDENT
deGASPÉ BEAUBIEN, Montreal, Que.

PAST-PRESIDENTS
*C. J. MACKENZIE, Ottawa, Ont.
‡K. M. CAMERON, Ottawa, Ont.
†C. R. YOUNG, Toronto, Ont.

VICE-PRESIDENTS
*W. P. BRERETON, Winnipeg, Man.
†G. L. DICKSON, Moncton, N.B.
†J. M. FLEMING, Port Arthur, Ont.
*L. F. GRANT, Kingston, Ont.
*C. K. McLEOD, Montreal, Que.
†E. B. WARDLE, Grand'Mère, Que.

COUNCILLORS
*J. E. ARMSTRONG, Montreal, Que.
*H. E. BRANDON, Toronto, Ont.
†H. L. BRIGGS, Winnipeg, Man.
§A. E. CAMERON, Halifax, N.S.
‡R. S. EADIE, Montreal, Que.
§J. W. D. FARRELL, Regina, Sask.
†G. H. FERGUSON, Ottawa, Ont.
†E. V. GAGE, Montreal, Que.
†P. E. GAGNON, Quebec, Que.
*R. E. HEARTZ, Montreal, Que.
*A. JACKSON, Kingston, Ont.
†J. A. LALONDE, Montreal, Que.
†ALEX. LOVE, Hamilton, Ont.
†P. A. LOVETT, Halifax, N.S.
*A. M. MACGILLIVRAY, Antigonish Harbour, N.S.
*N. B. MacROSTIE, Ottawa, Ont.
†J. McMILLAN, Calgary, Alta.
*A. W. F. McQUEEN, Niagara Falls, Ont.
†E. B. MARTIN, Moncton, N.B.
*G. E. MEDLAR, Windsor, Ont.
†W. MELDRUM, Lethbridge, Alta.
*J. P. MOONEY, Saint John, N.B.
†A. S. G. MUSGRAVE, Oak Bay, B.C.
*E. NELSON, Edmonton, Alta.
*H. G. O'LEARY, Fort William, Ont.
‡P. E. POITRAS, Montreal, Que.
†J. A. RUSSELL, Sydney, N.S.
§P. M. SAUDER, Strathmore, Alta.
*C. SCRYMGEOUR, Dartmouth, N.S.
†H. R. SILLS, Peterborough, Ont.
†C. STENBOL, Sault Ste. Marie, Ont.
§E. O. TURNER, Fredericton, N.B.
*J. A. VANCE, Woodstock, Ont.
*H. J. WARD, Shawinigan Falls, Que.
*J. W. WARD, Arvida, Que.
*C. E. WEBB, Vancouver, B.C.
†W. S. WILSON, Toronto, Ont.

*For 1944. †For 1944-45. ‡For 1944-45-46. §Representing the Provincial Professional Association

TREASURER
R. E. CHADWICK, Montreal, Que.

GENERAL SECRETARY
L. AUSTIN WRIGHT, Montreal, Que.

SECRETARY-EMERITUS
R. J. DURLEY, Montreal, Que.

ASSISTANT GENERAL SECRETARY
LOUIS TRUDEL, Montreal, Que.

STANDING COMMITTEES

FINANCE
C. K. McLEOD, *Chairman*
J. E. ARMSTRONG
G. A. GAHERTY
R. E. CHADWICK
R. M. CALVIN

LEGISLATION
P. E. POITRAS, *Chairman*
F. J. BLAIR
R. J. DURLEY

PAPERS
L. F. GRANT, *Chairman*

LIBRARY AND HOUSE
E. V. GAGE, *Chairman*
A. T. BONE
J. S. HEWSON
M. S. NELSON
G. V. RONEY

PUBLICATION
R. S. EADIE, *Chairman*
R. DeL. FRENCH, *Vice-Chairman*
R. C. FLITTON
J. A. OUIMET
C. A. PEACHEY

SPECIAL COMMITTEES

BOARD OF EXAMINERS
R. A. SPENCER, *Chairman*
I. M. FRASER
W. E. LOVELL
A. P. LINTON
H. R. MacKENZIE
E. K. PHILLIPS

GZOWSKI MEDAL
T. H. JENKINS, *Chairman*
E. G. M. CAPE
V. A. McKILLOP
W. H. POWELL
E. O. TURNER

DUGGAN MEDAL AND PRIZE
W. J. W. REID, *Chairman*
R. C. FLITTON
H. M. WHITE

PLUMMER MEDAL
P. E. GAGNON, *Chairman*
J. R. DONALD
R. R. McLAUGHLIN
H. J. ROAST
L. E. WESTMAN

LEONARD MEDAL
F. V. SEIBERT, *Chairman*
A. E. MacRAE
D. H. McDOUGALL
G. W. WADDINGTON

JULIAN C. SMITH MEDAL
deGASPÉ BEAUBIEN, *Chairman*
C. J. MACKENZIE
C. R. YOUNG

MEMBERSHIP
J. G. HALL, *Chairman*
S. R. FROST
N. MacNICOL

PROFESSIONAL INTERESTS
J. B. STIRLING, *Chairman*
J. E. ARMSTRONG, *Vice-Chairman*
J. B. CHALLIES
A. CIRCE
G. J. CURRIE
G. A. GAHERTY
W. G. SWAN
J. A. VANCE

STUDENTS' AND JUNIORS' PRIZES

H. N. Ruttan Prize—Western Provinces
W. P. BRERETON, *Chairman*
A. M. MACGILLIVRAY
C. E. WEBB

John Galbraith Prize—Province of Ontario
J. M. FLEMING, *Chairman*
H. E. BRANDON
A. W. F. McQUEEN

Phelps Johnson Prize—Province of Quebec (English)
C. K. McLEOD, *Chairman*
E. V. GAGE
R. E. HEARTZ

Ernest Marceau Prize—Province of Quebec (French)
E. B. WARDLE, *Chairman*
P. E. GAGNON
P. E. POITRAS

Martin Murphy Prize—Maritime Provinces
G. L. DICKSON, *Chairman*
J. P. MOONEY
C. SCRYMGEOUR

INTERNATIONAL RELATIONS
M. J. McHENRY, *Chairman*
E. A. ALLCUT
A. E. BERRY
C. P. EDWARDS
D. H. McDOUGALL
C. SCRYMGEOUR
L. E. WESTMAN

PRAIRIE WATER PROBLEMS
G. A. GAHERTY, *Chairman*
P. M. SAUDER, *Vice-Chairman*
T. D. STANLEY, *Secretary*
C. H. ATTWOOD
L. C. CHARLESWORTH
A. GRIFFIN
D. W. HAYS
G. N. HOUSTON
T. H. HOGG
C. J. MACKENZIE
H. J. McLEAN
F. H. PETERS
S. G. PORTER
B. RUSSELL
J. M. WARDLE

THE YOUNG ENGINEER
H. F. BENNETT, *Chairman*
C. G. R. ARMSTRONG
J. BENOIT
J. B. deHART
RENE DUPUIS
J. N. FINLAYSON
R. F. LEGGET
A. E. FLYNN
R. DeL. FRENCH
A. JACKSON
G. R. LANGLEY
A. E. MACDONALD
H. W. McKIEL
D. A. R. McCANNEL

ENGINEERING FEATURES OF CIVIL DEFENCE
J. E. ARMSTRONG, *Chairman*
P. E. ADAMS
J. N. ANDERSON
S. R. BANKS
H. F. BENNETT
W. D. BRACKEN
W. P. BRERETON
J. M. DAVIDSON
R. S. EADIE
E. V. GAGE
G. A. GAHERTY
R. J. GIBB
A. GRAY
J. GRIEVE
J. L. LANG
R. F. LEGGET
I. P. MACNAB
J. A. McCRORY
H. J. McEWEN
C. B. MUIR
W. H. MUNRO
J. A. A. PICHÉ
G. MacL. PITTS
C. J. PORTER
M. G. SAUNDERS
W. O. SCOTT
T. G. TYRER
H. K. WYMAN

INDUSTRIAL RELATIONS
WILLS MACLACHLAN, *Chairman*
E. A. ALLCUT
J. P. BRIERLEY
J. C. CAMERON
E. R. COMPLIN
J. A. COOTE
RENÉ DUPUIS
T. W. EADIE
S. M. GOSSAGE
F. W. GRAY
E. G. HEWSON
I. F. McRAE
W. H. MUNRO
W. J. W. REID

DETERIORATION OF CONCRETE STRUCTURES
R. B. YOUNG, *Chairman*
E. VIENS, *Vice-Chairman*
G. P. F. BOESE
A. G. FLEMING
W. G. C. GLIDDON
J. A. McCRORY
C. J. MACKENZIE
J. H. McKINNEY
R. M. SMITH

THE ENGINEERING INSTITUTE OF CANADA

OFFICERS OF BRANCHES

BORDER CITIES
Chairman, J. B. DOWLER
Vice-Chair., A. H. MacQUARRIE
Executive, G. W. LUSBY, J. M. WYLLIE, J. F. G. BLOWEY
(Ex-Officio), G. E. MEDLAR, G. G. HENDERSON
Sec.-Treas., W. R. STICKNEY, 1614 Ontario Street, Walkerville, Ont.

CALGARY
Chairman, H. B. LeBOURVEAU
Executive, J. V. ROGERS, F. C. TEMPEST, P. F. PEELE, J. LANGSTON
(Ex-Officio) J. McMILLAN, S. G. COULTIS, J. G. MacGREGOR, K. W. MITCHELL
Sec.-Treas., A. B. GEDDES, 4716 Elbow Drive, Calgary, Alta.

CAPE BRETON
Chairman, M. F. COSSITT
Executive, M. R. CHAPPELL, J. R. MORRISON
(Ex-Officio), J. A. MACLEOD, J. A. RUSSELL
Sec.-Treas., S. G. NAISH, Peacock Brothers Ltd., Moore Bldg., Sydney, N.S.

EDMONTON
Chairman, B. W. PITFIELD
Vice-Chair., J. W. JUDGE
Executive, H. W. TYE, I. F. MORRISON, J. D. A. MACDONALD, J. E. B. CRANSWICK, R. SCOTT, R. H. LINKE
(Ex-Officio), E. NELSON, C. W. CARRY, F. R. BURFIELD
Sec.-Treas., G. H. MILLIGAN, Calgary Power Company, 214 McLeod Bldg., Edmonton, Alta.

HALIFAX
Chairman, G. J. CURRIE
Executive, R. J. BETHUNE, J. W. MARCH, J. E. CLARKE, C. D. MARTIN, K. L. DAWSON, L. E. MITCHELL, D. C. V. DUFF, H. A. RIPLEY, J. H. M. JONES, R. B. STEWART
(Ex-Officio), A. E. FLYNN, A. E. CAMERON, C. SCRYMGEOUR, P. A. LOVETT
Sec.-Treas., S. W. GRAY, Wartime Bureau of Technical Personnel, 84 Hollis Street, Halifax, N.S.

HAMILTON
Chairman, H. A. COOCH
Vice-Chair., NORMAN EAGER
Executive, C. H. HUTTON, H. J. A. CHAMBERS, R. J. G. SCHOFIELD, A. R. HANNAFORD
(Ex-Officio), ALEX. LOVE, T. S. GLOVER
Sec.-Treas., W. E. BROWN, 91 Barnsdale Blvd., Hamilton, Ont.

KINGSTON
Chairman, S. D. LASH
Vice-Chair., J. R. CARTER
Executive, F. A. ATHEY, C. E. CRAIG, J. D. CALVIN, H. D. ROGERS
(Ex-Officio), L. F. GRANT, A. JACKSON, K. M. WINSLOW
Sec.-Treas., J. DOUGLAS LEE, Queen's University, Kingston, Ont.

LAKEHEAD
Chairman, S. T. McCAVOUR
Vice-Chair., W. C. BYERS
Executive, S. E. FLOOK, E. L. GOODALL, O. J. KOREEN, W. H. SMALL, A. D. NORTON, W. E. MACLENNAN, J. LUNDIE, S. C. WILCOX
(Ex-Officio), R. B. CHANDLER, J. M. FLEMING, H. G. O'LEARY
Sec.-Treas., J. I. CARMICHAEL, Aircraft Division, Canadian Car & Foundry Co., Ltd., P. O. Box 67, Fort William, Ont.

LETHBRIDGE
Chairman: A. L. H. SOMERVILLE
Executive, J. M. CAMPBELL, A. G. DONALDSON, P. E. KIRKPATRICK, R. S. LAWRENCE
(Ex-Officio), W. MELDRUM
Sec.-Treas, T. O. NEUMANN, Dept. of Transport, Post Office Building, Lethbridge, Alta.

LONDON
Chairman, R. S. CHARLES
Vice-Chair., H. G. STEAD
Executive, E. B. ALLEN, F. C. BALL, H. F. BENNETT, V. A. McKILLOP, G. N. SCROGGIE
(Ex-Officio), T. L. McMANAMNA, J. A. VANCE
Sec.-Treas, A. L. FURANNA, 732 Wellington Street, London, Ont.

MONCTON
Chairman, A. S. DONALD
Vice-Chair., H. W. HOLE
Executive, H. J. CRUDGE, A. GORDON, T. H. DICKSON, E. C. PERCY, E. R. EVANS, G. E. SMITH
(Ex-Officio), G. L. DICKSON, J. A. GODFREY, E. B. MARTIN
Sec.-Treas., V. C. BLACKETT, Engrg. Dept., C.N.R., Moncton, N.B.

MONTREAL
Chairman, C. C. LINDSAY
Vice-Chair., J. B. STIRLING
Executive, C. E. GÉLINAS, J. BENOIT, K. G. CAMERON, L. H. BURPEE, G. H. MIDGLEY, M. S. MACGILLIVRAY
(Ex-Officio), deGASPÉ BEAUBIEN, C. K. McLEOD, J. E. ARMSTRONG, R. S. EADIE, J. A. LALONDE, E. V. GAGE, P. E. POITRAS, R. E. HEARTZ
Sec.-Treas., L. A. DUCHASTEL, 40 Kelvin Avenue, Outremont, Que.

NIAGARA PENINSULA
Chairman, W. D. BRACKEN
Vice-Chair., A. G. HERR
Executive, M. H. JONES, A. D. SMITH, H. E. BARNETT, J. W. BROOKS, W. D. BROWNLEE, P. E. BUSS, L. J. RUSSELL
(Ex-Officio), A. W. F. McQUEEN, G. E. GRIFFITHS, J. H. INGS, 2135 Culp Street, Niagara Falls, Ont.

OTTAWA
Chairman, W. L. SAUNDERS
Executive, W. H. B. BEVAN, J. H. BYRNE, D. G. KILBURN, J. M. WARDLE, C. D. WIGHT
(Ex-Officio), K. M. CAMERON, G. H. FERGUSON, N. B. MacROSTIE
Sec.-Treas., A. A. SWINNERTON, Bureau of Mines, 562 Booth Street, Ottawa, Ont.

PETERBOROUGH
Chairman, C. R. WHITTEMORE
Executive, R. L. DOBBIN, A. L. MALBY, F. R. POPE, A. J. GIRDWOOD, W. T. FANJOY
(Ex-Officio), A. R. JONES, H. R. SILLS
Sec.-Treas., E. WHITELEY, 611 Weller Street, Peterborough, Ont.

QUEBEC
Life Hon. Chair., A. R. DÉCARY
Chairman, E. D. GRAY-DONALD
Vice-Chair., J. O. MARTINEAU
Executive, A. E. PARÉ, CHARLES LEMIEUX, Y. R. TASSÉ, W. J. MANNING, L. MARTIN, J. M. PAQUET
(Ex-Officio), P. E. GAGNON, RENÉ DUPUIS, P. MÉTHÉ, PAUL VINCENT
Sec.-Treas., GUSTAVE F. ST-JACQUES, Public Service Board of the Province of Quebec, Court House, Quebec, Que.

SAGUENAY
Chairman: CHAS. MILLER
Vice-Chair., G. B. MOXON
Executive, J. FRISCH, W. E. COOPER, F. T. BOUTILIER
(Ex-Officio), R. H. RIMMER, J. W. WARD, ALEX. T. CAIRNCROSS
Sec.-Treas., H. R. FEE, 836 - 6th Street, Arvida, Que.

SAINT JOHN
Chairman, C. D. McALLISTER
Vice-Chair., J. M. LAMB
Executive, G. M. BROWN, W. J. LAWSON, H. A. STEPHENSON, R. M. RICHARDSON
(Ex-Officio), J. P. MOONEY, A. O. WOLFF, F. A. PATRIQUEN, E. O. TURNER
Sec.-Treas., L. O. CASS, National Harbour Board, P.O. Box 1393, Saint John, N.B.

ST. MAURICE VALLEY
Chairman, R. DORION
Vice-Chair., H. K. WYMAN
Executive, G. B. BAXTER, A. G. JACQUES, A. W. PETERS, H. J. RACEY, M. EATON, W. E. A. McLEISH, W. H. HARVEY, J. JOYAL, E. E. WHEATLEY
(Ex-Officio), J. H. FREGEAU, H. J. WARD, E. B. WARDLE
Sec.-Treas., A. TRUDEL, 208-5th Avenue, Shawinigan Falls, Que.

SASKATCHEWAN
Chairman, J. McD. PATTON
Vice-Chair., N. B. HUTCHEON
Executive, F. C. CHRISTIE, G. W. PARKINSON, W. B. RAMSAY, F. E. ESTLIN, E. K. PHILLIPS, J. I. STRONG
(Ex-Officio), J. W. D. FARRELL, A. M. MACGILLIVRAY
Sec.-Treas., STEWART YOUNG, P.O. Box 101, Regina, Sask.

SAULT STE. MARIE
Chairman, A. M. WILSON
Vice-Chair., G. W. McLEOD
Executive, G. W. HOLDER, C. O. MADDOCK, H. W. SUTCLIFFE
(Ex-Officio), N. C. COWIE, C. STENBOL
Sec.-Treas., T. F. RAHILLY, 174 Pim Street, Sault Ste. Marie, Ont.

TORONTO
Chairman, S. R. FROST
Vice-Chair., C. F. MORRISON
Executive, C. D. CARRUTHERS, E. A. CROSS, D. G. GEIGER, A. H. HULL, R. F. LEGGET, J. F. McLAREN
(Ex-Officio), H. E. BRANDON, W. S. WILSON, C. R. YOUNG, W. H. M. LAUGHLIN, F. A. DAVIS
Sec.-Treas., S. H. deJONG, Dept. of Civil Engineering, University of Toronto, Toronto, Ont.

VANCOUVER
Chairman, T V. BERRY
Vice-Chair., A. PEEBLES
Executive, J. P. FRASER, F. H. BALLOU, E. S. JONES, R. C. PYBUS, G. W. ALLAN, J. A. TAMES
(Ex-Officio), C. E. WEBB, W. N. KELLY
Sec Treas., P. B. STROYAN, 2099 Beach Avenue, Vancouver, B.C.

VICTORIA
Chairman, H L. SHERWOOD
Vice-Chair A. L. FORD
Executive, P. B. HUGHES, C. M. TRIPP, S. R. WESTON, J. N. ANDERSON
(Ex-Officio), A. S. G. MUSGRAVE, KENNETH REID
Sec Treas., R. BOWERING, 41 Gorge Road West, Victoria, B.C.

WINNIPEG
Chairman, T. H KIRBY
Vice-Chair., C. P. HALTALIN
Executive, B. B. HOGARTH, N. M. HALL, R. A. SARA, W. F. RIDDELL, E. V. CATON
(Ex-Officio), W. P. BRERETON, H. L. BRIGGS, J. T. DYMENT,
Sec.-Treas., T. E. STOREY, 55 Princess Street, Winnipeg, Man.

ENDS AND MEANS IN SOIL MECHANICS

K. TERZAGHI, M.AM.SOC.C.E., M. INST. C.E.
Consulting Engineer, and Lecturer at the Graduate School of Engineering, Harvard University, Cambridge, Mass.

Paper delivered before the Montreal Branch of the Engineering Institute of Canada on October 12th, 1944

Foibles of Purely Empirical Methods

Some forty years ago when the author descended from the rarefied atmosphere of the university classroom into the brooding fogs of practical endeavour, he entered the services of a general contractor. At that time, reinforced concrete turned from a very profitable specialty into a commonplace routine procedure, whereupon the contractors tried to invade new fields where less competition was likely to be met. Foremost among the prospective sources of income were dam and tunnel construction. Since geology was the author's hobby, he naturally welcomed these developments and most of his colleagues shared his preference. Yet, more than once, the boss said to the flock of young and keen engineers: "When you boys get enthusiastic about a job, I know in advance that I am going to lose my shirt."

The financial set-backs were stark reality. But it took the author quite a while before he realized the causes. The causes can be briefly described as unwarranted extrapolation from past experience. The contractor had learned by experience to estimate the capacity of the pumps required to unwater excavation pits in sand, but he failed to realize that he always dealt with more or less silty sands. On one of his new jobs he went unwittingly into a stratum of perfectly clean sand and, as a consequence, he had to handle many times as much water as he had anticipated. He thought that he knew by experience that the sides of a cut in plastic clay can be held with a fairly light timbering and lost out when he made his first deep cut in a stiff clay with a marked tendency to swell.

As the author's experience increased he also noticed that the number of unsatisfactory foundations was very much greater than the text books would lead to expect. This discovery was rather disconcerting, because the design appeared to be based on experience and in a contractor's office, the word experience carries supreme authority. But as the years went by the author found out, little by little, that many of the so-called empirical rules and many time-honoured conceptions had apparently grown out of inadequate observation. It was taken for granted, in his firm, that the settlement of a building merely depends on the soil located immediately beneath the footings and that no attention needs to be paid to the soil located beyond a depth of eight or ten feet below the base of the footings. Still to-day, this conception dominates the regulations regarding allowable soil pressures in many building codes and it lures engineers into investigating foundation by means of small-scale loading tests. It was also quite generally believed that the settlement of a foundation on point bearing piles does not exceed the settlement of an individual test pile under the influence of the maximum service load and that the earth pressure on the timbering in a cut increases like a hydrostatic pressure in simple proportion to the depth below the surface. The practical implications of these widespread misconceptions can only be described as disastrous. A few examples may suffice to illustrate this fact.

Some fifty years ago a large post office building with sub-basement was constructed. The walls were supported by continuous footings resting on a stratum of dense sand and gravel. The footings were designed on the basis of an allowable soil pressure of about 2.5 tons per sq. ft. The settlement of such a foundation cannot possibly exceed half an inch, provided the gravel rests on another firm stratum. However, at a depth of about 30 ft. below the surface, the gravel overlaid a 50 ft. layer of soft clay. As a consequence, the building settled badly. Some ten years later, when the maximum settlement became about equal to two feet, the owners decided to stop the settlement by strengthening the foundation. Nobody suspected that the cause of the settlement may be located below the gravel. It was plainly visible that the cellar floor, a four-inch layer of concrete resting on the gravel, settled almost as much as the footings. Yet, not even this fact assisted in opening the eyes of the engineers who were trusted with the redesign of the foundation. The engineers decided that the unit pressure on the gravel was too high and they increased the width of the footings by 50 per cent, by means of a complicated reinforced concrete cantilever construction. As a matter of course, the expensive procedure did not have any effect on the trend of the settlement and during the following years, the maximum settlement increased by one more foot. This example illustrates the tenacity of the prejudices which are passed on from generation to generation.

In 1914, a monumental building was established on a pile foundation above a stratum of soft clay with a depth of about 70 ft. Some of the piles were driven to bearing in a layer of sand located above the clay and others were friction piles. After the designers had made 21 test borings and three test shafts, driven 80 test piles and carried out 38 loading tests, they felt sufficiently equipped to assure the owners and the public that the foundation which they had designed would not settle more than 1/16 inch. At present the maximum settlement approaches the one-foot mark.

In 1928, a paper mill with sensitive machinery was built on footings supported by about 5,000 wood piles of lengths ranging from 60 to 80 ft. Since none of the piles was assigned more than one-third of its ultimate bearing capacity, it was believed that the settlement of the buildings would be imperceptible. Yet, during construction, the building started to settle at an alarming rate. Subsequent deep test borings revealed the presence of a 30 ft. layer of soft clay located at a depth of about 100 ft. below floor level, or 20 ft. below the points of the longest piles. Above this layer the soil conditions are perfectly satisfactory. At present the maximum settlement of the foundations amounts to 28 inches.

In the open cuts for the construction of the subway of Berlin, the struts were designed over a period of more than twenty years on the assumption that the earth pressure on the sides of the cut increases like a hydrostatic pressure in simple proportion to the depth below the surface. In 1935, when the author expressed serious doubts about the legitimacy of this assumption, one of the contractors made provisions to measure the intensity and distribution of the earth pressure in ten different sections of a long cut. In every section it was found that the intensity of the earth pressure decreases from a maximum slightly below midheight to a very small value at the level of the bottom.

Purely Theoretical and Semi-Empirical Methods

For every recorded instance of flagrant contradiction between what engineers anticipated and what they experienced afterwards, ten others could be named which were hushed up. Hence, it became obvious, sooner or later, to every experienced engineer who had to carry responsibility or financial risks in connection with construction problems involving earth pressure or bearing capacity of soils, that the fundamental principles for design in this field were overdue for a revision.

In structural engineering such a revision took place in the second half of the eighteenth century and led to the development of applied mechanics. Although, at the outset, the theoretical approach to the solution of construction problems was summarily rejected by some and viewed with suspicion by others, the opposition gradually died out. Nowadays, the design of bridges or framed structures without the assistance of applied mechanics would be considered plain folly.

In foundation engineering the transition from purely empirical to a more rational procedure lagged behind the advance of other branches of civil engineering because the mechanical properties of soils are far more complex and far more difficult to determine than those of steel and concrete. Furthermore, some vital soil properties such as the stress-deformation characteristics can be evaluated with adequate accuracy under exceptional conditions only. Therefore, the field of application of pure theory to soil problems is rather limited. In many instances we depend on semi-empirical methods such as those for the design of cofferdams (1), and of the soil support in open cuts (2, 3), and in tunnels (4). But it took a long while until the workers in the new field recognized the existence of these limitations, because they were spoiled by the startling successes of applied mechanics in other fields of civil engineering and cherished the illusion that it was only a matter of time until pure theory should spread all over the domain of soil behaviour. Still to-day the semi-empirical procedures do not yet receive the attention which they deserve. But it is fairly certain that they will dominate the field in a not too distant future.

A semi-empirical procedure can be defined as an attempt to predict from the observed performance of the soil on one job what its performance on another job, under at least somewhat different conditions of loading or support will be. That is exactly what the old time practitioner believed he was doing all the time. But he did not realize that this method can be successfully used on two conditions only. The laws which govern the influence of the factors which constitute the difference between the jobs, such as the size of a loaded area or the diameter of a tunnel on the performance of the soil must be known and the soil conditions on the new job must be similar to those on the job which is used as a prototype.

Almost all the popular misconceptions regarding foundations grew out of a failure to observe or to recognize the influence of variable factors on the performance of soils. The following example illustrates the fundamental fallacies. The paper mill whose settlement was described at the outset was located close to an old railroad bridge whose piers rested on a pile foundation. According to the records of the railroad company, the settlement of the bridge piers was insignificant. To be on the safe side the designers of the new foundation assigned to their piles much less than the load which had been successfully carried by the piles beneath the bridge piers, whereupon they concluded that their foundation would be as solid as rock. That was their design based on experience. They did not know that the settlement of any foundation located above a bed of clay increases rapidly with increasing size of the area occupied by the buildings, at equal load per unit of this area. The load per pile is almost irrelevant provided it is smaller than the ultimate bearing capacity of the pile. As stated before, the maximum settlement of the mill foundation amounts to-day to 28 inches whereas that of the much older bridge piers is still insignificant.

The influence of variable factors such as the size of a loaded area or a timbered face on settlement or pressure could be learned by experience. But this procedure requires a lot of drudgery on the part of the engineers and active cooperation on the part of contractors and owners. Therefore it never was a prolific source of information. Most of our present knowledge concerning these influences was obtained by purely theoretical reasoning and the confirmation of the conclusion by observations in the field came afterwards.

In order to determine if the soil conditions on a new job are essentially identical with those on the prototype it is necessary to make a quantitative evaluation of all those soil properties which are responsible for what has been observed on the prototype in the field. At the time when the author started on his professional career, two soils were considered identical if they seemed to deserve the same name. This conception still dominates the routine methods for preparing test boring records. Every such record chiefly consists of a sequence of words such as medium sand, silty sand, peaty silt or soft or stiff blue clay. If these words are used by the members of the profession in one city, they may convey to observant engineers and contractors who live in this city a fairly well-defined conception of what they mean. But in two different parts of a large country or in two countries, the soils which are entitled to bear the same name are likely to have very little in common besides their superficial appearance.

Thus, for instance, it does not require much experience to know that the term "stiff clay" designates a large group of soils which have nothing in common except being smooth-textured and stiff. In some regions, such as northeastern France, the stiff clays exert formidable swelling pressures on the timbering in tunnels and cuts while in other regions such as eastern Tennessee, they do not perceptibly swell and the process of tunneling through these stiff clays is a very simple matter. In some localities the settlement of footings on "stiff clay" was found to be insignificant while other footings of the same size, supporting the same load and also resting on "stiff clay" settled so badly that the super-structure was damaged. Similar statements can be made regarding every family of soils whose members bear the same name. When used in connection with such a crude method of soil identification, even the very best semi-empirical methods of design may lead occasionally to utterly unsatisfactory results. Hence, one of the foremost tasks of soil mechanics consisted in replacing the traditional method of soil identification based on appearance by more suitable ones.

Soil Classification Based on Grain Size

The most conspicuous difference between soils resides in the grain size. It ranges between nut size for the coarser constituents of gravel and the size of submicroscopic particles for the finer constituents of clays. Therefore, it is not surprising that many different groups of investigators, the author included, made more or less independent attempts to improve the methods of soil classification with grain size as a basis. The attempts had such a universal appeal that the technique for making the grain size analysis became the main topic of many profound investigations. Later these methods became standardized and to-day the grain size analysis constitutes part of the daily routine in a great number of different soils laboratories.

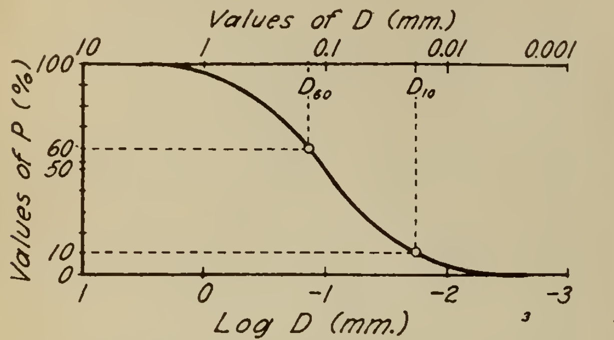


Fig. 1. Semi-logarithmic plot of results of grain-size analysis.

Figure 1 illustrates the standard method for plotting the results of the analysis. The abscissae represent the logarithm of the grain size and the ordinates the percentage P of the total weight of the soil composed of particles smaller than the size denoted by the abscissae. The grain size D_{10} which corresponds to $P = 10\%$ on the grain size diagram is known as the effective grain size. The uniformity coefficient U is equal to D_{60}/D_{10} wherein D_{60} is the grain size corresponding to $P = 60\%$. These two values D_{10} and U are commonly used to indicate the grain size characteristics of a soil in a general way. Figure 2 illustrates the meaning of the words which designate the different grain size fractions. In order to standardize the nomenclature for mixed grained soils, the Bureau of Public Roads in Washington, D.C., has worked out the triangular chart shown in Fig. 3. In this diagram every soil with known grain size characteristics can be represented by a point. The three corners of the diagram represent pure sand, pure silt and pure clay. The soil represented by point S contains 20 per cent sand, 30 per cent silt and 50 per cent clay.The percentages can be read at the outer ends of the three dotted lines which fan out from S.

It did not take very long until several investigators realized that the grain size characteristics reveal only one part, and by no means the most significant one, of the properties of a given soil. In order to avoid erroneous identification it is necessary to supplement the grain size data by others expressing those properties which can be different at equal grain size. As a matter of fact, the author has the impression that many soils laboratories continue to turn out grain size analyses

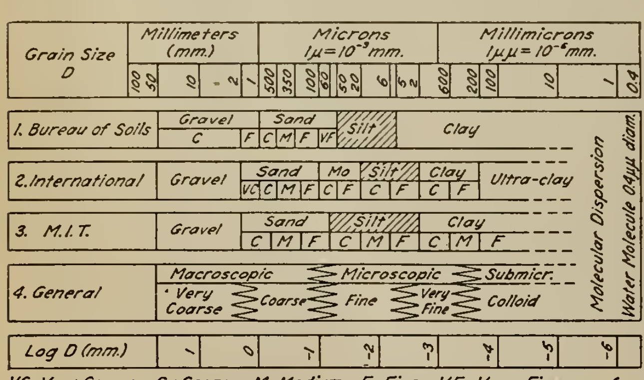


Fig. 2. Classifications of soil types on basis of grain size fractions.

by the dozen merely on account of inertia, because the instances are rather rare in which an accurate knowledge of grain size characteristics really contributes towards the sum total of useful information. In order to demonstrate this fact, two typical groups of soils will be examined, the sands and the clays.

Significant Properties of Sands

It does not need much imagination to realize that the significant properties of a sand, such as its compressibility, depend much more on the shape than on the size of the grains. If a sand contains ten per cent of mica flakes by weight, it has not the remotest resemblance to an ordinary sand. In contrast to the ordinary sand, it is extremely compressible and if the load is removed, the sand swells up. Yet in some parts of Switzerland and in Alaska, sands were encountered which contained more than 20 per cent mica. Hence, if such a sand is encountered, information regarding its mica content is much more important than data concerning its grain size.

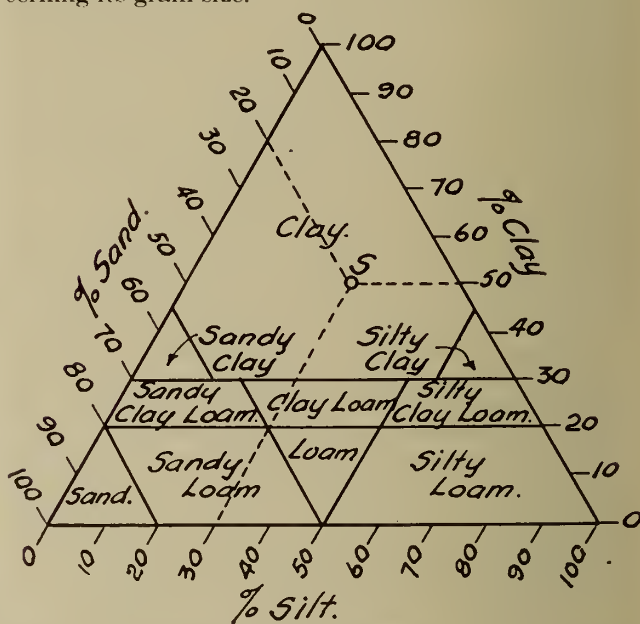


Fig. 3. Soil classification chart developed by U.S. Public Roads Administration.

Fortunately sands with a high mica content are very rare. But even two sands without any mica and with identical grain size characteristics can be extremely different depending on the density of their structure. This statement is illustrated by Fig. 4 which shows a vertical section through a quay wall near Rotterdam, Holland. Prior to designing the wall, one test boring was made for every 200 ft. of wall. All the borings indicated that the uppermost strata consisting of a succession of thin layers of silt, peat and very soft clay rested at a depth of about 60 ft. below the surface on a stratum of clean, coarse quartz sand. From local experience it was known that smooth precast reinforced concrete piles could not be driven without water jet to a depth of more than about five feet into the sand. Once a pile was driven to that depth, a static load of about 220 tons was required to increase the penetration by four inches. Hence, it was decided to establish the wall on precast reinforced concrete piles.

After the piles for the western part of the wall were driven, the depth at which the piles came to bearing increased rapidly. Finally the penetration produced by the blows of the hammer remained excessive even after the points of the piles arrived at a depth of 15 ft. below the level at which the sand was encountered in the test

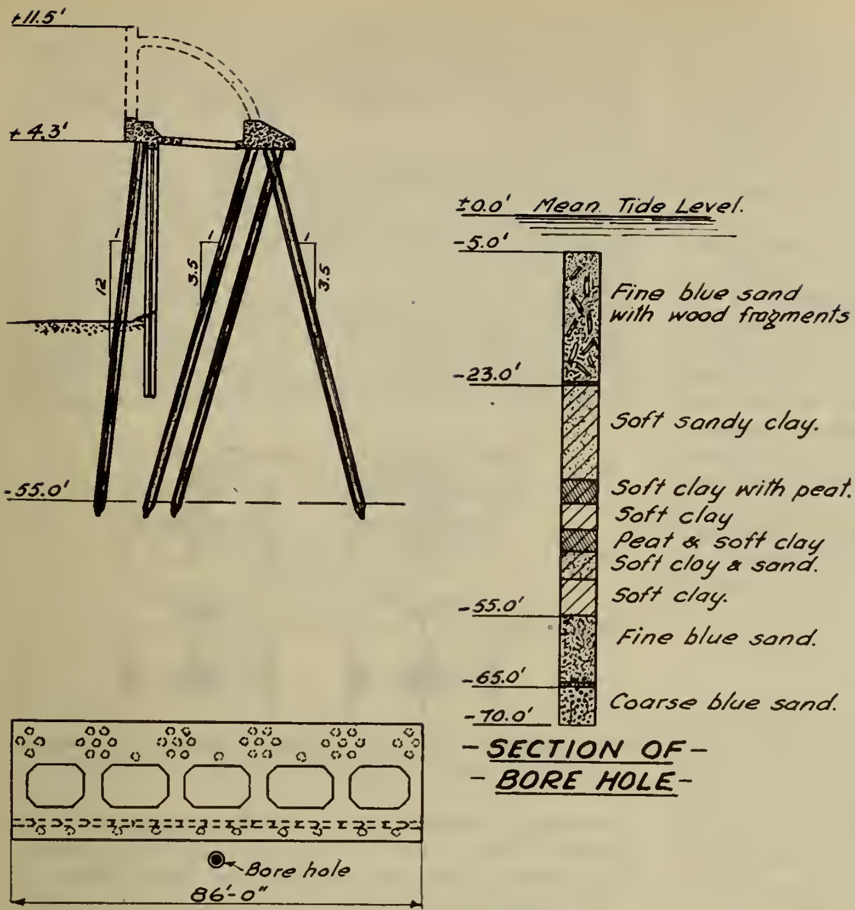


Fig. 4. Quay wall in Vlaardingen, near Rotterdam, Holland.

deep in Houston Street, New York; shaded area represents range for curves obtained between depths of 20 and 60 ft. on Houston Street; curve 5 represents loose, coarse, clean and very sharp sand at bottom of open excavation near Muskegon, Michigan. Curves 2, 4, and 5 are representative of sand in dense, medium, and loose states respectively. The sand represented by curve 2 was a very fine, uniform sand with a bad reputation as a quicksand. Yet when undisturbed by pumping from open sumps, it constituted a splendid foundation. The most unfavourable results, represented by curve 5, were obtained from a loading test on a clean, sharp, mixed grained sand which could be used as it was as a concrete aggregate. Yet its compressibility *in situ* was positively disconcerting.

The unit load required to produce a settlement of the bearing block by ½ in. ranged between 7 tons per sq. ft. (curve 2) and 0.4 ton per sq. ft. (curve 5). It is entirely independent of the grain size characteristics of the sand. It merely depends on whether the sand is dense, medium or loose. Hence, in connection with semi-empirical methods for the design of footings on sand, the grain size characteristics of the sand are perfectly irrelevant. The only factor which

borings. Hence it was believed that the sand may be absent at the site of the abnormal performance of the piles. In order to determine the depth of the suspected buried valley, a new test boring was made, in the proximity of the abnormal piles. Yet, to the surprise of everybody the sand was encountered at about the same elevation as in the other borings and the grain size characteristics were the same. Thus it became evident that the site of the wall was traversed by a belt in which the sand was exceptionally loose. In order to establish the wall above this belt, precast piles with a heavy, bulb-shaped point were used. The vibrations emanating from this point during the process of pile driving shook the sand down and created below the point a big pocket of compacted sand whose pressure reduced the unit load on the loose sand.

On several occasions during the years which followed this incident the author encountered strata of dense sand which contained band-like or lenticular inclusions of similar sand in a loose state. Since the density of a sand determines the bearing capacity of piles which are driven into it, it is obvious that it also determines the unit load at which a footing with a given size settles through a given distance. The importance of this influence is illustrated by Fig. 5. In this diagram, the abscissae represent the unit load and the ordinates the corresponding settlement of bearing blocks covering an area of one square foot, resting on different sands with different relative density. Curve 1 represents very dense clean medium sand in caisson 26 ft. below river bottom; curve 2 represents very dense, very fine sand in open excavation 26 ft. below ground surface in Lynn, Mass.; curve 3 represents medium slightly moist sand hand-compacted by tamping in layers; curve 4 represents medium dense sand at bottom of shaft 30 feet

counts is the compressibility which in turn is a function of the relative density. If the local conditions on a job permit the performance of loading tests at different depths below the base of a proposed foundation, the master curves shown in Fig. 5 can be used as a basis for judging the quality of the sand. If the local conditions exclude this possibility, other methods must be applied.

When investigating the properties of a thick sand

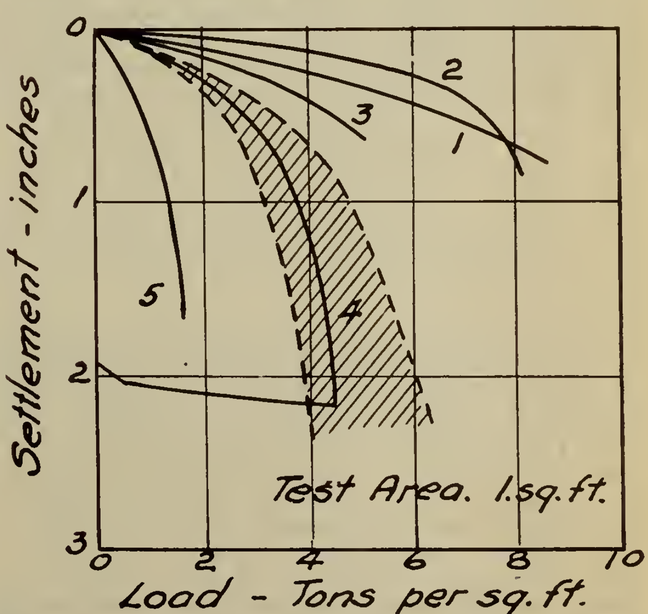


Fig. 5. Relation between unit load and settlement of bearing plate one foot square resting on surface of sand.

stratum beneath Houston Street in New York, the author improvised a device which measured the resistance of the sand against the penetration of a steel cone into the sand at different depths below the surface. To establish a relation between the measured resistance and the master curves shown in Fig. 5, loading tests were made in a shaft on a one square foot bearing block at different depths below the surface. (5) All the curves obtained from these tests are located within the shaded area shown in Fig. 5.

If a sand is very dense, wood piles cannot be driven into the sand to a depth of more than three or four feet. But if the sand is very loose, they can be driven without water jet to almost any depth and, in spite of the volume occupied by the piles, the surface of the sand subsides during the process of pile driving through a distance of several feet. As pile driving proceeds the resistance against penetration increases and finally the sand becomes dense enough to sustain the weight of the building. Therefore, if a sand is very loose, it is sufficient to compact it and in some instances it is possible to achieve this end with cheaper means than spiking it full of piles.

Significant Properties of Clays and the Atterberg Limits

According to the chart, Fig. 3, a soil is called a clay if the clay fraction exceeds 30 per cent of the total dry weight of the soil. The clay fraction is defined as that part of the soil whose particles are smaller than 0.002 mm. Every point S located within the clay area in Fig. 3 represents clays with identical grain size characteristics. The clay fraction of all clays is represented by the uppermost corner of the triangular chart.

If grain size were a significant property of the clays, the clay fractions of all the clays should have fairly similar properties. However, experience has shown that the difference between the clay fractions of two different clays can even be more important than the difference between an ordinary and a highly micaceous sand. It is due not only to a difference in the shape of the grains but also to a difference in the mineralogical composition of the clay fraction. This can be demonstrated by the following experiment.

Two samples of the clay fraction of the same clay soil are thoroughly washed with distilled water. Then a solution of calcium hydroxide is filtered through one of the samples, while the other one is treated in a similar manner with a solution of sodium hydroxide. After the distilled water in the clay fractions is completely replaced by the solutions it will be found that the mechanical properties of the two samples are different. The difference between the two treated samples of the clay fraction of one clay can be relatively small, while the two treated samples extracted from another clay such as a bentonite may be so utterly different that one could hardly believe their parent materials to be identical.

If the same experiment is made with any sand it will be noticed that the effect of the chemical composition of the interstitial liquid on the mechanical properties of the sand is practically nil. There is no exception to this rule. The reason for this vital difference between sand and clay is illustrated by Fig. 6. This figure represents four imaginary soils, a to d which differ from each other only in grain size. All of them are supposed to consist of spherical particles. The grain size of soil a is equal to the average grain size of sand fractions while that of soil d is equal to that of the finest constituents of clay fractions. It is known that every solid particle immersed in a liquid is surrounded with a layer of semi-solid liquid, the so-called adsorbed layer, whose thickness and mechanical properties depend on the chemical constitution of both the solid and the liquid. The thickness of these layers is of the order of magnitude of 0.0001 mm, or 0.1 micron.

In a sand, represented by Fig. 6a, the volume occupied by the adsorbed layers is negligible compared to the volume of the solid particles. As a consequence, the mechanical properties of the sand are practically independent of chemical factors. On the other hand in a clay fraction, represented by Figs. 6c and d, the adsorbed material occupies as much or even more space than the solid particles. Hence, it is not surprising that the mechanical properties of the aggregate depend not only on the shape of the grains. They depend to an equal or

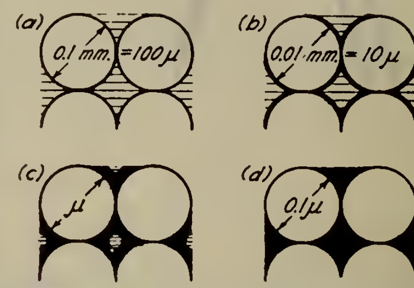


Fig. 6. Diagram showing relative thickness of adsorbed layers for spherical particles of different diameter.

even higher degree on the mechanical properties of the adsorbed layers which in turn depend on the chemical composition of both the solid and the liquid phase.

On account of the complex interaction between purely mechanical influences such as those of the shape of the grains, and of the chemical properties of both the liquid and the solid phase, the unraveling of the factors which determine the mechanical properties of clay soils is almost beyond the power of analysis. Still to-day, in spite of the progress achieved by means of X-ray methods, our knowledge has not yet advanced beyond grasping a few of the elements of the processes involved. Therefore, it is obvious that the routine methods for clay identification can be based only on the measurable mechanical effects of all the active agents combined. As a matter of fact, there is no practical need for any other method. The concrete engineer is in the same predicament. Still to-day some of the intricate processes to which the concrete owes its physical properties are still unknown. Yet a few simple laboratory tests such as the compression or the bending test provide the designer with all the information he needs.

Twenty years ago, when the author groped for suitable methods for expressing the significant properties of clays by numerical values to be obtained by cheap and simple tests, he came across a few publications by a Swedish agronomist, A. Atterberg. In his efforts to establish a classification of clay soils with respect to their performance under the action of the plow, Atterberg noticed that the water content at which they pass from one well defined state or consistency, into another, for instance from the liquid into the plastic state, is very different for different clays. The water content in per cent of the dry weight of the soil at which the transition occurs was designated as the limits of consistency.

The *liquid limit*, L_w is the water content at which two sections of a pat of clay having the dimensions shown in Fig. 7 barely touch each other, but do not flow together when subjected in a cup to the impact of sharp blows exerted by the palm of the hand.

The *sticky limit*, S_w is the lowest water content at which the clay still sticks to a metal spatula.

The *plastic limit*, P_w, is the water content at which the soil begins to crumble when rolled out into thin threads.

The difference between the liquid limit, L_w, and the plastic limit, P_w, is considered a measure for the plasticity of clay. It is designated as the *plasticity index*, I_w. For sandy clays I_w is less than five. For very plastic clays it exceeds 35.

After the author had determined the consistency values and the grain size characteristics for a considerable number of clays he noticed that the former are much more indicative for the general character of the clay than the latter. Yet the determination of the consistency values requires less time and labour than a thorough grain size analysis. Therefore, he proposed at an early date to use these values as index values for the identification of the solid substance of clays. To perpetuate the name of the investigator who conceived the idea of determining these values, he called them the Atterberg limits.

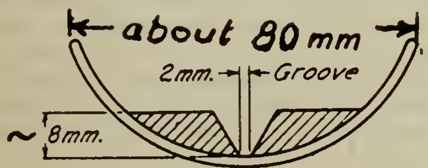


Fig. 7. Cross-section through soil pat for liquid limit test.

Subsequent experience showed that the choice was a happy one. In agronomy, the Atterberg limits never became popular, because they do not seem to be very suitable for agricultural purposes. But in the realm of civil engineering for which they were not even intended, they proved to be of inestimable value, although the knowledge of their bearing on the different significant properties of the clays is still increasing. Thus for instance, it was found that the compressibility of clay, which is a very important property, increases approximately in simple proportion to the liquid limit L_w. The position of the natural water content with reference to the boundaries L_w and P_w of the plastic range is indicative for the properties of the clay *in situ*. For clays of identical mineralogical composition, the liquid limit increases with decreasing grain size. Figure 8 illustrates the range of the plasticity indices of different types of clays. In this diagram the abscissae represent the liquid limit L_w and the ordinates the plasticity index I_w for different types of soils. If soils with different grain size characteristics have a similar geological origin, the points which represent these soils in the diagram are located in close proximity to a straight line.

The values of the liquid limit L_w obtained by means of Atterberg's original procedure depend to a considerable extent on the experimenter's conception of the meaning of the term "sharp blow." To eliminate this personal element a mechanical device has been constructed in which the blows are produced by an impact with a constant intensity. (6). The sticky limit S_w has not yet received the attention which it deserves. But in the Dutch Indies it was found by experience that the sticky limit is indicative for the degree of stability of rolled embankments. For all the clay embankments which failed in spite of small height and gentle slopes the sticky limit was well below the liquid limit. On the other hand, for the samples taken out of high clay embankments which were stable in spite of steep slopes,

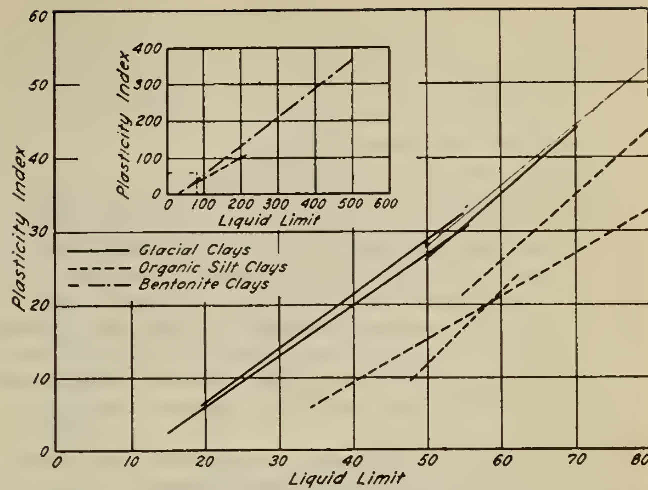


Fig. 8. Relation between liquid limit and plasticity index for soils of different geological origin (after A. Casagrande).

it was found that the sticky limit is consistently higher than the liquid limit. (7).

In nature, every clay may occur in any state intermediate between that of a thick slurry and that of a hard and brittle material. Hence the set of data describing a clay is not complete unless it contains a figure which determines the strength of the clay. Such a figure can be obtained by submitting a fairly undisturbed, cylindrical sample of the clay to an unconfined compression test. The strength of the clay is equal to the load, q_d per unit of area, which is required to produce a failure of the specimen by shear or bulging. By working such a specimen at unaltered water content, the strength of the clay is reduced from q_d to a smaller value q_{dw}. The ratio

$$S = \frac{q_d}{q_{dw}}$$

is known as the sensitivity of the clay. For ordinary clays the value of S ranges between about two and four. Yet, some clays are so abnormally sensitive that S is greater than ten. If a slide occurs in an ordinary clay the movement ceases as soon as the centre of gravity of the moving masses has descended through a moderate distance. But if a similar slide occurs in an extra sensitive clay, the clay turns liquid and flows like a thick slurry even on a gentle slope. Hence the sensitivity S of the clay must also be considered a significant value.

Prerequisites for the Practical Application of Soil Mechanics

For many years it has been known that the physical properties of almost every natural soil stratum vary more or less erratically at least in vertical directions. Therefore, it is obvious that the evaluation of the average physical properties of such strata requires continuous samples from several drill holes. The old-fashioned wash borings are utterly worthless because they fail to furnish reliable information even regarding the types of soils which are located beneath the surface. The significant properties, such as the degree of compactness of sand or the strength and compressibility of clay cannot even be guessed.

The type of boring which is needed for securing vital information on the subsoil conditions is different for sand and for clay. In connection with sand, we are primarily concerned in finding out whether the sand is dense, medium or loose. The answer to this question can only be obtained by means of loading or penetration tests at different depths below the base of the proposed foundation. If necessary these tests can be performed on the bottom of drill holes. In connection with clays, fairly undisturbed core samples are required. Otherwise, it is impossible to determine the strength and the natural water content of the clay.

Before starting the soil exploration in an untouched region, one may not know what is beneath the surface. On this condition one is compelled to start with what is known as a pilot boring. The pilot boring merely serves the purpose of determining the thickness, sequence and general character of the principal soil strata. On the basis of the information furnished by the pilot boring the engineer can decide which method should be used for the exploratory borings. The decision depends on the nature of the job and on the type of information required in the design.

The majority of exploratory borings serve to investigate the bearing capacity of the substrata or the unit load which can be applied on a given area without the settlement exceeding a specified value. If the foundation is located above a thick stratum of sand which rests on a firm base it may be sufficient to ascertain by appropriate means the degree of compactness of the sand. On jobs which require pumping, information regarding the permeability of the sand may also be required.

If the proposed foundation is located above a stratified subsoil consisting of layers of sand and soft clay, the layers of sand do not require any attention because their compressibility is negligible compared to that of the clay. But within the clay strata, continuous, fairly undisturbed samples must be secured. As a rule, satisfactory cores can be extracted by means of sampling tools consisting of 2-in. seamless steel tubing, 3 to 5 ft. long, with a sharpened edge. The diameter of the casing need not exceed 2½ in.

The samples are sealed as soon as they are hauled out of the hole and shipped to the laboratory in the tubes which served as samplers. Hence the length of tubing required for a boring job is equal to the total length of the cores to be recovered. In the laboratory the natural water content of the clay must be determined for every 6-in. section. The Atterberg limits and the compressive strength of the clay should be determined on at least one sample for every two or three feet of the thickness of the clay strata. The minimum requirement regarding the number of tests depends on the degree of homogeneity of the clay.

Whatever the purpose of a soil exploration may be it cannot possibly be accomplished by means of wash borings. Hence the first and foremost requirement for the practical application of soil mechanics consists in replacing the wash boring method by a more suitable one. If the wash boring method is used at all it should only be used in pilot borings between the points where drive samples are secured or in exploratory borings while passing through the soil located above or between clay strata. The second requirement is to submit all the cores to the soil tests specified before. If these two conditions are not satisfied the design of the foundation of important structures, particularly outside of city limits is nothing short of a gamble and nobody can tell in advance whether it is inadequate, appropriate or excessively expensive, because nobody, including the geologist, can possibly judge the physical properties of the subsoil with adequate accuracy without sampling and testing.

The contract price for 2½ inch seamless-steel-tube borings ranges between $2 and $4 per foot. It depends primarily on the number of drill holes. The price includes the seamless sample tubes which accompany the samples. The average price of soil testing amounts at present to about $2 per foot of sample. Even on medium-sized jobs the total cost of sampling and testing is less than one per cent of the cost of the foundation. Since the success or failure of the superstructure depends primarily on the solidity of the foundation the price of the exploratory work should be related to the total cost which would reduce the percentage to a small fraction of one per cent. Hence the price of the exploratory work is insignificant compared to its insurance value.

Professional papers on foundation or tunnel jobs should contain the soil profile, all the essential results of the soil tests and whatever is known about the geological origin of the soil strata. If a paper is published without these data it may bear splendid testimony to the ability and resourcefulness of its author. But the information which it contains cannot be used to advantage by the readers on any of their own jobs, because they cannot know which types of soil were involved.

Past and Future of Soil Mechanics

During the last fifteen years the experimental methods of soil mechanics passed from the horse and buggy stage into one of awe inspiring refinement. To operate the apparatus lined up in the more advanced soil mechanics laboratories requires specialized training, skill and experience. Similar trends can be noticed in the field of soil mechanics theory. A few years ago, when the author compiled a compendium on theoretical soil mechanics he had a hard time squeezing the essence of the material into a volume with five hundred pages.

All these recent developments have filled the minds of many capable and experienced professional men with resentment and have earned for soil mechanics the dubious reputation of developing into an esoteric cult. The author was associated with soil mechanics from its very beginnings and his interest in this subject is primarily that of a practising engineer. Had he arrived at the conclusion that the elaborate theoretical and experimental methods will be forever a prerequisite for the practical application of soil mechanics he would have severed his affiliation without any regret. But on the strength of his experiences he does not doubt that such a conclusion would be unjustified.

The elaborate methods of testing and the time-consuming soil mechanics research are merely the manifestations of a state of transition. The investigators who spend the best part of their lives in soil mechanics laboratories can be compared to prospectors who push out in many different directions into the great unknown. The chances that they strike a vein are one in a hundred. Engineering practice calls for clear and simple approximations whereas most of the investigations which are carried on in the various soil laboratories are very laborious and strive towards a degree of precision which seems to be out of proportion to the accuracy of the final result. But without the apparently wasteful hit-or-miss research activities carried on by many investigators with divergent opinions and different techniques and without the accumulation of a great number of data which may afterwards be recognized as worthless, simple and well balanced procedures cannot possibly be evolved because such procedures are fruits and not seeds.

The following examples illustrate the author's conception of mature procedures in applied soil mechanics. At the outset of this paper attention was called to important settlements due to the gradual consolidation of clay strata located at a considerable depth below the base of foundations or the points of foundation piles. One instance was mentioned in which the designers predicted a settlement not in excess of 1/16 in. while the real maximum settlement already approaches the one-foot mark. In other words the real settlement exceeded the estimated value by more than 15,000 per cent. Many other similar instances are on record. To-day we are usually in a position to estimate the maximum settlement of foundations located above clay strata in fifteen minutes within ± 50 per cent of the real value on the basis of no data other than the test boring record, the average natural water content and the average liquid limit of the clay. If the estimated settlement is greater than what the designer of the superstructure is willing to tolerate, the design of the foundation can be changed before it is too late. The procedure is very simple but the path which led to it was long and tortuous.

In the past the evaluation of the intensity and the distribution of earth pressure on the timbering in open cuts in soft clay was entirely based on opinion and the opinions were very far from being unanimous. To-day the distribution of the pressure is known and its intensity can be computed within ± 15 or 20 per cent from the average of the results of unconfined compression tests on a set of seamless-tube samples.

If a forecast in applied soil mechanics still requires elaborate investigations one can take it for granted that the method has not yet reached the state of maturity. However in many instances even an elaborate investigation can be much more economical than a wild guess.

BIBLIOGRAPHY

[1]Terzaghi, K. (1944), Stability and Stiffness of Cellular Cofferdams, Proc. Am. Soc. C.E., Vol. 70, No. 7, pp. 1015-1050.

[2]Terzaghi, K. (1941), General Wedge Theory of Earth Pressure, Trans. Am. Soc. C.E., Vol. 67, pp. 68-97.

[3]Peck, R. B. (1943), Earth Pressure Measurements in Open Cuts, Chicago (Ill.) Subway, Trans. Am. Soc. C.E., Vol. 69, pp. 1008-1036.

[4]Terzaghi, K. (1942), Liner Plate Method on the Construction of the Chicago Subway, Trans. Am. Soc. C.E., Vol. 69, pp. 970-1007.

[5]Terzaghi, K. (1935), The Actual Factor of Safety in Foundations, *The Structural Engineer* (London), Vol. 13, March, 1935.

[6]Procedure for Testing Soils, published by the Am. Soc. for Testing Materials, September, 1944.

[7]Van Es, L. J. C. (1933), Das Untersuchungsverfahren über die Eignung von Boden-Arten für den Bau von Staudämmen mit Hilfe der Konsistenzwerte von Atterberg. Rapport No. 21. 1. Congrès des Grands Barrages, Vol. III, pp. 125-131.

BRITAIN'S NEW RESEARCH CENTRE

By ALLAN P. SARGENT, B.Sc. (Eng.)

One of the major difficulties of planning on a large scale is to combine initiative and progressiveness with centralised control and a pre-arranged programme. The difficulty is not insuperable, as is shown by the organisation of research in Great Britain. The Department of Scientific and Industrial Research, set up by the Government, gives general direction and also undertakes research of a national character. Universities, industries, groups of industries, and private bodies like the Royal Institution conduct researches along various lines, ranging from pure science to strictly industrial investigations, and they receive grants from the State according to the amount of their own expenditure. Under this flexible arrangement every field of research is covered, and State guidance and help are co-ordinated with industrial enterprise.

The latest development in co-operative research is a project for establishing a large research centre at Leatherhead, a town within easy reach of London. Here the leading part has been played by the British Coal Utilisation Research Council, a body which embraces not only the producers of coal but also the makers of important coal-using appliances (such as boilers), and the manufacturers of the numerous by-products of coal. During the next five years the Council will spend up to £500,000 a year on systematic research, especially in the production of oil and of materials for the plastics industry. The work hitherto carried on in a number of centres will be concentrated in new laboratories which will be unrivalled in magnitude and in range of up-to-date equipment. Their most conspicuous feature, however, is that they form part of a most ambitious scheme of centralisation. On an adjacent site new laboratories will be erected also by the British Electrical and Allied Research Association, which is supported by the leading firms in all branches of electrical engineering and in certain closely associated lines of production. A similar step has been taken by the British Scientific Instrument Research Association—a smaller body but one of vital importance to the coal, electrical, and many other industries. The Printing and Allied Trades Research Association will also transfer its research activities to Leatherhead, and a number of other organisations are expected to follow.

The promoters of this scheme for the grouping of research laboratories hope that it will lead to the foundation of an informal kind of "industrial university." Proximity will certainly enable the workers in the various laboratories to exchange information, to assist each other in solving problems, and to hold valuable discussions on matters of common interest. Joint investigations by two or more associations will also become feasible. As all the associations concerned are planning research on a much larger scale than ever before, they will require to increase their staffs of experts and assistants and may thus be led to co-operate in a training scheme. The local education authorities are already considering the establishment in the neighbourhood of a technical college at which it will be possible for the junior members of the research staffs to qualify for promotion. Apart from educational facilities, however, the concentration of so many departments of research on a single site will make Leatherhead the Mecca of the ambitious research student and should attract many of the young men who during the war have been engaged on technical work and have disclosed a flair for experiment and invention.

The scheme is, of course, a wholly voluntary one; an excellent example of initiative on the part of private enterprise. No pressure is exercised by the Government or from any other quarter to induce a research association to cooperate in the "industrial university." The choice of the best location for a research centre is a matter which each industry has to decide according to its particular needs. Where the industry is itself localised, the area of choice is already defined. For example, the cotton industry must have its research facilities in Lancashire, the woollen industry in Yorkshire, and the linen industry in Northern Ireland. The Leatherhead enterprise does not represent concentration for the sake of concentration, but for a clear mutual advantage.

Thus the research system of Great Britain has developed by the adaptation of specific means to specific ends. Each part dovetails into the others, and all the parts, embracing every phase of scientific and industrial investigation, are integrated as a dynamic organism, not as a static structure. The need for division and sub-division of effort, which give an impression of complexity if not of confusion, is inherent in the nature of the research problem. Even when the field of operations is strictly limited, as in the case of a single product, several different types of laboratory, each with a specialised staff, may be required. This is illustrated by the history of the joint research committees formed by the Iron and Steel Institute and the British Iron and Steel Federation. The committees are concerned mainly with steel as a product and not with the process of making steel, yet they found it advisable to form four main research groups, dealing respectively with the heterogeneity of steel ingots, alloy steels, steel castings, and corrosion. Further, the main groups are divided into sub-groups, so that there are now twenty-three separate yet allied bodies engaged on this particular section of steel research. In addition to the researches undertaken by the groups themselves, others are handed over to non-industrial laboratories specially equipped to deal with them. Individual steel firms also co-operate in experimental work. All these activities are correlated by the main committees, and the results are pooled for the benefit of the entire steel industry.

THE CORPS OF ROYAL CANADIAN ELECTRICAL AND MECHANICAL ENGINEERS

Lt.-Col. A. O. MONK, b.sc. and Major R. T. BOGLE, b.a. sc., s.e.i.c.
Directorate of Mechanical Engineering, M.G.O. Branch, N.D.H.Q., Ottawa

A major reorganization of the repair and maintenance services of the Canadian Army took place when, on the 15th May, 1944, a new Corps, the Royal Canadian Electrical and Mechanical Engineers, came into being.

The Formation of the R.E.M.E. Corps in British Army

The rapid increase in the use of mechanical and scientific equipment for military purposes during the present war brought with it an immense and ever-increasing volume of maintenance and repair work requiring a constantly expanding engineering and maintenance service organization. Early in the war it became evident that a reorganization of the existing maintenance services was necessary if the Army's electrical and mechanical equipment was to be maintained at the desired high state of efficiency under all conditions. With this in mind the Corps of Royal Electrical and Mechanical Engineers (R.E.M.E.) was authorized in the British Army with two main objects in view:

(a) To provide more satisfactory direction and co-ordination of maintenance and repair services.
(b) To achieve a more economical use of skilled manpower.

The R.C.E.M.E. Badge.

The formation of the R.E.M.E. Corps was the result of exhaustive study and investigation over a period of years by several committees of high ranking officers and eminent industrialists. One of the most outstanding reports in this connection was that of Sir William Beveridge's Committee on the "Use of Skilled Men in the Services", presented to the British Parliament by the Minister of Labour and National Services. Paragraph 44 of this report, which proposes the formation of a Corps of Mechanical Engineers in the British Army reads as follows:

"*A Corps of Mechanical Engineers*—The other proposal, that there should be established in the Army a Corps of Mechanical Engineers is not due solely to the fact that the naval problems are simpler than those of the Army. It is due also to the fact that the Navy has had, for so long, an engineering branch of high authority and has had other technical branches specialized on torpedoes and electricity—The Navy is machine-minded. The Army cannot afford to be less so. The Navy sets Engineers to catch, test, train and use Engineers. Until the Army gives to Mechanical and Electrical Engineers, as distinct from Civil Engineers, their appropriate place and influence in the Army System, such Engineers are not likely to be caught, tested and trained so well as in the Navy; there is danger that they will be misused by men whose main interests and duties lie in other fields."

The culmination of these investigations was the formation of the R.E.M.E. Corps on the 1st October, 1942.

The Formation of R.C.E.M.E. in Canadian Army

The progress and operation of the British Corps was closely watched and was the object of constant study by officers concerned with maintenance and repair in the Canadian Army. Based on these studies and observations, and after much deliberation of the various phases of maintenance and repair, both in Canada and the Canadian Army in the Field, it was decided to regroup the maintenance and repair services of the Canadian Army by the formation of the Corps of Royal Canadian Electrical and Mechanical Engineers.

The Functions of R.C.E.M.E.

The functions of this new Corps can be set down under four main headings:—

First—Inspection, maintenance and repair of wheeled and tracked vehicles, all artillery (including field, anti-aircraft and coast defence), small arms and machine guns, communications equipment, radar, fire control and all other instruments, and non-classified electrical and mechanical equipment.

Second—Recovery and repair of all the above equipment consequent upon ordinary wear and tear or battle casualties.

Third—Investigation into defects of design and recommendation for improvements.

Fourth—Advice on prototype design from a maintenance angle.

Thus the R.C.E.M.E. have assumed the chief responsibility for maintenance and repair for the Canadian Army—a job that previously had mainly been carried out by the Royal Canadian Ordnance Corps in addition to their responsibilities for the provision and supply of vehicles, technical stores and general stores. The R.C.O.C. will continue to provide hold and issue the spare parts required by R.C.E.M.E.

to carry out any repairs, and the closest cooperation between the two Corps is essential for proper maintenance.

Certain electrical and mechanical engineering duties have also been transferred to R.C.E.M.E. from Royal Canadian Engineers (R.C.E.) and Royal Canadian Army Service Corps (R.C.A.S.C.). The R.C.E., however, continue to be responsible for the provision and repair of certain equipment peculiar to themselves and the R.C.A.S.C. continue to operate Workshop Platoons of R.C.A.S.C. personnel which form an integral part of their transport companies and carry out repairs within the R.C.A.S.C. forward areas.

Organization of R.C.E.M.E.

Object of Maintenance and Repair Organization

The object of a Maintenance and Repair Organization is to keep the maximum possible percentage of the technical equipment in the hands of the troops constantly fit for service. The percentage of the total which at any one time is in this category is the primary index of the efficiency of the maintenance and repair system adopted. The secondary index is the time taken to recondition and to put back into service equipment worn or damaged in normal service or after an engagement. On the other hand the number of equipments overhauled or otherwise reconditioned in a certain period is not by itself an index of efficiency of the system as a whole, since a high figure of output from rearward workshops may actually indicate the exact reverse of efficiency elsewhere. Credit for using output from Base Workshops without regard to other factors may put a premium on inefficiency in forward areas, depending on circumstances.

The attainment of the main object, that is maximum serviceability, is effected by three factors:—

(a) The design of the equipment, on which depends its ability to stand up to battle punishment and the wear and tear of day-to-day handling by the trained, or maybe the partially trained operator.

(b) The standard of daily or periodic maintenance by the operator.

(c) The efficiency of the Maintenance and Repair Organization behind the Operator's skill.

Thus, the problem of maintenance and repair of technical equipment in the field necessarily embraces consideration of specification and design, based on previous experience with similar equipment, definitions of day-to-day maintenance functions of the operator and the Organization of the repair services supporting him before, during and after operations.

The Repair Organizations

Nearly all technical equipment can be divided into constituent assemblies, each of which can be replaced, if worn or damaged, without undue disturbance of the remainder, as long as the main carcass of the vehicle, machine or whatever it may be, remains serviceable. The constituent assemblies are in turn, similarly susceptible to reconditioning by the replacement of their constituent components. These facts are the key to the maintenance and repair system in the field.

Advantage is taken of the constituent assembly feature of most types of technical equipment by adopting a repair system which as far as possible confines the procedure for forward reconditioning to the exchange of assemblies and components. Accordingly, the system comprises a series of échelons, each with a definite normal function, which, combined with the considerations of the types of equipment to be served, at once fixes the corresponding type of repair equipment to be provided at each echelon and also the technical personnel and the class of stores required. The various echelons and their basic functions follow:—

First Echelon Repairs are minor repairs and adjustments.

Second Echelon Repairs are primarily the replacement of defective assemblies by new or reconditioned assemblies.

Third Echelon Repairs are primarily the repair of assemblies by fitting new or reconditioned parts.

Fourth Echelon Repairs constitute complete overhauls and manufacture of parts, if necessary.

The R.C.E.M.E. Workshops which carry out the repair work in the field are organized in four progressive stages or lines:

First Line Workshops (normally Light Aid Detachments (L.A.Ds.)) undertake first echelon repairs beyond unit capacity. The L.A.D. is the smallest type of R.C.E.M.E. unit and is wholly identified with and under the same command as the unit, regiment or brigade which it serves. The Commanding Officer of an L.A.D. is the unit commander's technical advisor on matters pertaining to maintenance, repair and modification of equipment.

The L.A.Ds. are provided with hand tools and welding equipment. Machinery lorries having power operated tools are normally not included as first line equipment.

Second Line Workshops (Brigade Workshops) undertake second echelon repairs. These workshops are behind the L.A.Ds. in the Divisional Area, and are Divisional Troops but are normally allotted to the Brigades which they serve. They are fully mobile and their equipment consists mainly of machinery lorries of various types and in proportion to the size and type of the force they service. The Brigade Workshops work in

Removing the radiator from a Crusader Tank with the aid of a Breakdown Lorry.

R.C.E.M.E. personnel carrying out a difficult recovery operation in Italy.

close liaison with the L.A.Ds. in front of them and in the advance or withdrawal, Advanced Workshop Detachments are sent forward to assist the L.A.Ds.

Third Line Workshops are semi-mobile workshops situated in the Corps or Army Area, whose main function is complementary to that of second line and consists of repair of assemblies which have been replaced in second echelon. The repair of an assembly is usually carried out by replacing the defective components with new or reconditioned components. The repair of defective components may also be undertaken here when the repairs do not involve extensive and elaborate equipment. Third line work also includes the replacement of certain assemblies which are not conveniently replaced in second line because of time, labour or special apparatus involved.

Both second and third line shops carry an adequate supply of fast moving parts and assemblies which are replenished from R.C.O.C. Field Parks.

Fourth Echelon Workshops undertake the bulk of the third echelon and all fourth echelon repairs. These Base and Advanced Base Workshops are static and are equipped with the most modern machine tools and accessories. They are capable of complete overhaul of any and every type of equipment and the repair of assemblies. Fourth line shops are capable of manufacturing spare parts if replacements are not available locally.

It should be mentioned here that the functions of one workshop are frequently taken over by another and no hard and fast line of démarcation is drawn between the functions of various workshops. The load on any one workshop and the tactical situation may be such that a Brigade Workshop may be found doing first and third echelon work as well as its own. Similarly a Base Workshop might do second, third and fourth echelon work.

In order to efficiently carry out their duties, the workshops are built up of varying numbers of sections. The number and type of the sections is based on:

(a) The class of work normally to be done by the particular repair unit to all equipment in the formation which it serves.
(b) The quantity and type of the equipment to be maintained.
(c) The estimated average frequency of repairs to be carried out.
(d) The degree of mobility required.
(e) The estimated technical personnel required to cope with repairs at the estimated frequency, plus a reasonable margin.

Under active service conditions, the process of transporting heavy equipment long distances to a workshop for repair is a difficult task and for this reason repair units are required to accompany field force units during operations. The degree of mobility conferred upon a workshop unit automatically limits its repair capacity since it is prerequisite that the workshop equipment should be sufficiently light and compact to meet field conditions. Therefore, however desirable it may be for a workshop unit to be able to undertake repair of any kind and also keep up with its formation, it is not possible to cope with both these requirements. As a result the type of repair undertaken by mobile workshop units must, of necessity, be limited by the requirements of mobility. First and Second Line Workshops are, therefore, equipped to be sufficiently mobile to keep pace with the units which they service. Similarly, third line workshops, though not fully equipped with transport, are sufficiently mobile to keep up with the formation they serve, while fourth line workshop units which require, by nature of their work, to be static, are provided only with transport sufficient for carrying out the administrative responsibilities of the workshop.

RECOVERY ORGANIZATION

Recovery is the process of removing an equipment that has become a casualty from where it lies to a selected site. The recovery organization in the field is similar to the repair organization in that, like repair, recovery is normally carried out in progressive stages. Wherever possible a casualty is repaired *in situ*.

Units are not normally supplied with special recovery equipment, but certain vehicles are equipped with winches which are used for recovery purposes. The amount of recovery work that a Unit can carry out is dependent not only upon the power of these winches but also upon the tactical situation.

First Line Workshops, normally L.A.Ds., are responsible for recovery from Units and are provided with special recovery equipment so that they can recover casualties beyond the capacity of the Units or Brigades to which they are attached.

Second Line Workshops are responsible for recovery from L.A.Ds. or Recovery Posts to the workshop site. Recovery Posts are established in the forward Brigade areas and serve as an intermediate collecting point for equipment casualties that cannot be sent direct to the Second Line Workshop. These posts can be manned by either L.A.D. or Advanced Workshop Detachment personnel and they are provided with recovery equipment scaled to deal with the type of recovery that they are likely to have to undertake. Thus, an Armoured Brigade Workshop or Recovery Post would be equipped with tank transporters for the recovery of tanks, while an Infantry Brigade Workshop or Recovery Post would be provided with recovery equipment to take care of vehicles.

Special Recovery Companies are provided for transferring casualties from Second Line Workshops, Recovery Posts or, in certain circumstances, from the battle field itself to Third Line Workshops or to Army Collecting Points. The introduction of Special Recovery Companies, who have no responsibility for repair, allows the Second Line Workshop to keep up with its formation rather than remain behind to clear all its casualties. These Recovery Companies are equipped with the full range of recovery vehicles capable of dealing with recovery of any type of casualty. At this stage, R.C.E.M.E. recovery facilities may be augmented by the use of Royal Canadian Army Service Corps transporters when these Companies are not employed at their normal function of moving armoured vehicles towards the front.

Third Line Workshops are not provided with recovery equipment to undertake the recovery of complete equipments and any recovery vehicle with which these workshops are supplied is for the purpose of handling heavy assemblies on receipt and during repair.

Casualties are transferred from Third Line Workshops or Army Collecting Points to road or railhead by line of communication recovery companies. These companies are fourth line R.C.E.M.E. units and are equipped with a full range of recovery vehicles including crawler tractors and mobile cranes.

Fourth Line Workshops, which are static, are equipped with recovery equipment sufficient to collect casualties that have been sent to base either by rail or road, and, since it is prerequisite that good rail and road facilities be laid on at the site of a static workshop, the recovery equipment is normally not extensive.

Maintenance and Repair Organization in Canada

ORGANIZATION AT N.D.H.Q.

The Director of Mechanical Engineering is responsible, through a Deputy Master General of the Ordnance (D.M.G.O.) to the Master General of the Ordnance (M.G.O.) for the efficiency of the maintenance and repair services in Canada. The D.M.E. also advises the M.G.O. on technical matters and carries out inspections on his behalf in Districts and Commands. The staff of the Directorate of Mechanical Engineering is divided into two main groups, namely; Administration and Maintenance Engineering. The Administration Group is sub-divided into two subgroups namely; Administration and Personnel. These groups are responsible for the administration of the Corps as a whole; movement, transfer, promotion and records of Corps personnel, publication of technical information supplied by the technical groups; editing and publishing of Corps orders. The Maintenance Engineering Group is further sub-divided into four specialist sub-groups, namely; Armament, Telecommunications, Vehicles, and General Engineering. These sub-groups handle all technical repair questions pertaining to the equipment for which they are responsible; investigate defects in design and make recommendations for improvement; advise on prototype design from a maintenance angle; establish echelon repair schedules; prepare echelon maintenance information for publication; develop techniques and determine the special types of maintenance tools and equipment required for all echelons; advise on mobile and static workshop planning; and maintain liaison with respect to technical maintenance matters with all Government departments, Canadian Military Headquarters and Allied Governments.

COMMAND AND DISTRICT ORGANIZATION

It will be appreciated that a system rarely can be devised in which some compromise in practice will not be found necessary. Although the maintenance and repair organization in Canada is generally patterned on the field organization, major departures from the field organization are necessitated owing to the peculiar features of the static military organization in Canada as opposed to the Army organization in the field.

In each Military District, a District Electrical and Mechanical Engineer (D.E.M.E.) is appointed who is responsible to the District Officer Commanding (D.O.C.) for the efficiency of the maintenance and repair services in the District concerned. He also advises

Personnel of a Recovery Company halted at the roadside en route to a workshop with a disabled tank.

the D.O.C. on technical matters and carries out inspections throughout the District on his behalf.

Static workshops are provided for the areas within each District in accordance with the disposition of the troops and the Officer Commanding each workshop is responsible to the D.E.M.E. for the efficiency of the workshop. Similar to workshops in the field each workshop is composed of sections, the number and type being dependent on the equipment in the area.

In Canada, in the interests of economy of manpower and equipment, 3rd and 4th echelon roles are combined, and, in many instances, 2nd, 3rd and 4th echelon repairs are carried out by one workshop. First echelon repairs are normally carried out at the location of the equipment with the assistance of R.C.E.M.E. personnel as necessary. R.C.O.C. Spare Parts Stores Sections are provided for each workshop. Technical stores required for the repair of equipment are supplied through the Spare Parts Stores Sections direct to the tradesmen working on the equipment.

A damaged tank is winched onto a transporter for evacuation to a 2nd or 3rd line workshop.

Each District Electrical and Mechanical Engineer has an inspection staff under his command to carry out inspections of all technical equipment on his behalf. Armament and similar equipment is inspected twice yearly; vehicles, universal carriers and motorcycles are inspected every ninety days; and tires are inspected every thirty days.

As a result of the loss of crude rubber supply, conservation of rubber in the Army is extremely important. Tire repair shops capable of making all tube repairs and carrying out small vulcanized repairs to tires are operated in conjunction with each workshop. In addition, R.C.E.M.E. now operate three tire recapping plants capable of handling the recapping of all tires required for the Canadian Army in Canada.

R.C.E.M.E. Personnel

The bulk of the personnel for the new Corps, both officers and other ranks, was drawn from the maintenance and repair groups and units of the R.C.O.C. and many additional officers and men are undergoing technical training. It is intended that both the R.C.E. and R.C.A.S.C. will also contribute skilled personnel as the maintenance responsibility for their technical equipment has been transferred to R.C.E.M.E.

The Officer personnel of the Corps includes graduates of universities, suitably experienced personnel from industrial firms and specially selected armament artificers, armourers and artisans who have been promoted from the ranks. At the present time the appointments which are held, the qualifications and the duties of these officers are as follows:

ELECTRICAL AND MECHANICAL ENGINEERS

To qualify as an E.M.E. officer, candidates must hold a degree of B.Sc. or equivalent in Mechanical or Electrical Engineering or have Mechanical or Electrical experience and general education suitable to the needs of the Corps.

Their duties in general consist of the inspection and maintenance of tanks, wheeled vehicles, artillery, small arms and machine guns, radio location, fire control and other instruments, signalling equipment and transmitting sets, mechanical equipment of engineering origin, together with installation of Coast Artillery machinery.

ELECTRICAL AND MECHANICAL ASSISTANT ENGINEERS

This appointment is restricted entirely to personnel promoted from the ranks of the Armament Artificer Section of the R.C.E.M.E. Duties of E.M.A.Es. are similar to those of E.M.Es.

MECHANICAL OFFICERS

This appointment is restricted to personnel from civilian life in possession of experience and general education suitable to the needs of wheeled vehicle maintenance and also personnel possessing similar qualifications serving in the ranks but not qualifying as an Armament Artificer.

ASSISTANT INSPECTORS OF ARMOURERS

This appointment is restricted entirely to personnel promoted from the ranks of the Armourer's section of the R.C.E.M.E. Duties of A.Is.A. consist, in general, of the inspection and maintenance of small arms, machine guns and bicycles.

WORKSHOP EXECUTIVE OFFICERS

This appointment is generally restricted entirely to personnel from the Artisan Section of the R.C.E.M.E. Candidates for this appointment must have office experience and a good knowledge of general workshop routine and practice. Duties of W.E.Os. consist of supervision of all Workshop Office work, the handling of routine correspondence and the application of security measures thereto.

REGIMENTAL OFFICER

This appointment is generally restricted to personnel from the non-technical section of R.C.E.M.E. The Regimental Officer performs the duties of adjutant and supervises every detail in connection with the daily regimental routine and administrative business.

OFFICER TRAINING

The training of E.M.E. officers consists of eight (8) weeks pre Officers Training Course (O.T.C.) at A.21 Canadian Ordnance and Electrical and Mechanical Engineers Training Centre (C.O. & E.M.E. T.C.), Barriefield, Ontario, ten (10) weeks O.T.C., Brockville, Ontario, with the exception of Telecommunication Officers, thirty-one (3 1) weeks technical training at A.21 C.O. & E.M.E. T.C., Barriefield. Subject to successfully completing the Field Army Equipment (F.A.E.) Course, E.M.Es. are promoted from 2/Lt. to Lieut. at the end of forty-two (42) weeks from the date of entrance to the pre O.T.C. at Barriefield. On the completion of the F.A.E. Course, the E.M.Es. are fully qualified to take their places in any field workshop or, if so required, in any of the following specialized fields:

(a) Armoured Fighting Vehicles.
(b) Mechanical Transport.
(c) Armaments.
(d) Fire Control Instruments.

The Telecommunication officers take the basic eighteen (18) weeks course as above. Their specialist training on wireless and radar, at A.36 Canadian Radar Training Centre, Barriefield, varies somewhat in length depending on the experience and training of the officer prior to entering the service.

OTHER RANK PERSONNEL

Other ranks of the R.C.E.M.E. Corps include Armament Artificers, Armourers, Fitters, Artisans, Instrument and Radio Mechanics, Craftsmen (new title for R.C.E.M.E. tradesmen below N.C.O. rank), Drivers and General Duty personnel. Many of these have been drawn from garages and industrial plants while others have been trained in civilian and army training establishments.

The training of other ranks varies with the trade. On enlistment, men are given an "M" test which is a form of intelligence test and serves as a guide for personnel assessing officers known as Army Examiners. The Army Examiners pre-select candidates for trades training keeping in mind the qualifications and apparent capabilities of the man and the requirements for the various types of tradesmen. After completion of basic military training at A.21 C.O. & E.M.E. T.C., Barriefield, the men are dispatched to trades training centres at Barriefield, Canadian Army Trades School (C.A.T.S.), Hamilton or Canadian Army Motor Mechanics School (C.A.M.M.S.)London for further training at their trade. These courses vary in length from twelve (12) to twenty-three (23) weeks depending on the trade being followed. On completion of the courses all R.C.E.M.E. trainees are allotted one week at Barriefield during which time they are trade tested (with the exception of Telecommunication Mechanics), their documents are assembled and they are prepared for posting to the trained soldier holding unit. From this holding unit the tradesmen are dispatched to Home War Establishment or Overseas and there are employed in the various capacities for which they have been trained.

Electrical and Mechanical Engineering Regulations

In order to keep the officers and tradesmen of the Corps informed as to their responsibilities, both administrative and technical, and to keep the technical equipment for which the Corps is responsible maintained, repaired and modified to proper standards, the British system of issuing regulations in the form of Electrical and Mechanical Engineering Regulations (E.M.E.Rs.) has been adopted in Canada as in most parts of the Empire.

These Electrical and Mechanical Engineering Regulations (E.M.E.Rs.) will, as issued, govern the activities of the Corps and all work directed by the Director of Mechanical Engineering at N.D.H.Q.

For ease of filing and for reference purposes each E.M.E.R. is given a designation which indicates subject matter and relative position of the E.M.E.R. to all other E.M.E.Rs. in the series. As much of the information contained in E.M.E.Rs. is of a secret nature the security classification is also shown to ensure proper precautions being taken to keep the information from unauthorized persons.

The E.M.E.Rs. are distributed to the field in bulk by the Directorate of Mechanical Engineering. The basis of distribution is to make available to every user those E.M.E.Rs. relating to the work the user does or is likely to have to do under average conditions. This distribution is not made on a personal basis to officers or others but to units, headquarters of formations, etc., for the use of the personnel concerned. In this way, any appointment is assured at all times of having as complete a set of E.M.E.Rs. as is necessary for the carrying out of the duties of that appointment.

The R.C.E.M.E. Badge

One of the less functional, yet very essential items that goes with the formation of any new Corps, is the outward means of recognizing its members. The adopted badge design is shown at the heading of this article. The shields represent the basic divisions of maintenance, i.e., armament, telecommunications and vehicle. The wreath is the traditional heraldic laurel design representing victory and the surmounting crown symbolizes the Sovereign ownership.

The colours of the Corps follow those of the British R.E.M.E. which are dark blue, yellow and red—derived by combining the colours of the R.A.O.C., R.E. and R.A.S.C. The buttons are simple in design and contain a single gun of the same design that appears on the shield of the present R.C.O.C. badge.

Conclusion

The formation of R.C.E.M.E. was the last step necessary to show that the great and ever growing importance of the role played by the engineering maintenance services throughout the army had been recognized. Further recognition was given to the abilities of the officers (mostly engineers) of the Corps when, on formation, the Corps was made fully combatant. This means that, in addition to their technical duties, officers of the Corps are responsible for the administration and management of their men in the same way as officers of any other Corps. It means further that the officers of the Corps are eligible for Staff Courses which opens up higher ranks and more opportunities for advancement for mechanical and electrical engineers than in the past. Furthermore, electrical and mechanical engineers entering the army can at last be assured of the cooperation and guidance of a well qualified technical administration.

The Corps, young in name but old in experience, has been charged with great responsibilities and has, since its inception, conclusively justified its formation.

GAS TURBINES AND JET PROPULSION

Special Advantages Balance Lower Efficiencies

Abstracted by G. L. WHITE, affiliate E.I.C.
General Manager of Canadian Metals and Metallurgical Industries, Toronto, Ont.

Summary of a paper delivered by Dr. Lionel S. Marks, Professor Emeritus of Mechanical Engineering, Harvard University, at a joint meeting of the Toronto Branch of The Engineering Institute of Canada and the Ontario Section of The American Society of Mechanical Engineers, at Toronto, on October 24, 1944.

Present Status of Gas Turbine

In introducing the subject, Dr. Marks indicated that the great power developments starting with Newcomen about 1705 were in one sense a backward step since they replaced earlier continuous flow devices, such as the water wheel by reciprocating engines. Later with the development of the steam turbine by Parsons and de Laval, units were obtained with higher efficiency and less size for the capacity than could be achieved with reciprocating steam engines and as a result, the reciprocating engine is declining in application. The reciprocating internal combustion engine is a marvellous mechanism; running at 2,400 r.p.m., the complicated cycle of the cylinder must take place in 1/20 of a second. However, at the time that the internal combustion engine was developed, there were no materials available to withstand the conditions of continuous flow existing in a gas turbine and even yet gas turbines must operate at temperatures far below the 3,000 deg. F. reached at the time of explosion in the internal combustion engine. Also the efficiency of air compression was then about 70 per cent, and under such conditions one was very fortunate to secure enough power from a gas turbine to drive the compressor.

In spite of the advances that have been made, operating temperatures cannot be used in the gas turbine high enough for efficiency comparable to that of the gas engine. The measure of progress that has been made in the gas turbine must be credited largely to metallurgical advances which have allowed reasonable operating temperatures and the development of axial flow compressors with efficiencies of nearly 90 per cent. At present the gas turbine cannot be compared advantageously with the reciprocating engine on the basis of efficiency alone. But even with an efficiency half the 30-32 per cent of an airplane engine, the gas turbine has other advantages which render it valuable for many applications.

One of the greatest advantages in the gas turbine is its simplicity of construction and operation. The principal components of the gas turbine are an axial compressor, combustion chamber with provision for fuel injection and ignition, reaction type gas turbine, electric generator and starting motor, and a few other auxiliary items. Other advantages of the gas turbine of this type, are ability to come to full load in a few minutes, availability, compact design, ease of lubrication and absence of a cooling system. By certain improvements in the simple basic design, adding some bulk but introducing few complications, efficiencies of about 20-24 per cent may be attained which compare quite favourably with the efficiency of the average small steam turbine plant. One possibility for increasing the efficiency is to step up the operating temperature. Present turbines operate as a rule at about 1,000 to 1,200 deg. F. chiefly because of metallurgical limitations, although the General Electric Company is experimenting with an impulse type turbine to operate at 1,600 deg. F.

Certain modifications with special advantages include the closed circuit gas turbine in which a combustion chamber heats the gas in circuit. In such a turbine the pressures may be as much as ten times those used in an open circuit and the power developed is increased in the same proportion. This type of turbine is very clean in operation since the combustion gases do not enter into the turbine system.

Another interesting possibility offering quite high efficiency is the use of a Diesel engine with no crankshaft and opposed pistons as a power gas generator, providing gas exhaust at 150 lb. pressure and a temperature of 900 deg. F. The efficiency of this type of generator in connection with a turbine is high, running 35-40 per cent. Because of the high pressure of operation, the turbine system is relatively small but one has of course sacrificed simplicity by the introduction of the reciprocating principle.

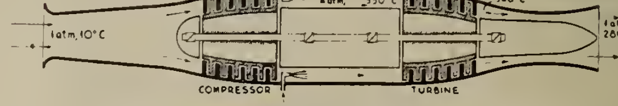
At its present stage of development, the gas turbine will be used principally where efficiency is not the top consideration. As an instance, it would provide an excellent stand-by unit in electrical generating systems where peak loads exist only a short fraction of the operating time. Due to its simplicity the gas turbine will stand by with a minimum of upkeep and attention. It can be shut down completely and yet be ready to deliver full power in a few minutes after pressing the starting button. Even if its efficiency is only one-half that of some other forms of power generation, it will matter very little since its running time in such service would be very short. Another possibility is the use of gas turbines in naval vessels, such as the destroyer. The power requirements of the destroyer step up enormously when it goes from cruising speed to its maximum 40-50 knots. With the conventional steam power, it is necessary to keep pressure up in the boilers at all times. A number of gas turbines could be installed to operate generators to deliver top loads to the ship's driving motors when required. By proper location of these gas turbines the vulnerability of the destroyer could be reduced much below that of the conventional steam power unit.

Another interesting possibility is in connection with blast furnace operation for providing the air blast.

Jet Propulsion of Aircraft

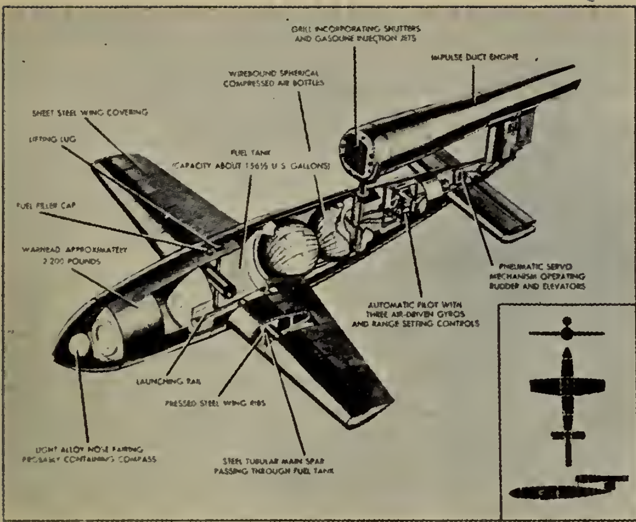
Any consideration of jet propulsion for aircraft must be based upon the current efficiency of internal combustion engines. The aircraft engine has an efficiency of about 32 per cent and the propellers transmit its energy with an efficiency of approximately 85 per cent to give an overall efficiency of about 26 per cent.

The force exerted in jet propulsion equals the momen-



JET-PROPULSION TUBE FOR AN AIRPLANE

Diagram of gas turbine used as jet propulsion device.



The robot plane.

tum of the jet, or the mass of the jet times its velocity. The conventional aircraft is really jet-propelled but the jet is produced by the propeller. Normally in jet propulsion we are thinking of a system in which air is taken in and compressed by the jet propulsion mechanism. The rocket on the other hand is a special case of jet propulsion in which no air is taken in and the jet is produced entirely from material contained within the body of the rocket.

One of the earliest jet propulsion aircraft utilized a reciprocating airplane engine to drive the compressor. In the current jet propulsion mechanisms the gas from the combustion chamber drives a turbine which in turn drives a compressor and the gas from the turbine then discharges through the jet at sufficient velocity to provide propulsion.

Since the force exerted by the jet is the product of its mass and velocity, and since the mass of the propulsion jet is small compared with the propeller jet, the speed of the former jet must be higher. For maximum efficiency the speed of the plane should be one-half the speed of the jet. The jet speed in most jet propulsion engines will run about 2,000 miles per hour, but 500-550 miles per hour is the practical limit in level flight for aircraft. Above these speeds the resistance to the aircraft (or its drag) increases suddenly and enormously. Thus the aircraft at its best is limited to a speed approximately one-quarter that of the jet and the efficiency is lowered considerably by these circumstances.

Taking a gas turbine with an efficiency of 18 per cent, and a jet being emitted at 2,000 miles per hour, an aircraft flying at 300 miles per hour will have an overall efficiency of only 9 per cent, and at 400 miles per hour it will only be 11 per cent. It must, however, be noted that the efficiency of jet propulsion increases at high altitudes while the efficiency of the normal propeller driven airplane decreases. Quite possibly at 40,000-45,000 feet the efficiency of the jet propulsion plane would equal that of the propeller driven plane at the same altitude but both efficiencies would be low. Jet propulsion delivers maximum thrust right at the ground and provides good take-off. It may be that a combination of propeller and jet propulsion will have its application in aircraft.

The Rocket and Its Current Uses

A special case of jet propulsion that has received a great deal of attention is the robot bomb. In the robot bomb there is no compressor. At the head of the propulsion mechanism there is a simple

U.S Army Air Forces Photo from Associated Press

U.S.A. and British jet propulsion planes.

valve-like arrangement made of steel strips which opens to allow air to enter and closes when the charge of the combustion chamber explodes. From various calculations it would appear that there are approximately ten explosions per second. The robot bomb has an efficiency of only 2-2½ per cent. With the explosive load twice the fuel load, its limit is about 100-130 miles. Even in a congested city, the buildings cover only about one-tenth of the area and when bombs are dropped vertically, only about one-tenth of the bombs will hit buildings directly. On the other hand, the robot bomb can be adjusted to come in almost horizonally with the result that practically every bomb will hit a building. However there are other serious effects to water, gas and electrical supplies from vertical bombing that do not accrue from robot bomb attack.

The rocket operated by jet propulsion with self-contained fuel, is by no means new. There are many compositions of propellents used giving a wide variety of rates of burning. The rate of burning of a solid rocket charge seems to be uncertain. Most rocket charges are very heavy with the total heat available per pound one-twelfth to one-fifteenth that of gasoline. A rocket charge could be made up with gasoline and liquid oxygen but the very high temperature would make it necessary to include liquid nitrogen or other inert substance also for dilution of the combustion gas. The rocket does, however, provide enormous power and all the work done on the rocket by its charge is additive so that a rocket discharged from an airplane travelling at high speed may attain very high velocity.

RIVER VALLEY DEVELOPMENT IN SOUTHERN ONTARIO

ROBERT F. LEGGET, M.E.I.C.
Associate Professor of Civil Engineering, The University of Toronto

An account of the Conference on River Valley Development held at London, Ontario, October 13 and 14, 1944

River Valley Development in southwestern Ontario was the central theme of an important conference held in London, Ontario, on October 13th and 14th. Sponsored and arranged by the newly formed Department of Planning and Development of the Government of Ontario, the conference was an unqualified success. It directed public opinion, in no uncertain manner, to the need for an active programme of rehabilitation of renewable natural resources, in the developed portions of Ontario. Its official sponsorship, and the opening and closing statements of the Honourable Dana Porter, Minister for Planning and Development, gave clear indication that governmental action may confidently be expected in starting to implement at least some of the many suggestions for the integrated conservation of renewable natural resources in Ontario. Attended by about 250 men and women, representing all the leading municipalities and most of the counties of southern Ontario, the conference was remarkable for the steady interest shown in its proceedings, and for the unusual attention given by all the delegates to the resolutions which were finally passed at the closing session.

A carefully selected and well arranged exhibition of photographs and drawings demonstrated the urgent need for conservancy measures in Ontario. Here were shown views of land denuded of all trees, and so intensively farmed that erosion of the soil had begun to take its tragic toll; fields on sloping ground plowed up and down hill with consequent washing of soil down all the furrows in spring time and after rains; cities and towns (including London itself) flooded with the excessive river flows from land stripped almost clean of nature's own means of retaining water—trees and associated vegetable cover; river beds dry as bones, in summer, and the same locations flooded in spring; rivers and streams fouled by the discharge of untreated waste waters . . . and all these in Ontario. Shown also were vivid pictures of remedial measures, of contour plowing and strip cropping on sloping land; of check dams and gully control; of reforestation projects and rehabilitated woodlots; of control dams for water conservation; of clear streams and properly conserved vegetation. Some of these scenes were from Ontario, views of forest nurseries and of the Shand dam near Fergus in particular, but not many. It was the purpose of the conference to consider generally the need for a wide application of all such remedial measures to "old Ontario".

Conservation Through Valley Development

Of special interest to engineers was the large scale map showing all the river catchment areas of southern Ontario. It was pointed out by Professor Alan Coventry, in his opening paper on "The Need of River Valley Development in Ontario" that if due attention be paid to the needs of the river valleys of southern Ontario (or of any comparable area) the conservation of the natural resources of all of southern Ontario is assured. For this to be achieved, public and governmental cooperation (at all levels of government) is essential on the widest possible scale. A new balance must be achieved, said Prof. Coventry, by methods which are well known and which have been thoroughly tried out in the U.S.A., consisting in the main of working according to natural laws instead of in defiance of them as most current practices do.

Quite logically, the second paper described one of the notable American experiments in conservancy, being an account of the development of the Muskingum River valley in the neighbouring state of Ohio, presented by Bryce C. Browning, secretary treasurer of the Muskingum Watershed Conservancy District; the paper was vividly illustrated by a film of the Muskingum conservancy work shown later in the meeting. Starting out as a flood protection project, the Muskingum work has developed into one of the most significant and comprehensive conservancy schemes of the U.S.A., involving extensive cooperation of federal, state and local governments. The work was assisted by the provisions of the Ohio Conservancy Act, and by the action of the federal government in constructing all the flood control dams, ten of which now form permanent artificial lakes 16,000 acres in extent. With construction complete, the District is now developing proper conservation practice in the use of land and forests as an integral part of its work. Many questions were asked of Mr. Browning, expecially about financing; his answers demonstrated that the Muskingum District is showing that conservation is economically sound as well as essential.

Rural and Urban Cooperation Essential

Last of the three opening papers was one by Watson Porter, Editor of *The Farmers' Advocate* of London, who discussed the need for rural and urban cooperation in river valley development. City dwellers and country dwellers have cooperated splendidly in denuding the countryside of Ontario of essential vegetation, said Mr. Porter; now they must cooperate to undo the terribly serious effects of this denudation before it becomes too late. He instanced the several municipalities which have already established municipal forests and urged the extension of this practice. By showing the inter-relation of all renewable natural resources, he showed that the interests of cities and country are intimately associated with the proper conservation of these resources. Similar stress upon the interests of town and country dwellers was laid by the speaker at the conference dinner, Dr. W. A. Albrecht of the College of Agriculture at the University of Missouri, who discussed the fertility of soils, with special reference to their mineral content, in a fascinating way which held the attention of his large audience long into the evening but which defies brief description.

Specific Measures Described

Four papers were presented at the second session of the conference, dealing respectively with reforestation, soil erosion control and conservation, underground water, and stream sanitation, all considered from the point of view of southern Ontario, the last by Dr. E. A. Berry, M.E.I.C. E. J. Zavitz, chief of the division of reforestation in the Ontario Department of Lands and Forests, dealt with reforestation as a means of controlling run-off and described the progress made in Ontario in developing reforestation programmes. Dr. J. F. Caley, of the Geological Survey of Canada, explained the importance of groundwater in the natural cycle and indicated that little accurate knowledge of groundwater in southern Ontario is available. Dr. G. N. Ruhnke, Director of Soil Surveys at the Ontario Agricultural College, Guelph, discussed soil erosion and soil conservation. After explaining the progress of soil mapping in Ontario (24 counties have been mapped to date), Dr. Ruhnke proceeded to detail the extent of soil erosion in Ontario suggesting that an average of about 50 per cent of southern Ontario's agricultural land is suffering from moderate to severe soil erosion. If flat lands are excluded, 70 per cent of Waterloo county is so affected. Generally, said Dr. Ruhnke, there is now sufficient evidence to show that soil erosion in Ontario is a vitally serious problem and that, correspondingly, soil conservation is quite essential. He proceeded to show that a start has been made in some parts of Ontario at proper soil conservancy work, mentioning the work in Essex and Simcoe countries as of special interest.

General view of the Grand River Dam near Fergus, Ont.

The Ganaraska Report

Against the background presented by these four factual papers, the Ganaraska Report was formally presented at the luncheon meeting, and described in addresses by E. H. Hampson, chairman of the "Guelph Conference" and A. H. Richardson, who supervised the carrying out of the survey on behalf of the joint interdepartmental committee responsible for it. The findings of this intensive survey of the Ganaraska river, flowing into Lake Ontario at Port Hope, are now well known but the complete report should be studied by all who are interested in any way in conservation—and even more so by those who are not yet aware of the need for conservation in Ontario and eastern Canada*. Printed copies of the Report are now available at the Department of Lands and Forests, Toronto; they should be widely distributed, with a copy in every public library and on the desk of every engineer in any way connected with natural resources.

Grand River Work

Discussion of the Ganaraska watershed paved the way for the final papers of the conference dealing with the work already done by the Grand River Conservation Commission, and the work in view on the Thames River watershed. Grand River work was clearly outlined by E. F. Roberts, secretary-treasurer of the Conservation Association, who explained that the Commission, having built the Shand dam as the start of its work, was now looking forward to cooperating with all units of government in the Grand River valley in the extension of conservancy work throughout the valley, and its associated development not only for agricultural purposes but as a place of beauty which may be expected to attract visitors from afar. W. Raywood Smith, M.E.I.C., engineer of Middlesex County, after explaining the serious floods in the Thames valley and associated interference with water supply in summer, described a reconnaisance survey which he had made of the upper reaches of the Thames and advanced suggestions, based upon the information thus obtained, for the rehabilitation of much of the land in the headwaters region of this important river. Mr. Smith's paper was supplemented by much factual information, in the assembly of which he was assisted by a committee of the London Branch of the Engineering Institute.

Starting with broad and general treatments of the general need for conservancy measures, the conference had gradually unfolded a clear picture of the pressing need for an active programme of conservation in southern Ontario. To many, this picture is all too familiar but at this conference it was introduced to many who had not previously given it consideration. The relevance of conservancy work to post-war rehabilitation schemes was repeatedly stressed so that with the need established, and the essentially practical character of conservancy work demonstrated, it was not surprising that the conference passed, unanimously, a strong resolution calling on the government of Ontario to institute as soon as possible a conservation authority for Ontario, to integrate work already done and promote generally the extension of conservancy practices. Another resolution urged the need for a survey of groundwater in southern Ontario while a third requested the Department of Planning and Development to hold a similar conference in eastern Ontario. The last resolution, which was enthusiastically endorsed, expressed the thanks of the assembled delegates to Hon. Dana Porter, Dr. George B. Langford (Director of the Department), Mr. A. H. Richardson, Dr. J. D. Detwiler of the University of Western Ontario, and Mr. Watson Porter, together with the regional committee responsible for local arrangements, for the privilege of attending what was well described as a landmark in the progress of the conservation movement in Canada.

* See also, *Engineering Journal*, August, 1944, p. 463, "The Ganaraska Survey", by A. H. Richardson.

THE ENGINEER'S NEED OF HUMANITIES

R. C. WALLACE, C.M.G., LL.D., HON.M.E.I.C.
Principal, Queen's University, Kingston, Ont.

A paper prepared for The Engineering Institute of Canada for distribution to the graduating classes in engineering at Canadian universities

A significant fact that has emerged from a study of student registration in recent years is that men of superior ability have selected the courses that lead to a degree in engineering. This is not a matter of war pressure only. It is true that men of ability feel that they may be more immediately useful in the war if they are trained in applied science, and that the government has placed special emphasis on this kind of education. But when this has been given due weight, there still remains the conviction that men are choosing this means of development because it seems to them the most natural way to express themselves in practical affairs. So far has this tendency gone that some concern has been expressed about the survival of the humanistic studies in the whole scheme of education. It would be unsafe to reach positive conclusions on the basis of the exceptional conditions of the war years. Were it not that the trend was already in evidence before the war began, there would be less justification for the considerations which are presented here. I think it may be taken as a reasonably valid conclusion that the ranks of the engineering profession are being recruited from the best brains of the younger generation.

This raises two questions. Are these young men being given the best education for the kind of world in which they are to be directing forces ? And how can the engineer of the future make his impact on society, and what are the ideals which are to animate him to that end ? The questions are complementary, and can be considered together.

Limitations of Engineering Courses

It has been hard to keep pace with the amazing advance in technological science. More and still more material has been added to the course of studies, which cannot wisely, on sociological grounds, be extended beyond the present limits of time. The result of it all has been that insufficient time can be found for the consideration of those fields of knowledge that have to do with the ideals and the aspirations of the men and women who make up the world in which the engineer must operate. As there is only a bare four years into which the formal education has to be compressed, the more specialized the training, the less human does the emphasis become. Men—very able men—with a school background which is necessarily limited, go direct into specialized scientific and technical courses, and continue in this atmosphere during their whole period of university education. As one who has lived his life in the scientific world, I would be the last to decry the values that science can contribute to a man's education, quite apart from its practical significance. It stimulates the imagination, it cultivates objectivity and respect for truth, and it develops a sense of reverence. But it cannot be said to concern itself primarily with human beings. It deals with material things and with material processes. The engineer, as I shall emphasize in the sequel, must do more, for his work is of value only insofar as it contributes to human aims.

There are many suggestions as to the way by which the engineer-in-training can be helped. A preliminary year may be devoted to literature, social studies and pure science. It would defeat its purpose unless it were stimulating and exciting. Interests must be created that will endure. There are those who feel, on the other hand, that a subject not directly professional might be part of each year's curriculum, but as far as possible related to some phase of the work of the year. Economics, industrial relations, the history of engineering, literature, all have professional implications, but are not, strictly speaking, professional. They serve to widen the horizon and to sharpen the understanding. Some specialized studies might have to be sacrificed, whatever the method of introducing non-professional interests. There are many engineers who feel that the gain would be greater than the loss. We must widen our reach in the matter of real education because of the demands on the engineers which society is now making and will make more urgently in the future.

Broadening the Outlook

This brings me to the second part of my argument. The engineer has been, and is, the builder of the material structure of civilization. He has made it possible for civilization, in its ever-changing outward aspects, to continue to function. He has performed an expert service of indispensable value. To that work he has dedicated his unswerving integrity, his high technical skill, his meticulous accuracy, and his business judgment. These are high gifts, and they have been, and always will be, *a sine qua non* of the engineer's equipment for life. The man who is not prepared to subscribe to these demands would wisely seek another field for his energies. But the scope of activity of the engineer and the responsibilities which it entails grow with the years. He has to deal with men in industry, and he must have an understanding of industrial relations. He has to see the implications of an engineering undertaking, in its repercussions on the social and economic structure in which it is placed. In a word, he is a social engineer. It is not enough that he should give his service, as he has done so well, as an expert on material problems. He must take a responsibility for the human aspect of the situation as well. If the managerial revolution which some predict is to come, the engineer will be in the forefront of the managerial forces.

There is a growing demand, not only from the people at large, but from the engineer as well, that he play this part. The ever recurring feeling that he should take greater part in public life is symptomatic. Public life means a concern with human as well as with material problems. The engineer has the right kind of approach; he insists on knowing his facts. His realistic attitude and his practical sense are much needed in the field of public life. Blended with the understanding that comes from the humane studies, these qualities will do great service in a world where human needs will be the criterion in all plans for the reconstruction of materials and resources.

It is inevitable that our growing dependence on the applications of science in the physical world should give the engineer a position of strategic importance in the maintaining and safeguarding of our mode of life. That position, already secure, will become even more significant when the physical and the social are merged, as they will be merged, into one, and the single aim of engineer and non-engineer alike will be the betterment of the lot, materially and spiritually, of every individual of the human family. This calls for the spacious view, the integrated approach. In a word, it needs the thoroughly educated man.

Lest the demands which are being made on the profession seem unduly high, may I close with this word of encouragement to the young engineer. I have been greatly impressed with the part that relatively recent graduates are playing in the communities in which they live. Particularly is this to be remarked in northern and isolated communities, where the younger members of the profession—and their wives—are giving of their time and talent to social enterprise and cultural activities. They are setting the tone for the whole settlement. With a feeling of competence which comes from practical achievement they become reliant and enterprising in the responsibilities of the community. And they find some time for the reading and the music that they seek for their own satisfaction. The power of personality grows slowly. It is built up brick by brick. It comes from a sense of mastery in one's own profession. It comes from participation in the responsibilities in the life of the neighbourhood, of the province, of the world. It comes from an inner sense of strength that grows with the communing with great minds. But it comes slowly. I have met many young engineers who are on the way and many other engineers who have arrived.

PREPARING R.C.A.F. PERSONNEL FOR REHABILITATION

GROUP CAPTAIN S. N. F. CHANT

Acting Director-General of Rehabilitation, Department of Veterans' Affairs, Ottawa, formerly Director of Personnel Selection and Manning, R.C.A.F.

An article written at the request of the Institute Committee on Industrial Relations, being one of a series prepared for the *Journal*

General recognition of the vital importance to this country of the successful rehabilitation of the several hundred thousand men and women in our armed forces may be taken for granted and no elaboration of this point should be necessary here. It need only be pointed out that the success of any plan for post-war reconstruction is more closely tied in with the success of rehabilitation than with any other factor. Since the problem of rehabilitation is so vast in scope it is important that those who have any concern with its various aspects should be fully informed about whatever methods are now being employed to deal with it in a practical manner.

Broadly speaking, rehabilitation may be considered as having two phases. The first or preliminary phase covers the preparation of men and women while they are still in the Service for their ultimate re-establishment in civil life. The second phase deals with the actual fitting of the individual into civil life upon release from the Service. The R.C.A.F. plan covers only the first phase since all matters pertaining to the rehabilitation of discharged personnel come under the control of civil government departments and are being cared for by the facilities already provided by these departments. Since these two phases necessarily relate very closely, the development of the R.C.A.F. programme has been greatly aided by the co-operation afforded by these government departments.

The R.C.A.F. programme is based upon the following general considerations.

(1) No one can ever actually rehabilitate anyone else; each must do it for himself by his own efforts. Others can aid an individual to become re-established but success depends upon the individual himself. Services and organizations can provide the essential facilities and opportunities for re-establishment in civil life as well as advise how these may be used to advantage, but any tendency toward undue paternalism or attempt to relieve the individual of all responsibility will prove to be only temporary expedients which but postpone any final solution to the problem of rehabilitation. Nevertheless, direction and assistance are required particularly with regard to younger persons in order that they may be shown how to rehabilitate themselves.

(2) The more completely a person is prepared to meet any situation the better is one able to deal with it successfully. Unpreparedness invariably places one at a serious disadvantage. Without interfering with their present duties many service personnel while still in the Service can be helped to prepare for their entry into civil life. Devoting a part of their free time to careful planning now will help avoid hasty and unwise decisions later.

(3) The post-war situation regarding employment

opportunities is difficult to predict but one can be assured that he who is best prepared will have the best chance of finding employment in keeping with his plans. Those who have the most to offer will be in the greatest demand and while still in the Service men and women can improve their qualifications to take their rightful places in post-war Canada.

(4) Because many have been at war for years and because many have lacked experience in civil employment before enlisting, a great deal of reliable information is needed in order to dispel misconceptions and to overcome ignorance concerning the requirements and conditions of civil employment. The Air Force is in a position to assemble and provide this information as a service to its personnel.

Such are some of the preliminary considerations which gave rise to the R.C.A.F. Programme of Personnel Counselling. This plan, described first by The Minister of National Defence for Air, Hon. Mr. Power, in the House of Commons, is now operating both in Canada and Overseas under the Air Member for Personnel, Air Vice-Marshal J. A. Sully, C.B., A.F.C. Reports on the success of this venture to date are most encouraging.

The R.C.A.F. Programme of Personnel Counselling is designed to help the men and women of the Air Force help themselves by preparing for their return to civil life. The first step in its development was the establishment of a Personnel Counsellors' School at R.C.A.F. Station, Rockcliffe. Here, carefully chosen officers with suitable civil experience in business, industry, education or a profession are given a basic training in counselling methods. The course includes instruction in the measurement and assessment of abilities and aptitudes, occupational and educational information, provisions and benefits available for civil re-establishment, and in the actual techniques of counselling. Those who successfully complete the course are posted to units in Canada and abroad to provide individual consultation with those who wish to seek advice and direction regarding rehabilitation and career planning.

Gathering occupational information for this course and for the use of counsellors when in the field has been one of the major tasks. For example, it was found that there has never been any series of brief descriptions of Canadian occupations. Close to one hundred of these have now been prepared in preliminary form from the best sources that were available. Since these were subject to incidental errors due to the paucity of information concerning Canadian occupations they are now being revised for a more permanent edition. The assistance of professional, educational, commercial, industrial and technical associations and organizations in providing information and carrying out the revision of these outlines has been of the utmost value. Extensive surveys of industrial and other organizations have been carried out in order to relate R.C.A.F. trades to the types of work available. Bulletins on education, agriculture, demobilization benefits and the like have been supplied. The counsellor is also instructed to study the community where he is located in order to gain further information.

In the development of this programme it was recognized early that some standardized method of counselling was imperative. The magnitude of the task requires the maximum benefit to the individual in the minimum time. To achieve this a highly systematic approach had to be developed and the first requirement in this regard was some definite point of departure for the counselling procedure. Because people differ so widely in their abilities and because the world of work provides such a diversity of occupational choice, the point of departure should constitute a link between the individual and the world of work. For this purpose the individual's Air Force trade whether air or ground was chosen. The Air Force trade fulfils the desired purpose because the individual was initially selected for his trade on the basis of aptitude measurements and educational and occupational history. Moreover, he has been carefully trained and experienced in his trade being regularly tested in order to determine his level of proficiency. A person's Air Force trade, rank and grouping therefore defines his present status and at the same time links his ability and training to the world of work. Hence all standard counselling procedures take as their point of departure what the person is now.

An analysis has been carried out of the skills and personal development which the various Air Force trades may be considered to have contributed to the individual. These are viewed as definite assets to be taken into account when planning a civil career. It has been found that a great many of our personnel have never reviewed these assets in any systematic manner nor completely appreciated some of their vocational implications. Some people have looked upon their Air Force training as all important in determining their future; others have considered it as of little significance. It is desirable that Service personnel recognize that they have something of definite value to offer in the post-war world so that they may look to the future with confidence rather than acquire a sense of futility or frustration. The first step, therefore, in the counselling procedure is to review in detail just what a person's Service trade means in terms of career planning and the general use to which Service training and experience may be put. This is largely carried out by a series of self-explanatory charts for the various Air Force trades which may be studied by the person before conferring with the counsellor.

The next step in the counselling procedure is to assess the individual's abilities as they relate to suitable occupations. This assessment is done on the scores obtained on various R.C.A.F. selection tests. These tests have been employed by the R.C.A.F. for assessing a person's general suitability for enlistment and for placing him in the trade for which he was found most suitable. They have been subject to extensive verification in terms of the actual performance of thousands of men and women in training and are therefore of proven reliability. Further studies have been carried out in order to relate these tests to various occupational groups and in this manner indicate to a man just how well he stacks up against persons who have been successfully employed in these occupations. By the use of the R.C.A.F. Classification Tests individuals are classified into three types.

(1) the professional who display a degree of intellectual ability compatible with professional or university education;

(2) the vocational who display a degree of ability suitable for many business, industrial and semi-professional occupations;

(3) the skilled, who display ability suitable for skilled and semi-skilled occupations.

Within each of these broad types a further breakdown is made regarding either mechanical or clerical and administrative aptitude by the use of scores on mechanical knowledge and clerical aptitude tests. A description of those occupations most suitable for individuals of the various types is provided. These occupational group-ings are largely based upon extensive employment studies conducted in the United States. By this means an individual is informed concerning the broad group of occupations for which he is best suited and within this group his particular choice is governed by his training and experience, his interests and his resources.

Of course, no one can be forced to choose a career in keeping with his ability. Every man is free to shift for himself. All that can be done is to place before him the facts concerning himself and the occupations for which he is best suited; but in the end the choice must be his own. When dealing with R.C.A.F. personnel, many of whom have come into the Service directly from school with little or no pre-enlistment occupational experience, we have found that the great majority do find an interest in occupations suitable for their type and grouping. Frequently, they have no very well-defined occupational preference and they are readily influenced by the fact that they stand a much better chance of being successful in certain occupations rather than in others.

Having reached some decision concerning the career to be followed the individual is now referred to the unit education officer or a training officer in order to plan an educational or training course which he can pursue in his free time in order to advance his preparation for this career. When courses are not available in the Air Force the counsellor frequently establishes a local contact whereby the person can obtain practical experience in keeping with his plan. As a result of the latter, many R.C.A.F. personnel in addition to those taking courses are now spending free evenings in business and industrial offices, radio studios, hospitals and the like, thereby gaining practical experience in the civilian world of work.

While it is too early to assess the ultimate success of this plan from a rehabilitation standpoint, the results to date are most encouraging. Most Personnel Counsellors are booked up for weeks in advance by persons wishing to avail themselves of this service. Some have already planned their future and wish only to confirm their choice, obtain information about their chosen field and direction concerning how to utilize their free time to advantage. Unless there is a wide discrepancy between their occupational choice and their ability, which latter may either exceed or fall short of their ambitions, no effort is made to dissuade them of their choice and the consultation time is devoted to helping them advance their plans.

Many, of course, have no well-defined occupational interests. These are in many respects the more interesting cases because of the seriousness of their concern coupled with the almost complete lack of knowledge regarding their own capabilities and their lack of any information concerning vocations and occupations. Never before have most of these been either encouraged or aided in planning a career. These young men and women wish to be clear-headed regarding their future and want to stand on their own feet but they have never been given any systematic direction in this regard.

Another gratifying result of Personnel Counselling is the help it has provided for those who are subject to restlessness from war strain. It has aided them to organize their thinking and activity about a positive goal. The terrific intensity of combat flying excludes from their minds almost any other consideration. On being removed from combat some have experienced a restless discontent. In several instances noticeable improvement has been reported from having a definite objective about which to organize their thinking and activity. In this sense career planning has been found to have a definite therapeutic value.

Some may wonder why no great emphasis is placed in this programme upon the so-called personal adjustment to civil life. It is our opinion that this will largely take care of itself if the individual is able to solve the practical problems which will confront him upon his return to civil life. One of the greatest of these will be finding a suitable vocation. It is to this end that the Personnel Counselling Programme is directed with the belief that as the individual is able to fit into the world of practical affairs he will acquire his own personal adjustment to civil life.

The ultimate success of this venture as a rehabilitation measure will depend upon individuals being able to follow their career plans in civil life. In order to provide for this, a record is being prepared for each person counselled which will show something of his Air Force training and experience along with this career plan and a description of his success in preparing for this career. It is hoped that this will be of value to government officials, educationalists and employers who control the means whereby these men and women can advance their plans after demobilization and find satisfaction in the civil world of work.

From Month to Month

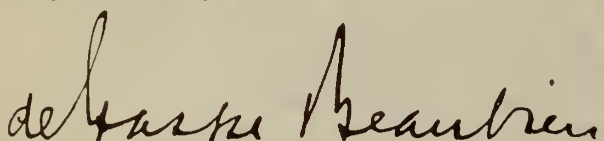
News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

New Year's Greetings

In this New Year's message to his fellow members, the President wishes to express his gratitude to all the branches he has visited and his appreciation of the hearty welcome he received everywhere from the Atlantic to the Pacific. It is indeed encouraging to find that our widely scattered membership is so intent on promoting the welfare of the profession and the Institute.

After more than five years of war, the storm clouds show some signs of breaking. This brings to our minds the time when our members overseas will be returning to resume their peace-time careers. To prepare for this period, the Council has taken an important step, in authorizing the addition to our headquarters staff of an assistant to help with the problems of rehabilitation which will confront our returning members. This is a very promising measure, which it is hoped will effectively supplement the official activities of the governmental organizations concerned with the re-establishment of returned men in civil life. To begin with, inquiries are already being made overseas to find out the views and desires of our members in the armed forces.

As regards Institute affairs, the past year has been one of steady though not rapid progress, achieved under conditions which wartime exigencies have rendered increasingly difficult. During the coming year, your president anticipates a continuation of this situation, sends his good wishes, and prays that further successes may crown the efforts of the Allies.



President

WESTERN TOUR

The president has completed the annual visit to the branches in western Ontario and western Canada. Mr. Beaubien left Montreal on October 9th and returned on November 25th, completing one of the most successful tours in the history of the Institute. He was accompanied by Mrs. Beaubien, Councillor R. F. Heartz and Mrs. Heartz of Montreal, and the general secretary. Madame Bray of Quebec, a friend of Mrs. Beaubien, was also a member of the party.

The details of the regular features of the tour will appear in the branch news, but there were several events that ordinarily are not part of such a tour. The first novel feature was the inspection trip to the Steep Rock mining project. The Lakehead Branch carried out a very difficult programme as a branch activity which required the party to leave Port Arthur at night on a special sleeper so that an early start could be made from Atikokan in the morning. The full day was spent at the mine and it is doubtful if a more interesting engineering undertaking has been examined by any Institute branch.

The Steep Rock Iron Mines Limited, through its staff, made everything possible. Transportation from the rail line was provided, meals were supplied in delicious abundance, and guides led the parties to all the interesting spots from which a broad picture of this project could be secured. It is not easy to describe adequately the hospitality and kindnesses of the staff, but each of the many persons present has an appreciation of it. Most of the party returned to Lakehead that night, but the president's group continued on to Winnipeg.

At Winnipeg Vice-President W. P. Brereton and Mrs. Brereton joined the party and continued as far as Edmonton, and at Regina W. G. Macdonald of Halifax, met the president and travelled with him to Calgary.

At Regina the president's party met with the officers and Council of the Association of Professional Engineers at a regular meeting of Council. This meeting followed a meeting of the executives of the branch, the officers being identical for both organizations.

At Edmonton a regional meeting of Council was held in the MacDonald Hotel at which the president presided. There were councillors present from Vancouver, Calgary, Edmonton, Regina, Winnipeg and Montreal.

At Calgary the party was taken to Banff over the week-end, where a group of 29 members and other engineers and their wives met with the president at dinner. Major P. J. Jennings, C.B.E., superintendent of Banff National Park, presided. This was a very pleasant departure from the usual itinerary and is likely to be included in future tours. Calgary members who accompanied the president to Banff were H. B. LeBourveau, chairman of the Branch, and Mrs. LeBourveau; Mr. and Mrs. R. S. Trowsdale, H. B.

At Trail, B.C.—Lorne A. Campbell, Mrs. R. W. Diamond, de Gaspé Beaubien, C. S. Montgomery, chairman, Mme. Beaubien.

Mrs. S. S. McDiarmid, L. A. Wright, Mrs. L. A. C. Smith, R. E. Heartz, Mrs. C. S. Montgomery.

Sherman, T. D. Stanley, G. A. Gaherty of Montreal and W. G. Macdonald of Halifax.

In Calgary, in addition to the Institute meetings, the president spoke at the Rotary Club. S. G. Coultis, a past-officer of the Branch, was in the chair as president, and S. G. Porter, a past-president of the Institute, introduced the speaker.

From Lethbridge the party went to Blairmore where a day was spent visiting the works of the West Canadian Collieries, of which company the president is a director.

The next stop was Trail, where arrangements had been made to see the plant of the Consolidated Mining & Smelting Company Limited. This visit began at South Slocan, with a tour of some of the power projects of the West Kootenay Power & Light Company Limited, under the guidance of Lorne A. Campbell, M.E.I.C., vice-president and general manager of the company, and S. C. Montgomery, M.E.I.C., of Consolidated.

The following day was spent at the great smelter and chemical plant, and the party is greatly indebted to officers of the company and members of the staff who did so much to make the visit both interesting and profitable, particularly Messrs. S. G. Blaylock, R. W. Diamond, R. R. McNaughton, S. C. Montgomery, F. Ransom, F. Willis and Clarke.

At noon the president met with the members of the Institute, and for the evening a dinner meeting had been arranged by the local members. There were 170 engineers and their wives present and S. C. Montgomery presided. In addition to the president, the speakers' programme included R. W. Diamond, D. Turnbull, reeve of Tadanac; S. S. McDiarmid representing the Mayor of Trail, and E. Stiles.

A pleasant feature of this dinner was the programme of music contributed by the ladies, Mrs. G. C. Mills, Mrs. C. A. H. Wright, Mrs. W. G. Jewitt and Carol Wright, with Mr. O. Niederman leading the orchestra.

Last year's president, K. M. Cameron, broke new ground when he held a meeting at Kelowna, B.C. This year Mr. Beaubien followed his good example, and again met the group at luncheon. There were 18 present and the Honourable Grote Stirling, Hon.M.E.I.C., presided. Thanks are due to D. K. Penfold for bringing this group together and making all arrangements. The motor drive from Penticton to Kelowna is a wonderful experience, particularly for persons who have not seen the Okanagan valley, as was the case with the entire presidential party.

A very pleasant and much appreciated feature of the Vancouver programme was an informal dinner tendered by the Council of the ProfessionalAssociation, at which F. M. Knapp, vice-president of the Association, presided. Both Mr. Knapp and Mr. Beaubien spoke of the future of the profession and the part that can be played by professional organizations. The programme was completed in Victoria. In addition to regular branch meetings there was a visit to the naval college at Royal Roads—an impressive and inspiring experience.

Always an interesting feature of the presidential tour, the visits to the universities were unusually pleasant. The attendance at each meeting was large and included the dean and many members of the staff as well as students from all years. It is an inspiration to meet these future engineers and to know that such promising people are coming along to take their places in the affairs of the nation and the professions.

For one who has not made this presidential tour of Western Canada it is difficult to comprehend the amount of detail and effort that is involved. Mr. Beaubien participated in thirty-one meetings of which

At Field, B.C.—*Left to right:* The general secretary, the president, T. Stanley, H. Lebourveau, Mme Beaubien, Mme. Bray, H. Sherman, Mrs. Heartz, Mrs. Trowsdale, Mrs. Lebourveau, R. E. Heartz, G. A. Gaherty, Capt. John Flanagan, R. S. Trowsdale.

twenty required him to make a public address. Six weeks of this, although extremely pleasant and interesting, is a bit of an undertaking, but there is no other way of realizing the breadth and scope of the Institute in the affairs of Canada, and there is no other single activity that does so much to join the branches together.

The hospitality of the West is proverbial. It is doubtful if there is any better means of discovering and enjoying it than to visit the branches of the Institute. This year's presidential party made a more complete tour than has been customary, and therefore is in a particularly advantageous position to appraise the position of this Institute and the hospitality of its members. Both appear to have reached new heights, much to the delight and gratification of the president and his party.

AERONAUTICAL PAPERS

The Institute has an agreement with the Royal Aeronautical Society whereby certain special privileges are available reciprocally to members of each organization. The agreement calls for the Institute to publish, from time to time, in reprint form its papers on aeronautical topics, which are then distributed by the Royal Aeronautical Society to its members.

Another "Aeronautical Reprint" is now ready. Members of the Institute may also secure copies by applying to Headquarters. All papers have been published in the *Journal*, but it may be advantageous to some members to have them in booklet form.

Herewith is a list of titles and authors:

Aerodrome Construction in Saskatchewan — G. T. Chillcott, M.E.I.C.

Some Problems in Aircraft Construction — J. I. Carmichael, M.E.I.C.

Plastic Laminated Wood in Aircraft Construction — W. J. Jakimiuk

Air Transportation — J. A. Wilson, M.E.I.C.

Aircraft Manufa ture — Ralph P. Bell

Development of Post-War Aircraft — James T. Bain

Some Design Features of the Mosquito Aeroplane — R. B. McIntyre

Plastic Plywoods in Aircraft Construction — R. D. Hiscocks

Post-War Possibilities of Air Transport — G. I. Stanton

R. E. Chadwick

NEW TREASURER OF THE INSTITUTE

Due to the transfer of F. C. Mechin from Montreal to Toronto it has been necessary for Council to select a new treasurer. It is announced that R. E. Chadwick has been chosen and will fill the office for the balance of the term.

Mr. Chadwick is best known as president and director of The Foundation Company of Canada Limited although he holds similar offices with several other companies in the construction and marine salvage field. He is also a director of the St. Lawrence Flour Mills Limited.

He has been a frequent contributor of technical papers and of discussions to Institute audiences. He is a graduate in engineering of the University of Toronto.

IN THE QUEBEC COURTS

The long awaited and much postponed case of the Province of Quebec Association of Architects versus Brian R. Perry, M.E.I.C., has at last been heard. Five days were consumed in the hearings and many witnesses were called by both sides. At the time of writing the argument of counsel has not been presented but the evidence is in and the argument is arranged for December 19th.

Even before a decision is handed down certain points stand out predominately. The most important one is that the case will settle nothing. If the engineers lose, it will mean simply that the engineers' act will have to be revised. Engineers and the employers of engineers cannot permit any other profession to design industrial buildings. Even if this case were lost and the act not revised they would have to go on designing such buildings, as they have in the past, because there is no one else competent to do it. The public safety and the financial interests of the owners demand it.

Another noticeable point is that all architects in the province do not seem to support the Association in its action. Many of them have expressed themselves strongly in opposition. This is an encouraging sign, and it is nice to know that the case may not be so much a matter of architect versus engineer as it is a small group of architects versus the engineer. Nevertheless in the eyes of the press and the public it is a quarrel between two professions—a washing of dirty linen in public. A Montreal paper refers to the case as "A Strenuous battle between Architects and Engineers" and in its heading says "Two Professions in Legal Row". This is precisely what the *Journal* said would happen if the Association proceeded with its charges. There is still no reason why the case should not have been settled out of court on a fair common sense basis. It was not necessary—nor astute—to demand the "pound of flesh."

Another noticeable point is that at no place in the proceedings is the public interest involved. The Association has not said that Mr. Perry was incompetent; it has not said that an architect could have done a better job. On the contrary, witnesses for the architects have almost unanimously said that it was well done. In essence the charge and evidence imply that even though it may be necessary in such cases to have the work done by an engineer it must be done over the signature of an architect. When the legislature of the province gave the architects a professional act it did so in the interests of the public—for the protection of the public, as stated by the petitioners themselves. All professional acts have been promulgated for the same purpose. Now we see one profession suing another on the basis of its legislation, without any regard or reference to the public interest. The legislation was not passed to give the architects a closed shop in a field pioneered and occupied by others. It was passed in the public interest and that interest requires that the design of industrial buildings be left with engineers as engineers, not as employees of architects.

The most outstanding feature of the case is that it proves nothing, except perhaps that we do not all yet appreciate the full meaning of the word "professional" and that somehow or other we have lost track of the public interest.

All engineers are indebted to Mr. Perry for his refusal to accept the ultimatum from the Association. He could have admitted the charges, paid the penalty of two hundred dollars and been finished with it. Instead he chose to fight it. He knew that morally his position was sound and he believes that legally it is sound also. He is fighting the charge on behalf of the entire profession, and at great personal inconvenience and sacrifice. For two years the case has hung like a cloud over his every thought and action and no matter how well the profession supports him, no matter what the decision, he will have paid a great price for his courage and his defiance of those who would curtail the field of practice of the profession of engineering.

REFRESHER COURSE IN SOIL MECHANICS

The Department of Civil Engineering in co-operation with the Department of Extension of the University of Alberta is sponsoring a refresher course dealing with the application of soil mechanics to the construction of airports, highways and earth dams, and also with the inspection and control of concrete on similar work. The school will be held in Edmonton, January 15th to 19th, 1945. Further details regarding the course may be obtained from the Department of Civil Engineering, University of Alberta, Edmonton, Alta.

59TH ANNUAL GENERAL AND PROFESSIONAL MEETING

THE ENGINEERING INSTITUTE OF CANADA

Winnipeg

Wednesday, Thursday, Friday
February 7-8-9, 1945

Headquarters - ROYAL ALEXANDRA HOTEL

Preliminary Programme

WEDNESDAY, FEBRUARY 7th

(a.m.)

Annual Business Meeting

Mining Development and Value of Steep Rock Ore:
WATKIN SAMUEL, Chief Engineer, Steep Rock Iron Mines Limited, Toronto.

Luncheon

(p.m.)

Diversion of Seine River at Steep Rock:
A. W F. McQUEEN, M.E.I.C., Hydraulic Engineer; C. N SIMPSON, Jr.E.I.C., Assistant Engineer, H. G. Acres and Company, Consulting Engineers, Niagara Falls, Ont.

The Port Arthur Iron Ore Loading Dock:
J. M. FLEMING, M.E.I.C., President, C. D. Howe Co. Ltd., Consulting Engineers, Port Arthur, Ont.

(Evening)

Panel Discussion on Rural Electrification.

THURSDAY, FEBRUARY 8th

(a.m.)

Application of Soil Mechanics to Earth-Filled Dams:
ROBERT PETERSON, Jr.E.I.C., Assistant Engineer, Soil Mechanics Laboratory, P.F.R A , Saskatoon, Sask.

Application of Soil Mechanics to the Design and Maintenance of Prairie Highways:
G. WILLIAMS, Public Works Department, Parliament Buildings, Winnipeg, Man.

Luncheon

(p.m.)

Principles Involved in a Modern Concept of Airline Operations:
J. T. BAIN, Superintendent of Engineering and Maintenance, Trans-Canada Airlines.

The Engineering Development of an Airline Aircraft:
J. T. DYMENT, M E.I C., Engineering Superintendent, T.C.A.

The Future Aspects of Radio and Communications in Commercial Air Transportation:
S. S. STEVENS, Superintendent of Communications and Electronic Development, T.C.A.

New Developments in the Field of Materials and Processes:
P. E. LAMOUREUX, Materials and Processes Engineer, T.C.A.

(Evening)

Dinner and Dance.

FRIDAY, FEBRUARY 9th

Visit to Trans-Canada Airlines, Winnipeg.

IT IS WISE TO MAKE RAILWAY AND HOTEL RESERVATIONS NOW!

Complete programme will appear in January Journal

CORRESPONDENCE

An Engineering Chief for the Army

December 5, 1944

The Editor,
The Engineering Journal,
Montreal.

Dear Sir:

The Corps of Royal Canadian Engineers has done excellent work. The accomplishments of our engineer officers overseas have been of course of the highest order. Canadian engineers have demonstrated their value and ability in the most exacting civil and military executive positions as well as in purely engineering capacities.

The Chief Engineer of the Canadian Army overseas was a Major-General earlier in this war as in the last. The Chief Engineer of the Army overseas as well as of each Corps is now a Brigadier. The highest-ranking officer at National Defence Headquarters in Ottawa devoting full time to engineering matters is a Colonel.

There is therefore no engineering executive at National Defence Headquarters comparable to that in the majority of Allied Nations. In England the Engineer-in-Chief at the War Office has executive control under the Quartermaster General of the Works Services of the Army, but, as Director of Royal Engineers, he is also advisor to the Chief of the Imperial General Staff on Royal Engineer policy and operations questions and to the Deputy Chief on the Imperial General Staff on Corps of Royal Engineer matters. Australia also has an Engineer-in-Chief reporting to the Chief of General Staff and Quartermaster General somewhat on the same pattern as the War Office.

I have had the opportunity of observing both the Royal Engineers and the United States Engineer Corps and have noted particularly the very high place which they hold both professionally and in the public esteem. In all engineer matters their advisors or directors are high-ranking officers of professional standing.

The Canadian Army has both a Medical and Dental Corps and advisors on matters of medical and dental policy are high-ranking medical and dental officers. Why not on engineer matters which may be of equal or even greater importance?

Engineer services at National Defence Headquarters include, under different directorates, the training of engineer personnel for the Army overseas, design and construction or supervision of construction and maintenance of Army establishments in Canada, as well as co-ordinating the latest developments in engineering materials and methods for Army use in Canada and overseas.

These observations and many others have convinced me that the appointment of an Engineer-in-chief at National Defence Headquarters is necessary. He should of course be an outstanding engineer and very preferably should have had overseas experience on a high level in this war.

The Engineer-in-Chief should hold a rank not lower than Major General in order to make representations on a sufficiently high plane. He should be empowered to advise the Chief of the General Staff directly on matters of Engineer Policy, Equipment and Training, and not through indirect channels as is done at present. He should, however, remain in executive control of the Works Services of the Army directly under the Quartermaster General. The Quartermaster General may be an engineer officer. However there is no guarantee that he will be and he has many other duties. The Training and Equipment Policy as well as the Works Services of the Corps of Royal Canadian Engineers are so important that they should be directed by the full-time services of a high-ranking engineer officer. The position of Engineer-in-Chief should be continued as a vital part of the Army peace-time establishment.

Rulings and recommendations on matters of Engineer Policy would then be on an adequate level. Proper supervision of engineer training would also follow since the Engineer-in-Chief would be a direct advisor to the Chief of the General Staff and thus to the Director of Military Training. Co-ordination to Army use of the latest engineering developments would be greatly facilitated thereby increasing the value of the engineering services rendered by National Defence Headquarters to an Army overseas.

The appointment of an Engineer-in-Chief, while very important to the Army, is also important to the profession at large. Every branch of the profession is vitally interested in seeing to it that every other branch is outstanding in every way. The suggestion warrants the wholehearted support of every engineering organization, both civil and military, and of every individual engineer in the country.

Yours very truly,

(Signed) E. P. MUNTZ, M.E.I.C.

ENGINEERS IN THE CABINET

The recent appointment of General A. G. L. McNaughton to the portfolio of Minister of National Defence puts two engineers in the Cabinet. So far as can be discovered, this is the first time the engineers have been so well represented in this all important body. Both gentlemen have exceedingly difficult assignments, and all engineers will wish them wisdom and strength in their undertakings.

Both Mr. Howe and General McNaughton have been members of the Institute for many years.

REGISTRATION IN ENGINEERING AT UNIVERSITIES

Again the *Journal* presents the tabulation of engineering students registered at Canadian universities. For several years the figures have been put together at Headquarters in an endeavour to keep the members informed and to discover any change in trends.

First it should be pointed out that an error crept into last year's figures shown in the December issue. Due to the omission of figures for the first year class at one university the total figures were quite incorrect. This error was corrected on page 110 of the February 1944, issue, but it is being mentioned again here for the benefit of those who want to make comparisons. The grand total for all students should have been 4,610 instead of 4,461 as reported.

This year's total is 4,651—almost the same as last year, and the number of graduates is 819 as compared with 815 last year. It is rather a remarkable achievement to maintain these figures in the light of all the difficulties.

There has been a marked increase in the number taking civil and electrical, but a falling off in mechanical and chemical. The greatest enrolment is now in electrical, with mechanical following and civil a strong third.

In the United States classes of engineers have been reduced to only those medically unfit. No boys 18 years or over are allowed to continue their courses, and consequently graduating classes have disappeared. Colleges will be almost empty in January at which time the special courses for the army and navy will have been completed.

Canadian authorities have encouraged properly qualified young men to enroll and to continue engineering study, and have given them postponement of compulsory service as long as they met the rigid requirements. This policy has worked out to the great advantage of the armed services and industry, and will be equally helpful for the post war period.

University	Year	General Course	Aeronautics	Agriculture	Architectural	Ceramic	Chemical Engrg. and Chemistry	Civil	Electrical	Electro-Mechanics	Forestry	Geology and Mineralogy	Mechanical	Metallurgy	Mining	Physics, Engrg.	Total
Nova Scotia Technical College....	1st	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	2nd	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	3rd	..	..	..	..	..	..	16	15	..	..	..	14	..	1	..	46
	4th	..	..	..	..	..	..	10	7	..	..	..	12	..	4	..	33*
Total....	....	..	..	..	..	..	..	26	22	..	..	..	26	..	5	..	79
New Brunswick.	1st	..	..	..	..	..	..	34	26	..	..	..	..	..	..	..	60
	2nd	..	..	..	..	..	..	23	21	..	..	..	..	..	..	..	44
	3rd	..	..	..	..	..	..	16	18	..	..	..	..	..	..	..	34
	4th	..	..	..	..	..	..	10	19	..	..	..	..	..	..	..	29*
Total....	....	..	..	..	..	..	..	83	84	..	..	..	..	..	..	..	167
Laval.....	1st	..	..	..	..	..	25	13	28	..	20	..	..	3	10	2	101
	2nd	..	..	..	..	..	13	2	18	..	6	..	3	1	3	2	48
	3rd	..	..	..	..	..	13	..	13	..	17	..	..	2	3	3	51
	4th	..	..	..	..	..	2	..	5	..	12	..	..	2	3	..	24*
Total....	....	..	..	..	..	..	53	15	64	..	55	..	3	8	19	7	224
Ecole Polytechnique de Montreal	1st	92	..	..	..	..	..	..	..	..	..	..	..	..	..	..	92
	2nd	78	..	..	..	..	..	..	..	..	..	..	..	..	..	..	78
	3rd	63	..	..	..	..	..	..	..	..	..	..	..	..	..	..	63
	4th	50	..	..	..	..	..	..	..	..	..	..	..	..	..	..	50
	5th	..	3	..	..	..	4	14	..	23	..	..	..	..	3	..	47*
Total....	....	283	3	..	..	..	4	14	..	23	..	..	..	..	3	..	330
McGill....	1st	157	..	..	..	..	..	..	..	..	..	..	..	..	..	..	157
	2nd	85	..	..	13	..	24	..	..	..	..	..	..	..	..	11	133
	3rd	..	..	..	15	..	23	22	28	..	..	..	29	5	2	..	124
	4th	..	..	..	4	..	20	7	13	..	..	..	29	2	..	..	75*
	5th	..	..	..	7	..	..	..	..	..	..	..	..	..	..	..	7*
Tota	....	242	..	..	39	..	67	29	41	..	..	..	58	7	2	11	496
Queens....	1st	178	..	..	..	..	..	..	..	..	..	..	..	..	..	..	178
	2nd	138	..	..	..	..	..	..	..	..	..	..	..	..	..	..	138
	3rd	..	..	..	..	..	25	15	30	..	..	9	37	8	2	10	136
	4th	..	..	..	..	..	24	9	15	..	..	4	34	8	9	9	112*
Total....	....	316	..	..	..	..	49	24	45	..	..	13	71	16	11	19	564
Toronto...	1st	..	21	..	22	..	96	69	74	..	..	3	67	16	6	44	418
	2nd	..	14	..	5	..	49	28	40	..	..	2	45	5	2	23	213
	3rd	..	11	..	9	..	51	52	48	..	..	1	70	18	1	22	283
	4th	..	2	..	5	..	42	31	49	..	..	2	62	16	6	18	233*
	5th	..	..	..	3	..	..	..	..	..	..	..	..	..	..	..	3*
Total....	....	..	48	..	44	..	238	180	211	..	..	8	244	55	15	107	1150
Manitoba..	1st	101	..	..	19	..	..	..	..	..	..	..	..	..	..	..	120
	2nd	66	..	..	9	..	..	..	..	..	..	..	..	..	..	..	75
	3rd	..	..	..	5	..	..	13	51	..	..	..	..	..	..	..	69
	4th	..	..	..	7	..	..	10	29	..	..	..	..	..	..	..	46*
Total....	....	167	..	..	40	..	..	23	80	..	..	..	..	..	..	..	310
Saskatchewan.....	1st	181	..	..	..	..	..	..	..	..	..	..	..	..	..	..	181
	2n	..	..	6	..	9	10	20	..	..	..	3	36	..	..	12	96
	3rd	..	..	2	..	4	6	23	..	..	..	3	59	..	..	15	112
	4th	..	..	5	..	..	8	10	..	..	..	..	33	..	..	8	64*
Total....	....	181	..	13	..	13	24	53	..	..	..	6	128	..	..	35	453
Alberta....	1st	139	..	..	..	..	..	..	..	..	..	..	..	..	..	..	139
	2nd	..	..	..	..	..	10	21	28	..	..	..	..	..	2	..	61
	3rd	..	..	..	..	..	30	18	33	..	..	..	..	..	7	3	91
	4th	..	..	..	..	..	12	14	15	..	..	..	..	..	6	3	50*
Total....	....	139	..	..	..	..	52	53	76	..	..	..	..	..	15	6	341
British Columbia......	2nd	183	..	..	..	..	..	..	..	..	..	..	..	..	..	..	183
	3rd	130	..	..	..	..	..	..	..	..	..	..	..	..	..	..	130
	4th	..	..	..	..	..	28	15	24	..	2	6	35	8	1	..	119
	5th	..	..	..	..	..	21	18	24	..	3	4	28	2	5	..	105*
Total....	..	313	..	..	..	..	49	33	48	..	5	10	63	10	6	..	537
Grand Total....		1641	51	13	123	13	536	533	671	23	60	37	593	96	76	185	4651

*Indicates those graduating in spring of 1945 (except 4th year architecture at McGill and Toronto)—Total 819.

WASHINGTON LETTER

A recent bulletin of the Foreign Policy Association opines that American opinion is sometimes distractingly mercurial. This is not necessarily a bad thing. Periods of pessimism are usually short lived and are more than compensated for by the vast and creative enthusiasm with which this country can meet a great emergency whose measure has once been taken. These letters, with all sorts of restrictions necessarily imposed, sometimes attempt to convey the tenor of events as seen from Washington. For the second time in a year it has been necessary to record a wave of optimism and then discount it. It is only fair to say that this time last year optimism ran equally high in both Canadian and British circles and that this year's optimism springs from both British and American pronouncements. As this is written the military situation is showing marked improvement. The Belfort break-through has enabled the French First Army to reach the Rhine. General Patton's Third is in possession of most of Metz. British and Canadian advances in the north complete what looks like the beginning of a winter offensive on the 400-mile front. Mr. Churchill's prediction that the European war may run beyond next Easter may be improved. But the present very wise attitude is to take no chances. Whatever happens, there are grim days ahead.

Post-Election Washington

A recent Washington cartoon shows Top-Sergeant Roosevelt, sitting under a sign "Re-enlist here for the Duration", accepting signatures on the dotted line from his various chief aides. Byrnes will stay on as Director of War Mobilization and Reconstruction. Davis, Taylor and Graham will continue to head the War Labor Board. The various working committees set up by J. A. Krug of the War Production Board are feeling their way with a caution hardly commensurate with the sweep of the original Krug reconversion announcement. War Mobilization Director Byrnes made a strong statement the other day in which he threatened to suspend the new and barely used "spot" authorization plan and to completely suspend resumption of civilian production unless lagging war programmes are shortly back on schedule. To speed up war programmes, top production executives from Washington have just returned from a tour through the mid-west during which ways and means were discussed with leading industrialists. Lt.-General Brehon Somervell urged, at a recent C.I.O. Convention, the recruitment of another 100,000 workers for war plants. A recent O.W.I. release places the duration of the Pacific war as at least eighteen months after the end of European hostilities. From Undersecretary of War Patterson comes a sober warning in an article in the current *Colliers* entitled "The Japs Are No Pushover." War production estimates have been revised upwards in the last week. The overall attitude, of course, continues to be optimistic—it is just a question of when. However, for the patient and long suffering people of Britain, subjected to the ravages of V1 and V2, this is a very significant "when". (Everyone should see the British Ministry's new film on the V1 Flying Bomb.) Most of the above items on the debit side may be countered by hopeful trends on the credit side. These have had plenty of publicity. The above few remarks do indicate the temper in post-election Washington. Such a feeling forms a natural part of the wider post-election philosophy of "getting back on the job."

Speaking of the election, some comment may be permitted now that November the seventh is past. Irrespective of party considerations, the constitution of both Houses appears to have been improved. The election was a defeat for the principle of isolationism and a vote in favor of co-operation. As a source of hope and encouragement to nations torn by civil strife, the holding of an American election in the critical stages of a great war and the preparations for the settlements to follow—the lack even of any questioning of the matter—is a real contribution to international affairs. It is well to remember that even when this nation was itself torn by civil strife, an election was held to pass on Lincoln's conduct of a war which was to test whether a nation "so conceived and so dedicated can long endure."

Civil Aviation Conference

The Civil Aviation Conference, after a stormy passage starting with the defection of the Russian Delegation, appears to be nearing agreement on global air regulations. The plan will lean heavily in the direction of the American proposals favouring free competition rather than in the direction of the British plan for a closely regulated control. Much of the plan has been taken from the original Canadian proposal. It is probable that an interim draft will be signed to cover an intervening period of several years pending ratification by participating governments of later and more permanent agreements. While it seems apparent that traffic quotas have been ruled out it seems equally probable that a floor will be placed under rates with a view to discouraging cut-throat competition and subsidy war. The Canadian plan for establishing rates and fares through operators' conferences will also be included. On the technical side the Conference has been very satisfactory.

International Business Conference

As this is being written the International Business Conference at Rye, N.Y., is drawing to a conclusion, and indications are that a number of interesting documents will be forthcoming. The recommendations of the Conference panel on cartels is indicative of a growing understanding in this country of the cartel problem.

The report from the panel, while noting the sharply opposed views on the subject, nevertheless asserted that "it is essential to preserve benefits of such agreements and to avoid their use in a manner which is contrary to the public interest of any nation." The report goes on to recommend that governments and business join forces to study and consult together in the various issues involved. To date cartels have been frowned on severely in this country. Until recently, it has looked as though disagreement with other countries of the world on the principles of the control of international business might prove to be a serious stumbling block. The State Department has been giving this matter intensive study for several years. There has recently been issued a report by the Senate Committee on Military Affairs. This report, entitled "Cartels and National Security" and known as the Kilgore Report, comes out strongly on the side of outlawing cartels. Perhaps it is the name that needs changing.

The Conference also made a further proposal for the setting up of an international organization to promote private enterprise. We were in communication with the Australian delegation prior to the Conference and I am expecting to have a lunch for them in Washington the latter part of this week and hope to get a first-hand story as to what transpired.

Situation in China

As is to be expected, the Pacific war is coming more and more into the news. The recent American naval victories and the quite outstanding success of General MacArthur's island-hopping technique have been very heartening. Russia's pronouncements regarding the Pacific war and Marshal Stalin's branding of Japan as an aggressor nation are also regarded as significant and encouraging signs. The Chinese situation, however, continues to give concern. The difficulties in China have been growing for the last year but it is only recently that the news of the situation has been allowed to be released. *Life's* article some months ago was one of the first indications. A review of the position has been precipitated by the recent recall of General Stilwell and the resignation of the American Ambassador. Within the last few days there has been a shake-up in the Chinese set-up itself. Dr. Kung, at present in the United States, has been replaced as Minister of Finance and seven other cabinet posts have been changed. A united and friendly China is of great importance to the cause of the United Nations and Chiang-Kai-Shek is the man most likely to maintain such a nation. This opinion was expressed in a statement by Sir Frederic Eggleston who has just arrived from a ministerial post in Chunking to be Australian Minister at Washington. Several weeks ago we received a call from Mr. Donald Nelson and I saw him before he left on his second trip to China to aid in the establishment there of an organization similar to the War Production Board here. I was, therefore, particularly interested to read in this evening's paper that he has been designated a personal representative of the President with cabinet rank.

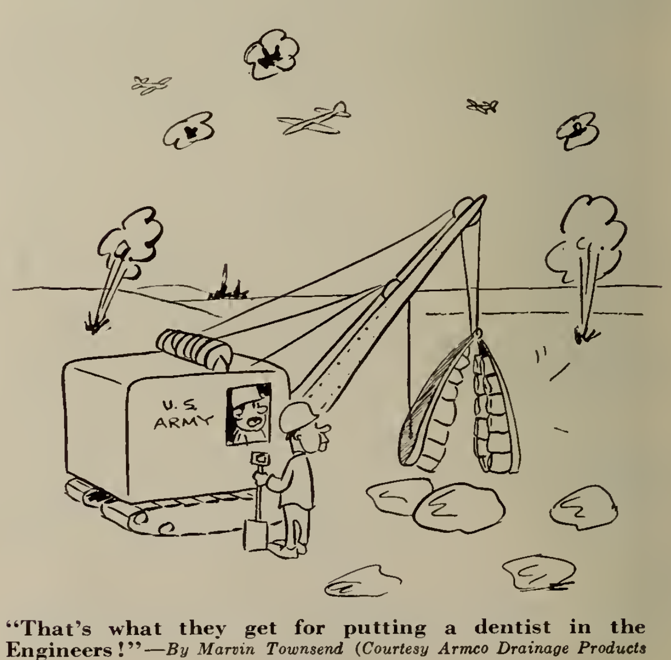
After the Normandy landings, returning visitors told of the amazing landing installations. The temptation to describe them was great. However, the story is now out and most of the details are known. Another great engineering feat which will have to be written up when security permits is the great two thousand mile pipe line at present being pushed from India into the heart of China.

A recent cartoon shows an army doctor inspecting the throat of a line of dejected German prisoners. Says he—"Say Aachen."

Seasons Greetings.

E. R. Jacobsen, M.E.I.C.

Washington, D.C., November 23rd, 1944



"That's what they get for putting a dentist in the Engineers!"—*By Marvin Townsend (Courtesy Armco Drainage Products Association.)*

QUEBEC ENDORSES CO-OPERATION

Just as the *Journal* goes to press word has been received that the ballot of the Corporation of Professional Engineers of Quebec and the ballot of the Engineering Institute on the proposed co-operative agreement between the two organizations have both been successful.

The Corporation count shows that out of all good ballots 69 per cent are in favour of the agreement. The Institute count shows that 88 per cent are in favour. The Institute Council ballot shows no negative votes.

The number of returns is unusually high. For the Corporation 74 per cent of all eligible members voted, and for the Institute the figure was 73 per cent of all eligible members.

These results must be very gratifying to the members of the two committees who have been negotiating for so long. They will be gratifying also to other engineers who have been interested in promoting co-operation across Canada.

THE FIFTY-NINTH ANNUAL GENERAL MEETING

Notice is hereby given, in accordance with the by-laws, that the Annual General Meeting of The Engineering Institute of Canada for 1945 will be convened at Headquarters at eight o'clock p.m. on Thursday, January 25th, 1945, for the transaction of the necessary formal business, including the appointment of scrutineers for the officers' ballot, and will then be adjourned to reconvene at the Alexandra Hotel, Winnipeg, Manitoba, at ten o'clock a.m. on Wednesday, February 7th, 1945.

MEETING OF COUNCIL

A regional meeting of the Council of the Institute was held at the Macdonald Hotel, Edmonton, Alta., on Saturday, October 21st, 1944, convening at nine thirty a.m.

Present: President deGaspé Beaubien (Montreal) in the chair; Vice-President W. P. Brereton (Winnipeg); Councillors J. W. D. Farrell (Regina), R. E. Heartz (Montreal), J. McMillan (Calgary), E. Nelson (Edmonton), P. M. Sauder (Calgary), C. E. Webb (Vancouver), and General Secretary L. Austin Wright.

There were also present by invitation—Past-President S. G. Porter (Calgary), Past-Vice-President R. S. L. Wilson (Edmonton); Past-Councillors G. N. Houston (Calgary), W. R. Mount (Edmonton), H. B. LeBourveau, chairman of the Calgary Branch; G. A. Gaherty (Montreal), chairman of the Institute's Committee on Prairie Water Problems, and a member of the Committee on Professional Interests and the Finance Committee; Julian Garrett (Edmonton), president of the Association of Professional Engineers of Alberta, and a past-councillor of the Institute, and J. G. Dale, registrar of the Association; B. W. Pitfield, chairman, J. W. Judge, vice-chairman, G. H. Milligan, secretary-treasurer, R. M. Hardy, past-chairman, F. R. Burfield, past secretary-treasurer, and R. H. Linke, J. D. A. Macdonald, I. F. Morrison and R. Scott, members of the executive of the Edmonton Branch.

Legal Action by Architects against an Engineer—By way of explaining the special meeting, the general secretary stated that it was considered desirable that certain statements should be made relative to the case of the Province of Quebec Association of Architects vs. Brian R. Perry, M.E.I.C.

Mr. Perry was charged by the Association with having designed a building while not a member of the Association, the Association claiming that only their members had that privilege in the province of Quebec. Part of the charge was that Mr. Perry's conduct was contrary to the Code of Ethics of the Institute.

A resolution passed at the special Council meeting stated that the Council of the Institute was most competent to pronounce upon this charge and that it considered Mr. Perry's conduct ethical in every detail.

There was considerable discussion relative to the rights and the ability of the architect to design industrial buildings. Many persons at the meeting could not see how the architects could make a case, but the secretary reported that as far as his information went the architects were pressing the case very firmly, but that a decision was not likely to be made for several weeks.

Mr. Gaherty explained that he had sat in at some of the preliminary meetings with Mr. Perry, representatives of the Corporation of Professional Engineers of Quebec, and the lawyers, to represent the Institute. He thought that there was little that the Institute could do beyond that which was being done by Mr. Perry and the Corporation. However, Mr. Perry had been informed that the Institute would support him in any way that it could.

The president emphasized the fact that according to his understanding there was no inference in the architect's charges that the safety of the public was one of the considerations prompting the action. In other words, it was simply a legal dispute, without regard to the interests of the public.

Mr. Dale described a case which had developed in Alberta wherein there was the question of the overlapping of the fields of the engineer and the architect. The architects' association and the engineers' association had formed a small committee to discuss the matter, and it was expected that a satisfactory decision would be reached without difficulty.

Appointment of Treasurer—The president explained that it was necessary to approve the selection of a new treasurer. Mr. Fred C. Mechin, who had been appointed treasurer earlier in the year, had been transferred to Toronto. At the last meeting of Council it had been left with him to select a new treasurer and he now submitted the name of R. E. Chadwick, president of the Foundation Company of Canada Limited, of Montreal. This was approved unanimously.

Annual Meeting 1945—The general secretary outlined the programme which has been arranged for the 1945 Annual Meeting, which is to be held at Winnipeg on February 7th, 8th and 9th. Already arrangements have been completed for four papers on the Steep Rock project, and four papers on civil aviation, also a panel discussion on rural electrification. There will also be a session on soil mechanics related principally to the investigation which has been undertaken by the Prairie Farm Rehabilitation Administration on the site of the St. Mary's River dam.

Mr. Brereton extended an invitation to all members in Alberta to attend the meeting.

Employment Conditions (Collective Bargaining)—Mr. Heartz gave a progress report on the work done by the committee of fourteen and the subcommittee of five. He emphasized that this was only an interim report relating to unfinished business, and therefore should be taken as confidential information. He stated that considerable progress had been made on a draft of new legislation to control collective bargaining for and by the engineers. This was in accordance with the almost unanimous opinion expressed by members of all societies. He hoped that a full report, in the nature of completed business could be made before long.

Following Mr. Heartz' report there was a discussion, at the conclusion of which Mr. Heartz' report was adopted unanimously.

Community Planning—The general secretary read a letter from I. P. Macnab, of Halifax, in which Mr. Macnab urged that engineers take a much greater interest in the subject of community or town planning. Mr. Macnab made these strong recommendations on the basis of his experience as chairman of the City Planning Commission of Halifax.

The general secretary reported that following the Kingston meeting of the Council the president had asked Mr. Arthur Bunnell, of Toronto, to accept the chairmanship of a committee which would recommend to Council a course which it could follow in order to assist in developing the subject. A letter had been received from Mr. Bunnell recently in which he stated that because of his absence from the city he had not been able to complete a report. It was hoped that it could be presented at the next meeting.

Mr. Nelson read from the July issue of the *Western Municipal News* an item which had been passed by the Union of Alberta Municipalities relative to town-planning. This resolution recommended that the appropriate sub-committee of the Post-War Rehabilitation Committee of Alberta be empowered to employ an engineer or engineers whose services, under the direction of the sub-committee, may be made available in an advisory capacity in the framing of municipal post-war reconstruction projects, without expense to the municipality.

Mr. Porter and Dean Wilson recounted instances where procedure of this type had been followed previously with satisfactory results.

Dean Wilson referred to a meeting which had been held in Edmonton, in which it was clearly indicated that many groups were interested in the subject of community planning. He emphasized particularly the interest taken by real estate dealers.

There was discussion relative to the necessity of re-establishing the Town Planning Institute as a medium through which engineers and others could develop their interests and their activities. It was agreed that because of the multiplicity of interests, none of the existing professional organizations could properly represent the field, but that further action should be delayed until Mr. Bunnell's committee had reported.

Report of Nominating Committee—The president announced that the Nominating Committee had made a unanimous report recommending the selection of E. P. Fetherstonhaugh, Dean of the Faculty of Engineering and Architecture at the University of Manitoba as president of the Institute for the year 1945. The report of the committee was approved unanimously and with enthusiasm.

Post-War Policy for Wartime Bureau of Technical Personnel—The president explained that the recommendations of the Advisory Board of the Bureau had been presented to the September meeting of Council, and that they had been considered of sufficient importance to justify further study. Therefore, a small committee under the chairmanship of K. M. Cameron had been established. The general secretary read Mr. Cameron's report.

It was noted that the committee's report in some details was at variance with the recommendations of the Advisory Board, but after long discussion it was agreed to accept it.

The meeting adjourned at twelve thirty, and reconvened at two o'clock p.m.

The first item on the agenda after luncheon was a further discussion as to the correct reply to the communication from the Advisory Board of the Bureau. Eventually it was agreed that the following motion be transmitted to Mr. MacRae, chairman of the Advisory Board:

"It was moved by P. M. Sauder, and seconded by E. Nelson, that the Bureau be continued in its present form for a period of three years after the cessation of hostilities, and that during that time a thorough study be made of the proper policy to be adopted at the end of the period; and that a part of the study be to determine whether or not the Department of Labour, in consultation with the professional organizations now sponsoring the Bureau, should establish a Professional Division of the Unemployment Service to take care of employment of the professional workers along the lines of the recommendations made in the Hankey Report for this class of worker."

Proposal for New Engineering Organization—The general secretary reported on a meeting held in Ottawa on October 3rd relative to collective bargaining, at the conclusion of which a motion was introduced by Professor O. N. Brown (C.I.M.M.) and seconded by A. A. Mackay (C.I.M.M.), recommending the immediate establishment of an organization which would represent several national professional or technical organizations.

He explained that the Institute had been represented only by Mr. Heartz who had gone to Ottawa solely to discuss collective bargaining, and therefore the Institute was not in a position to discuss the new proposals. Further, the Institute had not expected that the subject would come up at this time. He had asked the meeting to postpone consideration of the proposal, principally because the several organizations which had previously expressed opposition to it were not represented at this meeting. He thought the request was reasonable inasmuch as at the previous meeting a similar proposal had not been voted on because of the request of the representatives of the Dominion Council and the Ontario Association. He asked that a similar courtesy be now extended to the Engineering Institute and to the absent representatives whose organizations had previously disapproved of the proposal.

Several delegates thought the matter should be proceeded with immediately and did not support Mr. Wright's request that no vote be taken, so the chairman put the motion to the meeting and it was carried.

Mr. Wright now explained to Council that since the meeting several organizations including the Institute had been invited to name their representatives on the new organization, the suggestion being that their presidents be selected for the purpose. Mr. Wright explained that the situation was submitted to Council by the Institute's Committee on Professional Interests. The committee had not had an opportunity to make a recommendation, but would like to have an expression of opinion from Council before making a final report.

After a detailed discussion Mr. Porter, Mr. Webb and Mr. Heartz agreed in the suggestion that the matter should be referred back to the committee, with instructions that they consult the associations with which the Institute has agreements. A motion to this effect was approved unanimously.

Committee on the Young Engineer—The general secretary presented a report from Mr. Bennett, the chairman of the Institute's Committee on the Training and Welfare of the Young Engineer, advising of the formation of a joint committee to be known as "The Canadian Committee for Student Guidance in Science and Engineering," with Mr. Bennett as chairman, and J. R. Kirkconnell, of the Canadian Institute of Mining and Metallurgy (C.I.M.M.) as secretary. This committee has been established jointly by the Institute, the

C.I.M.M. and the Chemical Institute of Canada, upon the recommendation of the Advisory Board of the Wartime Bureau of Technical Personnel. The report outlined briefly the objectives of the committee, which will function independently of the Wartime Bureau. Council approved unanimously of the organization of this committee.

Technical Institutes—The general secretary outlined the response which had been given to the memorandum circulated to the branches. He thought that it was desirable to re-canvass the branches in order to survey the situation, and determine what progress had been made.

Dean Wilson and Professor Hardy expressed approval of the proposal, providing it was kept within proper bounds. It was pointed out that in Calgary there was a Technical Institute which very closely approximated the proposal made by Dean Young. The secretary explained that Dean Young had asked him to see this Institute when he was in Calgary. It was agreed that the Institute should continue its interest in this subject, particularly in view of post-war requirements.

Engineers' Council for Professional Development—The general secretary presented the resignation of Mr. Hewson, who represented the Institute on the Committee on Employment Conditions established by E.C.P.D. Mr. Hewson recommended that Mr. Heartz be appointed in his place, and the Council unanimously approved of the appointment.

Julian C. Smith Medal—The general secretary reported that no negative ballots had been received, and that therefore the nomination of J. A. Wilson, of the Department of Transport, Ottawa, and Dean E. P. Fetherstonhaugh, of Winnipeg, was approved. It was moved, seconded, and unanimously approved that an award be given to each of these two members.

Canadian Lumbermen's Association Prize—It was recommended that the following persons be approved as members of the committee to make the award of the Canadian Lumbermen's Association Prize: J. L. Lang, Sault Ste. Marie, chairman; T. A. McElhanney, Ottawa, W. J. LeClair, Ottawa, and C. T. Hamilton, Vancouver. This was approved.

Joint Finance Committee in Alberta—Mr. Dale asked Council to appoint its two representatives on the Joint Finance Committee for the province of Alberta. It was agreed unanimously that the previous members, Messrs. Burfield and Hardy, be reappointed.

Committee on Western Water Problems:—Mr. Gaherty, chairman of the committee, requested that Council approve of the addition of Benjamin Russell, of Edmonton, and P. J. Jennings, of Banff, to his Committee on Western Water Problems. This was approved unanimously.

Committee on Professional Interests—A telegram was read from Mr. Stirling, chairman of the Committee on Professional Interests recommending that the following persons be approved by Council as members of his committee: J. A. Armstrong, J. B. Challies, A. Circe, G. J. Currie, G. A. Gaherty, J. A. Vance and W. G. Swan. This was approved unanimously.

ELECTIONS AND TRANSFERS

A number of applications were considered and the following elections and transfers were effected:

Members

Broad, Robert L., B.A.Sc. (Univ. of Toronto), mgr., combustion service dept., Rochester & Pittsburgh Coal Co. (Canada) Ltd., Toronto, Ont.

Bushlen, Harvey Eby, B.Sc. (Civil), (Queen's Univ.), engr., western divn., McColl Frontenac Oil Co. Ltd., Calgary, Alta.

Cousineau, Yvon, B.A.Sc., C.E. (Ecole Polytechnique), M.E., M.Sc. (Queen's Univ.), mech. engr., Ore Plant No. 2, Aluminum Co. of Canada, Ltd., Arvida, Que.

Donnelly, James Playfair, grad. (Civil Eng.), R.M.C., executive engr., i/c aeronautical engrg. divn., Noorduyn Aviation Ltd., Montreal.

Fraser, John Ferguson, (Royal Tech. Coll., Glasgow), engr., power divn., engrg. dept. D.I.L., Montreal.

Gordon, Arthur I. E., B.A.Sc. (Civil), B.A.Sc. (Geol. Engrg.), (Univ. of B.C.), engr., City Engineer's Office, Vancouver, B.C.

Hollyhock, Walter Stanley, (London Univ.), chief dftsman. Hawker Aircraft Ltd., Kingston-on-Thames, England.

Maclaren, Ian Nicholson Murray, B.Sc., M.Sc. (Univ. of N.B.), president, Rochester & Pittsburgh Coal Co. (Canada) Ltd., Toronto, Ont.

Otter, George Edward, B.A.Sc. (Univ. of Toronto), chief aeronautical engr., Fleet Aircraft Ltd., Fort Erie, Ont.

Phillips, Ernest Albert, B.A.Sc. (Univ. of Toronto), production mgr., Canadian Wood Pipe & Tanks Ltd., Vancouver, B.C.

Shipley, Kenneth Rosser, B.ASc. (Univ. of Toronto), supervisor, No. 2 Plant, Imperial Oil Ltd., Sarnia, Ont.

Thompson, Murray O., B.A.Sc. (Univ. of Toronto), vice-president, Cargo Dockers Ltd. and combustion engr., Rochester & Pittsburgh Coal Co. (Canada) Ltd., Toronto, Ont.

Zacharias, Edward Ronald, B.Eng. (Civil), (Univ. of Sask.), factory production mgr., Jos. Stokes Rubber Co., Welland, Ont.

Juniors

Ansley, Richard Herbert, B.Sc. (Civil), (Univ. of Man.), Lieut., R.C.E., Cdn. Fd. Pk. Coy., Central Mediterranean Forces.

Dick, Sidney Alexander, B.Sc. (Queen's Univ.), Lieut. Engr., R.C.N.V.R., Toronto, Ont.

Transferred from the class of Junior to that of Member

Borbey, John P., B.A.Sc. (Univ. of Toronto), cost estimator, contracting dept., Dominion Bridge Co., Lachine.

Ferrier, John Alexander, B.Sc. (Queen's Univ.), Lieut. (E)., R.C.N.V.R., Victoria, B.C.

Trethewey, Graham D., B.A.Sc. (Chem. Engrg.), (Univ. of B.C.), research chemical engr., B.C. Pulp & Paper Co. Ltd., Woodfibre, B.C.

Transferred from the class of Student to that of Junior

Benson, Willard MacLean, B.Sc. (Civil), (Univ. of N.B.), company surveyor, No. 2 Drilling Co., R.C.E., C.A.O.

Admitted as Students

Abell, John D., B.A.Sc. (Univ. of Toronto), mfg. methods engr., Northern Electric Co. Ltd., Montreal, Que.

DuSablon, Gilbert (St. Francis Xavier Univ.), Antigonish, N.S.

Emmerson, John Outram, B.A.Sc. (Univ. of Toronto), junior engr., DeHavilland Aircraft, Toronto, Ont.

Power, Henry Edwin, (Dalhousie Univ.), 117 Kline St., Halifax, N.S.

Vergin, Leonard John, B.Sc. (E.E.), (Univ. of Man.), Y.M.C.A., Winnipeg, Man.

Students at McGill University

Angel, Henry, 2057 Maplewood Ave., Montreal, Que.
Archibald, Rupert Douglas, 3525 University St., Montreal.
Brock, Hymen Bernard, 738 Bloomfield Ave., Outremont, Que.
Brodylo, Stanley, 2106 Clark St., Montreal.
Carr, Laurence Edward Neil, Douglas Hall, McGill University, Montreal.
Ciment, Mortimer, 1206 Lajoie Ave., Outremont, Que.
Epstein, Norman, 615 Bloomfield Ave., Outremont, Que.
Fox, Charles James, 3581 Durocher St., Montreal.
Glassman, Alex., 1584 Badeaux St., Three Rivers, Que.
Haiblen, Alfred Hans-Dieter, 635 Grosvenor Ave., Westmount, Que.
Hammerschmid, Leo John, 3505 St. Famille St., Montreal.
Harris, John Richmond, 3581 Durocher St., Montreal.
Laporta, Philip, 1444 St. Elizabeth St., Montreal.
Lion, Edgar, 4869 Victoria Ave., Westmount, Que.
Mann, Stanley Lawton Wingate, 629 Prince Arthur West, Montreal.
Metcalf, Maynard Lyall, 117 Kenaston Ave., Town of Mount Royal.
Proctor, George Edward Miles, 3462 St. Famille St., Montreal.
Snelgrove, Laurence Henry, 3609 University St., Montreal.
Takeshige, Maurice, 3649 Park Ave., Montreal, Que.
Yuile, Arthur McL., Sqdn. Ldr., Baie d'Urfe, Que.

Students at University of New Brunswick

Brooks, Ralph Fraser, 606 Queen St., Fredericton, N.B.
Green, Donald Hughes, Lady Beaverbrook Residence, Fredericton, N.B.
Harrison, John Austen, 303 Northumberland St., Fredericton, N.B.
Henry, Charles Walter, 290 York St., Fredericton, N.B.
MacDougall, C. Donald, 138 George St., Fredericton, N.B.
Ross, Carl Wesley, 12 Waterloo Row, Fredericton, N.B.
Seely, Hubert Edward, 102 Waterloo Row, Fredericton, N.B.

Personals

Relatives and friends of members in the active forces are invited to inform the Institute of news items, such as locations, promotions, transfers, etc., which would be of interest to other members of the Institute and which should be entered on the member's personal record kept at Headquarters. These would form a basis of personal items in the *Journal*.

News of the Personal Activities of members of the Institute

Several appointments, in the directorate of mechanical engineering at the Department of National Defence Headquarters at Ottawa, have been made in recent months affecting members of the Institute:

Colonel R. L. Franklin, M.E.I.C., vacated the position of Director of Mechanical Engineering early in September and proceeded overseas.

Colonel H. G. Thompson, D.F.C., M.E.I.C., succeeded Colonel R. L. Franklin. Colonel Thompson held the appointments of D.D.O.S.(E) and D.D.M.E. respectively at Headquarters First Canadian Army while under the command of General A. G. L. McNaughton, C.B., C.M.G., D.S.O., M.E.I.C. Prior to taking over this appointment in June 1942, Colonel Thompson was Technical Observer for the Canadian Army in the Middle East from January of that year.

Lieutenant-Colonel E. C. Mayhew, M.E.I.C., has been promoted to Acting Colonel and Deputy Director of Mechanical Engineering (Technical) as of August 1st.

Lieutenant-Colonel LeS. Brodie, M.E.I.C., is Technical Staff Officer Grade 1, in charge of the Telecommunications Group.

R. A. Spencer, M.E.I.C., was appointed Dean of Engineering at the University of Saskatchewan in October. Dean Spencer had occupied the position of Acting Dean since Dean C. J. Mackenzie left for Ottawa in 1939 to take over the duties of acting-president of the National Research Council.

Francois P. Rousseau, M.E.I.C., who had been employed for some time with Anglo-Canadian Shipbuilding at Quebec, has now returned to Montreal where he has joined the staff of Angus Robertson Limited, contractors.

Lieutenant-Colonel J. F. Plow, M.E.I.C., well known for his long service in the 2nd Montreal Regiment, R.C.A., recently returned to Canada after three years overseas. Lieut.-Col. Plow was assistant general secretary of the Institute from 1930 until 1938 when he accepted a position with Chas. Warnock & Company, Limited, Montreal.

K. A. Brebner, M.E.I.C., is now designing and estimating engineer with the Brompton Pulp & Paper Company Limited at Red Rock, Ont. He was formerly with the Aluminum Company of Canada at Arvida, Que.

C. H. Fox, M.E.I.C., district engineer of the Canadian Pacific Railway has recently been transferred from Moose Jaw, Sask., to Winnipeg, Man.

C. A. Hellstrom, M.E.I.C., of the Brompton Pulp and Paper Company Limited has been transferred from Montreal, Que., to Red Rock, Ont.

Colonel G. W. F. Johnston, E.D., M.E.I.C., after five years of active service has recently been posted to the Reserve of Officers in order to permit him to join the staff of War Assets Corporation as chief of their durable goods division. Colonel Johnston left Canada with the First Division in 1939 in command of the First Anti-Tank Regiment, R.C.A., and a year later was transferred to the command of the First Medium Regiment, R.C.A. In December 1941 he underwent an operation and on recovery was placed in command of No. 2 Canadian Artillery Reinforcement Unit. In December 1943 he returned to Canada and in that year took over command of A1 Canadian Artillery Training Centre at Petawawa, Ont., which command he held until posted into the Reserve of Officers.

Dr. Albert E. Berry, M.E.I.C., director of the sanitary engineering division, Ontario Department of Health, was elected president of the Federation of Sewage Works Associations at the annual convention of this organization, held in Pittsburgh, Pa., on October 12th-14th. He succeeds A. M. Rawn, chief engineer and general manager of the Los Angeles County Sanitation District, Los Angeles, Calif., and is the first Canadian to hold the office of president. For the past year he had been vice-president, having been elected to this office at the convention of the Federation held in Chicago in October, 1943.

Dr. Perry is one of the most widely known engineers engaged in water-supply and sewerage work in Canada, he being responsible for exercising supervisory control over all of the public waterworks and sewerage systems in the province of Ontario. He is also secretary of the Canadian section, American Water Works Association, and the secretary of the Canadian Institute on Sewage and Sanitation. He is the author of numerous articles on sanitation subjects and is lecturer in public health engineering and special lecturer in municipal engineering at the University of Toronto. As director of the sanitary engineering division of the Ontario Department of Health he has also supervisory charge of 716 milk-pasteurizing plants in Ontario, and has under his direction an important research laboratory engaged in the study of sanitary problems.

R. E. McMillan, M.E.I.C., of the Aluminum Company of Canada Limited has been transferred from Toronto, Ont., to Montreal, Que.

G. R. Connor, M.E.I.C., has been transferred from the Hamilton office of Aluminate Chemicals Limited to the Toronto office.

Major Lyle G. Trorey, M.E.I.C., of the First Canadian Airsurvey Company, Royal Canadian Engineers, Canadian Army Overseas, has recently been awarded the degree of Ph. D (Eng.) (Lond). The subject is airsurvey or photogrammetry having regard to military mapping techniques and the design of photogrammetric apparatus. Investigations and researches have been carried out for the past few years for military purposes. Before enlisting, Major Trorey was with the Department of Public Works of British Columbia.

Wm. B. Korcheski, M.E.I.C., formerly of the Aluminum Company of Canada Limited is now with the Brompton Pulp and Paper Company Limited at Red Rock, Ont.

Group Captain D. C. M. Hume, M.E.I.C., is now District Supervisor of Vocational Training, District "D", Department of Education, Toronto, Ont. He was formerly national director of the Air Cadet League of Canada at Ottawa.

M. N. Hay, M.E.I.C., of the Aluminum Company of Canada Limited has been transferred from Kingston, Ont., to Montreal, Que.

D. A. Chisholm, M.E.I.C., has returned to Halifax, N.S., as resident engineer of the Department of Highways and Public Works of Nova Scotia.

C. H. Brereton, M.E.I.C., who has been with the R.C.A. Victor Company Limited at Winnipeg, Man., has been transferred to their engineering products department at Montreal, Que.

L. Sterns, M.E.I.C., has been transferred from the New Brunswick International Paper Company at Dalhousie, N.B., to the Canadian International Paper Company at Gatineau, Que., to take charge of construction on an extension to the paper mill there.

S/L R. A. McLellan, M.E.I.C., past-president of the Saskatchewan Branch of the Institute and the Association of Professional Engineers of the Province of Saskatchewan, has been posted from No. 4 Air Training Command, R.C.A.F., at Calgary, Alta., to the construction engineering division, Air Force Headquarters, at Ottawa, Ont.

J. A. Dickinson, M.E.I.C., of the Brompton Pulp and Paper Company Limited, has recently been transferred from Montreal to East Angus, Que., as chief engineer.

B. Chappell, M.E.I.C., who has been with the Canadian National Railway in Saskatoon, Sask., has been transferred to Winnipeg, Man., as division engineer.

F. S. Idenden, Jr.E.I.C., is now in charge of the purchasing department of the Demarara Bauxite Company Limited at Mackenzie, British Guiana, South America.

S. D. Levine, Jr.E.I.C., formerly in the United States Army, is now employed as technical foreman with the Metals Disintegrating Company, Inc., at Elizabeth, New Jersey.

F. M. Near, Jr.E.I.C., is employed by the Hydro Electric Power Commission of Ontario as a junior engineer in the hydraulic department at Toronto, Ont. He was formerly assistant engineer of North York Township, Ont.

J. P. Callum, Jr.E.I.C., is now employed as fuel oil engineer with the Shell Oil Company at Montreal, Que. He was formerly with the Algoma Steel Corporation in Sault Ste. Marie, Ont.

Gérard Beaulieu, Jr.E.I.C., has been appointed lecturer in structural design at the Ecole Polytechnique, Montreal. A graduate of the class of 1936 at the Ecole, he is presently employed as designer with Dominion Bridge Company, Lachine, Que.

Yvon Nadeau, Jr.E.I.C., formerly with Marine Industries Limited at Sorel, Que., has recently been appointed city engineer at Edmundston, N.B.

Nathan S. Bubbis, S.E.I.C., has been appointed to the position of Engineer of Water Works and Sewerage for the City of Winnipeg, Man. Mr. Bubbis graduated from the University of Manitoba in 1934 with a B.Sc. degree in civil engineering and in the same year started with the City of Winnipeg inspecting the manufacture of concrete sewer pipe. On completion of this work he entered the draughting room of the City of Winnipeg. In 1939 Mr. Bubbis was made designing draughtsman and three years later was promoted to assistant designing engineer. In January 1943 he became assistant engineer in charge of designing and draughting room and in September of this year was appointed to his present position.

Stanley Brodylo, S.E.I.C., a third year mechanical engineering student at McGill University, has been awarded the $100 bursary provided by the Corporation of Professional Engineers of the Province of Quebec.

B. B. Denyes, S.E.I.C., who was formerly with the Cockshutt Plow Company at Brantford, Ont., is now acting as demonstrator with the Mechanical Engineering Department at Queen's University, Kingston, Ont.

R. V. Tomkins, S.E.I.C., is at present employed as senior research assistant in the Division of Applied Biology at the National Research Council, Ottawa, Ont. Mr. Tomkins received his Bachelor of Science degree this year at the University of Saskatchewan.

Lieutenant (E) John M. Dyke, S.E.I.C., is now stationed at Halifax, N.S. Lieutenant Dyke was a graduate in mechanical engineering of the University of Toronto in 1943.

Obituaries

George Foster Hanning, M.E.I.C., died at his home in Clarkson, Ont., on October 21st, 1944. Born at Bowmanville, Ont., on October 7th, 1869, he graduated in civil engineering from the University of Toronto in 1889.

After graduation he entered the city engineer's office in Toronto as leveller and transitman on the roadway staff. He held this position until 1896 when he went with the Lake Manitoba Railway and Canal Company as leveller. In the following year he returned to the east and made numerous surveys for Sir Adam Beck. Among them was the hydro power survey at Niagara Falls, Ont., of which the outcome was the large power house located in the gorge. Some of his data there was gathered from a boson chair slung over the cliff. He also ran location lines for several proposed radials in the Niagara Peninsula.

Shortly after the turn of the century Mr. Hanning returned to railway location and construction during which time he worked on the North Shore line from Montreal to Quebec and the MacKenzie and Mann line from the head of the lakes to Winnipeg. After the completion of this latter line he remained for some time as divisional engineer, but later returned to railway location work during which time he ran a survey through what is now Cochrane, Ont., when there was only one log cabin there.

In 1917 he returned to hydro work for about four years when he joined the Ontario Department of Highways as district engineer. In 1926 he went to Grimsby, Ont., as resident engineer in charge of the Niagara residency which position he held until he retired in September 1943 on account of ill health.

Mr. Hanning joined the Institute as an Associate Member in 1897 becoming a Member in 1940.

Lawrence James Meredith Howard, M.E.I.C., died suddenly at his home in Ottawa, Ont., on October 25th, 1944. Born at St. Johns, Que., on July 12th, 1878, a son of the late Dr. Robert Howard and Mrs. Howard, he received his education at Bishop's College School, Lennoxville, Que., and Montreal.

Mr. Howard travelled for several years as a civil engineer with the Canadian Pacific Railway on construction work across the Dominion, being employed as follows: 1904-1905, chainman and rodman of construction of the Toronto-Sudbury line; 1905-1906, topographer on the Georgian Bay and Seaboard line;

1906-1907, instrumentman on construction of the Toronto-Sudbury line; 1907-1908, instrumentman on construction Linwood-Listowel, a subsidiary of the Canadian Pacific Railway; 1908-1910, transitman on maintenance of way and instrumentman on construction of bridges over the Saint John River, N.B.; 1910-1912, loaned to the Grand Trunk Pacific Railway as resident engineer on construction; 1912-14, resident engineer on construction of the Campbellford Lake Ontario and Western Railway, subsidiary of the Canadian Pacific Railway.

When the Canadian Pacific Railway suspended construction work in December 1914 on account of war conditions, he was acting as district engineer. At that time he went to work at the Dominion Bridge Construction Plant, Lachine, Que., as a government inspector for shells. In 1916 he was appointed to the valuation staff of the Commission of Inquiry into railways and transportation and in the following year to valuation work for the Imperial Munitions Board. From 1922 until 1926 he was with the Grant Brothers Construction Co. Ltd., Ottawa, in the capacity of secretary-treasurer.

In 1926 Mr. Howard joined the Beechwood Cemetery Company as engineer and later took over full management. He was manager, supervising engineer and secretary-treasurer at the time of his death. Mr. Howard's engineering ability had greatly improved Beechwood Cemetery. He had recently made arrangements for a plot of land to be used for the graves of sailors, soldiers, and airmen.

Acknowledged as one of the greatest Canadian authorities on curling, Mr. Howard had been a member of the Rideau Curling Club for the past 28 years. In 1937 he was made an honorary life member of the Royal Caledonia Curling Association, the highest honour that can be conferred on a curler.

Mr. Howard joined the Institute as an Associate Member in 1917, becoming a Member in 1940.

James Irving Mutchler, M.E.I.C., died on October 19th, 1944, at Shawinigan Falls, Que. Born in Milwaukee, Wis., on February 8th, 1905, he moved with his parents to Winnipeg in 1912 and later to Melville, Sask.

He graduated from the University of Saskatchewan in 1925 with a B.Sc. degree in agricultural engineering. He was an instructor in automotive engineering and farm machinery at the university for a year and then joined the engineering staff of the Canadian National Railways where he worked for three years. He was engineer in charge of construction with the Beauharnois Construction Company in the province of Quebec for seven years before joining the P.F.R.A. staff in 1936.

As senior assistant engineer with the Prairie Farm Rehabilitation Administration, Department of Agriculture, he was responsible for the organization and development of the engineering field staff as well as in charge of surveys and construction.

Mr. Mutchler had gone east several weeks ago as the P.F.R.A. representative of the western agricultural engineering committee and it was while there that his death occurred.

Mr. Mutchler joined the Institute as an Associate Member in 1938, becoming a Member in 1940.

News of the Branches

Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

EDMONTON BRANCH

G. H. Milligan, Affil.E.I.C. - *Secretary-Treasurer*

In the evening of October 20th the Edmonton Branch held a special meeting to welcome President de Gaspé Beaubien, General Secretary L. Austin Wright, and Mr. R. E. Heartz on the occasion of their visit to this branch. It took the form of a dinner meeting in the MacDonald Hotel with B. W. Pitfield, chairman of the Edmonton Branch, presiding when 117 members, their wives and guests sat down to dinner.

During the course of the evening President Beaubien addressed the meeting on **Industrial Relations and the Engineer,** following which Dr. Wright spoke briefly on Institute affairs and Mr. Heartz discussed the work of his committee in connection with P.C. 1003.

The men in the presidential party as well as several visiting councillors were taken on a tour of the American Army Air Base and the Civic Airport during the morning of October 21st, and in the afternoon the president addressed the Engineering students at the University of Alberta at which time he presented the E.I.C. prize for this year to Mr. Anatol Roshko.

On October 21st the Western council meeting was held in the MacDonald Hotel. It was presided over by President Beaubien and attended by some 22 councillors and visitors.

On both days the ladies in the presidential party were entertained by wives of the executive of the Edmonton Branch under the convenership of Mrs. B. W. Pitfield. The entertainment took the form of teas and drives to points of interest.

On Saturday, October 21st, President Beaubien Madame Beaubien, and others motored to Calgary and were followed later by the balance of the presidential party by railway.

HAMILTON BRANCH

W. E. Brown, M.E.I.C. - *Secretary-Treasurer*
L. C. Sentance, M.E.I.C. - *Branch News Editor*

On Tuesday, October 17th, members of the Hamilton Branch of the Institute met jointly with members and guests of the Hamilton Subsection of the American Institute of Electrical Engineers to hear Dr. Otto Holden, M.E.I.C., Chief Hydraulic Engineer of the Hydro Electric Power Commission of Ontario.

Dr. Holden spoke on **The Decew Falls Development—Past and Present.** This paper had previously been published in the October, 1943, issue of *The Engineering Journal.*

At the conclusion of his talk Dr. Holden answered numerous questions which were posed by an appreciative audience, many of whom had been closely associated with both old and new developments at Decew Falls.

The meeting was conducted under the chairmanship of H. W. Blackett for the American Institute of Electrical Engineers and N. Eager for the Engineering Institute. Attendance—115.

PRESIDENT AND MADAME BEAUBIEN AT EDMONTON

B. W. Pitfield, chairman of the Branch opens proceedings. The president is on his left and Madame Beaubien is on his right.

Above—Julian Garrett, president of the Alberta Association of Professional Engineers.

G. A. Gaherty with Mrs. Julian Garrett on his left.

Councillor E. Nelson introduces the president.

Above—Anatol Roshko receives the Institute prize.

Right—Mr. and Mrs. James McMillan of Calgary were welcome visitors.

At Lethbridge, the presidential visit took the form of a dinner, with the ladies present.

LETHBRIDGE BRANCH

T. O. Newman, m.e.i.c. - *Secretary-Treasurer*
A. G. Donaldson, m.e.i.c. - *Branch News Editor*

President de Gaspé Beaubien and General Secretary Dr. L. Austin Wright paid the Lethbridge Branch a brief visit October 27th. Accompanying the party were Mr. and Mrs. R. E. Heartz and Mr. G. A. Gaherty of Montreal.

A dinner meeting was held in the Marquis Hotel attended by approximately sixty engineers, their ladies and guests. P. E. Kirkpatrick, vice-chairman of the local branch acted as chairman in the absence of A. L. H. Somerville. The president and party were introduced by W. Meldrum, local councillor.

The president opened his remarks by depicting Canada as culturally holding a place half way between old Europe and the United States. He pointed out that the Dominion through its close ties to Britain has a good understanding of Europe while having enough of a bond with the United States to interpret the one to the other. He declared "Canada is the shortest way between civilizations," and predicted a bright future for the country, provided we are prepared to take advantage of the huge markets which will be immediately available for our industrial and agricultural products at the end of the war.

It will be Canada's responsibility to re-equip Europe with sorely needed machines. To cope with this is the duty of the engineers. We are fortunate to-day in having unprecedented numbers of skilled mechanics and technicians, a result of our expanded war-time industrialization, to help in this duty.

Economists generally agree that there will be a very wide market for about five years after hostilities cease. To retain markets after this will be up to the engineers, which can be done if we keep up our brilliant record of designing new machines and improving old. Engineers must broaden their range of activities and play a full part in public affairs. They must be prepared to take a lead in pulling the country through.

Canadians will not return to the old way of life, Mr. Beaubien stated. We have facilities for a much better and richer future and we will achieve it. The patriotic sense of Canadians has urged them to carry through a tremendous job during the war and it is a worthy undertaking that has been accomplished. The same spirit will prevail after the war.

MONCTON BRANCH

V. C. Blackett, m.e.i.c., *Secretary-Treasurer.*

On October 12th, the executives of the Moncton Branch of the Engineering Institute of Canada, the Board of Trade, the Junior Chamber of Commerce, and representatives from the City Council, heard J. S. Galbraith, m.e.i.c., of the National Housing Administration deliver an address on **Community Planning.** H. W. Hole, vice-chairman of Moncton Branch presided, and, at his request J. F. Parsons, president of the Board of Trade, introduced the speaker.

According to Mr. Galbraith, what people want most is light, fresh air and sunshine, and the work of community planning is to work with the ratios of people and space so that the former may have the greatest quantity of their three basic needs. To accomplish this, an even distribution of people is more desirable than a heavy concentration in a small area. It is now the standard practice to re-route main highways to avoid residential sections, and to dispense with the traditional grid system of laying out cities and substitute curved sections with adequate spaces for recreational facilities. Examples of well planned communities and crowded poorly laid-out cities were graphically displayed by slides and charts. The work of community planning, Mr. Galbraith said, is merely the scientific development of the community and, as such, is within the province of the engineer.

At the close of the address, a discussion period was held. A vote of thanks to the speaker was moved by Alderman T. B. Parlee.

MONTREAL BRANCH

L. A. Duchastel, m.e.i.c. - *Secretary-Treasurer*
H. H. Schwartz, Jr.e.i.c. - *Branch News Editor*

On Thursday, October 5th, the Montreal Branch held its first meeting of the 1944-45 season. Several films were shown among which was one of the recent Allied landings in Normandy. Another showed the construction and properties of Formica, a widely used plastic material. Refreshments were served at the close of the meeting.

Dr. Karl Terzaghi, the authority on soil mechanics, gave an address on Thursday, October 12th, to the Montreal Branch on the **Ends and Means in Soil Mechanics,** a copy of which appears elsewhere in this issue of the *Journal.* R. E. Chadwick presided over the meeting and the discussion period was led by Messrs. McCrory, Pratley and Elliot.

On Saturday, October 21st, Canada launched nine ships, one for each province, in a ceremony designed to send off the Seventh Victory Loan to a good start. As part of the plan, the United Shipyards of Montreal launched a 10,000 ton cargo vessel, the *SS. Portland*

PRESIDENTIAL VISIT TO CALGARY BRANCH

(*Left*) *Left to Right:* The president; H. B. LeBourveau, chairman of the Branch; Madame Beaubien, the general secretary.

Right: Councillor McMillan delights his audience. *Left to right:* Madame Bray, Mrs. S. G. Porter, R. E. Heartz.

Left: A general view of the dinner.

Park, and the Montreal Branch of the Institute was invited to attend the event. Several hundred members availed themselves of this opportunity. A complete radio description was provided by the Canadian Broadcasting Corporation.

Immediately after the launching a tour of the shipyards was to have taken place but, unfortunately, this had to be cancelled on account of rain.

NIAGARA PENINSULA BRANCH

J. H. Ings, M.E.I.C. - - - - *Secretary-Treasurer*
J. L. McDougall, M.E.I.C. - - *Branch News Editor*

The first meeting of the current season was held at the General Brock Hotel in Niagara Falls on October 26th, with O. G. Moffat, of the Air Control Department, Canadian Westinghouse Company Limited, Hamilton, as guest speaker. In the discussion of his subject, **Air Sanitation**, the speaker described in detail his company's dust collecting apparatus, the Precipitron, and also mentioned the Sterilamp and its applications.

The Precipitron has been developed primarily to eliminate extremely fine particles from the atmosphere, particles so fine that they will readily pass through the ordinary mechanical filter, and hence is applicable in cases where a very high percentage precipitation is required. After passing through a high-voltage electrical field, the particles are collected on banks of oiled plates spaced relatively close together, so that in industries where an extremely heavy accumulation of dust or lint is encountered, the Precipitron should be used in conjunction with a filter, in order to avoid rapid clogging of the collecting cells, and the resultant necessity of washing down the unit very frequently. Mr. Moffat brought with him a small commercial-sized unit, and demonstrated its effectiveness in filtering oil smoke. The result was really astounding.

The Sterilamp, a source of infra-red rays, is used in such places as hospital operating rooms for rendering inert various harmful organisms that may be present. The Sterilamp then, supplements instrument sterilization, thereby, further reducing the danger of infection.

SAULT STE. MARIE BRANCH WELCOMES PRESIDENT

Left—**Chairman A. M. Wilson opens the meeting to the delight of J. L. Lang, A. O. Evans, K. G. Ross and others.**

OTTAWA BRANCH

A. A. Swinnerton, M.E.I.C. - *Secretary-Treasurer*
R. C. Purser, M.E.I.C. - - *Branch News Editor*

At the noon luncheon of the Ottawa Branch held on November 9th two films were shown illustrating road construction in Northern Ontario. One dealt with the section between North Bay and Timagami and the other with that between Geraldton and Hearst. The latter section completed the Trans-Canada highway in 1942. Much of the construction was of a more difficult nature even than the more recently constructed Alaska highway and may be considered as a "dress rehearsal" for it.

The films, in colour, were taken by Walter Hutchinson, highway construction engineer for the North Bay district. During their showing W. L. Saunders, chairman of the Ottawa Branch and provincial highways engineer for the Ottawa area, gave a running commentary of the construction.

QUEBEC BRANCH

Gustave St-Jacques, M.E.I.C. - *Secretary-Treasurer*
Leo Roy, M.E.I.C. - - - - *Branch News Editor*

La branche de Québec commença son programme d'activités extérieures pour la saison 1944-45, par une causerie donnée le 6 novembre par le docteur Franco Rasetti, directeur de l'Ecole de physique de l'Université Laval.

Le docteur Rasetti traita, devant un auditoire de 51 membres ou invités, des rayons cosmiques. Il fit l'historique de leur découverte, décrit les moyens de les mesurer, signala quelques-unes de leurs caractéristiques et dévoila l'immense travail de recherches à accomplir pour les mieux connaître afin de voir s'ils peuvent avoir une valeur commerciale. Il fut présenté par monsieur J. O. Martineau, vice-président de la branche, et remercié par monsieur Yvan Vallée, sous-ministre provincial des Travaux Publics.

Le 13 novembre, monsieur Marcel Laflamme, ingénieur éclairagiste à la Canadian General Electric Company, traita du sujet **The Magic of the Spectrum.** Un auditoire de 151 membres, invités et étudiants apprécia les nombreuses démonstrations qu'il fit avec les différentes lampes.

Les propriétés des lampes au mercure, au sodium, germicides, infra-rouges, fluorescentes furent étudiées. Les possibilités commerciales de la lumière polarisée furent aussi envisagées. De nombreuses questions furent posées au conférencier qui fut présenté par le président de la branche, monsieur E. D. Gray-Donald, et remercié par monsieur P. Méthé.

REGINA GREETS PRESIDENT BEAUBIEN

Above: At the Council meeting of the Association. *Left to right:* Prof. Spencer, President Beaubien and President Patton.

Left: At the dinner meeting: J. McD. Patton presided as president of the Association and chairman of the Branch.

THE PRESIDENT AT SASKATOON

Left: The president presents the Institute prize to H. M. Graham.

Right: A luncheon meeting. *Left to right:* R. E. Heartz, Dr. W. P. Thompson, president of the university; the president, and Dean R. A. Spencer.

SASKATCHEWAN BRANCH

Stewart Young, M.E.I.C. - *Secretary-Treasurer*

The Saskatchewan Branch, jointly with the Association of Professional Engineers, met in the Hotel Saskatchewan, Regina, on Wednesday evening, October, 18, 1944, to welcome President de Gaspé Beaubien, O.B.E. Accompanying the president were L. A. Wright, general secretary, R. E. Heartz, councillor, Montreal Branch, and W. P. Brereton, vice-president, Western Zone. The meeting was preceded by dinner at which the attendance was 48.

President Beaubien addressed the meeting on the place of the engineer in the development of Canada. Stating that "The engineer understands the economics of production and can interpret them to both labour and management", he pointed out that Canada has a great future.

During the afternoon the wives of the members entertained Mme Beaubien, Mme Bray, Mrs. Heartz and Mrs. Brereton at tea. The attendance was 40.

TORONTO BRANCH

S. H. de Jong, M.E.I.C. - *Secretary-Treasurer*
G. L. White, Affil.E.I.C. - *Branch News Editor*

The members of the Toronto Branch met in the Debates Room, Hart House, on October 19th to discuss Trades Training.

Colonel W. H. Bonus, Director-General of Trades Training for the army, summarized the methods used in teaching his men the army trades. He explained that by upgrading the men from the simpler to the higher skilled trades, nearly every soldier was able to find his mark without undue loss of time.

G. M. Gore in charge of the War Emergency Courses of the Central Technical School, Toronto, spoke on the work of this institution in the war effort and gave many suggestions as to how to make the best use of a technical school after the end of hostilities.

J. M. Piggot of the Piggot Construction Company, Hamilton, stated that apprenticeship was the most important part of Trades Training. Boys of 16 years should be apprenticed for ten months of the year and then put in technical school for the slack periods of January and February. Here they would be taught the finer points which are difficult and costly to teach in the field. Before 1921 apprentices in Canada were practically non-existent and the country was relying on immigration for its skilled craftsmen. Contractors and Trade Union officials were wise enough to see the folly of this condition and in 1923 persuaded the Government to pass the Ontario Apprenticeship Act. To date there have been about 3,000 graduate apprentices and about 700 in training at the present time.

In the business portion of the meeting E. A. Cross was called upon to give a report on the meeting held between the representatives of 20 Toronto Technical Societies. The meeting was called to discuss the possibilities of erecting a building to serve the needs of all these societies for a meeting place. It was hoped that it would have an auditorium seating at least 350 persons, also committee rooms, club rooms and a paid secretary to look after much of the detail work of the societies now done by voluntary help. Office space would be available for rent to architects, consulting engineers and contractors. Mr. Cross reported that the idea was strongly supported and that a committee was chosen to look into the matter further to find ways and means of bringing it about.

After the discussion period the meeting was adjourned.

VANCOUVER BRANCH

J. G. D'Aoust, M.E.I.C. - *Secretary-Treasurer*
P. B. Stroyan, M.E.I.C. - *Branch News Editor*

The Vancouver Branch held its second meeting of the season on November 3rd during the visit of President de Gaspé Beaubien, who was accompanied by Mrs. Beaubien, Mr. and Mrs. Heartz, Mrs. Bray and General Secretary L. Austin Wright.

At the dinner meeting C. E. Webb introduced President Beaubien who spoke on his impressions of the trip across Canada. He dealt in some detail with Canada's progress in the last few years and her position in the industrial world of to-day. The enormous increase in industrial activity and technical development due to the war was stressed. In view of these developments, and because of the devastation wrought in the war torn countries, the speaker felt that there should be no concern for the future outlets of the products of industry and agriculture. In Mr. Beaubien's opinion the most difficult problem to be solved during the post war period would be the bridging of the gap between labour and management resulting from labour legislation and he called upon engineers, who by the nature of their work were the logical intermediaries between the two groups, to strive for unity between them. He felt that labour organizations would be useless in coping with the situation but that engineers who understand labour could, by ceaseless effort, maintain the necessary relations between management and the workers. He stated that there will be no time to rest when victory is achieved.

Councillor R. E. Heartz reviewed at some length the work of the Institute and of the Committee on Employment Conditions, of which he is chairman, in connection with Order-in-Council P.C. 1003. Although it was not possible at this time to say very much about the details of the work, Mr. Heartz left no doubt in the minds of his listeners that their interests were being cared for capably.

Dr. Austin Wright, general secretary of the Institute, gave a detailed review of Institute affairs. As it was four years since his last visit to Vancouver, Dr. Wright had a considerable amount of ground to cover in his remarks. The problem of engineers on active service, town planning and architects, and the publication of the *Journal* were among the interesting topics discussed.

Among other speakers during the evening were H. C. Anderson, president of the Association of Professional Engineers of British Columbia, and Dr. E. A. Cleveland.

The executive met the president, Councillor R. E. Heartz, and the general secretary at a luncheon held on Thursday, November 2nd, when Branch affairs were discussed.

The ladies of the presidential party were entertained at luncheon and at afternoon tea by wives of the members.

WINNIPEG BRANCH

T. E. Storey, M.E.I.C. - *Secretary-Treasurer*
V. W. Dick, M.E.I.C. - *Branch News Editor*

On Sunday, October 15th, President de Gaspé Beaubien and Dr. L. Austin Wright arrived in Winnipeg on their tour of the western branches to make a three-day visit with the Winnipeg Branch, with Councillor R. E. Heartz joining the party on Monday.

President Beaubien spoke to the Engineering Students of the University of Manitoba, Monday afternoon. At this meeting a certificate was presented by Mr. Beaubien to John Edward Page, winner of the Engineering Institute of Canada student's prize for 1943.

Monday evening the Winnipeg Branch executive and the Winnipeg Annual Meeting Committee held a dinner meeting at the Royal Alexandra Hotel, at which President Beaubien, General Secretary L. Austin Wright and Councillor R. E. Heartz were honoured guests. Madame Beaubien was entertained by the Winnipeg Engineers Wives Association, a reception being held in her honour at University House.

On Tuesday, a special noon hour luncheon meeting was held in the Hudson's Bay main dining room in honour of the presidential party, under the chairmanship of Thos. H. Kirby. Seated at the head table were: C. S. Rimington, president A.P.E.M.; Councillor R. E. Heartz, Vice-President W. P. Brereton, President de Gaspé Beaubien, Chairman T. H. Kirby, Dr. L. Austin Wright, general secretary; H. L. Briggs, councillor; Dean E. P. Fetherstonhaugh, president-elect; C. P. Haltalin, vice-chairman.

PRESIDENT BEAUBIEN AT WINNIPEG

Left to right: Lee Briggs, Dean Fetherstonhaugh, C. P. Haltalin, Fred Seibert.

Left: Presidential nominee Dean Fetherstonhaugh and President de Gaspé Beaubien.

R. E. Heartz, Vice-President W. P. Brereton, the president, Chairman T. H. Kirby.

The "service stick". J. E. Page receives the Institute Prize.

Mr. Beaubien was introduced by Vice-President W. P. Brereton. The president opened his talk by references to the experiences of his trip across Canada, and stated that Canada stands half way between the culture of the Old Country and that of the U.S.A. and can interpret both. After detailing the enormous expansion of Canadian industry in our war effort, the president expressed the belief that due to the great demand for agricultural and industrial products at the end of the war, there would likely be a 5 or 10 year period of expansion after the war is ended, and that Canada will be able to use its factories, technical staff and skilled labour to practically full capacity. In order to compete in the post-war market, Canadian products must be produced at a price, and an educational campaign is needed between labour, management and the public. This is a great opportunity for engineers to assist in promoting the necessary understanding between these groups, since in general the engineer has the confidence of labour, understands the laws of production, and is necessary to management for all machine and engineering designs.

Dean E. P. Fetherstonhaugh moved a vote of thanks to President Beaubien for his address.

Councillor R. E. Heartz then addressed the meeting and gave a detailed description of the work done by the Institute's Committee on Employment Conditions in connection with Order P.C.-1003, including the results of the recent questionnaire on this subject. The present standing of the negotiations at Ottawa was outlined and the hope was expressed that in due course the engineers would have something better than P.C.-1003 to bargain under.

Dr. L. Austin Wright, general secretary, spoke at some length regarding the year's activities at Headquarters, since most members are not in touch with the work carried on by the Institute. Items dealt with included membership, the *Journal,* treatment of engineers in active service, land mine survey, town-planning situation, technical institutes, and other matters which were of great interest to all those present.

A special luncheon and reception was held on Tuesday at 12.30 at Picardy's Salon, at which Mrs. de Gaspé Beaubien and Mrs. R. E. Heartz were honoured guests.

PRESIDENTIAL VISIT TO LAKEHEAD

Right to left—R. B. Chandler, Chairman S. T. McCavour, the president, Vice-President Murray Fleming and Gordon O'Leary.

J. Antonisen interviews the president.

At Steep Rock—*Right to left*—F. M. Fotheringham, mine manager; Gordon O'Leary and the president.

Library Notes

Book notes, Additions to the Library of The Engineering Institute, Reviews of New Books and Publications

ADDITIONS TO THE LIBRARY

TECHNICAL BOOKS

The Romance of Mining:
T. A. Rickard. Toronto, MacMillan Company of Canada, 1944. 5½ x 8¾ in. $3.75.

Aircraft Sheet Metal Blueprint Reading:
Harry H. Coxen, Gerald E. Jackson and Gilbert D. Masters. Chicago, American Technical Society, 1944. (Canadian representative General Publishing Co., Toronto). $3.75 (Canadian price).

Canadian Standards Association—Specifications:
A82.1—1944: Building brick (made from clay and shale). A82.2—1944: Standard methods for sampling and testing brick. A82.3—1944: Sand-lime building brick. A82.4: Structural clay load-bearing wall tile. A82.5—1944: Structural clay non-load-bearing tile. A82.6—1944: Standard methods for sampling and testing structural clay tile.

TRANSACTIONS, PROCEEDINGS

Society for the Promotion of Engineering Education:
Proceedings of the fifty-first annual meeting held at Chicago, Ill., June 18-20, 1943.

The Smithsonian Institution:
Annual report of the Board of Regents for the year ended June 30, 1943.

University of Toronto—Engineering Society:
Transactions and yearbook 1944.

REPORTS

Alberta—Research Council:
Report No. 35: Coals of Alberta, their occurrence, analysis and utilization by Edgar Stansfield and W. Albert Lang.

U.S. Bureau of Mines—Bulletin:
No. 458: Quarry accidents in the United States during the calendar year 1942.

U.S. Bureau of Mines—Technical Paper:
No. 667: Carbonizing properties of western region interior province coals and certain blends of these coals.—No. 670: Carbonizing properties of Pocahontas No. 3-bed coal from Kimball, McDowell County, W.Va., and the effect of blending this coal with Pittsburgh-bed coal.

McGill University:
Annual report 1943-1944.

American Society of Mechanical Engineers:
Addenda to the A.S.M.E. Boiler Construction code approved August 1944.

Purdue University—Engineering Extension Department—Bulletin:
Extension series No. 56: Proceedings of the thirtieth annual road school.

Massachusetts Institute of Technology—Department of Civil and Sanitary Engineering:

Serial No. 87: Model analysis of structures by Charles H. Norris.

Harvard University—Graduate School of Engineering:

Bulletin No. 394: A numerical method in the theory of vibrating bodies.—No. 395: Single and double stub impedance matching.—No. 396: Transmission line theory applied to wave guides and cavity resonators.

The Electrochemical Society—Preprints:

No. 86-13: Efficiency factors of cylindrical chlorine cells. No. 86-14: The anode problem in the electrodeposition of manganese dioxide. No. 86-15: Microscopic and diffraction studies on dry cells and their raw materials. No. 86-16: Practical aspects of the selection of frequency and time cycles for the processing of metallic parts by induction heating. No. 86-17: Chlorine cells in pulp mills. No. 86-18: Induction heating and its application to annealing and melting. No. 86-19: Electrochemical and allied industries of the Niagara frontier. No. 86-20: Effect of digesting, autoclaving and neutralizing some battery manganese dioxides. No. 86-21: The development of substitutes for Shawinigan acetylene black in dry batteries. No. 86-22: Case hardening by megacycle induction heating.

BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet all of these books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

A.S.T.M. STANDARDS ON COAL AND COKE

Prepared by A.S.T.M. Committee D-5 on Coal and Coke, American Society for Testing Materials, 260 So. Broad St., Philadelphia, Pa., Sept. 1944. 124 pp., illus., diagrs., charts, tables, 9 x 6 in., paper, $1.50.

This pamphlet brings together conveniently the Association's current directions for sampling, analyzing and testing coal and coke.

THE CONTROL OF GERMANY AND JAPAN

By H. G. Moulton and L. Marlio. Brookings Institution, Washington, D.C., 1944. 116 pp., tables, maps, 9¼ x 6 in., cloth, $2.00.

This new publication of the Brookings Institution is concerned with the problem of preventing future military aggression by Germany and Japan. The possibilities of their control by various economic measures, such as restriction of the importation of raw materials and the control of key industries are discussed, and the disadvantages of various plans are noted. A military control plan is described which offers possibilities and which the authors believe to be the only effective means of checking aggression.

Galvanómetros y Oscilógrafos, Tomo 1—GALVANÓMETROS

By S. Gerszonowicz. La Facultad de Ingenieria de Montevideo, University of Montevideo, Montevideo, Uruguay, (obtainable through G. E. Stechert & Co., 31 East 10th St., New York 3, and Editorial Médico-Quirúrgica, Buenos Aires, Diagonal Norte 615.) 1943, 391 pp., diagrs., charts, tables, 10 x 7 in., paper, $6.00.

This book is a very detailed and encyclopedic discussion of galvanometers, especially from the viewpoint of the user. Their theories, construction and performance are considered at length. Moving magnet, moving-coil and string galvanometers, electrodynamometers, induction instruments and moving-iron and electrothermic instruments are discussed. A final chapter tabulates the data on current instruments found in the catalogues of fifteen American and European manufacturers. Each chapter has a bibliography.

MECHANICAL SPRINGS

By A. M. Wahl. Penton Publishing Co., Cleveland, Ohio, 1944. 435 pp., illus., diagrs., charts, tables, 9¼ x 6 in., cloth, $6.00.

The fundamental principles that underlie the design of mechanical springs are presented, together with the more important developments in spring theory and testing that have occurred in recent years. Special attention is given to helical springs, to the calculation of their stresses and to their fatigue properties. Other springs discussed include disk, flat, leaf, torsion, spiral, volute and ring springs, and rubber springs and mountings.

National Research Council, HIGHWAY RESEARCH BOARD, Proceedings of the Twenty-third Annual Meeting held at Edgewater Beach Hotel, Chicago, Illinois, November 27-30, 1943; edited by R. W. Crum and F. Burggraf.

National Research Council, 2101 Constitution Ave., Washington 25, D.C., 1944. 606 pp., illus., diagrs., charts, maps, tables, 10 x 6 in., cloth, $3.50.

Some fifty technical papers dealing with highway research and planning are included in this volume. They are grouped under the following classifications: economics; design; materials and construction; maintenance; traffic and operations; soils; and aerial photography. Reports of particular committees are found under their proper respective classifications. A wide variety of information on current topics is provided in the 600 pages contained in the book.

NON-FERROUS METALS (Post-War Building Studies No. 13)

By a Committee convened by The British Non-Ferrous Metals Research Association; published for the Ministry of Works by His Majesty's Stationery Office, London, 1944. 72 pp., tables, 9½ x 6¼ in., paper, 1s. (obtainable from British Information Services, 30 Rockefeller Plaza, New York, 35c.).

This report provides a practical review of the uses of non-ferrous metals in building construction. After describing the general characteristics of these metals, their resistance to corrosion, mechanical properties and the methods of working and jointing them are considered. The report then discusses the suitability of each for special uses, such as for pipes, tanks, roofing and fittings. Finally, the recommendations are summarized.

PLASTICS MOLDS, Design, Construction, Use

By G. B. Thayer. 2 ed. American Industrial Publishers, Fairmount-Cedar Bldg., Cleveland 6, Ohio, 1944. 136 pp., illus., diagrs., 9¼ x 6 in., cloth, $3.50.

An experienced engineer here presents his ideas on the design and construction of molds. The various classes of molds used in compression and injection molding are described, and detailed description of various molds given. New material has been added to this edition, including contributions by several collaborators.

RIFLES AND MACHINE GUNS, a Modern Handbook of Infantry and Aircraft Arms

By M. M. Johnson. William Morrow and Co., New York, 1944. 390 pp., illus., diagrs., tables, 9½ x 6 in., cloth, $5.00.

Modern small arms are analyzed from the practical viewpoint of use. The book describes all the important United States and foreign weapons of the period of World War II from the rifle and pistol to the aircraft machine gun, covering their development, operation, loading, firing and disassembling, with data on their ammunition, stoppages, accuracy and employment. Line drawings and photographs illustrate the text.

(The) TECHNIQUE OF THE TERRAIN, Maps and Their Use in the Field in Peace and War

By H. A. Musham. Reinhold Publishing Corp., New York, 1944. 228 pp., illus., diagrs., charts, maps, tables, 9¼ x 6 in., linen, $3.85.

This book is intended as a text on maps and their uses in field operations in war and peace. It is not concerned with the making and production of maps nor does it cover the whole subject of topography. The first twelve chapters deal with general considerations such as scales, relief, coordinates, etc., while the last four chapters cover briefly aerial photography, tactical topography, maps and logistics, and military geography. Numerous tables of pertinent data are appended for reference use.

ULTRA-HIGH-FREQUENCY RADIO ENGINEERING

By W. L. Emery. Macmillan Co., New York, 1944. 295 pp., diagrs., charts, tables, 8¾ x 5½ in., cloth, $3.25.

Intended for electrical engineering students with a background in elementary communication and electronics, this text is confined to basic principles. Emphasis has been placed on the discussion of the component parts of U.H.F. systems. The problems and experiments included provide a comparison between theoretical and experimental results. A list of literature references accompanies each chapter.

USES AND APPLICATIONS OF CHEMICALS AND RELATED MATERIALS, Vol. 2

By T. C. Gregory. Reinhold Publishing Corp., New York, 1944. 459 pp., 9¼ x 6 in., cloth, $9.00.

This compilation is intended for sellers, users and makers of chemicals and related materials. It lists some 2,600 such substances and tells their uses in detail. It also lists them by uses. Patents which control certain uses of various chemicals are listed and the addresses of patent owners given. There is an index of synonyms. The book supplements the first volume, issued in 1939, and the indexes of uses and patents cover both volumes.

PRELIMINARY NOTICE

of Applications for Admission and for Transfer

Nov. 27, 1944.

The By-laws provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described at the January meeting.

L. Austin Wright, General Secretary.

*The professional requirements are as follows:—

A Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science or engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examination of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainment or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

ANDERSON—THOMAS TULLOCH, of Arvida, Que. Born at Shetland Islands, Scotland, Nov. 3rd, 1917. Educ.: B.A.Sc. (Chem.Eng.), Univ. of B.C., 1942; 1939 and 1942, various types of plant testing and control work for Powell River Pulp & Paper Co. Ltd., as undergraduate and finally as graduate; 1942 to date, asst. supervisor, hydrate dept. and supervisor, precipitation dept., i/c alumina precipitation, classification and thickening, Bayer ore plant, Aluminum Co. of Canada, Ltd., Arvida, Que.

References: G. A. Antenbring, A. C. Johnston, D. D. Reeve, A. T. Cairncross, P. M. deChazal.

BALL—J. STEWART, of Montreal, Que. Born at Toronto, Ont., April 5th, 1908. Educ.: B.A.Sc., Univ. of Toronto, 1933; with the Hydro-Electric Power Commn. of Ont. as follows: 1927 (summer), chainman, 1927-28 and 1929-30 (summers), lab. asst., Toronto, 1931 (summer), oiler, Queenston Power House; with the Shell Oil Co. of Canada as follows: 1933-34, operations dept., Toronto, 1934-36, engineering dept., Toronto, 1936-40, dfting., layout, master mechanic, and 1940 to date, mech. and mtce. engr., Montreal East Refinery.

References: J. E. Sproule, S. Mitcheson, C. E. Bedford-Jones, J. P. Borbey, H. J. Muir.

BARBER-STARKEY—JOSEPH WILLIAM MAINGUY, Lieut. (E), R.C.N., of Sidney, B.C. Born at Shrewsbury, England, Sept. 28th, 1918. Educ.: 1937-40, Royal Naval Engineering College, Devonport; 1941, training for Watchkeeping Certificate in 7,000-ton cruiser (later awarded certificate), i/c steaming watch and also Engr. Officer for turbo generators, steering gear, etc.; 1942, Dfting. Officer, engine room ratings, and 1942 (Sept.) to 1943, asst. to Supervising Naval Overseer, Esquimalt, acting as Engineer Overseer on frigates under constrn. at Yarrows, Ltd.; 1943 (March-July), Officer i/c course and responsible for producing syllabus, acting as chief instructor and Divisional Officer to 50 probationary Sub. Lieuts. (E), R.C.N.V.R. At present, convalescent following discharge from R.C.N. for medical reasons.

References: E. W. Izard, N. A. Yarrow, A. D. M. Curry, B. R. Spencer.

BLAYLOCK—SELWYN GWILLYN, of 410 Ritchie Ave., Trail, B.C. Born at Paspebiac, Que., Feb. 18th, 1879. Educ.: B.A.Sc., 1899, and LL.D., 1929, McGill Univ.;LL.D., Univ. of Alberta, 1930; R.P.E. B.C.; 1899-03, chemist, and 1903-06, engr., metallurgist and purchasing, Consolidated Mining & Smelting Co.; 1907, genl. supt., Hall Mines Smelting Co.; 1907-10, genl. supt., St. Eugene Mines; with the Consolidated Mining & Smelting Co., Trail, B.C., as follows: 1910-19, asst. genl. mgr., 1919-27, genl. mgr. and director, 1939-43, pres. and mgr., 1943 to date, chairman and pres.

References: G. H. Bancroft, T. W. Lazenby, A. C. Ridgers, S. C. Montgomery, deGaspé Beaubien.

BLEAKEN—MAYNARD DOLLERY, of Fort William, Ont. Born at Winnipeg, Man., April 13th, 1913. Educ.: B.A.Sc., Univ. of Toronto, 1940; 1941 (7 mos.), asst. chief mill inspr., Cdn. Johns-Manville, Asbestos, Que.; with the D.I.L. as follows: 1941-43, supt. of cartridges and propellants, Bouchard Works, 1943 (5 mos.), asst. to planning supervisor, 1943-44, tool controller, Westmount Tool Works. At present, mech. engr. for hydraulic equipm't., aircraft divn., Canadian Car & Foundry, Fort William, Ont.

References: A. T. Hurter, D. S. Laidlaw, W. G. Scott.

BOHRAUS—WERNER, of Thorold, Ont. Born at Zurich, Switzerland, Dec. 15th, 1898. Educ.: Elec. Engineer, The Swiss Federal Inst. of Technology, Zurich, 1924; R.P.E. Que.; R.P.E. Ont.; 1913-19, elec. shop practice, and 1924-27, sales and planning of rectifier substations for large outputs, test stand for rectifiers, etc., Brown Boveri & Co., Baden Switzerland; 1927-35, elec. dfting. and designing on many large constrns., including Royal York Hotel, Sun Life Assce. Bldg., 3 hospitals, etc., Canadian Comstock Co.; 1935, elec. design for rewiring Beauharnois plant, Howard Smith Paper Mills, Ltd., and elec. design for Bayer process plant, Aluminum Co. of Canada, Arvida; 1936 to date, designing elec. engr., all elec. constrn. in Ontario and Quebec, Ontario Paper Co. Ltd., Thorold, Ont.

References: M. H. Jones, A. D. Ross, D. Anderson, H. C. Karn, G. E Griffiths, A. W. Lash.

BURTON—GEORGE ERNEST, Flt. Lieut., R.C.A.F., of 111 Bayswater Ave., Ottawa, Ont. Born at Peterborough, Ont., June 8th 1904. Educ.: Grad., R.C.A.F. School of Aero. Engrg.; 1923-27, ap'ticed engr.; 1927-30, cost clerk and 1930-33, asst. to chief accountant, Shawinigan Engrg. Co. Ltd.; 1934-35, master mechanic, Cross Roads Gold Mines; 1935-37, produc'n. inspr., Beatty Bros.; 1937-39, mtce. engr., Spruce Falls Power & Paper Co.; 1939-40, tool designer and toolmaker, Ottawa Car & Aircraft Co.; 1940-41, School of Aero. Engrg., R.C.A.F., 1941, Aero. Engr., i/c accidents investigation, 1941-43, Sqdn. Engr. Officer, overseas, 1943-44, O.C. Aircraft Servicing Echelon, 1944, O.C. Servicing Sqdn. and later O.C. Repair and Inspn. Sqdn., repatriated to Canada Oct., 1944. At present, Aero. Engr. Officer, and O.C. Mtce. Unit, R.C.A.F., "Uplands."

References: J. A. Ferrier, E. W. Stedman, K. Y. Lockhead.

CAMERON—NORMAN SIDNEY, Elect. Lieut., R.C.N.V.R., of Edmonton, Alta. Born at Biggar, Sask., Feb. 1st, 1911. Educ.: B.Sc. (Arts), Univ. of Alberta, 1935; 1926-28 (summers), timekeeper and material clerk, Cdn. National Rlys.; 1937-42, inspr., weights and measures, Dominion Govt.; 1942-43, A/S Base Mtce. and Installn. Officer, R.C.N., Prince Rupert, and 1943-44, A/S Base Mtce. Officer, Esquimalt, B.C. At present, student, undergoing a conversion course to aircraft mtce. duties, Univ. of Toronto, Toronto.

References: A. D. M. Curry, W. S. E. Morrison, T. Fife.

COLLS—EDWARD ARTHUR GEOFFREY, of Trail, B.C. Born at London, England, July 22nd, 1902. Educ.: 1920-23, fuel diploma course, Univ. of Sheffield; 1922 (summer), chemist, Bureau of Mines, England; 1923 (6 mos.), asst. chemist to steel mgr., Messrs. Steel, Peech & Tozer, Ltd., Sheffield; with the Consolidated Mining & Smelting Co. of Canada, Ltd., Trail, B.C., as follows: 1923, assayer, 1925-28, tech. foreman, elec. fce. plant, 1931-33, supt., ammonia plant, 1933-36, supt., hydrogen and ammonia plants, 1936-40, asst. supt., 1940-43, supt., and 1943 to date, genl. supt., chemical and fertilizer dept.

References: S. C. Montgomery, A. C. Ridgers, T. W. Lazenby, G. H. Bancroft, C. E. Marlatt.

DeWolf—EDWARD GERALD, Sub.-Lieut. (E), R.C.N.V.R., of Halifax, N.S. Born at Halifax, N.S., Sept. 12th, 1921. Educ.: B.Eng. (Mining), N.S. Tech. Coll., 1944; 1937-42 (summers), Imperial Oil Refinery; 1943, 2nd Lieut., R.C.E. At present, Sub.-Lieut., R.C.N.V.R.

References: A. E. Flynn, E. L. Baillie, R. W. McColough, S. W. Gray.

DIES—ABRAM STUART, of 4870 Hingston Ave., Montreal, Que. Born at Shannonville, Ont., Sept. 22nd, 1901. Educ.: B.S.A. (Chemistry), Ontario Agricultural College, Guelph, Ont., 1928; I.C.S. course in elec. engrg.; 1921-22, experimental dept., and 1922-23, tool design, Kelsey Wheel Co., Detroit, Mich.; with the Canada Cement Co. Ltd. as follows: 1926-27 (summers), lab. asst., and 1928-29, asst. chemist, Belleville, Ont., 1929-31, transferred to Hull plant to study wet process rotary kiln operation, 1931-34, genl. foreman, coal pulverizing and kiln room, plant No. 1, Montreal East, 1934-42, genl. foreman i/c all plant operations, engrg. and dfting., 1943, asst. supt., plant No. 3, Hull, Que., 1943 to date, genl. kiln supervisor, responsible for kiln operation and mtce. in all plants.

References: A. G. Fleming, E. Viens, H. S. Van Scoyoc, W. G. H. Cam, J. M. Breen, J. A. Creasor.

FOSS—LEIV, of Montreal, Que. Born at Kristiansund, Norway, Oct. 22nd, 1902. Educ.: Civil Engineer, Royal Institute of Technology, Trondhjem, Norway, 1927; 1919 (summer), chainman; 1925 (summer), surveying, triangulation, etc.; 1927-28, engr., road constrn., Tromso, Norway; 1929, chainman, dept. of water supply, C.N.R., western region; 1929-31, reinforced concrete designer, Northwestern Power Co., Winnipeg; 1931-35, field dftsman. and res. engr., Dept. of Northern Development, Kenora, Ont.; 1936-39, sub-foreman, mechanic and dftsman., hydro-electric system, City of Winnipeg; 1940-44, field engr., on constrn. of Aluminum Plant at Arvida, and at present, design engr., The Foundation Co. of Canada, Ltd., Montreal, Que.

References: H. V. Serson, H. L. Briggs, J. W. Sanger, W. Griesbach, L. H. Burpee, M. V. Sauer.

GARNER—ALBERT GEORGE, of 335 Douglas St., Stratford, Ont. Born at London, England, July 21st, 1883. Educ.: Borough Polytechnic (evening classes in bldg. constrn.); R.P.E. Ont.; 1897-07, Math. T. Shaw & Co. Ltd., London; 1909-13, chief dftsman., 1913-18, chief engr., and 1918-26, vice-pres. and chief engr., Stratford Bridge & Iron Works, Stratford, Ont.; 1928-31, sales engr., McGregor-McIntyre Iron Works and Dominion Bridge Co.; 1931-37, private practice, Stratford; 1937 to date, sales engr., engrg. and contracting dept., Hamilton Bridge Co.

References: C. C. Parker, A. Love, F. T. Julian.

HAWKINS—STUART SCHOFIELD, Capt., R.C.E., of Montreal, Que. Born at Walkerville, Ont., Dec. 16th, 1887. Educ.: B.A.Sc. (Arch.), McGill Univ., 1911; M., R.A.I.C.; 1906 (summer), constrn., G.T.P. Rly.; 1907 (summer), genl. contract work, 1908 (summer), reconstrn. of engrg. bldg., McGill Univ., and 1910, i/c Ottawa office for Byers & Anglin, contractors; 1911-15, chief dftsman., Winnipeg School Board; 1915-19, Overseas with 78th Btn.; 1919-20, i/c Kingston Unit, Engrg. Branch, D.S.C.R.; 1920-24, dftsman., premises dept., Merchants Bank, Viau & Vienne, Bell Telephone; 1924-31, i/c archtl. work, Price Bros. & Co., constrn. of Town of Riverbend, etc.; 1932-33, clerk of works, Neurological Institute; 1933-39, asst. supt. bldgs. and grounds, McGill Univ.; 1939-40, clerk of works, Sir Arthur Currie Gym.; 1940 to date, Works Officer, R.C.E., H.Q., M.D. No. 4.

References: G. L. Wiggs, G. M. Pitts, L. H. D. Sutherland, W. G. Hunt, R. E. Jamieson, H. R. Little, H. L. Trotter, J. R. Donald, G. H. Kirby.

HUTCHISON—WILLIAM LESLIE, of 57 Knoll Drive, Hamilton, Ont. Born at Ottawa, Ont., July 18th, 1911. Educ.: B.Eng., McGill Univ., 1934; 1930-32 (summers), carpenter's helper, etc.; with the Wabi Iron Works, New Liskeard, as follows: 1934-36, dftsman., 1936-38, chief dftsman., responsible for design and detailing of all products, 1938-40, plant supt., responsible for operation of pattern shop, hall foundry, gray iron foundry, mach. shop, etc., 1940-42, in complete charge of operations and management of the organization; 1942 to date, general supt., Hamilton Bridge Co. Ltd., Hamilton, Ont.

References: H. J. A. Chambers, W. Nicol, A. Love, H. W. Sutcliff, N. L. Crosby, W. S. Macnamara.

LUSCOMBE—HARRY, Staff Captain, Air Survey Liaison Section, Canadian Army Overseas. Born at Plymouth, England, Dec. 19th, 1891. Educ.: 1911-12, Plymouth Polytechnical School (evening classes), and also during this period articled pupil to A. N. Cole, structl. engr.; 1913, field dftsman., transitman, C.N.R., 1914-19, Sgt. Major and Lieut. R.F.A., overseas; 1919-22, asst. divn. engr., G.T.Rly.; 1922-29, own practice in California; 1929-32, produc'n. mgr., Fairchild Aerial Survey; 1932-40, own practice aerial mapping; 1940, Lieut., R.C.E. (Survey); 1940-41, Lieut., (Field Engr.), H.Q. 2nd Cdn. Divn. Engrs.; 1941-42, Lieut., 1st Cdn. Field Survey Coy.; 1942-43, DD Survey Staff, 1st Cdn. Army; 1943 to date, Staff Capt., 30th Cdn. Air Survey Liaison Section, Cdn. Army Overseas. (A.M., E.I.C. 1920-26)

References: J. P. Mackenzie, W. Walker, L. G. Trorey.

LYMAN—STEPHEN M., of 4155 Cote des Neiges Road, Montreal, Que. Born at Westmount, Que., July 19th, 1910. Educ.: Diploma, R.M.C., 1932; B.Eng. (Civil), McGill Univ., 1934; 1928-29-30 (summers), power house constrn. and modernization projects, Shawinigan Engineering Co.; with the C.I.L. as follows: 1934-35, dfting. and design, engrg. dept., 1937, modernization project in salt plant, 1938-39, asst. to res. engr., design and constrn. of small units of chemical plant, and 1940, asst. to res. engr., design and estimate for wartime expansion of chlorine plant; 1941, Squadron Engineer Officer, Central Flying School, R.C.A.F., Trenton, Ont.; 1941-42, organization and supervn. of tech. training programme, and 1942-43, supt. of services, supervn. of personnel, training, stores and bldg. mcte. depts., D.I.L. At present, asst. project engr., industrial engineering section, C.I.L., Montreal.

References: I. R. Tait, A. B. McEwen, A. T. E. Smith, C. H. Jackson, H. B. Hanna, B. A. Evans, C. R. Lindsey.

McGILLIVRAY—DONALD LACHLAN, Lieut. Cmdr. (E), of Ottawa, Ont. Born at Sarnia, Ont., Nov. 2nd, 1914. Educ.: B.Sc. (Chem. Eng.), Queen's Univ., 1937; 1934-36 (summers), lab. technician, and 1937-40, junior research chemical engr., technical service divn., Imperial Oil Ltd., Sarnia,Ont.; with the R.C.N. as follows: 1940-41, Sub.-Lieut. (E), Engineer Officer in Training, 1941-42, Lieut. (E), Engineer Officer of Watch, engine and boiler rooms, 1942 (3 mos.), Engineer Officer (chief engr.), 1942 to date, technical advisor on petroleum products (fuels and lubricants), R.C.N. at N.S.H.Q., Ottawa, Ont.

References: G. L. Stephens, A. C. M. Davy, D. H. Parker, A. Jackson, J. H. Parkin.

McKINNON—WILLIAM JOHN, of 5134 Azilda St., Montreal, Que. Born at Montreal, Nov. 1st, 1911. Educ.: B.Eng. (Mech.), McGill Univ., 1944; 1930-40 and 1940-41-42 (summers), mechanic, oil refinery and combustion control instruments, Imperial Oil Ltd., Montreal; 1943 (summer) and 1944 (May) to date, junior engr., Dominion Oilcloth and Linoleum Co. Ltd.

References: E. Brown, O. R. Brumell, F. C. Mechin, C. E. Bedford-Jones.

MURRAY—RALPH MILLS, Capt. ,R.C.E., of 474 Wilbrod St., Ottawa, Ont. Born at Saint John, N.B., Mar. 25th, 1893, Educ.: 1910-13, Univ. of N.B.; 1914-15, asst. engr., St. Lawrence River Ship Channel; 1920-22, research engr., Natural Resources Intelligence Bureau, Dept. of the Interior, 1922-32, sales engr., Truscon Steel Co. of Canada, Ltd.; 1934-43, sales engr., and asst. dist. sales mgr., Building Products, Ltd. At present, Capt. R.C.E., engr. design section,] Directorate of Works and Constrn., N.D.H.Q., Ottawa, Ont.

References: H. E.Maple, F. C. C. Lynch, J. A. McCrory, J. Adam, D. Blair, S. W. Coleman, A. G. Grant, H. B. MacCarthy, R. K. Odell, F. P. Flett, C. B. McRitchie, F. R. Murray.

RAIDEL—ISAAC SAMUEL, of 76 Lusted St., Winnipeg, Man. Born at Nikolaiev, Russia. Jan. 28, 1912, Educ.: B.Sc. (C.E.) Univ. of Man., 1935. R.P.E. Man.; 1935-36, technical correspondent for "Canadian Machinery", "Modern Power" and engrg. magazines, etc.; 1936-37, assessment inspr., City of Winnipeg; 1938, tech. adviser to various insurance adjusting companies, investigated aircraft crash and prepared report for Rex McCrea, attorney to Lloyds of London; 1939-40, post graduate studies in aero. engrg. subjects, Southern California; 1941 to date, personnel training, engr. and engrg. consultant, MacDonald Bros. Aircraft Ltd., Winnipeg, Man.

References: A. E. Macdonald, N. M. Hall, J. N. Finlayson, W. J. D. Cameron, P. G. McAra, W. F. Riddell.

RODWIN—STEFAN, of 2097 St. Luke St., Montreal, Que. Born at Olomuniec, Czechoslovakia, Jan. 21st, 1905. Educ.: Mech. Engr., Univ. of Dantzig, 1930; 1923, mach. shop ap'tice. and mechanic, Shipbldg. and Engrg. Co. Ltd., Dantzig; 1926-27, mechanic, Steelworks, Chorzow & Zgoda, Poland; 1929-30, shop asst., Shipbldg. & Engrg. Co. Ltd., Dantzig; 1931, designing engr., Mech. Engrg. Works, Cracow; 1931-36, own engrg. office at Bielsko, evaluation of machy., plant layouts, job analysis, time study, etc., also professor, state controlled Tech. Coll. at Bielsko and at this time published a text book on tools and tool machines; 1936-39, chief produc'n. engr., Steelworks and Mining Industry, Poland; 1939-40, produc'n. engr., Fabrique de Fer de Mauheuge, Louvroil, France; 1941-42, tool designer and checker of tool drawings, Dominion Engrg. Co., Longueuil; 1942 to date, chief engr., aircraft divn., Canadian Car & Foundry Co.

References: L. A. Duchastel, L. Trudel, G. H. Burdett, H. M. Black, V. Harisay.

STAPLES—WILLIAM J., of Arvida, Que. Born at Toronto, Ont., Aug. 28th, 1919. Educ.: B.A.Sc., Univ. of Toronto, 1942; 1942-43, engrg. dftsman., General Motors of Canada, Oshawa, Ont. At present, mtce. engr., Aluminum Co. of Canada, Arvida, Que.

References: J. T. Nichols, W. J. Melsted, M. J. Waite, P. E. Radley, A. T. Cairncross.

STEWART—ALISON GARFIELD, of 3005 Champlain St., Calgary, Alta, Born at Westville, N.S., Jan. 4th, 1907. Educ.: B.Sc. (Arts), Univ. of Alta., 1931; with the Imperial Oil, Ltd., as follows: 1930-39, asst. chemist, 1939-42. technical operator, comb. unit., 1942-43, foreman, tech. supervisor, and 1944 to date, asst. supt., Calgary, Alberta.

References: J. J. Hanna, F. C. Tempest, W. D. Suitor, H. R. Hayes, W. A. Smith, D. A. Hansen.

SYLVESTER—IRA I., of 84-51st Ave., Lachine, Que. Born at West Branch, Mich., Feb. 2nd, 1902. Educ.: Mech. Engrg., Kelvin Tech. School, Winnipeg, Man. With the Cdn. National Rlys. as follows: 1918-23, special ap'ticeship course (mech.), 1923-25, on staff of mech. engr., assisting in steam locomotive tests, 1925-27, asst. mech. engr. on tests of locomotive appliances, 1927-29, supervisor Diesel Equipm't., i/c mtce. and redesign of early Diesel equipm't., also asst. test engr. on contract with Westinghouse, 1929-31, responsible for design improvements of rly. Diesel traction engines, South Philadelphia Works; 1931-39, special engr. on staff of chief electl. engr., 1940-44, chief inspr., Diesel electric equipm't., also locomotives, stationary plants and wk. equipm't.; at present, transportation specialist, Cdn. Genl. Elec. Co. Ltd., Montreal, Que.

References: D. H. McDougall, W. E. Ross, D. L. McLaren, R. G. Gage, H. F. Finnemore.

TURCKE—EDMUND WOLFGANG JOHN, of 380 Laird Blvd. West, Town of Mount Royal, Que. Born at Zurich, Switzerland, Nov. 20th, 1913. Educ.: Diploma (Civil Eng.), Swiss Federal Institute of Technology, Zurich, 1936; 1937-41, structl. design of various bldgs. in province of Quebec, J. M. Eug. Guay, Inc., consltg. engrs.; 1941 to date, structl. design engr., A. Surveyer & Co., consltg. engrs., Montreal, Que.

References: A. Surveyer, E. Nenniger, J. G. Chenevert, V. Anderson, O. Biedermann.

WILLIS—W. PAUL R., of London, Ont. Born at Aurora, Ont., Nov. 5th, 1900. 1919-20, engr. of mixer and i/c constrn. personnel, Warren Paving Co., Toronto; 1920-28, special product test courses, Peterborough, and 1928-40, genl. sales, and special courses at Nela Park, Cleveland, Pittsfield, Peterborough and Toronto Works, Cdn. Genl. Elec. Co. Ltd., London; 1940-41, Elgin Regiment (Cdn. Active Forces); 1941 to date, tech. sales representative and specialist on distribution equipm't., street lighting, carrier current and aircraft equipm't., etc., Cdn. Genl. Elec. Co., London, Ont. (Asks for admission as an Affiliate.)

References: E. V. Buchanan, V. A. McKillop, J. W. Peart, T. L. McManamna, R. S. Charles. W. C. Miller, J. Vance, R. W. Garrett.

FOR TRANSFER FROM JUNIOR

GIAUQUE—LOUIS FREDERICK, of Hamilton, Ont. Born at Elbow, Sask., Jan. 28th, 1914. Educ.: B.Eng. (Mech.), Univ. of Sask., 1942; 1942-43, metallurgy, McMaster Univ., Hamilton; with the B. Greening Wire Co. Ltd., Hamilton, Ont., as follows: 1941-42, detail and design, 1942-43, individual design work, complete new cable stranding machine, developed new processes and machines, etc., 1944, took complete control of largest weaving dept. to reorganize and gain personnel handling experience, and at present, foreman of screen bar dept. (preparatory to becoming weaving engr. over all weaving and allied depts.). (Jr. 1942.).

References: W. E. Brown, I. M. Fraser, G. D. Archibald, R. A. Spencer, C. J. Mackenzie, L. C. Sentance, H. O. Peeling, W. E. Lovell.

LANGSTON—JOHN FRANCIS, of Calgary, Alta. Born at Calgary, Alta., March 11th, 1911. Educ.: B.Sc. (Civil), Univ. of Alberta, 1937; R.P.E. Alta.; 1929-35, timekeeper and supervisn., constrn. work, hydro-elec. power dam, water storage reservoir, highway constrn., etc., Calgary Power Co. 1936;

(summer), asst. observer on geophysical prospecting with reflection instrument; 1937-38, junior engr., power line survey and constrn., also power plant experience and stream flow measurements, Calgary Power Co.; 1938-41, field engr., operating gun perforating equipm't., oil well surveying equipm't., etc.; 1941 to date, petroleum engr., General Petroleums, Ltd., Calgary, Alta. (Jr. 1938.)

References: R. S. L. Wilson, H. B. Lebourveau, J. McMillan, F. K. Beach, D. P. Goodall.

POPE—FRANCIS ROBERT, of Peterborough, Ont. Born at Montreal, Que., July 6th, 1913. Educ.: B.Eng. (Mech.), McGill Univ., 1935; 1932-33-34 (summers), Cdn. Genl. Elec. Co., Peterborough, Ont.; 1935-36, student course, and 1936-39, outside plant engr., Bell Telephone Co. of Canada Ltd.; 1939-40, student training, and 1940 to date, asst. supt., Western Clock Co. Ltd., Peterborough, Ont. (St. 1933.) (Jr. 1940.)

References: R. L. Dobbin, A. L. Killaly, I. F. McRae, A. R. Jones, H. R. Sills.

WOOLSEY—JOHN TOWNLEY, Major, R.C.A., of Ottawa, Ont. Born at Ottawa, Ont., Jan. 29th, 1911. Educ.: Diploma, R.M.C., 1933; Regimental duty, 1933-35, medium artillery and 1935-38, coast artillery; 1938-39, gunnery staff course (England); 1939-42, regimental duty, coast artillery, super heavy rly. and field artillery; 1942-43, D.A.Q.M.G. (M & A), Cdn. Military Headquarters. At present, Technical Liaison Officer, Armament Research Dept., Ministry of Supply, England. (Jr. 1938.)

References: F. F. Fulton, H. M. Bailey, J. D. Relyea, C. V. F. Weir, L. F. Grant.

FOR TRANSFER FROM STUDENT

BISHOP—PERCIVAL WILLIAM, of Oliver, B.C. Born at Carbon, Alta., Feb. 4th, 1914. Educ.: B.Sc. (Civil Engrg.), Univ. of N.B., 1942; 1941 (summer), transitman and dftsman., N.B. Geological Survey; 1941 (fall term), asst. surveying instructor, field work, and 1941-42, mgr. engrg. stores, Univ. of N.B.; 1942, transitman and later chief of party on constrn. and asst. res. engr., Alaska Highway, U.S. Govt.; 1943, constrn. foreman, Dufferin Paving Co.; 1943-44, asst. office engr., and dftsman., designing and installing airport waterworks, pumping plants, etc. At present, transitman, C.P.R., Oliver, B.C. (St. 1940.)

References: E. O. Turner, J. H. Moore, T. Lees, W. G. Dyer, D. A. Livingston.

BRETT—JOHN EDWARD, of 4180 Melrose Ave., Montreal, Que. Born at Montreal, Que., Jan. 10th, 1920. Educ.: B.Eng., McGill Univ., 1942; R.P.E. Que.; 1941 asst. field engr., i/c pile-driving for gun plant, Dominion Bridge Co., Burnaby, B.C.; 1942-43, junior engr., United Shipyards, Ltd.; 1944 to date, consltg. engr., Montreal. (St. 1942.)

References: W. Taylor-Bailey, G. R. Stephen, R. DeL. French, G. J. Dodd, E. Brown, J. F. Brett.

COURTRIGHT—JAMES MILTON, of Toronto, Ont. Born at North Bay, Ont., Dec. 16th, 1914. Educ.: B.Sc. (Civil), Queen's Univ., 1941; 1940 (summer), field engr., airport constrn., Dibblee Constrn. Co.; 1941-43, engr.-in-training, and 1943 to date, lubrication engr., home office lubricants dept., Shell Oil Co. of Canada, Ltd., Toronto, Ont. (St. 1941.)

References: J. B. Stirling, M. W. Huggins, R. F. Legget, D. S. Ellis, R. A. Low.

DUPUY—HARRY EDWARD GLEN, of Galt, Ont. Born at Bow Island, Alta., March 13th, 1915. Educ.: B.Eng. (Mech.), McGill Univ., 1938; with Babcock-Wilcox & Goldie-McCulloch, Ltd., as follows: 1938-41, 6 mos. in shop and on erection work, 6 mos. in dfting. room and remainder of this period in proposition and contract dept., laying out new jobs, estimating materials, etc., Galt, Ont., 1941-42, sales engr., Montreal office, 1942 to date, service engr., Galt, Ont. (St. 1938.)

References: R. E. MacAfee, L. A. Duchastel, J. W. MacDonald, J. B. Hayes, J. T. Farmer, W. L. Yack.

ETKIN—BERNARD, of 317 Lauder Ave., Toronto, Ont. Born at Toronto, Ont., May 7th, 1918. Educ.: B.A.Sc., Univ. of Toronto, 1941; 1941-42, postgrad. study, Univ. of Toronto, in theory of elasticity and advanced structl. analysis; 1940-42 (summers), shop work, dfting., stress analysis, etc., DeHavilland Aircraft; 1941-42 (winter), demonstrator, airplane design, aero-dynamics, and 1942 to date (winters), lecturer, Faculty of Applied Science, Univ. of Toronto, Toronto, Ont.; 1944 (summer), liaison engr., stress analyst, Victory Aircraft Ltd. (St. 1941.)

References: T. R. Loudon, C. R. Young, M. W. Huggins, R. F. Legget, C. F. Morrison, C. E. Helwig, S. H. deJong.

GRIESBACH—ROBERT JOHNSTON, of Hampstead, Que. Born at Montreal, Que., Aug. 5th, 1920. Educ.: B.Eng. (Civil), McGill Univ., 1942; with the Foundation Co. of Canada Ltd. as follows: 1938-41 (summers), instru'man. and asst. to job engrs., 1942 to date, engr. on outside work and designing engr., 1943-44, superintending repairs to 2 concrete tanks at J. R. Booth Ltd., Ottawa, for the Gunite Waterproofing Co. (on loan from the Foundation Co.). At present, designing engr., Montreal, Que. (St. 1942.)

References: O. J. McCulloch, F. G. Rutley, H. V. Serson, L. H. Burpee, G. J. Dodd, E. P. Muntz.

HARVIE—JOHN DUNCAN, of Norman Wells, N.W.T. Born at Regina, Sask., Nov. 21st, 1920. Educ.: B.Sc. (C.E.), Univ. of Man., 1942; 1940 (summer), rodman, C.N.R.; 1941 (summer), instru'man., P.F.R.A.; 1942 (summer), transitman, rly. location, U.S. Engrs. Office, Prince George, B.C.; 1942-43, junior mtce. engr., cordite plant, D.I.L., Transcona, Man.; 1943 to date, engr. on canal project i/c pipelines, river crossings, constrn. of roads, etc., Imperial Oil Ltd., Norman Wells, N.W.T. (St. 1941.)

References: A. E. Macdonald, B. B. Hogarth, W. W. Ramsay, G. H. Herriot, W. F. Riddell, C. H. Rogers.

HARVIE—THOMAS ALLAN, F/Lt., R.C.A.F., of Montreal, Que. Born at Montreal, Que., April 28th, 1919. Educ.: B.Eng. (Mech.), McGill Univ., 1941; 1938 (summer), underground work, Little Long Lac Gold Mine; 1940 (summer), dfting., Dominion Engineering Works, Lachine; 1941, prodn. engrg., Verdun Ammunition Works, D.I.L., and later with the Army Engrg. Design Branch, Tank Divn., D.M. & S.; 1941 (Aug. to date), with the Aeronautical Engrg. Branch, R.C.A.F., 1942 (9 mos.), aircraft mtce., No. 3 B. & G. School, Macdonald, Man., 1942-43, development of aircraft, operational types, H.Q., Ottawa, 1943-44, aircraft mtce., Trenton, and at present, development of aircraft engines, Overseas. (St. 1940.)

References: T. W. Harvie, F. T. Peacock, R. E. Jamieson, C. M. McKergow.

HASTEY—WILLIAM KINGSLEY WRIGHT, Flt. Lieut., R.C.A.F., of 421 Edgewood Ave., Ottawa, Ont. Born at Ottawa, Ont., Oct. 8th, 1916. Educ.: B.Sc., Queen's Univ., 1940; 1940-42, genl. work in engrg. office and steam plant, operating paper mach., etc., Belgo divn., Consolidated Paper Corp., Shawinigan Falls, Que.; 1942 to date, Aircraft Mtce. Engr., i/c of all major repairs to aircraft and inspec'ns., and Asst. Chief Technical Engr., No. 10 S.F.T.S., Dauphin, Man. (St. 1941.)

References: D. S. Ellis, R. A. Low, A. Jackson, D. M. Jemmett, L. F.Grant.

KRAFT—ROBERT WILLIAM, of Arvida, Que. Born at Kitchener, Ont., July 2nd, 1919. Educ.: B.Sc., M.Sc. (Chem.), Queen's Univ., 1940 and 1941; 1937-38 (summers), lab. asst., Dominion Tire Factory, Kitchener, Ont.; with the Aluminum Co. of Canada Ltd., as follows: 1939-40 (summers), analyst and chemist, routine and special chem. analysis, Arvida, Que., 1941, study of plant process control and operation and later supervisor, constrn. and operation, chemical pilot plant, Arvida, Que., 1942-43, research analyst, Aluminum Laboratories, Ltd., Kingston, 1943 to date, chemist, research and investign. on carbon electrode mfre. in the plant and in the lab., Arvida, Que. (St. 1941.)

References: R. F. Legget, A. Jackson, P. E. Radley, R. H. Rimmer, McN. DuBose, A. C. Johnston, B. E. Bauman.

LAFONTAINE—DANIEL JOSEPH, of 4832 Wilson Ave., Montreal, Que. Born at Tweed, Ont., Aug. 10th, 1909. Educ.: B.Sc., Queen's Univ., 1933; with the Ford Motor Co. of Canada, Ltd., as follows: 1930 (summer), plant ap'tice., 1931-32 (summers), tool designing, 1934-37, senior tool designer, 1937-38, instructor in mech. drawing and blueprint reading, Trade School; 1938-41, shop supt., and 1941-44, chief engr., Electric Tamper & Equipment Co. of Canada Ltd., Montreal, Que. (St. 1931.)

References: O. J. McCulloch, L. T. Rutledge, L. M. Arkley, J. B. Dowler, J. B. Stirling, J. F. Blowey.

LATREILLE—ANDRE, of Montreal, Que. Born at Montreal, Nov. 6th, 1917. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1942; 1939-40 (summers), Quebec Streams Commn.; 1941 (summer, Milton Hersey Co. Ltd.; 1942 to date, estimator and engr., Atlas Construction Co. Ltd., Montreal, Que. (St. 1939.)

References: A. Circe, J. A. Lalonde, L. Trudel, A. Duperron, H. Gaudefroy, P. P. Veint, H. R. Montgomery.

LEBEL—MARCEL, of 17-B Boisclerc St., Quebec, Que. Born at St. Lin-des-Laurentides, Que., May 6th, 1915. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1943; R.P.E. Que.; 1939-40-41 (summers), plans, estimates, levelling, etc.; 1942 (summer), road inspr., St. Charles, Bellechasse, and 1943 to date, soils engr., Dept. of Roads, Quebec. (St. 1940.)

References: H. Gaudefroy, A. Circe, E. Gohier, J. O. Martineau, L. Trudel.

MACBRIDE—JAMES MALCOLM, of Montreal, Que. Born at Knoxford, N.B., July 19th, 1917. Educ.: B.Sc. (Civil Eng.), Univ. of N.B., 1938; 1937 (summer), dftsman., Fraser Co. Ltd., Edmundston, N.B.; 1938, instru'man., Edmundston, N.B.; with the C.P.R. as follows: 1939-42, junior dftsman., Windsor Station, 1942-43, dftsman., 1944 to date, asst. engr., Montreal, Que. (St. 1939.)

References: J. E. Armstrong, J. G. Sutherland, L. W. Deslauriers, J. Stephens, E. O. Turner, G. E. Shaw, R. B. Jones.

MASON—GEORGE ANTHONY RITCHIE, of Calgary, Alta. Born at Calgary, Alta., Nov. 25th, 1912. Educ.: B.Sc. (Elec. Eng.), Univ. of Alberta, 1934; 1934, constrn. and survey work, East Crest Holding & Development Co., Oban, Sask.; with the Northern Electric Co. Ltd., as follows: 1934-36, mfg. of domestic radio receivers, transformers, chokecoils, etc., and 1936, supervn. of transformer dept., 1936-41, design of audio frequency equipm't. including amplifiers, transformers, wave filters and networks, mobile police transmitter, etc., 1941-43, redesign and produc'n. of tank radio equipm't., Dept. of Munitions & Supply (including study of mfg. in England), 1943, audio design engr., special products development dept. At present, on leave of absence due to ill health. (St. 1934.)

References: S. J. Davies, C. B. Fisher, S. T. Fisher, H. J. Vennes, R. S. L. Wilson.

PEPALL—JAMES EDWARD, of Arvida, Que. Born at Toronto, Ont., Nov. 21st, 1913. Educ.: B.A.Sc. (Chem. Eng.), Univ. of Toronto, 1936; with the Aluminum Co. of Canada as follows: 1936-37, ap'tice. engr., Toronto, Montreal and Arvida, 1937-38, engr., Arvida Works, 1938-40, supervisor i/c process control alumina and cryolite plants, 1940-42, asst. supt., i/c operations, No. I alumina plant and 1942-43, i/c process control and development, No. 1 and No. 2 alumina plants, 1943-44, on loan to the Govt. of India in connection with the produc'n. of alumina. At present, asst. alumina plant supt., Arvida, Que. (St. 1934.)

References: A. C. Johnston, R. H. Rimmer, M. G. Saunders, McNeely DuBose, F. T. Boutilier.

ROCHON—ANDRE, of 1029 Parc Lafontaine, Montreal. Born at Three Rivers, Que., Aug. 11th, 1919. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1942; R.P.E. Que.; 1938 (summer), Dept. Public Works, Berthier; 1939 (summer), Dept. of Roads (Quebec), St. Hyacinthe; 1940 (summer), Milton Hersey Ltd., Dorval; 1942 to date, asst. supt., and engr., electl. dept., Marine Industries, Ltd., Sorel, Que. (St. 1941.)

References: J. A. Lalonde, A. Circe, L. A. Duchastel, H. Gaudefroy.

SHAW—DOUGLAS THOMAS, Capt., of Ottawa, Ont. Born at Liverpool, England, July 24th, 1919. Educ.: B.Eng. (Elec.), McGill Univ., 1942; 1938-42 (summers), Montreal Light Heat & Power (4 seasons), and with the Northern Electric Co. (1 season); 1942 to date, Capt., Directorate of Electrical and Communications Design, Ottawa, Ont. (St. 1942.)

References: C. V. Christie, H. Milliken.

SIMARD—JOSEPH EDMOND, of St. Joseph de Sorel, Que. Born at Montreal, March 4th, 1913. Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1942; 1940 (summer), mining dept., Geological Survey, Que.; 1941 (summer), mass produc'n. inspr., tanks, Angus Shops, C.P.R.; 1942-44, engr., mech. dept., and at present, cost engr. on ship repairs, Marine Industries, Ltd., Sorel, Que. (St. 1940.)

References: J. A. Lalonde, A. Circe, H. Gaudefroy, H. Gendron.

SMITH—ROBERT LOVELACE, of 2171 St. Luke St., Montreal, Que. Born at Winnipeg, Man., Nov. 14th, 1919. Educ.: B.Sc. (E.E.), Univ. of Man., 1942; 1942 to date, mfg. engr., Northern Electric Co. Ltd., Montreal, Que. (St. 1941.)

References: N. M. Hall, W. F. Riddell, G. H. Herriot, C. P. Wright, S. Sillitoe, C. A. Peachey. *(Continued on page 656)*

Employment Service Bureau

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.

NOTICE

Technical personnel should not reply to any of the advertisements for situations vacant unless—

1. They are registered with the Wartime Bureau of Technical Personnel.
2. Their services are available.

A person's services are considered available only if he is—
(a) unemployed;
(b) engaged in work other than of an engineering or scientific nature;
(c) has given notice as of a definite date; or
(d) has permission from his present employer to negotiate for work elsewhere while still in the service of that employer.

Applicants will help to expedite negotiations by stating in their application whether or not they have complied with the above regulations.

FOR SALE

The following used engineering and scientific instruments:
Tachmeter, Dr. Horn's system 80—3200 r.p.m.
12″ sextant with silver scale. Complete with telescopes and wooden case.
Fuller spiral slide rule in wooden case.
Keuffel and Esser Polar planimeter with 6½″ tracer arm with wooden case.
Price rotating vane water current meter in wooden case.
Seven-day recording thermograph.
Lufkin 50′ steel measuring tape graduated in feet and inches.
Lufkin 100′ steel measuring tape graduated on one side in links and on the other in feet and inches.
Bronze plumb bob.
Set 34 Vulcanite railroad curves in wooden case.
Brass cross staff head in leather case.
Flexible transit rod in metal container.
Chesterman (English) 100′ steel measuring tape graduated on one side in links and on the other in feet and inches.
Canvas pack sack.
These may be inspected in Montreal; for further information, please write Box No. 55-S.

SITUATIONS VACANT

GRADUATE CIVIL OR MECHANICAL ENGINEER wanted. See page 58 of the advertising section.

MECHANICAL ENGINEER wanted. See page 59 of the advertising section.

EXECUTIVE ENGINEER, MECHANICAL ENGINEERS wanted. See page 58 of the advertising section.

MECHANICAL DRAUGHTSMAN for established and growing firm in western Canada. Preferably experienced in layout of general mechanical equipment for mines and packing plants. Permanent job for right man. In first letter give age, experience and salary desired. Apply to Box No. 2850-V.

CHIEF ENGINEER required by prominent Toronto company. This position requires a thorough background and experience in machine tool design, together with a good knowledge of foundry practice and structural steel design essential. Established post-war future. Graduate engineer or equivalent. Apply to Box No. 2851-V.

STRUCTURAL ENGINEER required by prominent Toronto company. This position requires a thorough knowledge of structural steel design, estimating and fabrication, particularly in the building and related fields. This engineer must be able to satisfactorily deal with owners, architects and contractors in the development of projects and their installation. Permanent post-war employment. Apply to Box No. 2852-V.

SALES ENGINEERS—large manufacturer of air handling ventilating and air conditioning equipment requires sales engineers with good technical background for industrial and contractor sales. Position would be permanent and on a salary basis. Applicants should give age, nationality, education, training and experience. Apply to Box No. 2877-V.

GRADUATE MECHANICAL ENGINEER about thirty for a permanent position with a well-established, growing concern engineering and manufacturing conveying equipment in their own plant. A working knowledge of mechanics and light structural steel, with the aptitude for applying same, along with the desire to learn the conveying business from the ground up is essential. Apply to Box No. 2878-V.

OTTAWA SUBURBAN ROADS COMMISSION—applications will be received up to January 15th, 1945, for the position of engineer. The engineer is the chief executive officer of the Commission. An applicant must have had experience in the design, construction and operation of highways, should be a professional engineer registered as a civil engineer under The Professional Engineers Act of Ontario and must be eligible under regulations presently administered by the W.B.T.P. Salary $3,200. minimum with annual increments of $200. to $4,200. maximum. The Commission also supplies transportation. Apply to F. A. Heney, Chairman, 279 Carling Avenue, Ottawa, Ont.

SENIOR TIME STUDY AND/OR LAYOUT MEN

For industrial consulting firm; energetic, bilingual, dependable, excellent salary and permanent prospects to right men. Do not apply unless available under Part III, P.C. 246, administered by the Wartime Bureau of Technical Personnel.

Apply in writing to Dufresne, McLagan & Associates Reg'd., Room 402, Bank of Nova Scotia Building, Montreal.

Wanted...

2 ENGINEERS

A Pulp & Paper Company with Mills in the Province of Quebec will, within the next few months, require the following men:

1—PLANT ENGINEER—Age 30 to 38
To be responsible for Steam Plant, Electrical Equipment, Machine Shop, Drafting Room, and all Maintenance and Repairs.

1—ASSISTANT TO CHIEF ENGINEER—Age 33 to 43
To conduct investigations of manufacturing processes, and make studies of the design and maintenance of equipment. This is a Senior position.
Good working knowledge of the Mechanics of Steam, Electricity, and Hydraulics, as well as experience in the use of such materials as Timbers, Structural Steel, Reinforced Concrete and Piping is necessary.

- **Graduate Engineers, preferably Mechanical or Electrical, are required for these positions.**
- **There are also openings for several Junior Engineers in similar types of work.**
- **Preference will be given to men with service in the armed forces.**

Please outline your experience in detail to

Box No. 2876-V

THE ENGINEERING JOURNAL, 2050 Mansfield St., Montreal, P.Q.

Please do not apply unless your services are available under regulations P.C. 246—Part III—(Jan. 19, 1943) administered by Wartime Bureau of Technical Personnel.

SITUATIONS WANTED

MECHANICAL ENGINEER, M.E.I.C., English, married, 39, bilingual, presently employed as plant engineer, desires responsible position with Canadian-owned, progressive company. Experienced in engineering of industrial and institutional developments, steam power plants, etc. Available early in 1945. Apply to Box No. 270-W.

CHEMICAL ENGINEER, age 27, married. Six years' experience in steel, coal by-products distillation, asphalt and tar products, solvents, heating and ventilating design. Located in Montreal at present. Apply to Box No. 1827-W.

CIVIL ENGINEER, R.P.E. (Ont.) P.G. III, Toronto Graduate, Age 31, married, seven years' experience including structural engineering, traffic and mass transit study. Experienced in design, maintenance, estimates, preparation of reports and specifications, administration and supervision of construction. Possesses ability to supervise and to co-operate with others. Would consider foreign assignment. Seeks municipal position as assistant city engineer or consultant in charge of town planning and city development. Available immediately. Apply to Box No. 2466-W.

MECHANICAL ENGINEER, B.Sc. 1930, M.Sc. 1931, now a Wing Commander in the R.C.A.F., wishes to secure a permanent position for post-war employment. Has high qualifications and wide engineering experience in position of responsibility. Apply to Box No. 2468-W.

CIVIL AND ELECTRICAL ENGINEER, M.E.I.C., age 37, married, eight years' experience in public utility field, transmission lines, distribution systems, power sales, estimating, inspection, rates, electricity and gas. Seeks responsible position with public utility or similar organization. Registered with W.B.T.P. Available December 1st, 1944. Apply to Box No. 2469-W.

ENGINEER, B.Sc. (civil and mechanical), A.M.I.C.E., M.E.I.C., age 39, married, with eighteen years' experience in civil, mechanical, structural and chemical engineering field covering design and construction of filtration plants, industrial buildings, structural steelwork and chemical plants. Recently returned from wartime chemical plant design, construction, operation and management in Australia. Accustomed to technical development of industrial processes, supervision of operations and executive responsibility. Ready for new appointment requiring engineering qualifications combined with executive ability. Interested in permanent position with progressive chemical or industrial concern or with firm of engineers planning development. Ontario location preferred but not essential. Services are available under regulation P.C. 246, part 3, administered by W.B.T.P. Apply to Box No. 2470-W.

LIBRARY NOTES *(Continued from page 654)*

SMITH—WILFRID EWART, Elect. Lieut., R.C.N.V.R., of Port Arthur, Ont. Born at Fredericton, N.B., Feb. 7th, 1914. Educ.: B.Sc. (Elec.), Univ. of N.B., 1935; 1935 (summer), topogl. dept., Dominion Geological Survey; 1936-37, light mech. dfting., mach. shop, and 1937-41, electl. dfting., layout, constrn. and mtce., Buffalo Ankerite Gold Mine, South Porcupine, Ont.; 1942 (2 mos.), electrn., Dominion Engineering Plant, Scarborough, Ont.; 1942-43, Inspr. of DeGaussing, R.C.N.V.R., and June to Dec., 1943, i/c DeGaussing, Montreal and dist.; 1944 (Jan. to date), Principal Electl. Engrg. Overseer, Port Arthur Shipbuilding Co. Ltd., Port Arthur, Ont. (St. 1934.)

References: A. F. Baird, E. O. Turner, J. Stephens, R. B. Chandler, K. E. Buchanan, O. J. Koreen.

STOPPS—FRANK SIDNEY, of 2061 St. Luke St., Montreal, Que. Born at Verdun, Que., Dec. 28th, 1916. Educ.: B.Eng. (Mech.), McGill Univ., 1941; 1941 to date, engr., Longueuil plant, Dominion Engineering Works, Ltd., Montreal, Que. (St. 1941.)

References: H. M. Black, J. B. Milne, V. Harisay, G. J. Dodd, E. Brown.

STRACHAN—JACK LYON, of Winnipeg, Man. Born at St. Vital, Man., May 13th, 1915. Educ. B.Sc. (E.E.), Univ. of Man., 1939; 1937-38 (summers), meter dept., Winnipeg Electric Co.; with the D.I.L. as follows: 1940-41, engrg. dept., Montreal, 1941-44, asst. shop engr., Winnipeg, and at present, engr., Montreal. (St. 1939.)

References: E. P. Fetherstonhaugh, W. F. Riddell, G. H. Herriot, N. M. Hall, A. E. Macdonald, C. H. Jackson.

SWALLOW—MURRAY GORDON, of Chandler, Que. Born at Russell, Man., May 26th, 1917. Educ.: B.Sc. (Civil), Univ. of Alberta, 1942; 1941 (summer), chainman, Northern Alta. Rly. Co. Ltd.; 1942, C.I.L., Nobel, Ont.; 1942-43, with the D.I.L. at Nobel, Ont., and 1942-44, at Verdun, Que. At present, dftsman., Gaspesia Sulphite Co. Ltd., Chandler, Que. (St. 1941.)

References: I. F. Morrison, R. M. Hardy, R. S. L. Wilson, J. E. Thom, R. J. Chambers.

VERDIER—PAUL ANDRE, Lieut. (SB) (E), R.C.N.V.R., of Montreal, Que. Born at Copenhagen, Denmark, April 28th, 1918. (Naturalized British subject). Educ.: 1938-42, Sir George Williams College (evening classes, completed part of the course towards B.Sc. degree); 1937-38, dftsman., Cdn. Marconi Co., Mt. Royal, Que.; 1939 (3 mos.), deHavilland Aircraft, Toronto, Ont.; 1940 (7 mos.), lab. asst., National Research Council; 1940-41, engrg. dept., Mtl. Light, Heat & Power Co.; 1941-42, Dominion Engrg. Co., Longueuil, Que.; 1942 (June), joined R.C.N.V.R., and has been engaged in an engrg. capacity since that time, at present under command of Chief of Naval Engrg. and Constrn., Naval Service Headquarters, Ottawa, Ont. (St. 1941.)

References: J. Middleton, W. S. E. Morrison, V. Harisay, R. C. F. Alexander A. C. M. Davy.