Ontario Department of Agriculture

DISTRICT REPRESENTATIVES

BULLETIN 208

Farm Poultry and Egg Marketing Conditions

IN

ONTARIO COUNTY

BY

J. H. Hare, B.S.A., Whitby

(District Representative for Ontario County)

AND

T. A. Benson

(Assistant District Representative)

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By J. H. Hare and T. A. Benson.

INTRODUCTION.

In Circular 140 of the United States Department of Agriculture entitled, "The Egg Trade of the United States," there is reported a loss of 17 per cent., due to the marketing of stale and bad eggs. It is further reported in the "Care of Market Eggs," Bulletin No. 16 of the Dominion Department of Agriculture, that this percentage of loss as reported for the United States is a conservative estimate for that which is sustained in the Canadian trade. Over two hundred Canadian egg dealers advanced that opinion and some would have the figure placed still higher. This means that for every 30 dozen case marketed, there is a loss equal to the value of 5 dozen eggs.

This tremendous toll naturally has a very serious effect upon those concerned with the production and consumption of eggs. By reason of this loss or "shrinkage" the producer is made to accept a lower price for his eggs. Produce dealers are put to the extra expense of employing experts to examine carefully all of their receipts for the purpose of rejecting those that are not fit for food. Where eggs are not examined, as in the case of practically all those that do not go through the hands of large produce dealers, the consumer finds himself paying out his good money for eggs of which upwards of 20 per cent. are badly deteriorated, or perhaps entirely unfit for use. And that is not all. What is still more serious to the industry is that when a consumer has many such experiences he naturally learns to regard eggs with a degree of suspicion. When possible he makes it a point to substitute something else for eggs. In this way the consumption of eggs is very materially curtailed, the demand is lessened, and their reputation as a dependable food product is very seriously impaired.

Another prominent feature of present conditions is the pronounced indfference with which the great majority of people regard the poultry enterprise. It may safely be said that the poultry industry suffers more from unjustifiable neglect than does any other branch of agriculture.

And what is still more surprising is that this is particularly true of the farmer himself. There is absolutely no justification for such indifference, not even from a straight financial point of view. By making a fair comparison; that is, taking into consideration the capital and labor involved, the farmer's poultry will yield returns equal to if not greater than any which can be derived from any other branch of his business.

Having some knowledge of these facts, and a special interest in poultry work, the writers of this report some time ago determined, if possible, to find just where the above stated loss in eggs occurred, who was responsible for it, endeavor to increase interest in poultry, at least in Ontario County, and to establish, if possible, some marketing system whereby the heavy loss in eggs might be curtailed or perhaps entirely eliminated.

Fig. 1.—A Typical Farm Flock.

To accomplish this, it was deemed necessary, first of all, to obtain more extensive and complete information as to actual conditions under which farm eggs are marketed, following their course carefully from the country producer to the final consumer in the larger town or city. It was also thought necessary to make a careful examination of actual poultry conditions upon a large number of farms. Although this phase of the investigation was confined entirely to Ontario County, there is reason to believe that the conditions in that County are fairly representative of the entire Province. In order to make the investigation of farm conditions unmistakably representative in its character, three different sections of the County were chosen, and in each section a block of farms selected. All farms in each selected block were investigated. The following form was used in recording the information:

ONTARIO DEPARTMENT OF AGRICULTURE,
OFFICE OF DISTRICT REPRESENTATIVE, WHITBY.

FARM POULTRY AND EGG MARKETING INVESTIGATIONS.

Form used for Investigating Conditions on the Farm.

Name of farmer ....
Address ....
Date ....

CHARACTER OF FARM:

Size ....
Crops raised ....
Stock kept ....
Possible accommodation for colony houses ....

POULTRY ACCOMMODATIONS:

HOUSES—

Number ....
Kind ....
Size ....
Exposure ....
Location and drainage ....
Kind of floor ....
Floor space per hen ....
Light ....
Ventilation ....
Draughts ....
General convenience ....
Roosts, kind ....
Roosting accommodation ....
Cleanliness, frequent removal of droppings ....
Scratching material ....

NESTS—

Kind ....
Proportionate number ....
Cleanliness ....
Location ....

RUNS OR RANGE—

Character ....
Drainage ....
Shade ....
Cultivation ....

POULTRY KEPT:

Varieties ....
Number.............. Males.................. Females ....
Breeding ....
Ages ....

Vigor ....
Health ....
Special diseases ....
Insect pests ....
Natural or artificial incubation ....
Natural or artificial brooding ....
Late or early hatching ....
Success in rearing chicks ....

EGG PRODUCTION:

Quantity produced (a) summer months ....
(b) winter months ....
Frequency of gathering ....
By whom gathered ....
In what ....
Weight of eggs per dozen ....

KEEPING FOR MARKET:

Where ....
In what temperature ....
Freedom from contamination ....
How long kept ....
Grading ....
Eggs found in stolen nests ....
Washing eggs ....
How marketed ....
Distance from market ....
Name and address of person to whom sold ....
Separation of males from flock out of breeding season ....
Separation of cockerels from pullets ....

METHODS OF FEEDING:

Drink ....
Variety of grain feed ....
Grain feeds ....
Animal feeds ....
Grit ....
Shell ....
Feeding of chicks and young stock ....

While the primary object of this farm investigation was to gather data with reference to actual poultry conditions, advantage was taken of the opportunity to record certain interesting statistics which have been summarized in the following table:

TABLE NO. 1, SHOWING ACREAGE AND HEN POPULATION ON 448 ONTARIO COUNTY FARMS.

Section of County	No. of farms investigated	Total acreage	Average size of farms in acres	Total No. of hens	Average No. of hens per farm	Average No. of hens per acre
North....	112	13,211	117.9	7,685	68.6	.58
Centre...	180	21,576	119.8	10,108	56.7	.46
South....	156	16,873	108.1	10,137	64.9	.60
Total....	448	51,660	115.3	27,930	63.4	.55

INVESTIGATION OF FARM POULTRY CONDITIONS.

THE FARMER'S ATTITUDE TOWARD POULTRY.

Particular note was taken in this investigation of the attitude of the farmer towards his poultry. To record this information the following classification was made:

First, " Uninterested Poultrymen," or those farmers who had practically no business interest in their poultry.

Second, those whom, for convenience sake and for the want of a better name, we have designated as " Indifferent Poultrymen."

Third, " Interested Poultrymen," or the more progressive farmers, who gave evidence of having some desire to make the most out of their poultry.

Our findings are as follows:

Uninterested poultrymen	29.4 per cent.
Indifferent poultrymen	32.0 per cent.
Interested poultrymen	38.6 per cent.

It is evident from these figures that almost two-thirds of the producers of our market eggs are either indifferent or entirely uninterested so far as the business management of their poultry is concerned. From such a disclosure it is not difficult to understand or believe the claim which often has been made, that the loss due to the marketing of stale and bad eggs is largely the result, either of indifference or carelessness, and is therefore almost wholly preventable.

TABLE NO. 2.—SHOWING PROPORTION OF LARGE AND SMALL FLOCKS ON 448 ONTARIO COUNTY FARMS.

Section of County	No. of farms investigated	Percent. of farms with less than 60 hens in flock	Percent. of farms with from 60 to 100 hens in flock	Percent. of farms with more than 100 hens in flock
North.......	112	30%	49.1%	20.9%
Centre......	180	68%	17.7%	14.3%
South.......	156	56.6%	28.2%	15.2%
Total.......	448	51.5%	31.7%	16.8%

FLOCKS ON MOST FARMS TOO SMALL.

It will be noticed in this table that for the centre section there is recorded a very large proportion of small flocks. As a matter of fact the farmers in this section have had the least success in the production of winter eggs. We may therefore conclude that the size of the flock contributes at least something to the farmer's success with poultry. From observations made in this investigation the rule seems to be, the smaller the flock the less interest there is in poultry. Where flocks are larger, usually the success attained is greater, and the general conditions are better. A flock of seventy-five and upwards is usually regarded as a commercial enterprise, and of sufficient importance to warrant the necessary time to give it what, in the farmer's estimation, is proper care. Ordinarily small flocks do not receive this attention. They are maintained principally for the convenience of the home, to supply it with eggs and fowl. If there is a surplus, it is sold in any convenient way; perhaps given to the local grocer in trade for groceries and other household necessities, or if sold for cash to a travelling huckster, the housewife is generously awarded the proceeds.

It is generally accepted that in order to manage a farm economically, there should be some provision made for poultry. And since it is also accepted that poultry may be made one of the most profitable, if not the most profitable department of the farm, it stands to reason that the flock should be of a commercial size. For these and other obvious reasons, a farmer should keep a flock of not less than one hundred hens.

Age to Which Hens are Kept.

In a large number of instances no system of selling off hens which have outlived their usefulness as layers, is practised. It is common knowledge among good poultrymen that a hen becomes less useful as an egg producer as she grows older. Mr. F. C. Elford, in his recent publication entitled "Farm Poultry," says: "Many such experiences have gone to prove that as each year a hen grows older her egg-laying ability decreases 25 per cent." Flocks containing a large proportion of hens, three to five years old, are quite common, and on many farms some hens are kept as long as they will live. For ordinary farm purposes hens older than two years should not be retained. A good plan is to leg-band all pullets. Place the bands on the left leg one year and on the right leg the following year, and so on, alternating each year. In this way there will be no difficulty in identifying the older fowl.

Table No. 3.—Showing How Flocks are Bred on 448 Ontario County Farms.

Pure Bred Flocks			Crossbred and Mongrel Flocks		
Breed	No. of farms	Percent. of total	Breed predominating	No. of farms	Percent. of total
Barred Plymouth Rock.	53	11.8	Barred Plymouth Rock.	207	46.2
White Wyandotte......	6	1.3	Black Minorca..........	44	9.8
White Leghorn.........	5	1.1	White Leghorn..........	32	7.1
Silver Grey Dorking....	3	.7	Rhode Island Red......	26	5.8
Silver Laced Wyandotte	2	.4	Brown Leghorn.........	22	4.9
Buff Orpington.........	1	.2	White Wyandotte.......	19	4.2
			Buff Orpington..........	8	1.8
			Black Spanish..........	5	1.1
			Silver Grey Dorking....	4	.9
			Houdan................	4	.9
			Silver Spangled Hamburg	3	.7
			White Rock............	3	.7
			Ancona................	1	.2
Total.................	70	15.5	Total..................	378	84.3

General Practice in Breeding.

There seems to be prevalent among many farmers the erroneous idea that much crossing of breeds is a helpful practice in the production of a heavy laying strain of fowl. This contention is borne out by the fact that only 15.5 per cent. of the farmers visited keep their flocks pure. (See Table 3.) Certain first crosses may get useful birds if intelligently mated, but for a flock, the chief purpose of which is to produce eggs, the pure-bred bird is unquestionably the more profitable. If the farmer after making one cross always returned to the use of the original breeds, the results would be less serious, but the mistake which is almost universal, so far as those having mongrel flocks are concerned, is to continue using the cross-bred birds for breeding purposes without even the slightest effort at a proper selection. The inevitable result is the reversion to a degenerate and much less useful class of mongrel fowl.

Regular inbreeding without regard to defects or good qualities in the fowl mated is another serious mistake which many farmers make. This indiscriminate breeding invariably results in a lack of size in the offspring, a lack of uniformity in the product, and a general debility of the flock. Such a practice should be strongly condemned.

Still another practice which has a strong influence toward reducing the size of fowl, and indirectly the eggs they produce, is that of breeding from late hatched birds that have not attained their full maturity. In other cases, eggs for hatching have been kept too long before setting, and in places not conducive to the preservation of their freshness. Still other flocks, not properly fed, and compelled to live in unsanitary houses, produce eggs that when hatched, the offspring showed marked evidences of debility and weakness.

Under ordinary circumstances the farmer should choose one of the heavier general purpose breeds, keep the breed absolutely pure, and practice careful selection in choosing those birds from which to breed, instead of taking settings from the general flock as is the common practice.

Serious Mistakes in Incubation.

As a rule, farmers do not appreciate the importance of the early hatching of chickens. Winter egg production is quite impossible unless pullets have been matured early and considerably before the cold winter weather sets in. To accomplish this early maturity, the chickens—having reference particularly to the heavier breeds—should be hatched before the end of May. It is evident from the following table that a large majority of farmers make the serious mistake of hatching too late in the season.

TABLE No. 4.—SHOWING PRACTICE OF FARMERS WITH REFERENCE TO SPRING HATCHING ON 448 ONTARIO COUNTY FARMS.

Section or County	Number of farms investigated	Percent. of farmers who complete hatching before May 20th	Percent. of farmers who fail to complete hatching before May 20
North	112	12.4%	87.5%
Centre	180	10.1%	89.8%
South	156	27.3%	72.6%
Total	448	16.6%	83.3%

Other errors in this connection that are common with a large proportion of the farmers visited are: The use of eggs produced by unhealthy and mismanaged parent stock; the setting of broody hens in the laying pen where they are constantly subject to noise and disturbance; failure to rid the body of the setting hen from lice and mites; no attempt at having the season's hatches come off at about the same time, in order to have chicks of an even age; and the indiscriminate selection of eggs regardless of size and imperfections. Naturally the hatchability of such eggs, and the livability of chicks hatched therefrom must be greatly reduced. In this, together with a combination of bad conditions resulting in high percentages of infertility, weak germs and mortality, may be found the explanation for the tremendous loss experienced during the incubating and brooding seasons.

ARTIFICIAL METHODS OF INCUBATION AND BROODING.

Artificial incubation and brooding is not general among farmers, as may be seen from a study of Table No. 5. There are several reasons for this, which might be summarized as follows: Low-priced, unreliable incubators, being advertised and sold on easy payment terms; a lack of knowledge of the most rudimentary laws of incubation, such failure being either the result of carlessness or a disposition to discard these instructions for some supposedly better original methods; low-priced brooders—veritable death-traps—a menace to chick life even in the hands of an expert; the feeding of chicks too soon after hatching; the rearing of chicks upon soured or otherwise contaminated land upon which many generations of chicks have been reared and the land having had practically no cultivation during this time. All of these and other preventable errors bring disaster, and result in a sweeping condemnation of artificial methods.

TABLE NO. 5.—SHOWING METHODS OF INCUBATION AND BROODING ON 448 ONTARIO COUNTY FARMS.

	Incubation				Brooding		
Section of County	No. of farms investigated	Natural	Artificial	Combination	Natural	Artificial	Combination
North.......	112	102	3	7	103	3	6
Centre......	180	173	6	1	173	6	1
South.......	156	134	15	7	140	10	6
Total.......	448	409	24	15	416	19	13

METHODS OF FEEDING.

Commencing with the newly hatched chicks various methods of feeding prevail. Many of these might be relied upon to bring success if proper attention were given to other important details. Bread crumbs fed dry, or soaked in either milk or water and squeezed dry, small wheat, oatmeal, cornmeal, and shorts figure prominently as foundation rations. In a fair proportion of instances a moderate amount of care is exercised in the feeding of chicks, but in many cases where chicks begin to die, due to errors previously enumerated, interest is soon lost, the chicks are neglected, and those surviving are compelled to take "pot-luck" with the older birds. Sometimes they forsake their own quarters—usually unsanitary—for the houses occupied by the adult fowl, where evil conditions are perhaps of longer standing, and where the "red mite" holds undisputed sway. It often happens, however, that some of the young birds which have come along fairly well, through fear of the older birds will remain in their original quarters, or take to some outlying shed where development is much more rapid and satisfactory.

The feeding of the adult birds during the summer season is, with a large proportion of the farmers visited, either entirely neglected or done in a very haphazard and irregular manner. The mistaken impression that hens do not require attention in the summer season, seems to prevail very largely. Then, too, the fact that hens will abundantly repay a little extra attention given them during the moulting period, is not, as a rule, considered. The result is that all birds to be kept over winter, enter the cold season in a condition very unfavorable for egg production. For good advice in this connection we cannot do better than quote from Prof. W. R. Graham in his recent bulletin on "Farm Poultry." In reference to the methods of feeding the summer laying stock at the O. A. C., he says: "At the present time our plan of feeding is to scatter whole grain in the litter both morning and evening. The grains used are wheat, barley, oats, and occasionally buckwheat and corn. Green food is supplied in the form of grass, etc., in the runs. Sour milk is given as drink." As to the methods of feeding the winter laying stock the following is written: "Equal parts of wheat, corn and buckwheat are fed both morning and evening. The morning feed is fed the previous evening after the hens have gone to roost, by sowing it on the litter and then turning the litter over; the straw is now on top and the grain below, and when the hens get up in the morning they start to dig out the grain, and are kept busy all forenoon. At noon we feed mangels, cabbage or clover hay. The night feed consists of the whole grain fed in troughs, and what the birds do not eat is taken up. Rolled oats are kept constantly before the hens in hoppers. Buttermilk only is given as drink."

Fig. 2.—Farm poultry house amid filthy surroundings.

Dearth of Scratching Material.

A very important factor contributing to the general experience of no winter egg production is the lack of exercise. To ensure vigor and health in hens—which conditions are absolutely essential to a maximum egg yield—scratching material must be liberally supplied, and the birds induced to exercise by scattering at least a part of their feed in a dry litter of straw or leaves, which should be from six to ten inches deep. Though there is usually an abundance of scratching material close at hand, it may be said that practically all farmers, either through ignorance or pronounced indifference, fail to attend properly to this simple but very important matter.

Unsanitary Conditions Propagate Disease.

Objectionable Locations.—It is an uncommon thing to find the poultry-house separated from the barnyard by any great distance. In many cases the fowl are allotted a section of the main stock stable or they are given the entire run of an outbuilding situated very close to the barnyard. While there are certain advantages in such a location where the fowl may pick up grain and feed that would otherwise go to waste, there are serious evil effects of this arrangement. In the wet season of the year most barnyards are in a very muddy and dirty condition, and during this time it is difficult to keep eggs clean and attractive in appearance. Moreover, under these conditions, the fowl not only have access to, but are often forced to drink the filthy barnyard drainage water. This greatly facilitates the spread of disease, and in view of that fact it would seem advisable to discourage such a location. The nearby orchard or lane not too far from the buildings is much to be preferred.

Fig. 3.—A typical farm poultry house—light and ventilation entirely inadequate.

House Sanitation.—The health of the average farm flock is not as a rule well looked after. In a few cases regular and systematic cleaning of the house is observed, but these are the exception rather than the rule. In a very considerable proportion of the poultry houses examined the term "filthy" does not exaggerate the conditions found. The usual practice is to allow the droppings to accumulate for several months before any attempt is made at a proper cleaning. In some instances houses are provided with dropping boards, and where these are neglected the condition of the roosting pen is often much worse than where there is no dropping board.

The majority of houses are lighted by means of a small all-glass window about four feet from the ground, usually in the south side, but not infrequently in the north, east or west. In some instances no light whatever is provided. The question of ventilation is seldom considered. An occasional opening of the door in the winter season is usually regarded as sufficient to supply the necessary fresh air. In many houses draughts, especially floor draughts, are particularly bad. Such conditions as these contribute very materially to the propagation of disease.

Fig. 4.—A good farm poultry house; (a) cotton screen between the windows; (b) runways; (c) frame covered with cotton for windows.

Note.—By making provision for still more glass and cotton the front of this house could be greatly improved.

TABLE NO. 6.—SHOWING PREVALENCE OF DISEASE ON 448 ONTARIO COUNTY FARMS.

Section of County	Number of farms investigated	Percent. of flocks showing serious disease
North	112	21.5%
Centre	180	10.5%
South	156	15.4%
Total	448	15.8%

THE PREVALENCE OF DISEASE.

One of the most surprising discoveries made in this investigation was the high percentage of flocks that were more or less affected with disease. It is difficult to estimate with any degree of accuracy the losses suffered by farmers from this trouble. In some instances flocks were found to have been so seriously affected that large numbers of the affected birds were entirely lost through illness.

The investigation, in this particular alone, discloses a very deplorable condition of affairs, and points to the imperative need of giving these farmers such education and instruction as will enable them not only to diagnose the important diseases but to treat them intelligently.

Insect Pests.

Body Lice.—It is generally admitted to be a most difficult matter to keep a flock of adult fowl absolutely free from body lice, but given a fair chance, hens in good health will keep them sufficiently under control to prevent causing any serious trouble. There are several different species of lice that infest hens. Of these two are very common and are generally known as body lice. The species, *Menopon pallidum,* is probably the most common, and it is a rare thing to find a farm flock which is not seriously troubled with this pest. They are exceedingly active and may be found on all parts of the body. They often crawl on the hands when handling or plucking fowl. Another important species, *Menopon biseriatum,* is found confined to special regions of the body. Although capable of crawling, it is usual for them to remain stationary, sometimes with the head buried in the skin and the body erect. Body lice breed and spend their life on the body of the fowl. The eggs or nits are laid upon the down feathers about the vent and can often be found there, hanging in clusters. It is estimated that the second generation from a single louse may number 2,500, and a third generation 125,000, and that all of these may be produced within eight weeks. Thus it is that a flock considered to be quite free from lice, is often found to be infested after being neglected for only a few weeks. Exercise, proper feeding, and pure air, all help to keep the birds in a condition unfavorable to the existence of lice. Good sanitation is imperative. It is necessary to provide sunny, well-ventilated houses, in which there is no dampness and no accumulation of droppings. A suitable dust bath should be provided and placed in a sunny part of the house. In this box, earth, or sandy loam should be placed, rather than coal ashes, as the earth is beneficial to the skin of the birds in addition to ridding them of lice. A few handfuls of powdered sulphur will add to the effectiveness of the dust bath. All flocks should be carefully watched and frequently examined for lice, particularly young stock, so much of which is ruined by lice and mites.

Red Mites.—The so-called red mite is undoubtedly the most virulent and aggressive enemy of the farm flock. The natural color of the insect is grey. It is only when gorged with blood, like the musquito, that it becomes red.

Few farmers appear to realize the enormity of the ravages of these mites, and, having no knowledge of their life history or habits, they are ignorant of the best methods of eradication. Instances of broody hens leaving the nest due to mites are common. The investigators have frequently examined poultry houses, after being told that the flock was absolutely free from all insect pests, and discovered myriads of red mites merely by lifting a roost or nest box. At this the farmer would express the utmost surprise. Without doubt these mites are responsible for a large proportion of prevalent disease. The birds are thereby reduced to a condition which leaves them an easy prey to disease germs. Furthermore, such conditions render the fowl utterly useless as layers of winter eggs. This undoubtedly is the explanation of many flocks failing to lay, even where special efforts are made to obtain eggs during the winter season.

In a recent bulletin (1911) published by the Maine Agricultural Experiment Station, and edited by Messrs. Pearl, Surface, and Curtis, there is given some excellent advice upon methods of prevention and treatment for red mites. It reads as follows:—"Clean, dry, well ventilated houses which get plenty of sunlight, are seldom badly infested. The first step in eradicating or controlling the pest is thoroughly to clean the houses. Remove the droppings and all the old nesting material. Clean, and, when possible, scrub or wash with a stream from the hose, all the perches, nests, floors and walls, with a mixture composed of three parts kerosene and one part crude carbolic acid. Work the mixture into all cracks, crevices and joints of the building.

"With this spray it is necessary to make two or more applications at intervals of a few days to destroy the mites which hatch after the first application. The liquid may be put on with a hand spray pump or with a brush. Cleanliness, fresh air, and sunlight are cheap and effective preventatives."

Another spray successfully used, and which is less expensive is kerosene emulsion. This is made up of kerosene (coal oil), 2 gallons; rain water, 1 gallon; soap, ½ lb. Dissolve the soap in water by slicing and boiling; take from fire, and while hot pour in kerosene and churn vigorously for five minutes. For use dilute with nine parts of water so that the above three gallons of stock emulsion will make thirty gallons of the spray mixture.

According to the following table the examination of poultry houses on 448 Ontario County farms revealed the fact that 75 per cent. of them were more or less seriously infested.

Table No. 7.—Showing Prevalence of Red Mites.

Section of County	Number of farms investigated	Percent. of flocks infested
North	112	71.4%
Centre	180	78.4%
South	156	76.5%
Total	448	75.4%

CARE OF EGGS UPON THE FARM.

COLLECTING EGGS.—The frequent and regular collection of eggs from the poultry house is not viewed with sufficient importance by the majority of farmers. The usual practice is to gather the eggs but once a day during both winter and summer. While this may suffice at certain times of the year, collections should be made more often during the hatching season when broody hens are continually invading the laying pen. In the hot midsummer weather, and during the colder part of the winter, a similar practice should obtain. If frequent collections are not made during these periods the loss due to frozen, heated and hatched eggs, though not apparent to the farmer, will nevertheless be great.

A general lack of system is also evident on many farms. The responsibility of collecting eggs is seldom allotted to one person. The result is that on some days no collections are made, or, if one is given the work who is not familiar with the location of all the nests, some may be overlooked and left until a day, or perhaps several days, latter. A surprising discovery in this investigation was the fact that 11.8 per cent. of the farmers visited were so uninterested in their poultry that no special provision whatever had been made for nests. In the case of others there were far too few nests for the number of hens kept, and in still others too many, a condition which, in winter, favors the chilling and freezing of eggs. These facts are evident from a study of Table No. 9. It is little wonder that when the product of such farms is candled and graded, there is found a very heavy shrinkage. Few of the above difficulties arise where there is provided one clean, inviting nest for every five hens in the flock.

TABLE NO. 9.—SHOWING RELATION OF NUMBER OF NESTS TO NUMBER OF HENS ON 448 ONTARIO COUNTY FARMS.

No. of farms	Percent. of total	Nests provided
53	11.8	No special provision for nests
59	13.1	From 2 to 10 nests per 100 birds
145	32.4	From 10 to 20 " " 100 "
103	22.9	From 20 to 30 " " 100 "
49	10.9	From 30 to 40 " " 100 "
39	8.7	From 40 to 46 " " 100 "

IMPROPER METHODS OF KEEPING EGGS PREPARATORY TO MARKETING.

The mistake of storing eggs in improper places, preparatory to marketing, is common with many farmers. There seems to be a general lack of appreciation of the fact that an egg is a very perishable product. Few realize that the heat of an adjoining room or the odor of some strong-smelling vegetable, is sufficient greatly to reduce the quality of eggs. The source of trouble in many instances is the holding of eggs in a damp cellar, or in a small room or pantry, adjoining a heated kitchen. Eggs should be kept in a cool room free from draught, dampness or any foul odors, and in a temperature not exceeding sixty degrees. Usually such a place may be found in a cool dry cellar or cellar-way.

Washing Eggs.

Careless, neglectful methods in the poultry house as well as wet and dirty ranges often result in a large proportion of dirty eggs. It is the common practice of some of the most self-respecting farmers or their wives to carefully wash these stained or otherwise soiled eggs. For immediate consumption such eggs are as good as those that are unwashed, but for storage purposes they are not so valuable. This is due to the fact that the soluble portion which serves as a hindrance to evaporation, and a protection against the entrance of organisms of deterioration, is washed from the surface of the shell. Moreover, such a practice is liable to dampen the membrane which is immediately beneath the shell. When this membrane is wet, germs of putrefaction effect an entrance much more readily, thus rendering the egg more subject to contamination.

Fig. 5.—A "found" nest.

Marketing of Partially Incubated Eggs.

Unfortunately cases of this dishonest practice are not wanting. It certainly can hardly be claimed that such a practice results from ignorance. The same may be said of marketing eggs from stolen nests, which is an all too common practice, as borne out by the candlers of large city egg dealers. Many of these eggs are found in the fields or in favorite hiding-places about the buildings. While accumulating before discovery, they are probably being subjected to dampness from frequent rains or exposed to the direct rays of the hot sun. Both of these factors cause eggs to deteriorate very rapidly.

Removal of Male Birds After the Breeding Season.

It is remarkable how few farmers appreciate the importance of infertility in market eggs. To make provision for the infertility of an egg does not necessarily guarantee the absolute preservation of its good quality; but such an egg, being free of the active germ cell, will not, under ordinary storage conditions, deteriorate seriously. The great bulk of eggs which are spoiled for purposes of consumption are the fertile eggs, which, having been subjected to heat above seventy degrees, undergo partial incubation. If the heat is continuous and strong enough, the development of the chick will continue; but if it ceases or is intermittent, putrefaction at once sets in and the eggs become bad. Such eggs are known to the trade as "blood rings," "floats," "heavy floats," or "rots," depending upon the degree of deterioration they have undergone. Few farmers have any knowledge of these facts, and consequently practically none have made any effort to ensure infertility. They seem to have the erroneous impression that the presence of the male bird is essential to the production of a maximum number of eggs; but it has been proved beyond all question of doubt that such an arrangement is not necessary, and for the reasons set forth, is highly undesirable.

REVIEW OF PRESENT METHODS OF MARKETING EGGS AND CONSEQUENT LOSSES.

The Flat Rate System and the Country Merchant.

The farmer is not the only one accountable for the heavy shrinkage in market eggs. Along the course of trade through which eggs pass, there are other handlers commonly known as "middlemen," with whom should be placed much of the responsibility. This is true because of the system which they invariably employ in the purchase of the farmers' eggs. This system is known as the "case count," or "flat rate" system, and consists of paying one common price for all eggs.

The country merchant, who is usually the first to receive the farmer's eggs, is in the habit of receiving weekly or semi-weekly quotations from large egg dealers, and upon these quotations he bases his price. The evil feature of this system is in the fact that no consideration whatever is given to the question of quality. The farmer who is in the habit of supplying the merchant with an attractive lot of clean and strictly fresh eggs receives no more in price than the farmer whose eggs are small, soiled, stale, or part of which are bad and entirely unfit for consumption. The result is that the farmer is in no way induced to properly care for the product upon the farm. There is also held out to unscrupulous producers the temptation to include in the case prepared for the market, eggs that are known to be of questionable quality. Though the merchant to whom such eggs are sold has absolute knowledge, or, at least, well-founded suspicions, that the eggs brought in by the farmer are not fresh as represented, he usually prefers to accept them without making the slightest complaint. The merchant's policy is to cultivate as large a trade as possible in eggs. He knows that by so doing other departments of his business will be proportionately increased. As a result he is strongly tempted to bid high for eggs, seeking to outdo his competitors, knowing that if he chances to lose on the eggs he handles he can very easily make the loss good, simply by inflating proportionately the cost of the miscellaneous articles the farmer desires to purchase or take in trade.

Still another practice of some local merchants is to advertise two prices; one a cash price, and the other a trade price, usually about two cents higher than the cash price. If the farmer is determined to have cash he is forced to be satisfied with the lower price. If, on the other hand, he consents to take groceries or other goods in trade for his eggs, he is represented as being paid the higher price. In reality this higher one is not the real price, but a fictitious one which is set by the merchant for no other purpose than to secure the farmer's trade. Upon the account form rendered by the merchant there may be represented goods to the value of the eggs figured out at the higher price, but at the same time the merchant is often careful to increase the cost of the goods taken in trade equal to the advance given for eggs, or in some other way make up the difference.

Fig. 6.—Careless handling of returned egg cases.

Note.—The paper fillers in these egg cases were thoroughly soaked by a drenching rain. This is one of the causes of mouldy and musty eggs.

Another evil of this "case count," or "flat rate" system, is that the innocent suffer with the guilty. Those farmers who are supplying the markets with strictly fresh eggs, and of first quality in other respects as well, suffer from the low price, caused by the presence of inferior eggs supplied by others who are careless, or perhaps dishonest in their dealings. Commission merchants know what shrinkage to count on at certain seasons of the year, and naturally they pay a price which is sufficiently low to cover at least a portion of that shrinkage. And not only does the unoffending farmer suffer by reason of this present antiquated system of marketing eggs, but the equally innocent consumer is at the same time charged a higher price to assist in covering the shrinkage or so-called loss suffered by commission merchants.

The Huckster.

The travelling egg buyer, commonly known as the huckster, figures very prominently in the egg trade of Ontario. His custom in some sections is to call at the doors of the farm houses and solicit the purchase of the farmer's eggs. In other sections he will establish himself in some convenient central point—usually a small village in the midst of a good trading section—and announce to the farmers in the community that on a certain day he will receive their eggs. As a rule, there is little or no com-

Fig. 7.—Market day in a country town.

petition, and needless to say he buys at his own price. From here he passes on to another point, duplicating the practice on the following day. From the standpoint of quality in eggs received by the larger markets, those received from the huckster generally compare very favorably with those coming from other sources. It is the usual practice of the huckster to make regular weekly collections. Where farmers are in the habit of selling to him regularly, such eggs are fair in quality. But, with this system, the price received by the farmer is usually not so high.

While the huckster, as a rule, makes regular weekly shipments to the larger markets, careless or deliberate holding of eggs is sometimes his practice. In one instance which came under our notice, a large quantity of eggs was left over by a huckster in an ordinary shed for a whole week during the hottest weather experienced in the summer of 1911. His excuse for holding these eggs was that his waggon was overloaded, and that if the eggs were shipped by express or freight, his profit would be too small. However, it is worthy of note that at that particular time the market price for eggs was on the upgrade.

Fig. 8.—Candling and grading eggs.

The Local Market.

In many small country towns, particularly in districts surrounding large consuming centres, there have been established market places which are utilized by farmers on a set day of each week, for the exclusive purpose of selling poultry, eggs and butter to visiting agents of large produce firms. It is often stated in support of the local market that this system is superior to all others, for the reason that there is keen competition between the buyers, and because of this, high prices rule. But the most superficial investigation will give one well founded suspicions that, as a rule, there is no trace of the avowed competition, but in its stead, an arrangement to pay a certain fixed price. Here, too, all eggs are bought on the " case count " basis.

Though these are the most important methods by which farmers dispose of their eggs, there is still one other that is worthy of notice. A certain proportion of the better and more progressive farmers, in seeking to obtain a higher price for their eggs, pass by one or more middlemen and deal directly with large produce houses, retail stores, or with the final consumer. Such eggs are generally of a higher grade and are acknowledged by those accustomed to receiving them, to be of a better class than eggs marketed in any other way.

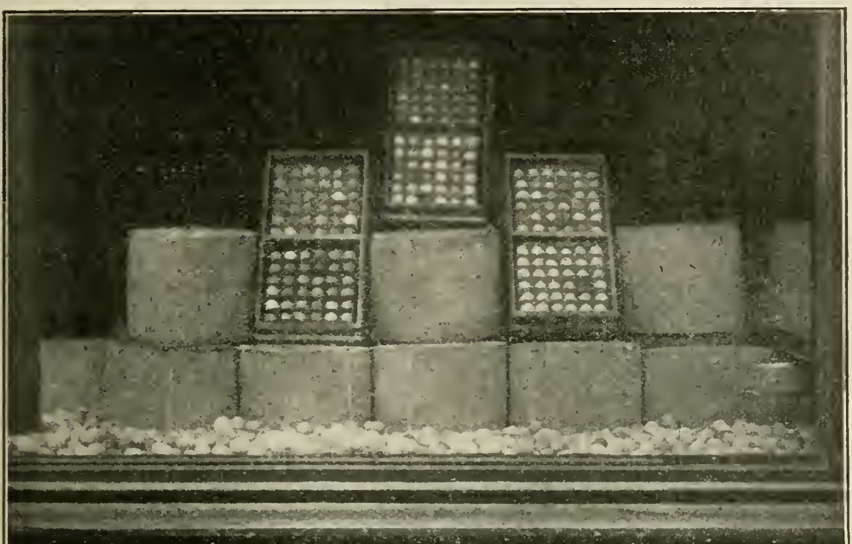

Fig. 9.—Spoiling eggs by subjecting them to the direct rays of the hot sun—a common mistake of the retailer.

CANDLING AND GRADING MARKET EGGS.

While by no means all eggs delivered to the larger markets are candled, there is that portion of the trade, handled by the large produce dealers, which is carefully examined and graded. The process of candling consists simply in the examination of the egg in a dark room before an opening in a shield covering a small incandescent light or coal oil lamp. Before such a light, an egg appears comparatively transparent, sufficiently so to enable the expert to determine the extent to which the contents of the egg have evaporated, or the degree to which the egg has deteriorated in quality. The illustration (Fig. 8), which is a flashlight photograph, shows very clearly the nature of the apparatus used, the candler at work, and also the various grades made of the eggs after examination. This process of course is costly, taking considerable time and expert service, adding not only to the cost of eggs to the consumer, but to the reduction of the farmer's receipts.

However, it is fortunate for the general public, at least of large consuming centres where such establishments are operating, that such eggs are to be had, and that they are subjected to such careful examination. In buying candled eggs consumers may feel comparatively sure that the eggs they are purchasing are as represented.

The Town or City Retailer.

On the other hand, there is a portion of the trade which comes from the country storekeeper, the huckster, or the farmer, directly to the retail merchant, which, as a rule, is not candled or graded. Consumers in villages and outlying towns are supplied with this class of ungraded eggs almost entirely. Consequently they have to assume the entire risk. This practice undoubtedly results in a great curtailment of consumption, and indirectly loss to the industry. To illustrate the truth of this general statement it may be said that the housewife, in buying bad eggs is so disgusted that the next time when eggs are desired, she determines that something more dependable must be bought. The consequence is, fewer eggs are purchased, the price goes down and the reputation of this commodity is seriously injured.

Nor is the retail merchant always free from blame in the matter of selling deteriorated eggs. Often his zeal for business seemingly overcomes his reason and he apparently forgets, or is ignorant of the fact that eggs take on strong odors in a favorable atmosphere, as in a room where kerosene is stored; that they become mouldy and musty if placed in damp locations; and that they actually hatch into chickens if placed in a suitable temperature. The merchant is often as much in need of education as the farmer.

THE NEED OF EDUCATION.

The poultry industry is in need of a great awakening. The farmer should be aroused and made to see that his poultry is in reality one of the best revenue producing branches of his farm; that there is a distinct place in his business for poultry; that his flock should be made larger and thus put on a better commercial basis; and that he would be abundantly rewarded with better results if he directed the management of his poultry according to the few well established and generally recognized successful methods. He should be made to realize that as a matter of fact, he, and not the middleman, suffers heavily by reason of the loss due to spoiled eggs. Such work as this may be accomplished by the distribution of more educational literature, by more public discussion, by the agricultural press, and through the agency of the Government's agricultural experts.

THE DEMONSTRATION POULTRY HOUSE.

During the past few years a great deal of effective teaching has been done by means of demonstration. One branch of agriculture, namely, fruit-growing, seems to have lent itself very readily to this method. The District Representatives who are located in fruit-growing sections, have taken advantage of this, and by the management of demonstration orchards have wonderfully increased the interest taken by farmers in the proper care and management of their fruit trees. The success achieved along this line suggested to us the possibility of the adoption of the same idea in connection with poultry. Our desire was to work out some means of illustrating to farmers, a good type of poultry house, proper appliances to install in the house, proper methods of feeding, and chief of all, to demonstrate the possibility of winter egg production. In the fall of the past year the house as illustrated by Fig. 10 was built. It was loaned to an energetic and enterprising farmer on condition that the flock it contained be managed and fed according to directions given. The results in winter egg production were excellent. The pullets were not of a bred-to-lay strain, but were early hatched, healthy, vigorous birds from pure-bred stock.

Fig. 10.—Demonstration poultry house.

This scheme was eminently successful in arousing the interest of the farmers in that locality. Everyone had the privilege of making an examination of the house and enquiring as to methods of management, etc. Surprising advantage was taken of this privilege and the effect upon production during the first winter season was very marked.

A BREEDING STATION.

Such a poultry house which has been so effectively used as a Demonstration house may also serve the purpose of what in European countries would be called a Breeding Station. The house should contain well-bred utility hens, that the eggs and offspring therefrom would be of such a character as to effect improvement in the farmer's flock. If the farmer or poultryman who has the management of the station is at all successful in getting good results he should have no difficulty in finding ready sale, at moderate prices, for eggs during the hatching season and for male birds in the fall of the year. This line of work is most essential as a part of a poultry improvement campaign. In fact, one cannot hope to make poultry educational work effective unless there is provided some source from which farmers may secure improved breeding stock.

CO-OPERATION IN THE MARKETING OF EGGS.

The egg trade requires a marketing system, the working or selling principle of which is based upon quality. What is known to the trade as the "loss off" system should be adopted in place of the "case count" system which is now so universal. So long as the latter system prevails, proper and sanitary methods of production and care of this very perishable product will be discouraged. As a matter of fact, the present method amounts practically to the placing of a premium on careless and dilatory methods. By reason of this basis of buying eggs, educational work is rendered difficult if not very largely fruitless. The farmer is repeatedly advised to improve the breeding of his poultry stock in order to weed out the small egg, to keep his poultry house and nests in a clean and inviting condition in order to reduce the number of stale eggs through hens stealing their nests, to gather the eggs twice daily, to keep them stored, preparatory to marketing, in a clean, cool place, and to market them more frequently. To follow this advice is most essential if it is the desire to produce eggs of the highest quality. But it entails some little care which the poultry department of the average farm is not in the habit of receiving. Therefore, when given such advice, the farmer naturally asks this question: "What are we going to get for it?" So long as the "case count" system of marketing continues, the answer which must follow is, "Practically nothing." The system is at fault, therefore the system must necessarily be changed. The price paid for eggs should be based upon the quality of the product at the time of sale. Such a system would, by the encouragement of better methods of caring for and marketing the product, very greatly assist in preventing the heavy loss which the Canadian egg trade now sustains.

The produce of all Co-operative Marketing Associations (which are commonly known as "Egg Circles" where eggs only are handled) is sold on a quality basis. The members also are paid according to the grade of the product which they supply to the management of the Association. This is one of the leading and most important features of such an organization. The success of the movement has been very largely due to the strict observance of that principle.

The organization of Co-operative Egg Marketing Associations is, therefore, one method of instituting and enforcing the system of buying eggs on a quality basis. Such an organization has also the advantage of cheaper transportation where large quantities of eggs are shipped. In some cases unnecessary middlemen may be eliminated. Such an organization also facilitates more frequent shipment and greater dispatch in placing the product upon the market. Where good management is employed, the members also derive benefit from the expert salesmanship of the manager.

The Movement in Ontario County.

About two years ago a movement was started in Ontario County to establish the co-operative system of selling poultry products. The work commenced with the handling of eggs. Egg Marketing Associations were formed in two of the most promising sections. It was our desire that the farmers should try out the scheme for themselves. If the result showed no improvement over present methods, the matter, of course, could be dropped. On the other hand, if it proved to be a useful and remunerative organization the movement would naturally grow, and that growth being largely spontaneous, progress would therefore be much more satisfactory. Eight organizations have since been formed. According to the last reports the present membership is over 500 farmers. The total membership has increased one hundred per cent. in the past year, and this has been very largely due to farmers voluntarily asking for organizations or for permission to join one or other of the organizations already established. In the case of one organization, No. 7, with headquarters at Cannington, the business has averaged over $1,000 per month for the past ten months. The movement has made a natural growth, its development being entirely due to the success of those organizations which were first established. In all cases the extension of the movement has taken place in those sections surrounding and in the immediate vicinity of established organizations. This is the best evidence which we can give of what the farmers themselves think of the movement, or of the Co-operative Marketing Association.

The growth and popularity of the movement has been brought about largely because of the increased prices which the members of these organizations have been receiving over and above prevailing local market prices. It is difficult to obtain accurate figures showing the advance in price which members have been getting, because of the influence which the movement has on local market prices; but, to give approximate figures, the advance in the spring and summer sesasons has ranged from one to three cents, and in the fall and winter months from three to as high as twelve cents. This premium which the "marked" eggs from these organizations have been bringing on the near city markets is directly due to an improvement in quality. However, the quality even yet is by no means perfect. A great deal more remains to be done than that which is already accomplished. But the fact remains that some improvement has been made, and because of that improvement, the eggs have commanded a higher price.

Though this increased price is largely responsible for the rapid growth which the movement has made, it must be kept in mind that this is not by any means the only benefit to be derived from a Co-operative Marketing Association. In the writer's estimation, it is the least important. The chief virtue of such an organization is the effect which it has upon the farmer's attitude toward his poultry, and the handling and marketing of eggs. By reason of the better prices and general satisfaction which this system gives, farmers are particularly desirous of remaining with the organization after once having joined. In order to retain his membership the farmer must carefully follow the rules and regulations as outlined in the Constitution and By-laws. In order to do this, he seeks advice and instruction from the management of the organization. In this way the old-time indifferent farmer is changed into a keenly interested one. He becomes remarkably receptive and even looks to the management to guide him in the detailed management of this part of his business. This offers a wonderful opportunity for doing most effective educational work.

The following is a suggested Constitution and By-Laws for a Co-operative Marketing Association.

CONSTITUTION AND BY-LAWS.

Constitution.

1. The ———— Co-operative Poultry and Egg Marketing Association has for its object the increasing of the profits to poultry raisers by Co-operation.

2. The Association seeks to reach its object:

(a) By marketing eggs and poultry of only the best quality.

(b) By selling eggs and poultry delivered to its members at the highest possible price.

(c) By buying for its members grit, feed, shell, and such other supplies as are needed in the production of poultry.

(d) By buying such pure bred stock and eggs as may be needed in improving and supplementing the stock already kept by the members.

(e) By the dissemination of poultry knowledge.

3. The annual meeting of the Association shall be held during the first two weeks in January of each year.

4. Notice of the annual meeting shall be given each member by the Secretary not more than one week previous to the date of this meeting.

5. Special meetings may be called at any time upon call of the President, by written notice mailed to each member five days before the meeting. Special meetings shall be called by the President whenever required to do so in writing by any ten members.

6. At the annual meeting a Board of seven Directors shall be elected, of whom four present and voting shall constitute a quorum at any board meeting.

7. The Directors shall be elected for a period of two years except at the time of organization, when four shall be elected for two years and three for one year. In succeeding election all members elected to the Directorate shall be elected for the full period of two years. A retiring member may be re-elected.

8. The officers shall consist of a President, Vice-President, Secretary and two Auditors.

9. The President, Vice-President and Secretary shall be chosen by the Directors from among themselves at the first board meeting after the annual meeting. The Auditors shall be elected at the annual meeting at the time of the election of Directors.

10. The Directors may select three of their number to act as an Executive Committee (the President to serve as Chairman) to have general charge of the affairs of the Association.

11. The President shall preside at all meetings. He shall call meetings of the Board of Directors and members when necessary, and shall advise with and render such assistance to the Manager as may be in his power. In his absence the Vice-President shall have and exercise all rights and powers of the President.

12. The Secretary shall keep a record of the proceedings of all meetings, and of all receipts and disbursements and report the condition of the finances annually or as often as the Directors shall desire.

13. The Board of Directors shall be responsible for the work of the Association. They shall closely supervise the work of the Manager and shall deal with misdemeanors of members. They shall carry on educational work among members of the Association by the distribution of educational literature, and by arranging for educational meetings from time to time.

14. It shall be the duty of the Auditors to examine the accounts of the Association twice during the year (July 1st and January 1st). The July report of the Auditors shall be made to the Board of Directors, and the January report at the general meeting. The Auditors, however, possess the right to examine the accounts whenever they so desire.

15. The Board of Directors shall employ a business Manager who shall also act as Treasurer of the Association. The business Manager shall not be a member of the Board of Directors.

16. When a vacancy shall occur through any cause in any of the offices established by the Constitution and By-laws of the Association, it shall be filled at the next regular or special meeting.

17. The Directors of the Association have full power to expel any member who refuses or neglects to comply with the rules of the Association.

18. All the elections shall be by ballot, plurality electing, conducted by two scrutineers appointed by the Chairman.

19. This Constitution, or any part thereof, may be amended at any regular or special meeting by a two-thirds affirmative vote of the members present.

By-Laws.

1. The Manager shall have charge of the affairs of the Association in detail under the direction of the Board of Directors.

2. The remuneration of the Manager shall from time to time be fixed by the Directors, and may be by way of salary or commission.

3. Members of the Association are subjected to the following regulations:

(a) They must deliver all eggs not to be used for their own housekeeping or breeding purposes at a time and place determined by the Board of Directors. All eggs must be unbroken, clean, fresh, of good size, and not more than one week old.

(b) Before being delivered all eggs must be stamped at the broad end with the stamp supplied by the Board of Directors. The stamp is the property of the Association and must be returned to the Manager when membership ceases.

(c) Only false eggs of gypsum, china, etc., may be used as nest eggs.

(d) Eggs must be gathered twice a day, and kept in a cool room, free from draught, dampness or any foul odors, and in a temperature not exceeding 60 degrees nor lower than 45 degrees.

(e) No member shall be permitted to dispose of eggs through the Association, from other hens than his own.

4. Membership may be obtained by all poultry keepers living in the vicinity of   upon payment of an entrance fee of thirty cents. Only those will be admitted who will strive to promote the aims of the Association, and whose applications are accepted by the Board of Directors.

5. Application for membership must be made to the Board of Directors in writing, the application specifying the number of hens which the applicant keeps. Entrance fees must be paid on acceptance by the Board of Directors.

6. An annual membership fee of 25c shall be imposed upon each member at the beginning of each year, the said membership fee to be used for defraying the running expenses of the Association. Where a balance remains at the close of the year it shall be carried over to the following year, and held as a reserve fund. In case membership fee is not sufficient to meet the running expenses of the Association, a special fee may be levied by the Board of Directors, sufficient to meet the liabilities of the Association.

7. In case members do not observe the rules of the Association, a system of fines may be adopted and enforced by the Board of Directors.

8. If the Association should become dissolved, the profits which remain after all debts have been paid, shall be divided among the remaining members. The deposits shall first be paid back, after which any remaining assets shall be distributed among those members who have belonged to the Association at least one year, the said distribution to be made in proportion to the value of the eggs delivered by each member.

9. These by-laws may be amended at any regular or special meeting by a two-thirds affirmative vote of the members present.

It is the experience of the writers what if those in charge of Co-operative Marketing Association formulate a very arbitrary set of rules and stipulate that a violation of the said rules will result in immediate expulsion, the outcome will be disastrous. Some theoretical co-operators may object to this, but we question if any other policy will work out in practice. Strict observance of the rules should, of course, be kept continually before the members as being the secret of success, but it must be kept in mind that the average farm flock does not as yet command much interest from the farmer, and is not, as a rule, looked upon as a business proposition. It becomes important, therefore, first to enlarge his view of the enterprise; to enable him to see the advantage of the better methods agreed upon by the Association and by means of this education, he will soon develop into a desirable member.

The egg gatherer is usually the manager of the organization. He collects the eggs on a certain day each week, candles and prepares the same for shipment, and delivers them to the shipping station. He also receives the returns for the shipment, reserves his commission, pays the

Fig. 11.—Egg collector of an Ontario County Egg Circle.

freight or express charges, places to the credit of the Association Bank Account any fraction of a cent which would make payment to the farmers difficult and with the balance he returns to the members as high a price as possible, of course making deductions where bad or inferior eggs are delivered.

A Poultry and Egg Marketing Association is not unlike a co-operative fruit growers' association. They are alike in this particular, at least, viz., that success depends to a very great extent upon the energy, ability and honesty of the manager employed; and so important is this, that unless an association is able to secure a man of such character, it had better give up the idea altogether, and thus avoid the disappointment of failure.

A FEW CONCRETE CONCLUSIONS.

1. In the investigated district, only 38.6 per cent. of the farmers appeared to be taking a business-like interest in their poultry.

2. The great majority of farm flocks are composed of cross-bred or mongrel fowl. Such indifferent and neglectful methods of breeding as are indicated by the type and quality of birds commonly found on most farms naturally result in a lack of size and uniformity in market eggs and dressed fowl, and an increase in constitutional weakness.

3. Old hens are not profitable egg producers. This fact is not regarded by the majority of farmers.

4. Allowing male birds the freedom of the flock after the breeding season is practised almost universally. The discontinuance of this practice would greatly reduce the shrinkage in market eggs.

5. Hatching too late in the season is one of the greatest of the farmers' mistakes. This is one of the chief reasons for little or no winter egg production.

6. The feeding of farm hens in midsummer is often very seriously neglected.

7. The incomplete ration is another factor contributing to poor winter results. Eggs cannot be manufactured unless all of the necessary constituents are supplied, viz., grain (including whole grain and dry mash), animal food, green food, grit, and oyster shell.

8. Lack of exercise when confined is another important reason for poor results in winter egg production. Scattering the grain in a deep, dry litter of straw will overcome this difficulty.

9. The great majority of farm poultry houses are unsanitary, ill-ventilated and insufficiently lighted.

10. Disease is prevalent to an alarming extent.

11. The Red Mite is the chief enemy of the farm flock. This pest, which is common everywhere, is a potent factor in destroying the usefulness of otherwise productive and profitable flocks.

12. The reason for hens stealing their nests is found usually to be in an uninviting condition of the hen house and nests, or the supply of an insufficient number of nests. Nearly 12 per cent. of the farmers visited have provided no nests whatever.

13. Hatched, mouldy, musty and stale eggs are largely due to eggs being laid away in hidden nests, inattention to broody hens, or to irregularity or infrequency in making egg collections.

14. The perishable nature of an egg is too little understood. Dampness, excessive heat (above 60 degrees), strong odors, draughts, delay in marketing, are factors which very quickly destroy the freshness and good quality of eggs.

15. It is the opinion of the majority of Canadian egg dealers, that the Canadian Egg Trade sustains a loss of at least 17 per cent. This means that for every 30-dozen case marketed, there is a loss equal to the value of five dozen eggs. This loss is very largely the result of defective methods of production and marketing.

16. The chief fault of the present method of marketing eggs is the "case count," or "flat rate" system of buying and selling the product.

17. Eggs should be bought and sold on merit. The price received or paid should be strictly in accord with the quality of the product.

18. To allow as much for inferior eggs as for eggs of the highest quality is practically the same as placing a premium on careless and dilatory methods.

19. The basis of payment of an Egg Selling Association or an Egg Circle is that of quality. Only first-class eggs receive a first-class price. All eggs are paid for according to their grade, as shown by the process of candling.

20. In an Egg Circle, members have the advantages of more frequent marketing, cheaper transportation, the elimination of unnecessary middlemen, access to the latest and best in poultry knowledge, and expert salesmanship, all of which naturally result in the elimination of loss, a higher class product, a keen demand for their product, and larger net profits.

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200	April	1912	Fruit Juices	L. Meunier.
201	May	1912	Peach Growing in Ontario	F. M. Clement.
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202	May	1912	Grape Growing in Niagara Peninsula	T. B. Revett.
203	May	1912	Cabbage and Cauliflower	A. McMeans.
204	June	1912	Decay of the Teeth	Ont. Dental Soc'y.
205	Sept.	1912	Dairy School Bulletin (No. 172 revised). Part I. Cheese-making and Butter-making	Staff of Dairy School.
206	Nov.	1912	Dairy School Bulletin (No. 172 revised) II. Dairying on the Farm	Dairy School.
207	Dec.	1912	Ice Cold Storage on the Farm...	R. R. Graham.
208	Jan.	1913	Farm Poultry and Egg Marketing Conditions in Ontario County	J. H. Hare. T. A. Benson.

Ontario Department of Agriculture

ONTARIO AGRICULTURAL COLLEGE

BULLETIN 209

A Revised Edition of No. 155

Farm Forestry

By

E. J. ZAVITZ, B.A., M.S.F.

Professor of Forestry

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ONTARIO AGRICULTURAL COLLEGE

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Farm Forestry

E. J. ZAVITZ

INTRODUCTION.

This bulletin has been prepared to assist the farmer and small landowner of the Province of Ontario to give more rational treatment to the wooded and waste portions of his land.

No space is devoted to arguments showing why the woodlot should be cared for nor why waste lands should be planted. It is assumed that the reader is beyond that stage and desires to make improvements if they can be made in a practical manner.

Through such mediums as the agricultural press, the Farmers' Institutes, and Experimental Union, much has been done to advance the cause of farm forestry, Many prominent men in agriculture have seen the need of conserving a portion of our woodlands and re-planting the non-agricultural soil, which should never have been denuded.

Owing to the peculiar nature of a forest crop, in that it takes so long from the planting to the harvest, the individual is very liable to shirk his responsibility. It has been found in the older countries of Europe that Forestry must have the aid and supervision of the State if anything like a rational policy is to exist. It is fitting that the farmer should receive all possible assistance in improving conditions which will in many cases benefit posterity more than the present generation.

An endeavor has been made to make this publication practical for the farmer, and as far as possible technical language has been avoided. Various things have been suggested which might not be practical for the large landowner. However, the farmer is especially fitted to carry out work as outlined in these pages, as he has a knowledge of plant life in relation to the soil; he has the equipment for such work and he can personally superintend and give it future inspection.

LIST OF FOREST TREES IN ONTARIO.

Most species of our native trees have synonymous names varying with locality. An example of this is the common maple of Ontario, which is called Sugar Maple, Rock Maple, and Hard Maple. To avoid confusion in this publication it is necessary to agree upon some common name.

Canadian and American species have been given the vernacular and scientific names adopted by Bulletin No. 17, of the Division of Forestry, U. S. Department of Agriculture. The names adopted in Bulletin 17 are in almost every case known in Ontario: so it has been felt advisable to conform to this standard. One exception is the Hornbeam (*Ostrya virginiana*), which in Ontario is commonly called Ironwood.

The adopted names are given in large type with the synonymous names in parentheses.

TREES INDIGENOUS TO ONTARIO.

Scientific Name.	*Common Name.*
1. Abies balsamea	Balsam Fir. (Balsam; Canada Balsam.)
2. Acer negundo (Negundo aceroides)	Box Elder. (Ash-leaved Maple; Cut-leaved Maple; Negundo Maple; Three-leaved Maple; Manitoba Maple.)
3. Acer nigrum	Black Maple.
4. Acer pennsylvanicum	Striped Maple. (Moosewood.)
5. Acer rubrum	Red Maple. (Swamp Maple; Soft Maple; Water Maple; White Maple.)
6. Acer saccharinum (Acer dasycarpum)	Silver Maple. (Soft Maple; White Maple.)
7. Acer saccharum (Acer saccharinum)	Sugar Maple. (Hard Maple; Sugar-tree; Rock Maple; Black Maple; Maple.)
8. Amelanchier canadensis	Serviceberry. (June-berry; Shad bush; Service tree; May cherry; Shad-berry.)
9. Asimina triloba	Papaw. (Custard Apple.)
10. Betula lutea	Yellow Birch. (Gray Birch; Swamp Birch; Silver Birch.)
11. Betula papyrifera	Paper Birch. (Canoe Birch; White Birch; Silver Birch; Large White Birch.)
12. Betula Populifolia	White Birch. (Gray Birch.)
13. Carpinus caroliniana	Blue Beech. (Water Beech; Hornbeam; Iron wood.)
14. Castanea dentata (Catsanea vesea) (Castanea vulgaris)	Chestnut. (Sweet Chestnut.)
15. Celtis occidentalis	Hackberry. (Sugarberry; Nettle-tree.)
16. Cornus florida	Flowering Dogwood. (Dogwood; Boxwood.)
17. Cornus alternifolia	Blue Dogwood. (Dogwood; Purple Dogwood.)
18. Fagus atropunicea (Fagus ferruginea)	Beech. (Red Beech; White Beech.)
19. Fraxinus americana	White Ash. (Ash; American Ash.)
20. Fraxinus nigra (Fraxinus sambucifolia)	Black Ash. (Hoop Ash; Basket Ash.)
21. Fraxinus pennsylvanica (Fraxinus pubescens)	Red Ash. (Brown Ash; Black Ash.)
22. Fraxinus lanceolata (Fraxinus viridis)	Green Ash. (Blue Ash; White Ash.)
23. Fraxinus quadrangulata	Blue Ash.
24. Gymnocladus dioicus (Gymnocladus canadensis)	Coffee Tree.
25. Hamamelis virginiana	Witch Hazel. (Winter Bloom.)
26. Hicoria ovata (Carya alba)	Shagbark. (Hickory; Shellbark Hickory; Shagbark Hickory; Shellbark.)
27. Hicoria minima (Carya amara)	Bitternut. (Hickory; Bitternut; Swamp Hickory; Pig Nut.)
28. Hicoria alba (Carya tomentosa)	Mocker Nut. (Hickory; Whiteheart Hickory.)
29. Hicoria glabra (Carya porcina)	Pignut. (Hickory; Bitternut.)
30. Juglans nigra	Black Walnut. (Walnut; Walnut-tree.)
31. Juglans cinerea	Butternut. (White Walnut.)
32. Juniperus virginiana	Red Juniper. (Red Cedar; Cedar; Juniper.)
33. Larix laricina (Larix americana)	Tamarack. (Larch; American Larch.)
34. Liriodendron tulipifera	Tulip-Tree. (White-wood; Yellow Poplar; Tulip Poplar.)
34. Magnolia acuminata	Cucumber Tree.
36. Morus rubra	Red Mulberry.
37. Nyssa sylvatica (Nyssa multiflora)	Black Gum. (Sour-gum; Tupelo; Pepperidge.)

38. Ostrya virginiana .... Hornbeam. (Hop hornbeam; Ironwood.)
39. Picea mariana (Picea nigra) .... Black Spruce. (Spruce.)
40. Picea canadensis (Picea alba) .... White Spruce.
41. Picea rubens .... Red Spruce.
42. Pinus rigida .... Pitch Pine.
43. Pinus strobus .... White Pine. (Pine.)
44. Pinus resinosa .... Red Pine. (Norway Pine.)
45. Pinus divaricata (P. banksiana) ...... Jack Pine. (Scrub Pine; Gray Pine.)
46. Platanus occidentalis .... Sycamore. (Button-wood; Plane-tree; Button-ball.)
47. Populus tremuloides .... Aspen. (American Aspen; Poplar; Popple.)
48. Populus grandidentata .... Largetooth Aspen. (Poplar; Popple.)
49. Populus balsamifera .... Balm of Gilead. (Balsam; Balsam Poplar; Cottonwood; Poplar.)
50. Populus deltoides (Populus monilifera). Cottonwood. (Carolina Poplar; Poplar.)
51. Prunus serotina .... Black Cherry. (Wild Black Cherry; Wild Cherry; Rum Cherry.)
52. Prunus pennsylvanica .... Wild Red Cherry. (Pin Cherry; Pigeon Cherry; Wild Cherry.)
53. Prunus virginiana .... Choke Cherry. (Wild Cherry.)
54. Ptelea trifoliata .... Hoptree.
55. Pyrus americana (Sorbus americana) .. Mountain Ash.
56. Pyrus coronaria (Malus coronaria) .... Sweet Crab.
57. Quercus alba .... White Oak. (Stave Oak.)
58. Quercus macrocarpa .... Bur Oak. (Mossy Cup Oak; Blue Oak.)
59. Quercus prinus .... Chestnut Oak.
60. Quercus acuminata .... Chinquapin Oak.
61. Quercus rubra .... Red Oak. (Black Oak; Spanish Oak.)
62. Quercus coccinea .... Scarlet Oak. (Red Oak; Black Oak.)
63. Quercus palustris .... Pin Oak. (Swamp Spanish Oak; Swamp Oak; Water Oak.)
64. Quercus platanoides (Quercus bicolor). Swamp White Oak. (Swamp Oak.)
65. Quercus velutina (Quercus tinctoria) .. Yellow Oak. (Black Oak.)
66. Rhus hirta .... Staghorn Sumach.
67. Salix nigra .... Black Willow. (Willow.)
68. Salix amygdaloides .... Almondleaf Willow. (Willow.)
69. Salix fluviatilis (Salix longifolia) ... Longleaf Willow. (Sandbar Willow.)
70. Salix discolor .... Glaucous Willow. (Pussy Willow; Willow.)
71. Salix cordata mackenzieana .... Mackenzie Willow. (Heart-leaved Willow.)
72. Sassafras sassafras (Sassafras officinale) .... Sassafras. (Sassifrax; Sassafac.)
73. Thuya occidentalis .... Arborvitae. (White Cedar; Cedar; American Arbor Vitae.)
74. Tilia americana .... Basswood. (Linden; American Linden; Whitewood.)
75. Tsuga canadensis .... Hemlock. (Hemlock Spruce; Spruce.)
76. Ulmus pubescens (Ulmus fulva) .... Slippery Elm. (Red Elm.)
77. Ulmus americana .... White Elm. (Soft Elm; Swamp Elm.)
78. Ulmus Racemosa .... Rock Elm. (Cork Elm; White Elm.)

TREES INTRODUCED FROM UNITED STATES.

Abies concolor .... White Fir. (Balsam Fir.)
Abies nobilis .... Noble Fir. (Red Fir.)
Aesculus glabra .... Ohio Buckeye. (Buckeye.)
Catalpa catalpa (Catalpa bignonoides). Catalpa.
Catalpa speciosa .... Hardy Catalpa.
Chamaecyparis thyoides (Chamaecyparis sphaeroidea) .... White Cedar. (Swamp Cedar; Juniper.)
Cotinus cotinoides (Rhus cotinoides) .. American Smoke-Tree.
Gleditsia triacanthos .... Honey Locust.
Picea engelmanni .... Engelmann Spruce.
Picea parryana (Picea pungens) ...... Blue Spruce. (Colorado Blue Spruce.)
Pinus ponderosa .... Bull Pine. (Yellow Pine.)
Pseudotsuga taxifolia (Pseudotsuga douglassii) .... Douglas Spruce. (Red Fir; Douglas Fir.)
Robinia pseudacacia .... Black Locust. (Locust.)

Fig 1.—Sugar maple woodlot, showing good reproduction.

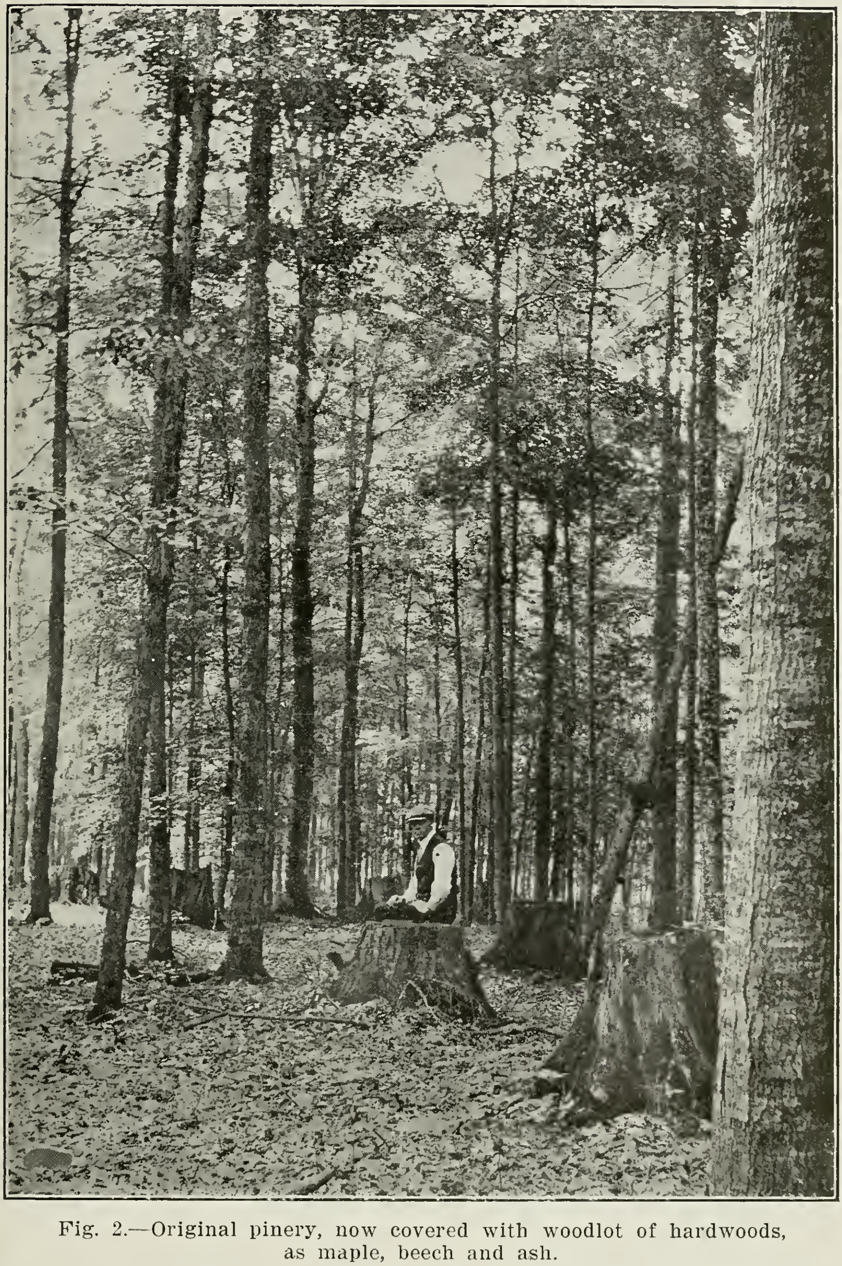

Fig. 2.—Original pinery, now covered with woodlot of hardwoods, as maple, beech and ash.

TREES INTRODUCED FROM OTHER COUNTRIES.

1.	Abies nordmanniana	Normann's Fir.
2.	Acer pseudo-platmus	Plane Tree. (Sycamore.)
3.	Acer platanoides	Norway Maple.
4.	Aesculus hippocastanum	Horse-Chestnut.
5.	Ailanthus glandulosa (China)	Ailanthus.
6.	Betula alba	Silver Birch.
7.	Carpinus betulus	European Hornbeam.
8.	Fagus sylvatica	European Beech.
9.	Fraxinus excelsior	European Ash.
10.	Gingko biloba (China)	Gingko (Japanese Maidenhair Tree.)
11.	Juglans regia	European Walnut.
12.	Larix europaea	Larch.
13.	Morus alba (China)	White Mulberry.
14.	Pinus austriaca	Black or Austrian Pine.
15.	Pinus sylvestris	Scotch Pine.
16.	Pinus mugho	Mucho Pine.
17.	Picea excelsa	Norway Spruce.
18.	Populus alba	White Poplar.
19.	Populus pyramidalis	Lombardy Poplar.
20.	Quercus pedunculata	English Oak.
21.	Salix alba	White Willow.
22.	Salix fragilis	Crack Willow.
23.	Tilia europaea	Linden. (Lime-tree.)
24.	Ulmus campestris	English Elm.
25.	Ulmus montana	Scots or Wych Elm.

THE WOODLOT.

Introduction.

The forest has been spoken of as an organism, and the forest tree finds its best development as one of a community. Soil conditions, leaf litter, vegetable mould or humus, undergrowth and the influence of the trees upon each other are all important factors in the proper development of the forest tree. The woodlot, being small in area, often lacks protection, and there is great difficulty in keeping the above factors properly balanced.

The woodlot is a part of the farm which in too many cases has been neglected and looked upon as of no real value in its relation to the farm. It has furnished the owner with fuel and building material and frequently revenue by the sale of a few logs to the local mill. In many cases, however, the woodlot has not been considered as being a permanent resource or a necessary part of the farm economy.

In early days the woodlot was considered important as being a source of fuel, but when the farmer discovered the charms of anthracite coal one of the most evident arguments in favor of its existence seemed to pass away. At the present time many farmers in older Ontario depend almost entirely upon the supply of coal for fuel. Local mill operators have frequently been allowed to go through the woodlot and take out the best timber, leaving only a slash. The owner has felt satisfied with the ready cash that such an operation left him and quick returns is a strong argument in favor of denuding the land.

No arguments are advanced in these pages to show that the use of the land for wood crop production would give greater financial returns than its use for other farm purposes. Neither will we discuss the percentage of land which should be under trees, as this is a question which must be settled by the individual owner. Many farmers in Ontario find that from the standpoint of labor and management they are limited in the amount of land which they can profitably cultivate.

The following pages take it for granted that the owner desires to make the woodlot a permanent and paying part of the farm.

Ground Fires as Related to the Woodlot.

Injury to Soil. Fire should never be allowed to run through the woodlot. By burning off the leaf litter and vegetable mould or humus the soil is greatly weakened. As was pointed out in previous pages, the healthy development of the forest is dependent upon the humus condition of the soil.

Injury to Reproduction. Ground fires also destroy the seed and young growth and make it much more difficult for seeds to germinate in the future. The natural seedbed of humus soil covered with the leaves gives a protected, natural seedbed which is necessary for reproduction.

Fig. 3.—Effects of ground fires on white oak.

Injury to Old Trees. Ground fires frequently pass through the woods in spring and by the middle of the summer the woods seem to have recovered. This is not the case, for usually large trees, which seem to have bark thick enough to withstand the small amount of heat of a ground fire, are injured in a manner not at once visible to the observer. The heat from a ground fire, which it seems is too small to injure a tree with heavy bark, frequently affects the tree very seriously. The injury is of two kinds.

By burning off the humus and litter the soil is left unprotected so that it lacks moisture during the dry season, as well as weakening the soil in regard to food supply for the trees. Frequently the burning kills the shallow roots or leaves them unprotected.

The living tissue beneath the bark of the tree close to the ground becomes so heated that it is either killed or partly destroyed. The first visible effect may be seen in the form of a fungus growth about the base of the tree. This parasitic fungus gradually weakens the tree, making it subject to insect pests, and finally causing its death, but the real and first cause was the innocent looking ground fire.

Stock Grazing.

Probably one of the most serious hindrances to the proper growth and development in the woodlot has been caused by grazing. There were many, a few years ago, who claimed that grazing did not injure the woodlot.

Fig. 4.—Showing grazed woodlot on the left, and protected woodlot on the right.

Experience has shown, however, that in the Ontario woodlot grazing must always be injurious. Many examples, as in Fig 4, may be seen in Ontario where the comparison of grazed and ungrazed woodlots show the result. While the injury is admitted by many, there are those who claim that the woodlot is of more value in protecting the cattle during the heat of the day and giving them pasturage than for wood producing purposes. It is very difficult to compare the rental value of the woodlot used for purposes of pasturage and that of the woodlot used exclusively for wood production. One thing is certain, that to have a permanent woodlot, where conditions are favorable for tree growth the stock must be excluded.

Domestic animals are frequently classed as to the amount of injury they inflict on the woodlot. From the standpoint of browsing the degree of injury may be placed in the following order: Goats and sheep, horses, cattle, swine, the first mentioned being the most injurious and the last being least.

Injurious effects of allowing stock to run in the woodlot may be discussed in its relation to the soil, the reproduction of young growth and the older trees.

Soil. While the effects of grazing on the soil may be least noticeable, it is

Fig. 5.—Tops of trees dying from effects of stock grazing.

very important. Destruction of young growth soon opens the woodlot to drying winds which carry off the humus-forming leaves and greatly lessen the moisture content of the soil. Light begins to enter and reach the ground, causing grass and weeds to start which soon develop a stiff sod. Trampling of the soil causes it to become impervious, thus allowing the water to run off rapidly instead of being held in the soil as is the case in normal conditions. After these unfavorable conditions have come to prevail, the tree seeds find it very hard to germinate and soon there is no reproduction taking place.

Young Growth. The leaves and tender branches of the young growth in the woodlot are eagerly browsed by the animals. Some species of trees are less liable to browsing than others. The Ironwood seems to be particularly immune from browsing, so that in many Ontario woodlots that have been grazed the larger percentage of the young growth is composed of Ironwood.

Cattle have been noticed standing in good, fresh clover, greedily devouring the leaves from limbs of Sugar Maple which were thrown into the pasture. Evidently they enjoyed a change in diet.

Old Trees. The trampling of the soil, the destruction of young growth, which should protect the soil from sun and wind, and the formation of an impervious sod, all aid in lessening the vigor of growth of the standing, full grown trees. In this case the injurious effects are scarcely noticeable to the common observer owing to his lack of knowledge as to what healthy tree growth actually means. The annual amount of wood production is far below what it should be when the soil conditions are in an abnormal state from grazing.

Many woodlots contain trees that have not reached maturity, but whose tops are dying. Such trees are spoken of as being stag-headed. Stag-headedness is caused by lack of nourishment and moisture in the soil, a result of grazing.

Weed Trees.

Many woodlots contain a large percentage of weed trees or inferior species. Weed trees such as Ironwood, Hawthorn, and Blue Beech have gradually taken possession as an undergrowth.

Everything seems to favor the development of these species. In cutting operations these trees are seldom disturbed. The stock in grazing prefer the leaves and branches of the better species, thus giving these weed trees another advantage. The seedlings of the Ironwood and Blue Beech seem very hardy and vigorous and can stand a great amount of shade, so that they get an early start in the struggle for possession of the soil. When once the Ironwood has obtained a footing its dense foliage so shades the ground that better species cannot develop beneath it. In many woodlots from seventy-five to eighty per cent. of the trees under three inches are made up of Ironwood.

Inferior Species.

The question of the inferiority of a species is relative and depends on local conditions.

Inferior species, as Poplars and Slippery or Red Elm, are often growing on soils which are capable of producing much better species. Then in some cases the woodlot has gradually become filled with Sugar Maple when it might be wise to introduce other species.

Defective and Overmature Trees.

The average woodlot contains many defective and overmature trees. The defective trees are of various descriptions. Trees with old fire scars, trees injured while young by the felling of neighboring trees, trees wantonly scarred by the careless blow of an axe, trees broken and deformed by wind or snow, are all forms which should gradually be removed. Overmature trees frequently show a tendency to become stag-headed, and if left standing gradually deteriorate in value. Such trees are a menace to the surrounding growth and frequently in felling destroy more than their own value.

Improvement Cutting.

Cutting operations which aim to overcome the above defects, namely, weed trees, inferior species, defective and overmature trees, are spoken of as "improvement cuttings."

In the farm woodlot all cutting for firewood should be made from such trees. It is not to be understood that it is advisable to go through the woods and cut down all the above mentioned trees without regard to the future of the area thus cut over. The first consideration should be to protect the soil, that is, do not cut

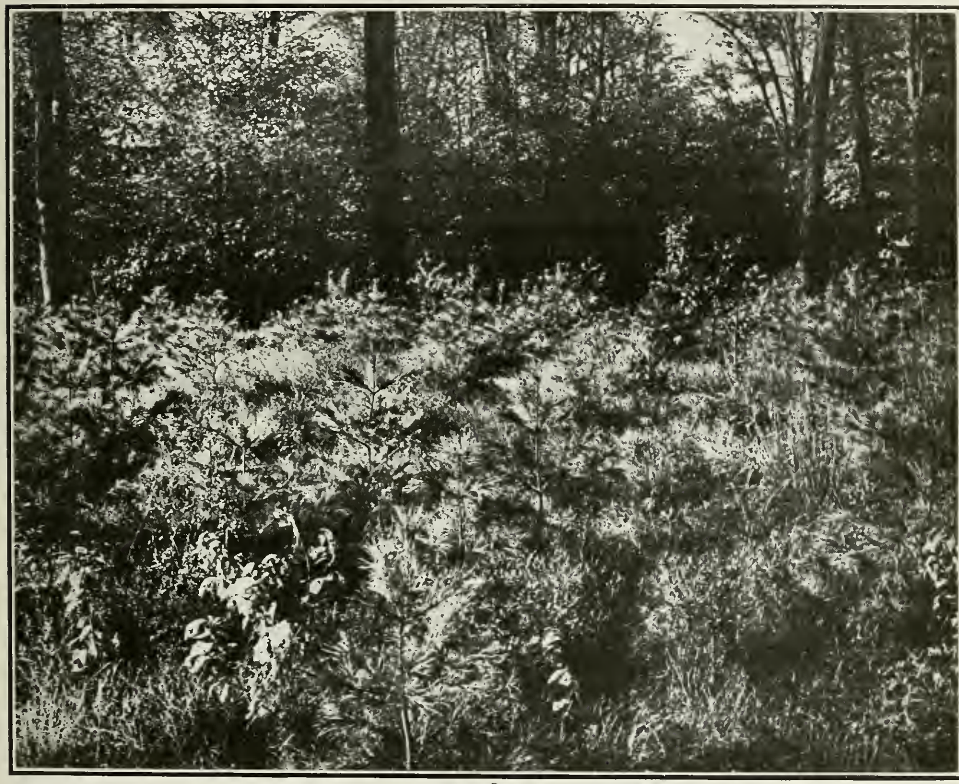

Fig. 6.—White Pine, planted in open spot in the woodlot.

down a tree or a group of trees unless you are certain that there will follow another crop. If you do not get reproduction the following season it is almost certain that grass and weeds will come in and the soil will soon lose its valuable character as related to tree growth. Whether you can depend on the area reproducing from the seed of neighboring trees or whether it will be necessary to use artificial means can only be judged by local considerations.

Thin Borders and Open Spots.

The borders of woodlots become thin owing to various factors. This outside portion of the woods is more subject to winds and storms which cause windfalls, dry out the soil and blow away the leaves which should go to form vegetable mould. Frequently the border is overcut, as the owner does not trouble going to the interior of the woods for his fuel, etc. In time the soil deteriorates, grass and weeds follow, and then we have the characteristic border which is neither woodland nor pasture.

The development of large open grassy spots in the woodlot is usually due to the effects of grazing. The old trees have been taken out and the young growth destroyed by the stock until grass has taken possession and formed an impervious sod in which the tree seeds find it impossible to develop.

The above conditions may be improved in the case of the thin borders by planting evergreens or coniferous trees about the border in order to form a windbreak. Norway Spruce and White Pine will be found to be two of the best species for this purpose. One or two rows of White Pine planted along the fences. especially on the west side of the woods, which is the side most subject to winds in Ontario, would make a splendid protection.

Open spots in the woods if covered with grass could be improved by roughly breaking the sod and allowing the seeds to reach the mineral soil. Such breaking can be done with a disk-harrow or plow. In some cases where there is no young growth to injure, it may be advisable to turn in hogs as they frequently make a good seedbed by their rooting in search of grubs, seeds, etc.

These measures are to be adopted when the surrounding trees are bearing seed. If there is little chance of such areas being seeded from neighboring trees, or if the owner desires to introduce better species into his woodlot, he may resort to planting.

Planting of this nature may be done by using the young plants or by sowing seed. With the exception of nut trees, it will be advisable to use plants rather than seed. Methods of planting the woodlot are similar to the methods of planting described elsewhere. While the general methods are similar, there are many bare spots which may need special attention owing to the small amount of light which is able to reach the ground. When breaking the sod with disk or plow is impracticable it is usually possible to break spots about twelve to fifteen inches square with the mattock. In these spots nuts can be dibbled or plants inserted.

The success of planting and the vigor of growth depends on the question of light as well as the condition of the soil. In general the locations that have enough light to allow a development of grass may be successfully filled with young tree growth.

The woodlot should have a definite boundary with a belt of evergreens especially on the side from which the prevailing winds come. Too many woodlots have no definite boundary, but are surrounded by slash. Keep a definite boundary well stocked with trees and soon the woodlot will have every acre productive.

Coppice.

Coppice is a form of growth in the woodlot which is little understood by the average owner. Trees are reproduced from seed, cuttings, suckers and shoots. Coppice growth originates from shoots or suckers developing from the stump or root collar of previous trees. The new shoots depend upon the root system of the original tree for nourishment. In Fig. 7, one-year-old shoots may be seen which have developed from a Chestnut stump. All native deciduous or hardwood trees have the power of reproducing in this way, especially where trees are cut young and at the proper season. Evergreens, with a few exceptions, as Arborvitæ, never reproduce in this way. Certain species, as Chestnut, Basswood, the Oaks, Elm, Poplar, Birch and Soft Maples seem to develop these shoots more freely and vigorously than other species.

In many woodlots, especially in the southern part of the Province, a large percentage of the growth is of this nature rather than of seedling origin. Fig. 8 shows at least two generations of coppice. An old Chestnut stump about three feet in diameter has, growing from its base, a coppice Chestnut about twenty-six inches in diameter, and from this is growing a six-inch Chestnut which is the third generation. The twenty-six inch tree developed from the root-system of the old stump, but in time produced a root system of its own which is now helping to support the six-inch tree. In this case the coppice is developing before the parent tree has been cut. In Fig. 7 the coppice probably developed after cutting of the parent tree.

Fig. 7.—One year old Chestnut Coppice.

To obtain good tree growth of coppice after cutting certain considerations must be given attention.

Age of Parent Tree. Coppice from overmature trees will not produce strong growth, as the old root system has lost its vigor. Coppice loses its vigor of growth by following the system too far, the third and fourth generations becoming weak and decrepit. In many woodlots dwarfed and stunted growth exists from the above causes.

Time of Cutting. Coppice is best produced by cutting in late winter or early spring. Late fall or early winter cutting often allows frost and moisture to loosen the bark. The coppice shoots originate beneath this outer bark, and if it is destroyed there is small chance of shoots developing.

Height of Stump.—In cutting with a view of obtaining coppice, the stump should be cut as closely to the ground as possible. It is desirable to obtain resulting shoots as near the ground as possible. Coppice which originates high up on the stump does not become vigorous. Frequently we find trees in the woodlot with the base partly rotted, and such trees are often of coppice origin. In this case the shoots developed from a high point on the original stump with the result that as the old stump decayed the new coppice growth was left weakened at the point of contact.

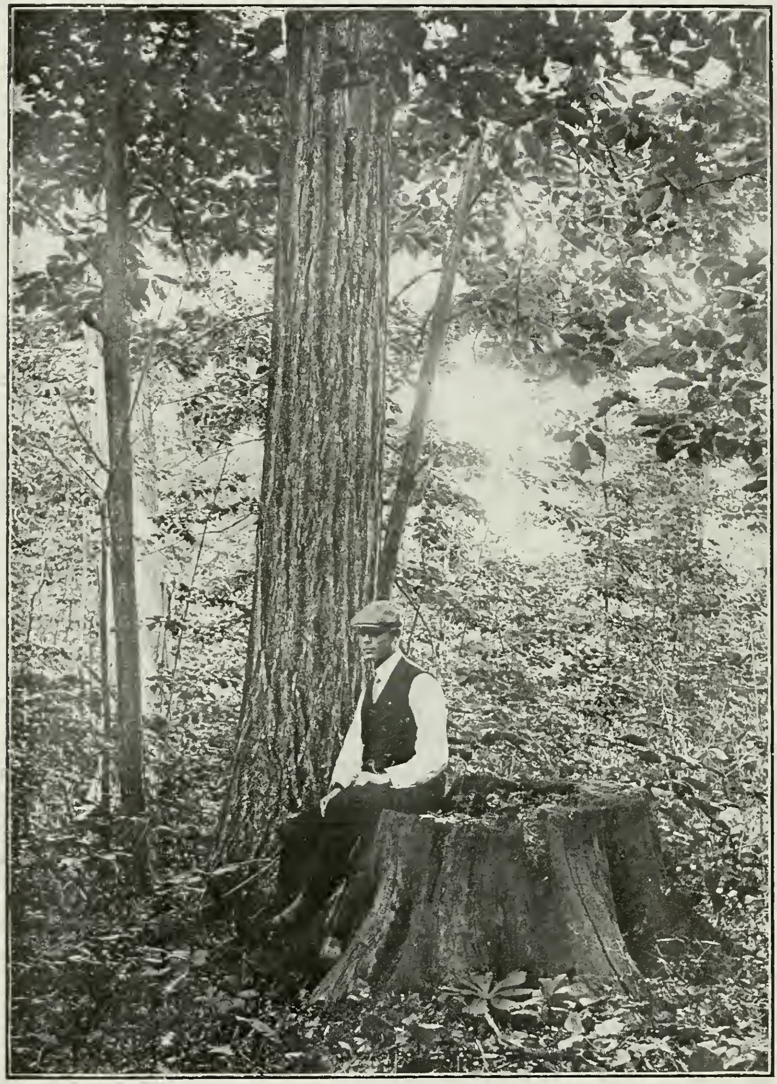

Fig. 8.—Three generations of Chestnut Coppice.

Number of Sprouts on Stump. As may be seen in Fig. 8, a great many sprouts may develop from one stump. It will be found that in a few years a few of these will outgrow the others. Not more than three of these sprouts should be left for a final crop. After the first year a large proportion of the poorer sprouts could be cut out, care being taken not to injure the others. In another year or two the rest of the poorer sprouts should be taken out, leaving two or three of the strongest. Those to remain should be chosen with regard to their location on the stump, having thought as to what their future development will be.

Frequency of Application. As was pointed out, coppice loses its vigor of reproducing after a few cuttings. When two or three generations of trees of coppice origin have been taken off it is advisable to endeavor to obtain new growth of seedling origin. Nuts may be dibbled in where favorable spots can be found, or planting may be resorted to if desired. In any case the area should be gradually restocked with trees of seedling origin.

Fig. 9.—Chestnut Coppice, five years old, in need of thinning.

FOREST TREE PLANTING.

Introduction.

The rapid disappearance of the forest from southern Ontario has brought many to feel the advisability of reforestation. In the days when the forest was an obstacle to agricultural development there were many hillsides, ridges and other forms of poor soil cleared, which would have been better left under forest conditions.

As the nature of forest planting becomes better understood many will undertake this work who at present are deterred by the fear of cost or lack of knowledge. Many confuse forest planting with park or orchard planting, and do not understand how plantations can be made within reasonable costs. In forest planting small plants, with well formed roots especially adapted for transplanting, are used, and the operation of planting is much more simple than that of orchard planting. The following pages will endeavor to describe the various operations employed in forest planting.

Time of Planting.

The transplanting or moving of a plant should be done at a time when it will least interfere with its growth. If the transplanting can be carried on without disturbing the soil about the roots and without subjecting the plant in its new surroundings to adverse conditions, the operation might be performed almost any month of the year.

In the rough operation of forest planting the plant must be handled at a season when it is in a dormant condition. For the climatic conditions of southern

Fig. 10 illustrates a plantation of Scotch Pine made about twenty-five years ago. This was a gravelly hillside of small value for cultivation. At a very small cost it was replanted, and to-day is a valuable asset to the farm.

Ontario, the early spring seems to be the most suitable season for this work. The end of April to the end of May will in general be the safest time, in spring, to plant.

Planting of evergreens may also be successfully carried on between the middle of August and the middle of September. Where there is no winter protection, and the young plants are subject to the sudden changes, without a snow cover, as often happens in southern Ontario, fall planting may receive considerable injury.

Transplanting larger, ornamental evergreens is done at other seasons than those mentioned above, but this form of planting must not be confused with forest planting.

Material for Planting.

The possibility of successful forest planting at a low cost depends largely upon the size and quality of the plant used in the operation. In reforesting, a small plant is used with a well developed root-system, as shown in Fig. 11.

The small plant can be produced at a low cost, and it can be placed in the ground with little labor. In handling and transplanting the small plant there is little injury to the root-system, so that it has better chances of becoming established than a larger plant or tree.

Care of Planting Material in Handling.

The protection of the plant, from the time it leaves the nursery until it is safely placed in its final location, is very important. The roots of trees (especially of evergreens) are very liable to injury from wind and sun and should be protected from drying out.

Fig. 11.—Common size of evergreen transplant ready for final planting. Note the stocky tops and fibrous root-systems, which enable the plant to stand adverse conditions; White Pine on the left, Scotch Pine on right.

When nursery stock is transferred from the nursery lines direct to the planting area, the roots can be protected by layering in wet moss, chaff, or by the use of wet burlap.

Where the prospective planter receives his nursery stock from a distance by freight or express, it should not be left lying at the office any longer than possible. The trees should be unpacked at convenient places on or near the ground to be planted. The plants are usually tied in bundles of 25, 50 or 100. In taking them out the roots should be dipped in water, the bundles opened up, and then "heeled in," which is illustrated in Fig. 12. If possible the trees should be "heeled gathers in the sleeve to the vanishing point, a feat of no mean order. Mrs. A. does not approve of French seams in shirt waists and she says all seams to look well should be of a good width, an inch or three-quarters of an inch at least.

When we began the skirts, each one was given a pattern which could be used for a 2, 3, or 4 piece skirt, and we used this pattern with a panel for our separate skirts, and are using it again as a 3 or 4 piece skirt in the one-piece dress. We were given very clear directions for cutting the panel and had no difficulty in doing it without the pattern. When basted up the skirts fitted perfectly. We were shown how to pin the belt on and how to get the length, each member of the class doing this for some other member. Mrs. A. gathers the edge of the hem, distributing the fulness so as to do away with all plaits.

The kimona waist seemed to be the object of the greatest interest and many were the conversations on the relative merits of a kimona and a waist of the set-in sleeve variety. We were given no pattern for the kimona waist, but Mrs. A's. instructions, as in the draughting of the panel, were most explicit and under her watchful eye there were no mishaps. The little 3 inch square which she used under the arm was a surprise to most of us, and being placed so as to draw on the bias will prevent tearing which has always been a serious defect in the kimona waist. When through we each had a shirt waist, a skirt, a one-piece dress and perfect fitting patterns for each of these, which we shall be able to use for ourselves with profit and pleasure; for surely we must be better qualified after our course with Mrs. Altenburg to meet the difficulties that so often present themselves in dress-making.

Extract from Communication Received from Miss Frances Bevan, Ancaster.

Our Branch his just finished the class in dressmaking under Mrs. Altenburg, and everyone is more than pleased with it.

Each woman has such pretty new things and so beautifully made, quite elaborate silk dresses and some muslins, but one and all are satisfied, with the one exception; one woman who made a print dress has been so angry with herself for not making up better stuff. She was rather skeptical about the class and thought any old thing would do, but when she saw the lovely dresses of the others she wished she had something better.

The class has done the Institute a world of good. We charged each non-member 25c. extra, so they should become members, and already they are showing great interest in the work of the W. I., and attend the meetings.

Ontario Department of Agriculture

WOMEN'S INSTITUTES

Application for Special Course of Lectures 1913-14

Name of Institute ....
Course chosen (Cooking, Home Nursing, or Sewing) ....
(make X through the Course chosen)
Number who have definitely promised to take advantage of the Course, if arranged for ....
Number of additional persons who will probably take advantage of the full Course ....
Probable number who will take advantage of occasional lectures ....
Prospects for class of school girls ....
....
Place where regular class will be held ....
Place where school girls' class will be held ....
Day of week preferred ....
Accommodation for board and lodging for demonstrator ....
....

Time chosen for Course, October 6th to December 13th ....

January 5th to March 14th ....

March 16th to May 23rd ....

(make X opposite time preferred)

Remarks ....

....

....

....

....

Branch President ....

Branch Secretary ....

Place ....

Date ....

Note—This form to be filled in and forwarded to the District Secretary or Geo. A. Putnam, Superintendent of Institutes, Parliament Buildings, Toronto, Ont. at as early a date as possible If application is sent direct to the Department, the District Secretary should be notified.

Where hardwoods as White Ash, Elm, Maple, Oak and Chestnut are being planted upon cultivated soil and where the planting material is cheap and the operation can be done at a low cost, it will pay to plant even as close as 4 x 4 feet apart each way, so that soil protection may be obtained as early as possible.

Number of plants required to plant an acre in squares:—

3 ft. x 3 ft.	4,840	plants.
4 ft. x 4 ft.	2,722	"
5 ft. x 5 ft.	1,742	"
6 ft. x 6 ft.	1,210	"

The area may be planted in regular lines if the roughness of the site does not prevent it, but if the land is broken by stumps, rocks, etc., it will be necessary to distribute the plants wherever possible.

The more regularly the planting is done the easier it will be to find and protect the plant and to replace dead plants if necessary. The following diagrams illustrate two methods of regular distribution over an area, although in ordinary planting the spacing must be carried out in a rough manner. Alternate distribution takes more plants for an acre, but gives the individual plant more growing space.

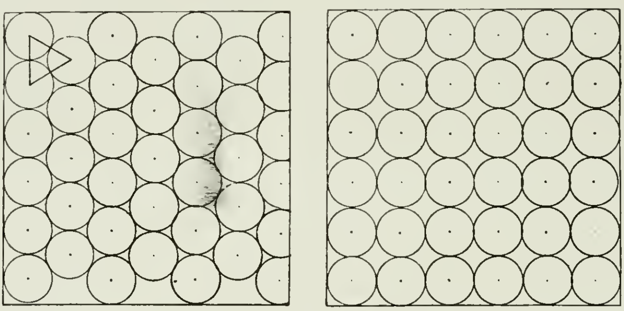

Fig. 15.—Two methods of spacing plants—alternate and opposite.

Preparation of Soil and Methods of Planting.

In Ontario, forest planting will usually be done on soils unfit for agriculture, where it will be impossible to cultivate. Forest planting on large areas as a purely commercial proposition would likely preclude cultivation, even if possible, as the initial expenditures in this work must be kept as low as possible.

Occasions may arise when cultivation of the soil will be advisable where financial investment is not the chief consideration, and where the equipment and work can be obtained as on the average farm. Where cultivation is advisable the land should be fallowed and the planting may be done similar to that described in the following pages.

Planting may be done by running furrows in which the plants should be placed before the soil has time to become dry. If the soil is so loose that it will not "hold up" in the furrow, allowing the roots to be properly placed, then the planting may be done as in Fig. 21.

In most cases cultivation for one or two years will give the trees such a start that the grass and weeds will not afterwards interfere with their development. Some slow growing trees may need cultivation a little longer, but this question must, in the end, be judged on the spot.

On rough land or soil which would wash if cultivated, planting furrows may be run out as shown in Figs. 16, 17.

These furrows should be as shallow as possible so that the roots in planting will not be placed below the good soil. The plant should be placed near the heel

Fig. 16.—Shallow plow furrows for forest planting, run upon sandy-loam hillsides.

of the furrow as shown in Fig. 17, where it will be protected for a while against grass and will receive some protection from wind.

In cases of running furrows of this nature on a hillside, plowing should commence on the highest point, so that rolling turf will not interfere with the

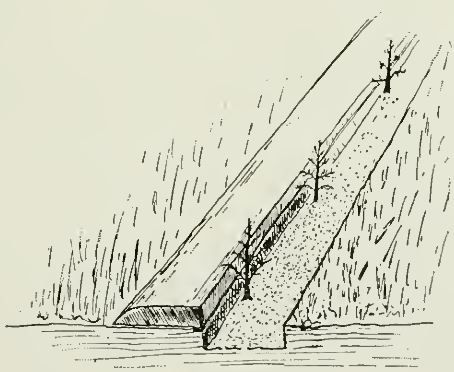

Fig. 17.—Shallow planting furrow, showing plants placed on the protected side.

operations. Furrows should not be run with the slope or "up and down" the hill as washing might occur. If cases arise where this cannot be avoided it would be well to throw pieces of turf back into the furrow to prevent chances of washing.

The plants should be transferred from the spot where they are "heeled in" or packed, to the planting hole by carrying in a pail. Usually the plants are small enough so that 100 or 200 can be carried in a 12-quart pail as shown in Fig. 19.

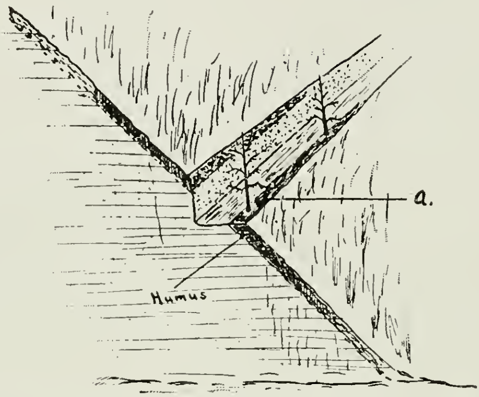

Fig. 18.—Furrow on hillside, showing plant placed in good soil at (*a*).

Fig. 19.—Showing the use of the pail in carrying plants along planting line.

This pail should be filled with enough water so that the roots will be well covered. It is often recommended that the roots should be puddled before planting. The writer has found that a satisfactory puddle can be made only when dealing with a heavy, clay soil. Ordinary soils, common to forest planting, settle to the bottom of the pail and only increase its weight. Plants should be transferred direct from the pail to the planting hole and not dropped ahead of the planter.

Fig. 20.—Planting on loose, sandy soil where only the spade is needed, and where planting gangs of two prove most satisfactory. One man opens the hole, the other places the plant and firms the soil about the roots.

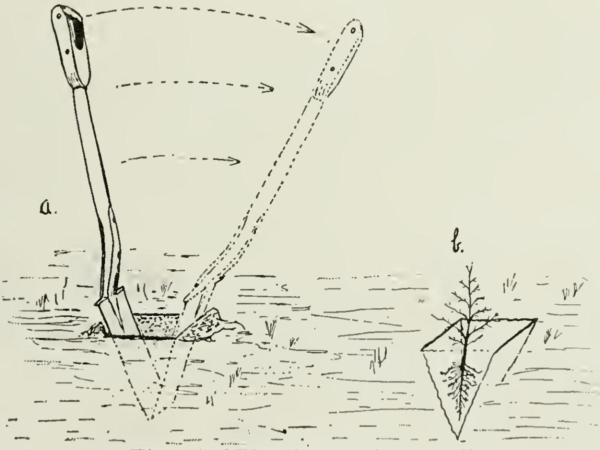

Fig. 21.—Planting in loose soil.

Planting can best be done by two working together, one preparing the planting hole, the other placing the plant and covering it. The planting hole may be made in several ways, depending upon the looseness of the soil. In comparatively loose soil the planting hole may be made by driving in the spade and moving it backward and forward as shown in Fig. 21. In some cases there is danger of an air space being left at the lower point of the spade, and this should be guarded against. If the soil is very loose and sandy, the plant may need to be placed in position before the spade is removed to prevent the filling up of the planting hole.

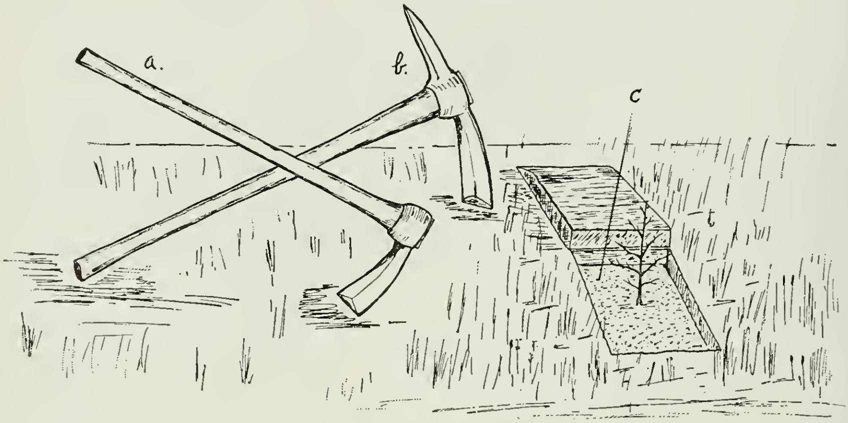

Fig. 22.—(*a*) Grub hoe. (*b*) Planting mattock. (*c*) Sod removed from planting hole.

The planting hole may also be made by using the mattock or grub hoe. (Fig. 22). The soil is loosened with one of these tools and the planting hole can be made with the broad edge of the tool.

Fig. 23.—Showing use of mattock in planting on rough ground with stiff turf.

If it is desired to plant in rough conditions where the running of furrows is impracticable, other methods may be followed. Where there exists a dense turf in stony soils the mattock or grub hoes (Fig. 22), may be of great service. The sod can be cut off with the grub hoe or mattock and the soil loosened with a pick, or in case of using the mattock by using the picklike part of the mattock. In very rough planting one man can handle the mattock and prepare the planting spot, another prepare the planting hole with the spade, and a third do the planting. However, no definite rules can be laid down, and the arrangement must be settled for the individual case. In some lands it might take two men with mattocks to prepare ground for one planter.

Planting of Nuts.

Species which have seeds and seedlings subject to many dangers if sown in rough, wild places should be reproduced by using the nursery plant.

Many of the nut tree species, however, can best be propagated by planting the nuts in final position rather than by using nursery stock. Nut tree seedlings are generally quite hardy after germination, making it quite safe to plant them in rough places.

The common nut trees growing in Ontario are White Oak, Bur Oak, Red Oak, Black Oak, Beech, Chestnut, Bitternut Hickory, Shagbark Hickory, Butternut, and Black Walnut. Of the above species, Red Oak and Chestnut give promise of being the most useful and practical in waste lands, especially where the soil is light and sandy. Red Oak, White Oak, Chestnut, Shagbark Hickory, and Black Walnut are found naturally in loamy soils. Bur Oak and Bitternut Hickory are found in the heavier classes of soils.

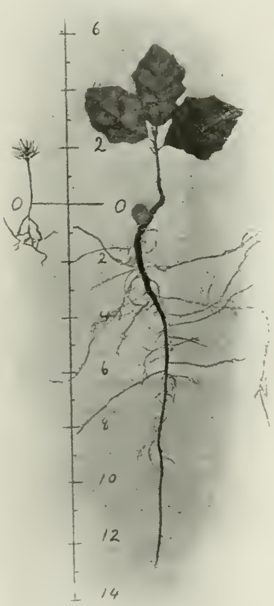

Fig. 24.—Showing root development of one year old white pine and red oak.

The collecting of nut seeds need not be described, as everyone has had some experience. Care should be had not to gather such nuts as Black Walnuts too green. The safest time to collect is after the nuts have naturally fallen to the ground.

White Oak acorns in the southern part of the Province frequently germinate in the autumn shortly after falling. Acorns which have started to germinate will need careful treatment in handling. If the acorns are collected upon falling to the ground and placed in a cool, dry place, there will be little danger of autumn germination.

Nuts may be planted in the autumn or stored and planted in the spring. Autumn planting has some drawbacks. The edible nuts are frequently found by squirrels or other rodents before they have germinated. In wet soils and cold, damp seasons the nuts may lose their germinating power from decay.

The care and storage of nuts needs some attention. The nut may have the husk taken off, although there is less danger of drying out if it is not removed. Drying out is the greatest danger to be feared after nuts have been collected. In no case should they be placed in artificially heated rooms. After collection the nuts should be spread out in some dry, cool place for a few days until they are well matured. Care should be taken both in storing and maturing not to leave nuts piled so deep that they might heat. While maturing they should be turned over occasionally.

Seed may be stored by putting them on a well drained spot and covering them with leaves or hay over which may be placed a light covering of brush. Storing in a pit, as shown in Fig. 25, is a safe method. Layers of nuts (*a*) six to ten inches deep covered with leaves or small twigs (*b*) and topped off with soil (*c*) three to four inches in depth, provides good storage. A light covering of brush or hay over the pit will prevent washing of the top dressing of soil. A ditch at the side, as in Fig 25, (*d*), will give drainage. The bottom of the ditch should be well below the general level.

Nuts can also be safely stored by stratifying them in sand. Stratifying seed is done by making a layer of sand and then a layer of seed mixed with sand. This may be done in a well drained trench or in a box. In the case of storing in a box the box should be covered lightly with soil. If left standing unprotected it will dry out and injure the seed.

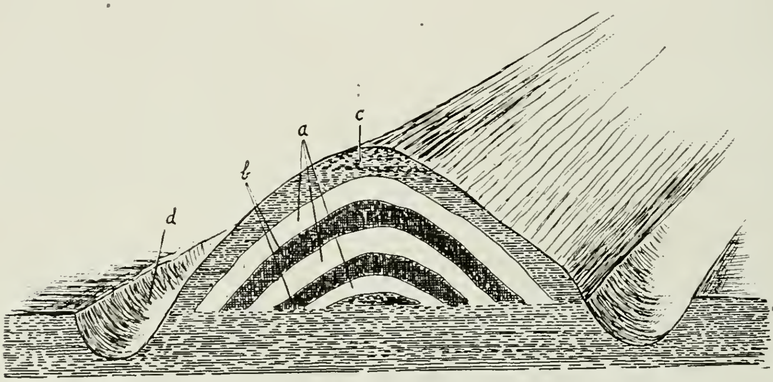

Fig. 25.—Cross section of pit for storing nuts.

The preparation of the planting area will be similar to that described in previous pages. Where planting is to be done in sod it will be necessary to cut away a square of sod, as in Fig. 22. Planting the nut is very simple and may be done with a sharp-pointed stick or dibble. With this instrument a hole is made in the planting spot and the nut dropped in. In loose soils the nut can be sufficiently covered by a stamp of the heel. When the soil is heavy it may be necessary to cover the nut by prodding with the dibble. The nut should be planted deeper in loose than in heavy soils. The depth should be from two to three inches, depending upon the looseness of the soil.

Red Oak and Black Walnut should not be planted alone to form a plantation. These species do not form crown cover or canopy enough to protect the soil and obtain the desirable forest soil condition. Mixtures of Red Oak and White Pine will probably give good results, although our lack of experience with native species makes it difficult to advise mixtures. In many waste lands there are spots in which the soil is better than that of the general area. In waste sand lands there are frequently low areas where the moisture content of the soil is better than the average. In planting such lands where the White Pine is being used to stock the area, these spots could be filled with Red Oak.

Planting in Swamp or Marshy Land.

Frequently there exists on the farm a portion of low or swamp land which has been cleared of trees, but which cannot be drained satisfactorily for cultivation.

Swamp land planting presents certain difficulties which make it advisable to give definite instruction as to treatment. When continual overflowing exists during spring or rainy seasons, little can be done in the way of practical planting. Before spending time or money in swamp planting the possibilities of future drainage should be considered. Many swamp soils, when drained, will become valuable agricultural lands. In exceptional cases, where tree growth is desired, mounds can be thrown up on which lowland species can be planted.

In most Ontario types of swampland there exist many spots which are higher and better drained than the main part of the swamp. On such spots, in the natural conditions in Ontario, we frequently find White Pine thriving well. The better class of such spots may be planted with White Pine, White Spruce, Arborvitæ, White Elm, Red Maple and Silver Maple. The poorer parts of the area may be stocked by using cuttings or slips of Poplar and Willow.

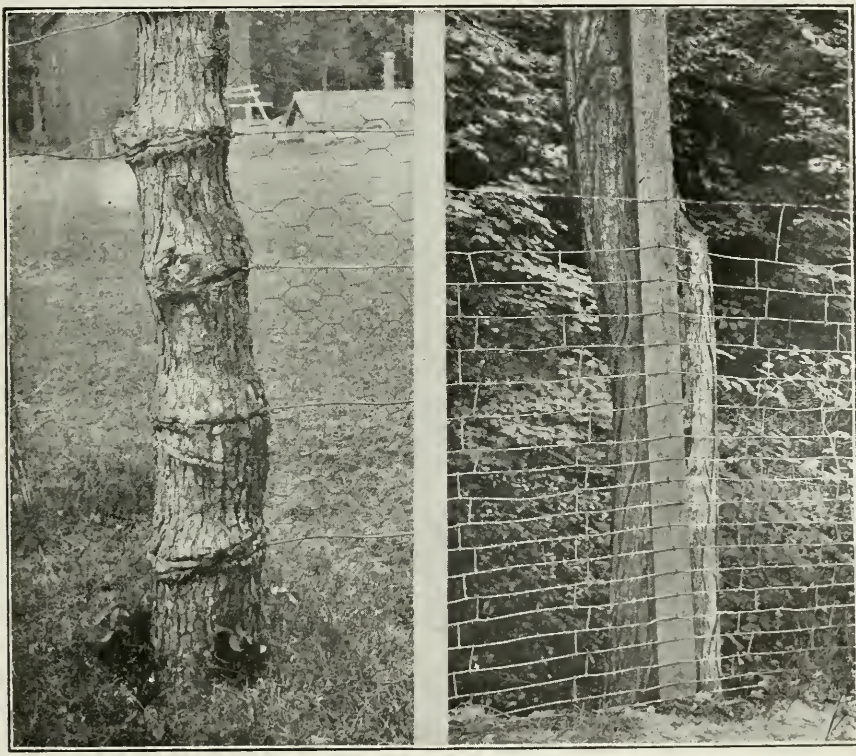

Fig. 26.—Proper and improper methods of attaching wire fence to tree.

Planting Clumps for Protection of Stock.

On stock and dairy farms clumps of trees afford valuable protection during the heat of the day. It is a common sight to see animals retreat to the shelter of trees which may happen to stand in the field. In permanent pastures and even in fields occasionally used for pasturage small clumps of trees could be planted in corners on waste portions of the field if any existed. It would be necessary to fence in such planting and give it protection till the trees reached a size of three or four inches in diameter.

Deciduous trees as Box Elder, White Elm, or Soft Maples, would be best suited for such work. Box Elder and White Elm grow fast, develop plenty of shade, and stand the abuse to which they must be subjected by the animals.

Protection Belts.

Belts or rows of trees are frequently planted for protection to orchards, fields or buildings. There is no doubt about the advantage of such planting. Stock in protected barns will need less feed. Protected houses will need less fuel. Orchard

Fig. 27.—Stock protection clump of White Elm and Box Elder in the background.

or field crops benefit by having protection. The drying winds of summer do less harm where tree protection exists. Orchards heavy with fruit are often protected so that loss from wind-falls and broken branches is lessened. Protected fields of clover, fall wheat, etc., hold the snow longer in the spring, which gives protection from frosts and loss of moisture by evaporation.

Throughout the Province of Ontario the prevailing winds are westerly, which should be taken into consideration in planting shelter belts. That is, to protect buildings or fields it is wise to plant on west, southwest and northwest sides.

The most satisfactory protection is to be had by planting evergreens, as Norway Spruce or native White Spruce. These evergreens give protection both summer and winter by forming a dense growth down to the ground. Arborvitæ, Hemlock and White Pine are sometimes used in such planting, but the spruces are the best.

Where one row of Spruce is to be planted, the trees should be spaced from six to ten feet apart. When two rows is desired the trees should be eight to ten feet apart in the row and the rows eight feet apart. The trees should be planted alternately as in Fig. 15. Where trees are to be planted as a protection to buildings, it may be advisable to plant a mixture of evergreens in clumps rather than a straight row of Spruce. This would require more space, but would have a better appearance. In such planting the trees should not be planted too near the building, as they may become a nuisance when full grown.

Planting material may be of two kinds. Small seedlings from ten to twelve inches in height, costing about eight dollars per thousand, or transplants which may be anywhere from ten inches to several feet in height, costing fifteen dollars and upwards per thousand. If the prospective planter does not feel like paying prices for large transplants it may be of advantage to buy the small seedling or transplant and keep it a year or so in the garden where it can be cultivated till ready for final planting. Ten to twelve inch plants can be put in the garden in rows twelve to eighteen inches apart and ten to twelve inches apart in the row. Planting can be done as described in previous pages.

Fig. 28.—Protection belt sheltering peach orchard.

Planting Along Permanent Fences.

The question of securing fence posts at a reasonable rate and their short life after being placed in the ground is a problem confronting the agriculturist in Ontario. One solution of the problem may be found in planting trees along permanent fences. In a short time it will be possible to attach the wires to these trees.

The trees can be planted every sixteen feet or even every eight feet as the owner desires. Strong, vigorous plants should be chosen for such work, and in case of using evergreens, transplants should be used as the fence lines are frequently filled with dense grass and weeds which will endanger the young plant. More attention can be given the making of planting holes and the actual planting than in the case of waste land planting. Where a rail fence now exists and there is no chance to cultivate, the planting hole should be made by cutting away a large sod about two feet square, as in Fig. 22. Ocasionally it may be practical to cultivate a strip four to six feet wide along a fence which can be moved a few feet after the trees have grown. Preparation of this strip by summer fallowing will give results in future tree growth which will repay the effort. Whether planting is done in planting holes or on a prepared strip, future cultivation will give best results. This cultivation should be carried on for two years at least—longer will pay—until the trees have become well established. It will be an advantage to mulch the trees with grass or old manure. The trees should be inspected during the summer to see that weeds, etc., do not overshadow them. In case the owner does not want large trees along cultivated fields, the first planting can be done every sixteen feet and a few years later trees can be planted between. When the first trees become too large they can be cut off the height of a common fence post and later the fence can be attached to the younger generation of trees as the older ones decay.

The choice of species for this work must be given some consideration. The fastest growing species will be Box Elder, Hardy Catalpa, and Black Locust. In the southern portions of the Province and in the best classes of fresh, moist soils Hardy Catalpa may prove valuable for this purpose. Black Locust will grow on the poorest of locations and will be of more general value than Hardy Catalpa. Sugar Maple may be employed in this work, although the growth will be slower than the preceding species and it requires very good soil. Some may desire to plant nut-producing trees so that a return may be had from nut crops. Black Walnut, Shag-bark Hickory, and Chestnut would be the most valuable in this case. The Chestnut would grow on the lighter soils, while the Black Walnut should be planted in good, rich soil. If evergreens are desired, Norway Spruce, White Spruce, Larch and Arborvitæ will give best results. The Arborvitæ should be placed in moist soil, while Larch will stand dry, poor locations.

In placing wire on trees, care should be taken not to injure the tree more than necessary. Fig. 26 shows two methods common in Ontario. Where the strip of wood is used in which to place staples, the tree gradually forces the strip over the head of the nail and in time it may be necessary to put in new nails. As a rule, large bolts or heavy spikes are used to fasten this strip to the tree. The use of such large fastenings is unnecessary and usually a much smaller nail will hold just as well. For an inch and a half strip two and a half inch nails are sufficiently large.

LIST OF BULLETINS

PUBLISHED BY THE ONTARIO DEPARTMENT OF AGRICULTURE, TORONTO.

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168	Oct.	1908	The Perennial Sow Thistle and some other Weed Pests	J. E. Howitt.
169	Feb.	1909	Legume Bacteria: Further Studies of Nitrogen Accumulation in the Leguminosæ	S. F. Edwards. B. Barlow.
170	Mar.	1909	Mitchell-Walker Test Bottle	J. W. Mitchell. W. O. Walker.
171	April	1909	Insects Affecting Vegetables Fungus Diseases Affecting Vegetables	C. J. S. Bethune. J. E Howitt. J. W. Eastham.
172	May	1909	Dairy School Bulletin (No. 143 Revised)	Dairy School.
173	Oct.	1909	Birds of Ontario	C. W. Nash.
174	Dec.	1909	Farm Underdrainage: Does it Pay?	W. H. Day.
175	Dec.	1909	Farm Drainage Operations	W. H. Day.
176	Dec.	1909	Bacterial Blight of Apple, Pear and Quince Trees	D. H. Jones.
177	Dec.	1909	Lime-Sulphur Wash	H. L. Fulmer. L. Caesar.
178	Dec.	1909	Character and Treatment of Swamp or Muck Soils	W. P. Gamble. A. E. Slater.
179	Feb.	1910	Fruits Recommended for Ontario Planters (No. 147 revised)	Fruit Ex. Stations.
180	April	1910	Flour and Breadmaking	R. Harcourt. M. A. Purdy.
181	June	1910	The Teeth and Their Care	Ont. Dental Society.
182	July	1910	Bee-keeping in Ontario	Fruit Branch.
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184	Nov.	1910	Uses of Vegetables, Fruits and Honey	....
185	Nov.	1910	Little Peach Disease	L. Caesar.
186	Dec.	1910	Children: Care and Training	J. J. Kelso.
187	Jan.	1911	The Codling Moth	L. Caesar.
188	April	1911	Weeds of Ontario (No. 128 revised)	J. E. Howitt.
189	May	1911	Farm Poultry (151 revised)	W. R. Graham.
190	May	1911	Bee Diseases in Ontario	Fruit Branch.
191	June	1911	Bee-keeping in Ontario	Fruit Branch.
192	July	1911	Agricultural Co-operation	S. E. Todd.
193	Nov.	1911	Tuberculosis of Fowls	S. F. Edwards.
194	Dec.	1911	Apple Orcharding	Fruit Branch.
195	Jan.	1912	Insectides and Fungicides. (No. 154 revised	R. Harcourt. H. L. Fulmer.
196	Jan.	1912	Tomatoes	A. G. Turney.
197	Feb.	1912	Bee Diseases in Ontario	Morley Pettit.
198	Feb.	1912	Lime-Sulphur Wash	L. Caesar.
199	Feb.	1912	Onions	A. McMeans.
200	April	1912	Fruit Juices	L. Meunier.
201	May	1912	Peach Diseases Peach Growing in Ontario	F. M. Clement. L. Caesar.
202	May	1912	Grape Growing in Niagara Peninsula	T. B. Revett.
203	May	1912	Cabbage and Cauliflower	A. McMeans.
204	June	1912	Decay of the Teeth	Ont. Dental Society.
205	Sept.	1912	Dairy School Bulletin (No. 172 revised) .. Part I. Cheese-making and Butter-making	Staff of Dairy School.
206	Nov.	1912	Dairy School Bulletin (No. 172 revised) .. Part II. Dairying on the Farm	Dairy School.
207	Dec.	1912	Ice Cold Storage on the Farm	R. R. Graham.
208	Jan.	1913	Farm Poultry and Egg Marketing Conditions	J. H. Hare. T. A. Benson.
209	March	1913	Farm Forestry (No. 155 revised)	E. J. Zavitz.

Ontario Department of Agriculture

FRUIT BRANCH

BULLETIN 210

Strawberry Culture

AND

The Red Raspberry

By

F. M. CLEMENT, B.S.A.

TORONTO, ONTARIO, MARCH, 1913

BULLETIN 210] [MARCH, 1913

Ontario Department of Agriculture

FRUIT BRANCH

Strawberry Culture

F. M. CLEMENT

The object of this bulletin is not to attempt any technical description of the strawberry from a botanical point of view, or discuss methods of improvement or selection, but to sum up in a simple, practical manner the methods of culture as practised by the most successful growers in the Province. The writer has had the opportunity of not only growing strawberries commercially and observing the methods practised on the nearby farms, but has visited the sections of the Province that have an established reputation and observed the methods practised there.

The strawberry, unlike our tree fruits, is not limited to any narrow range of territory, but is found both growing wild and in the gardens in the coldest and warmest parts of the Province. The comparative ease with which the plant is cultivated, and the high quality of the fruit, both for canning and dessert, make it a general favorite No kitchen garden is complete without its few rows. It is the first fruit to ripen in the spring, and just at a time when fresh fruit is most relished. The season opens about the middle of June, with the earliest varieties and continues from four to six weeks, depending on the weather, and especially the rainfall. But while it is grown everywhere for home use, it is the commercial side that we are at present most interested in, because the methods in vogue in the commercial plantings can readily be copied into the gardens. On the other hand, the commercial plantation is no place for the fads of some small gardeners. In some few sections of the Province a number of growers have given intensive cultivation their careful attention, and years of successful experience have put them in the foremost rank as specialists in their line. It is to these men that we must look for the newest ideas, and it is to them that the writer extends his sincerest thanks for the valuable assistance given him at different times. Also in some few instances the writer has copied paragraphs from other bulletins, because his own experience and observations did not cover the point in question, but in every case credit has been given to the author.

LOCATION AND SOIL.—Almost any location on the farm will do for strawberries, provided the soil is suitable. A warm southern slope is, however, to be preferred for early fruit, if it is sufficiently protected (perhaps I should say exposed) to be free from early spring frosts or frosts during the blossoming season. The blossoming season is, however, to some extent at least, under the control of the grower, as it may be delayed for a few days or a week by not removing the winter mulch from the rows until growth has started, or until the plants begin to suffer from the cover. A warm southern slope is on the other hand not conducive to the greatest quantity because of the warm winds and drying sun during the picking season. If, however, the soil is fairly retentive of moisture there is no serious objection to such a slope.

The soil factor is decidedly important, because, while the berry is grown on a great variety of soils, from the lightest sands to the heaviest clays, it naturally prefers a deep, warm sand loam, that is retentive of moisture. Whether such a soil can be made too rich or not is a disputed point. The writer does not believe it can, provided the cultural methods are intensive, and especially where strawberries are grown as a regular crop and have a place in the rotation. But the fertilizers applied must be balanced. At the same time, while maximum crops might be expected under such ideal conditions it must not be supposed that other

The Type of Plant Necessary for a Large Yield.

soils will not produce profitably. Even a light sand may be made to yield good returns by the application of large quantities of farmyard manure. The problem is as much one of moisture retention as of fertility. Farmyard manure and commercial fertilizers may be applied in large quantities, at the will of the grower, but for the water supply, except where irrigation plants have been installed, we are entirely dependent on nature. The same facts apply to a clay soil, except that when intelligent cultural methods are exercised, commercial fertilizers are not required to such a large extent. Farmyard manure, however, instead of tending to make the clay heavier as it does the sand, makes it lighter and easier to cultivate and in this way more retentive of moisture. Very heavy applications of farmyard manure are sometimes desirable on both sand and clay, thirty to forty tons per acre not being considered too heavy.

While plenty of moisture is very desirable, standing water is very harmful. Strawberry plants are always weakened by being under water, even for a few hours, and many times they do not survive the shock. A water-logged or puddled soil is not desirable for the same reason that it is not desirable for other plants.

In the experience of the writer the fruit from the clay soils is sweetest, but comparatively smaller than the fruit from the lighter soils. Generally also the picking season is about one week shorter.

Underdrainage will improve most soils for the production of strawberries and especially clay soils that are inclined to puddle.

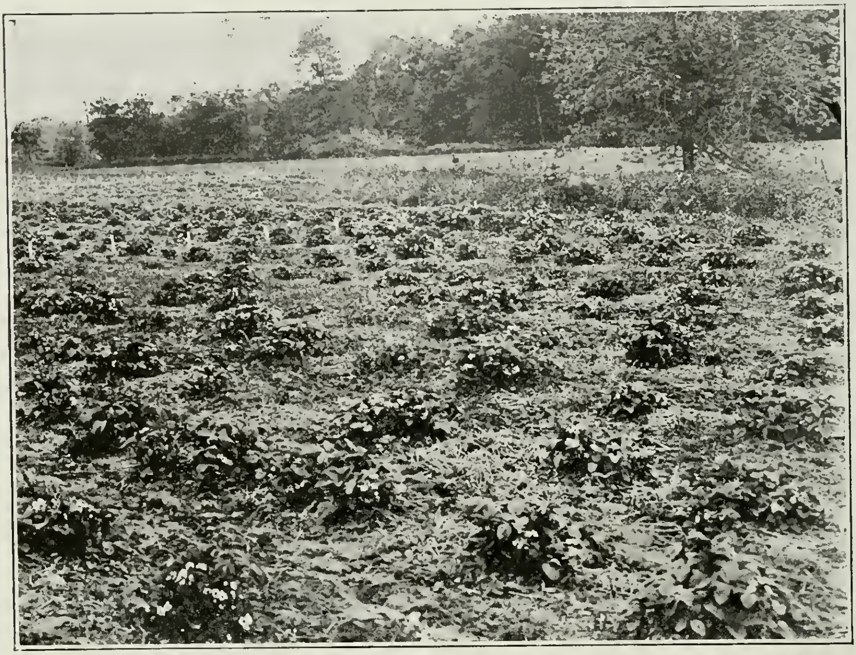
Preparation of the Soil.—Begin to prepare the land at least one year previous to planting. If the field is in sod fall plow and grow a crop of corn, potatoes or roots. A heavy application of farmyard manure may be applied for this crop, because then an opportunity is afforded to free the soil from any weed seeds that may be added with the manure. Fall plow again, and if a second dressing of manure is to be applied, let it be either in late fall or in winter. The manure will then work into the soil much better. Any manure that is applied when the field is being prepared for the plants in the spring should be well rotted, because strawy manure tends to loosen and dry out the soil, especially if the season is unfavorable. In most cases it is not advisable to use a sod at all, especially if it is inclined to be tough from age. Strawberries, like other crops, should be in a regular place in a rotation. The grower then knows what is coming and begins to prepare the ground much in advance of the crop. A good one year clover sod is the choice next to a well-manured piece of land that has been under cultivation several years. This should be fall plowed and manured in the winter. The only serious objection lies in the fact that such lands are often infested with White Grubs. A two-year sod or older is even less desirable than a one year.

Bone meal, muriate of potash or wood ashes may be added with the final cultivation before planting. Cultivate thoroughly about two and a half or three inches deep so that all manure is thoroughly incorporated with the soil. The soil cannot be in too fine tilth for the plants. Land that is infested with couch grass, chickweed or any other serious pest should not be used.

Marking.—The marking out of the field is accomplished in various ways as the marking depends on the manner in which the plants are to be set. The old way of plowing a furrow, spreading the roots of the plants on the bottom or against the side of the furrow and covering by hand is no longer largely practised by the best growers. A field marker, such as is used for corn, but set the proper width, is the quickest way. There is no necessity of marking deeply. If the soil is somewhat dry on top rolling ahead of the marker with a land roller will tend to bring the moisture to the surface and fewer plants will be lost if set in moist soil. Do not roll a clay that is likely to pack. The cultivator must, however, follow the planting as soon as possible, and as close to the plants as possible, without covering, to check evaporation.

The distance of planting varies all the way from three to four feet between the rows. At four feet apart the plants are set from fifteen to twenty-four inches apart in the rows; eighteen or twenty inches is a good average. With three feet between the rows, the plants are set from two to three feet apart in the rows. This latter distance has the advantage of making a large number of comparatively narrow rows, when the plants have ceased running, instead of fewer comparatively wide rows. Eighteen or twenty inches between the rows is plenty space for the pickers to work, and in the matted row system the best berries are usually found on the outside of the rows. Then why not grow as many narrow rows as possible?

The plants may be set in rows both ways. This has the distinct advantage of permitting of cultivation, both ways until the plants begin to run. Time is saved in hoeing, of course, but an objection is found in the fact that if a plant does not grow, too great a distance is left to be filled in by runners from the nearest plants. All vacancies must consequently be filled as they occur. The greater distances apart of planting are gradually losing ground in favor of a medium distance of about forty inches between the rows by twenty-four to thirty inches in the row.



Hill System.

Choice of Plants.—Plant only the best. Many growers are still making the mistake of setting plants from the edge of the row. In this way they unconsciously select the last runners that were formed the previous year, most of which, because of their lateness in forming, have not yet developed strong root systems. Such runners can not be expected to make first class parent plants. It is much to be preferred to dig up all the row, the best row in the patch, and select from this only the best plants, those with large, white, healthy roots. Do not set the old black rooted parent plant or any plant that has been weakened by disease, frost or water. The poorer plants can easily be distinguished by the dark and discolored roots.

The strength, health and vigor of the plants may be improved by setting aside a row or two of selected plants to be saved for planting the following year. In these rows space the runners carefully; allowing from four to six inches square to each plant. This will permit of a strong uniform development of crown and root. There is just as much individuality in the strawberry as in the apple.

In some cases, however, it is not possible, for the grower to raise his own plants, and consequently he may have to purchase from a distance. Also new varieties are often shipped from a distance. For the information of those who may have to make such purchases I quote the following from W. T. Macoun, "Small Fruit Culture," Central Experimental Farm, page 5:

"If the plants for setting out are obtained from a distance, they should be ordered to arrive as early in the spring as possible after the soil can be worked, and planted soon after their arrival. It is often, however, not convenient to plant at once; but in any case, the parcel containing the plants should be opened up when it arrives, otherwise they are liable to heat or dry out, either one of which conditions should be avoided if possible. The plants should now be heeled in in some place where the soil is well drained. Open a trench sufficiently deep to cover the strawberries well, and so that the crown will be just above the ground. Now place the plants close together, but in a single row in the trench. Another trench is now opened parallel with the first and about six inches from it, using the soil to cover the roots of the plants in the first trench. The soil should

Narrow Matted Row System.

be firmly packed or tramped against the roots so that the moisture will come into close contact with them. If loosely heeled in, they are very likely to dry out and the plants die. Other trenches should be dug parallel with the first two, if needed. By the time the field is ready for planting these heeled-in plants will have made new roots, and be in better condition for planting than if they had been set out at once."

Setting the Plants.—The plants may be set in either spring or fall, but usually nothing is gained by fall planting. Unless the plants become well established and make some growth there is a possibility that a large share of them will not survive the winter. Spring is the recognized time. As soon as the plants have developed two or three sets of leaves they should be carefully dug with a fork, pruned, and set at once. Do not allow them to wilt. If the day is very drying cover them carefully with a sack or cloth as they are packed into the planting basket. Sometimes the plants develop too much top before the grower is ready to transplant, in which case it is well to remove all but two sets of leaves. Many growers do not prune the roots at all, but growth starts quicker if they are cut back from one-fourth to one-third of the total length. A safe rule to follow when transplanting any plant is to leave as much root and as little top as can be done consistently.

Two men or a man and a boy are employed in each gang to set the plants and they may use either a spade, trowel or dibble. The spade seems to be the most popular tool, though the dibble is used a great deal. The man with the spade walks backward following the marks and makes a three cornered hole by pushing the spade into the ground with the left foot, about three or four inches, shoving it slightly from him and then with his foot still holding one side of the spade pulling the top toward him. This makes a three cornered hole into which

The Wide Matted Row System Before Picking Time.

the boy places the plant, holding it firmly until the spade is removed. The foot is then used to pack the earth firmly around the plant. The boy is expected to place the plant at the proper depth and hold it in place until the soil is firmed. This method is much superior to working the spade backward and forward, as it does not pack the sides of the hole or leave an open space below the plant. Also with a little practice it is much quicker. Great care must be taken not to injure or cover the crown of the plant when tramping. Also care must be taken not to plant too deep or too shallow. The crown should be even with the surface of the ground.

The dibble is used in a similar way. It is a wedge shaped piece of wood about six inches long, which is pressed into the earth by the foot. It should be shod with a thin piece of iron or steel.

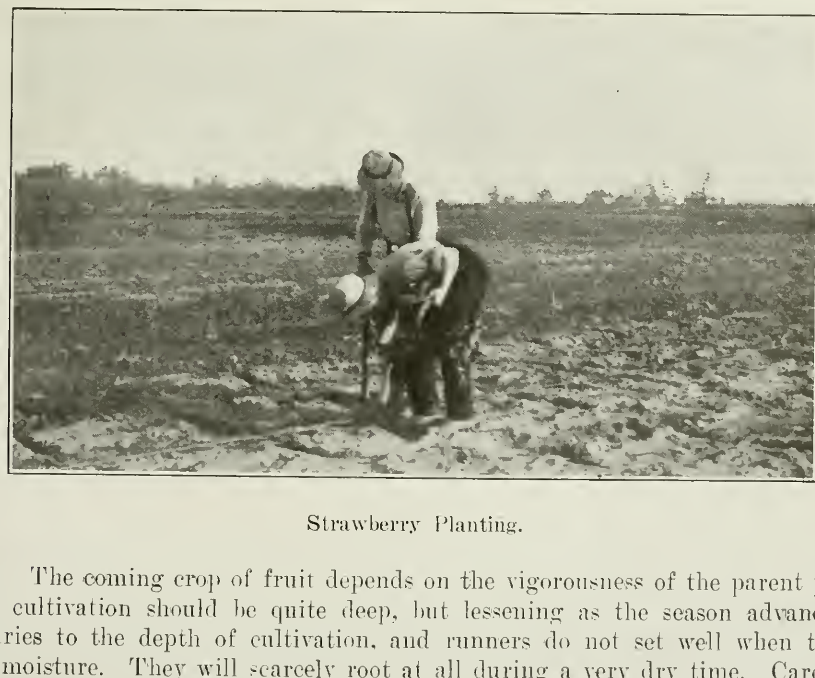
A surer way of securing a stand, especially if the soil is dry and the weather is unfavorable, is to use a trowel as mentioned above. The roots are then spread at a depth where there is moisture and covered carefully. The method, though, is very slow, and is not advised where conditions are at all favorable to growth.

A planting machine, such as is used for cabbage and tobacco in some parts

Planted too Shallow. Planted Proper Depth. Planted too Deeply.

of the Province, might be used where very large areas are planted, but so far, to the knowledge of the writer, it has not proved entirely satisfactory.

CULTIVATION.—Cultivation must be thorough and continuous. It should be begun as soon as the plants are set and continued till early fall or later, if weeds



Strawberry Planting.

start. The coming crop of fruit depends on the vigorousness of the parent plants. Early cultivation should be quite deep, but lessening as the season advances, as soil dries to the depth of cultivation, and runners do not set well when too far from moisture. They will scarcely root at all during a very dry time. Care must be taken also not to allow the cultivator to injure the roots of the parent plants, from too close deep cultivation: it is better when using unskilled labor to keep some distance from the plants and then loosen the surface soil close to them with a hoe. Hoeing should be thorough and regular, because if weeds once get a start among the new plants and runners the labor is much increased.

A careful man with the hoe can do much toward increasing the crop. Every new plant formed by the runner should have a space of at least four or five inches square, and while it is not practicable to space the runners by hand the man with the hoe can do much to prevent crowding. If a runner is placed where wanted and a little earth put on it, leaving the terminal bud free, it will take root and grow where covered. Many growers make the mistake of conserving all the runners no matter how great in number they may be. This, of course, is advisable where they are not of sufficient number to make a matted row, but if new plants average, as stated previously, one to about four or five inches square there is nothing lost and sometimes much gained by cutting out the surplus.

The following quotation is taken from the Department of Pomology report, in the Report of the Ontario Agricultural College for 1910, and shows quite conclusively the value of the careful spacing of the runners; if one year's experiments as here quoted can be accepted as conclusive.

The following table shows results secured in spacing strawberry runners by hand instead of allowing them to find their places naturally:—

Row No. 1.	Row No. 2.
Runners hand-layered:	Runners layered naturally
29 lbs. 3¼ ozs.	14 lbs. 11¾ ozs.

"The figures given represent the yields for thirty feet of measured row. Plants were set at eighteen inches in the row, with rows four feet apart. Runners were spaced to six inches in the case of Row No. 1, and evenly distributed around the parent plant to a total width of fifteen inches. A large number of surplus runners were removed entirely. Row. No. 2 was somewhat wider than Row No. 1 and, of course, contained a much larger number of plants.

"It will be noted that these yields are at the rate of 10,600 pounds of fruit per acre from the plants spaced by hand, and 5,348 pounds per acre from those which were allowed to form runners without interference—a difference of 5,242 pounds per acre in favor of the former. The variety was Parson's Beauty. The specific reason for the great difference in the yields lies, no doubt, in the fact that the season was particularly dry, and the conclusion to be drawn is that crowded plants suffer much more under such conditions than those not crowded. In order to prepare for seasons like 1910, it would most certainly pay to take the extra time necessary in preventing over-crowding of plants in the row."

The man with the hoe is also expected, in the new planting, to carefully pinch off all blossoms as they appear at the beginning of the season. A plant cannot produce both fruit and runners well, and just at this time it is well to conserve all energies for the production of plants.

When cultivating it is good practice to always cultivate the same way on each row, or the same way on either side of the row at each cultivation. By taking this precaution many runners are not disturbed that otherwise would be.

All surplus runners that extend beyond the required width of row should be removed either by hand or with the cultivator.

Matted Row or Hill System.—The matted row is the system followed in all the large commercial plantings, because it has the distinct advantage of producing large quantities. It has been argued that berries of largest size and highest quality cannot be produced in this way, which may or may not be true; good fruit is, nevertheless, produced. In the hill system the plants are set twelve to fifteen inches apart in the row and from twenty-four to thirty inches apart between the rows, and all runners, as well as all blossoms are pinched off as soon as they form the first year. This permits of marked development of the parent plants and the forming of a large crown or a number of crowns and when blossoming time comes instead of one or two average flower stems, as from each plant formed from runners in the matted row, we have a number of strong flower stems from one plant whose energies have been conserved for this purpose alone. In this way we get a large berry of excellent quality, but it is doubtful if the quantity produced on an average is equal to that of the matted row. However, in the home garden or where there is a special trade at a remunerative price, the practice of hilling is not to be discouraged. The extra labor entailed of keeping the plants within bounds makes the system impractical in the average commercial plantation. Another disadvantage lies in the fact that the loss of a single plant from grubs, ice, water, etc., leaves a large space in the row from which no returns can be obtained. The individual plants also suffer more in dry weather because of the less protection to the crowns.

The following systems of forming the rows are copied from "Small Fruit Culture," by Mr. W. T. Macoun. They are not practical in extensive commercial plantings, but are of value in the home garden or when producing fruit for a special trade.

"The so-called single hedge and double hedge row systems are merely modifications of the matted row. The runners, instead of being allowed to form indiscriminately, are most of them removed and the rest placed where it is desired for them to grow. In the single hedge row system, two to four runners are left on, and these are placed in line with the row on each side of the parent plant.

"When grown in this way the rows are two and one-half to three feet apart and the original plants about two feet or more apart in the rows. When the row is formed the plants are six to eight inches apart in a single row.

"In the double row system, six runners are left to each plant in the row and two on each side of the original row, all about equal distances apart. Trained in this way, the original rows should be about three feet apart and the plants two feet or more in the row."

Winter Protection and Mulching.—If the soil is at all inclined to be wet, or subject to standing water, furrows should be opened here and there. Even on tiled land and land with an open subsoil this is good practice. Oftentimes during a thaw in winter water collects in low places and unless the furrows are opened, and sometimes even then, ice forms and destroys the plants.

A good heavy row of plants is sometimes all the protection that is needed, especially in the parts of the Province where there is a fair snow fall and the winter temperature is fairly uniform. But snowfall and steady weather cannot always be depended upon. A steady cold when the plants are at all protected is not so injurious as freezing and thawing. Strawberries, like wheat, will not stand this, unless there is a heavy top, and even then, some plants are weakened. Generally it is best to supply the cover by mulching the rows with a light covering of farmyard manure or straw. This covering does not need to be heavy, but still of sufficient thickness, about two or three inches, to prevent drifting and freezing and thawing. Straw will answer if manure is scarce. Sometimes straw is given the preference because it does not settle so heavily on the rows and tend to smother, especially if there is a heavy fall of snow weighing it down. The mulch should be applied as soon in late fall or early winter as there is sufficient frost to hold the waggon nicely. No damage can at this time be done to the cultivated and consequently loose ground. Do not wait too long, as the mulch is better under the snow than on top of it.

Many growers do not make a practice of removing the mulch from the rows in the spring, but rather loosen it up well to permit the plants to work their way through. The mulch must be light in such cases. The better way is to rake between the rows all rough or coarse materials to act as a mulch there, where it will conserve moisture and tend to keep the fruit clean or free from dust. This may be done quite early in the spring, or about the time that here and there in the patch a few leaves begin to blanch from too much cover or protection. If it is desired to produce early fruit, the mulch may be raked between the rows much earlier or as soon as there is any sign of life or growth. The early growth may be delayed some days by not removing the mulch, but it is doubtful if this is a desirable practice, except in special cases, such as when early blossoms are liable to frost injury or it is desired to cater to a late market. There is one serious objection to the mulch and that is, unless the manure, or straw, is practically free from weeds such a number of seeds are scattered over the field that it is almost impossible to keep the patch free from them. This applies even more strongly when the patch is to be kept for a second or third crop. Because of this objection many of the best growers do not mulch at all, but rather manure heavily before the plants are set, and depend on them to make sufficient growth to protect themselves. It seems safer, though, as a rule, to mulch with as clean manure as can be obtained, and chance damage from weeds rather than damage from freezing. Also in some cases the rough or strawy part of the mulch is removed entirely from the field and the spaces between the rows well cultivated until the picking season opens. This method, however, is not to be commended, as it not only removes a quantity of vegetable matter that would make humus, but detracts from the quality and appearance of the fruit by exposing it to dust and dirt.

Renewing the Plantation.—It is doubtful, in the majority of cases, if it pays to fruit a plantation more than one year. Weeds, insects and diseases, get a strong foothold, and generally the fruit is smaller and produced in less quantity, though some growers claim greater quantity. The fruit, however, ripens a little earlier, and consequently commands a high price, but the season is, as a rule, shorter.

Some growers argue that since it takes the better part of two years to fruit a patch, it should be renewed, as the second crop is then produced in one year. At the same time it is admitted that the work of renovation must be done just at the time when there is a rush of other work, and at a time when the soil is usually hard and dry. There are many cases, in rich sandy soils, especially, where it no doubt pays well to renovate; but since no comparative figures of yields and returns are available we must for the present at least, leave the point to the individual preference of the grower. He alone knows what is best for his particular location—after some years of experience.

There are a number of systems of renovation recommended, and not one of them is simple or easily accomplished. At best it is a difficult task. In every case, however, the patch should first be mowed and raked, or if at all possible burned over.

Cleaning by hand-hoeing, narrowing the rows and thinning the plants, is slow but sure, and has given good results.

A furrow may be plowed on either side of the row, away from it, and narrowing it to about eight or ten inches. The remaining part of the row is then hand-hoed and the weeds unless in too great quantity pulled into the furrow. The whole is then levelled by cross-harrowing. Some plants will be injured by this, but with care a sufficient number will be left to reproduce the row.

Again a furrow may be plowed on either side of the row and thrown on to it, and the whole levelled with a drag harrow. The plants under fair weather conditions will then start afresh, coming up through any small quantity of soil that may have been left on them. The hoe must then be used to cut out any weeds that are left, to straighten up any injured plants, or to bank up any plants that have had the earth drawn away from them.

A few growers recommend narrowing the rows to about ten inches with the plow, by plowing away and then filling the furrow with well-rotted farmyard manure. The row is then cleaned of weeds and thinned with the hoe and the whole levelled with the drags. Some plants will be destroyed by the drags, but the remaining ones enriched by the manure are expected by fall to produce a heavy row. In a favorable season they will do this.

It is not necessary to leave all the old plants in the narrowed row as a great many growers do. Fewer strong healthy plants will make a good row by fall. At the same time it is not well to thin too much. Some have recommended to leave the plants as much as sixteen inches apart, but in a dry season this involves a great deal of risk; better leave the plants fairly close, and if too many runners are produced cut out some in the fall.

Picking.—The picking and marketing of the fruit is the biggest problem that the grower has to face. Where only small areas are grown the necessary assistance can usually be obtained from the neighboring families or nearby villages, but when many acres are grown other provisions for handling must be made early in the season. The pickers must be ready when the fruit is. Generally on the best managed fruit farms there is work for a number of people from early spring till late fall. The strawberry plants must be set, tomatoes transplanted, weeds, etc., kept under control; and again, when the strawberry season is over, there is the old patch to renovate and raspberries, currants and other fruits to pick, etc. In many cases the grower engages one, two, three or more families of Indians and houses them in fairly comfortable shacks. These people, with a little experience, make very good workmen; but they must be kept busy, and consequently, if picking and general farm work is spread out well over the season the problem of assistance is solved for a time at least.

Italians and Poles are used similarly, and make very good workmen, indeed, but are not so easily handled as a class. The women and girls make the best pickers, and when properly directed have helped many a grower out of a serious difficulty.

The berries are ready to pick when they are from three-fourths to all red in color. They should not be allowed to get over-ripe, which does not take long, especially if the weather is hot and dry. If over-ripe and dry they sour, and if over-ripe and damp they mould. There still seems to be a feeling among many growers that "strawberries are strawberries," and that there is no place for grading according to size, quality, etc. But such is not the case. Medium to large berries of good color and not over-ripe always bring a higher price than fruit of all sizes, especially if it is shrivelled and "mussy" looking. Small, green berries here and there in the box, and some that are decaying from being left too long on the vines, always detract from the appearance. It is a safe rule to remember that someone is expected to eat every berry put in the box, and that previous to eating someone is expected to make them look attractive, and, lastly, that a good berry increases demand, while a poor berry decreases it.

Why not take as much pride—a few are already doing so—in the picking, grading, packing and marketing of the strawberry as in the apple, pear, peach or plum? It is a smaller fruit, and very perishable, but when marketed attractively, is in great demand.

Yields and Returns.—We are many times asked concerning yields, as the prospective grower has heard of some almost fabulous quantity being produced on an acre. But the average grower does not get anything like the number of boxes per acre that is sometimes reported. The writer knows a number of instances where patches of one acre or more have yielded, under good average conditions, but no irrigation, four hundred twenty-four box crates or more per acre. Such patches, though not rare, are exceptional. About two hundred and twenty-five to

two hundred and seventy-five crates of above size is a good yield, and would be above the average, if the poorest of the growers were taken into consideration. The yield depends quite as much on the individuality and experience of the grower as on any other factor.

Following are the figures of two leading horticulturists, and though figures in fruit production can never be accepted as absolute they are given to show approximately what is possible and as a guide to the prospective grower. No two growers estimate yields and costs alike, and consequently averages only can be quoted.

By Mr. Robt. Thompson, Manager, St. Catharines Cold Storage and Forwarding Co., in 1910. The price per box has increased considerably since these estimates were made.

ONE ACRE OF STRAWBERRIES.

Rent of one acre	$10 00
Taxes	3 00
Management	50 00
Plowing	2 00
Cultivating	2 00
Plants, 7,000 at $3.00 per 1,000	21 00
Planting	5 00
Fertilizers	17 00
Hoeing and Cultivating (8 times)	41 00
Winter covering	25 00
Delivering	12 00
Profits, over and above allowance for management	28 00
	$216 00
300 crates or 7,200 boxes at 3 cts. on the plants	$216 00

By W. T. Macoun, Central Experimental Farm, Ottawa, from his address before the Standing Committee of the Senate on Agriculture and Forestry:

COST OF GROWING ONE ACRE OF STRAWBERRIES.

(6,000 boxes.)

Rent of land (2 years)	$10 00
Preparation of land	4 00
Fertilizers	30 00
Plants	36 00
Planting	5 00
Cultivation	15 00
Mulching	10 00
Boxes	21 00
Picking	60 00
Crates and marketing	25 00
	$216 00
Selling 6,000 boxes at 5c. per box	$300 00
Net Profit	$84 00

VARIETIES.—The choice of varieties for commercial plantings is very important, and perhaps, in no other fruit have we such a wide choice. In the leading berry sections of the Niagara Peninsula the Williams is planted almost entirely as the main crop, while in some other sections of the Province this variety is considered one of the poorest. Some varieties seem to be adapted to sandy soils and very warm conditions generally, while others seem to prefer heavier soils and cooler conditions. A variety that does excellently on one farm may be of a great deal less value on a farm less than a mile away, or indeed, just over the fence. Each grower must select for himself the variety that does best with him under his special conditions and care. No man can select this variety or varieties for him: he must find out for himself from test plots, or rows, or experience.

Strawberry flowers may be either perfect or imperfect, depending on the variety. Imperfect flowers are those which have pistils only: perfect flowers are those in which both stamens and pistils are present. A variety with perfect flowers can fertilize itself, and no other variety need be planted near it, as far as pollination is concerned, but a variety with imperfect flowers must have a variety with perfect flowers planted near it or no fruit will be produced, at least the fruit produced will be small and deformed. In such cases one row of plants with perfect flowers should be planted to about every three rows of plants with imperfect

Imperfect Flower

Perfect Flower

flowers. Do not put the imperfect variety on one side of the field and the perfect variety on the other side, but rather mix them up in the above proportions.

The following is a good list from which varieties for commercial plantings may be selected.

Splendid.

Beder Wood.—Perfect flower, early, plant vigorous, producing numerous runners, a good pollenizer, valuable on account of its earliness.

Michel or Michel's Early.—Perfect flower, very early, hardy, and on some soils very productive, largely planted and quite popular: quickly crowded off the market by the later berries.

GLEN MARY.—Perfect flower, ripens in midseason, numerous runners, and quite popular on account of its productiveness.

Sample

SAMPLE.—Imperfect, medium to late season, large berry of medium to high quality, numerous runners, and quite popular on some of the lighter soils in the Province.

Parsons

WILLIAMS.—Perfect, medium late, hardy, numerous runners, fruit has white or green tip, good shipper and canner, very popular, more largely planted than any other variety in the Niagara Peninsula.

Senator Dunlop.—Perfect, medium early, large size, good quality, numerous runners, at one time quite popular.

To the above list we might add: Buster, Parson's Beauty, Ruby, Splendid, Warfield, Brandywine, William Belt, Pride of Michigan, Uncle Jim.

It is not recommended for anyone to discard an old and tried variety that has been doing well for years for some new variety. It is much better to first try

Williams.

Dunlop

out the new variety on a small scale, and then if it proves equal to, or better than the old variety it may be planted more largely. Not one in twenty of the new varieties introduced proves better than, or equal to, the old established varieties.

Stick to the varieties that are doing best with you. They may not be included in this list, but they suit your conditions. Change to the new varieties gradually.

INSECTS AND DISEASES.

White Grubs.—White Grubs are by far the most serious pest that we have attacking the strawberry, because they usually do their most damage to the young plants as they are set in the spring, by eating the roots. When damaged thus the plants turn brown and die. In such cases there is no remedy, except to dig into the ground at the base of old plant, destroy the grub if he can be found and then replant.

The best remedy is prevention. The white grub is the larva of the June beetle, and lives and feeds in the ground at least two years. If the soil is plowed anc cultivated yearly or not allowed to remain in grass or sod for more than one year the larvæ cannot mature, as such cultivation destroys them. Strawberries two years in succession encourages them. In any case strawberries should not be planted on land that has been in sod one, two, or more years, unless it is known that such land is free from this pest. Grow corn, potatoes, or roots and free the soil of these pests first.

Strawberry Leaf Roller.—As far as is known to the writer this pest has not proved serious in Ontario, and only one instance is known to him where it was sufficiently troublesome to demand treatment. The pest may be identified by the damage it does. The larvæ fold the leaves by drawing the upper surfaces together and fastening with bands of silk. They then eat away from the inner side all green portions of the leaves.

The remedy is to spray with three pounds of arsenate of lead in forty gallons of water before the leaves are folded or just when the larvæ are first noticed to be working. Repeat again at intervals, but not when the plants are in bloom, or after the fruit is set. The young plants may be sprayed at any time.

Strawberry Leaf Spot is the only disease known to the writer that is serious, and even this shows up largely only on plantings that have been kept the second and third years. Spraying with Bordeaux Mixture in early spring has been recommended for this, and when carried out thoroughly, brightens the plants and gives them a healthier color. The best method is prevention. When renewing a patch for the second year, if possible, mow and rake off or burn all the old plants and weeds that may have collected. Experimental work has not demonstrated that burning the old plants is entirely effective, but it is the method practised by the best growers.

The Red Raspberry

F. M. Clement

The object of this Bulletin is not to give a detailed, botanical or horticultural description of the red raspberry, but to put into readable form a few facts that may be of value to the grower. The information was collected in the Orchard Survey of Clinton, Louth, Grantham, and Niagara townships in the summer of 1910, by conversing with practical men and getting their opinions and methods, also by observing the methods of the leading growers in Elgin and adjoining counties when District Representative in 1911-12. In no case are the statements theory only. All are backed up by the best practices of the best growers.

The red raspberry (*Rubus strigosus*) is indigenous to Ontario, and grows wild in profusion in almost all sections of the Province. It is especially adapted to the above and adjoining townships, and grows wild everywhere in the woods there. The black raspberry (*Rubus occidentalis*) is also very common, growing wild almost everywhere, but is not cultivated as largely as is the red. Almost every farmer has a small patch of both species, producing sufficient for family use. These small patches were not considered when quoting figures previously and neither is their cultivation considered here. The black raspberry (black caps) bears fruit and produces new plants in a manner distinct from the red, and requires different conditions and treatment; consequently it is not included in this discussion.

Extent of the Industry. The marked growth of our home cities, the extension of private trade and the operations of canning factories have done much to stimulate the production of this fruit. It is not long since raspberries were considered only a garden product, but the above mentioned factors have operated in such a manner that patches of six or seven acres are by no means rare. The four townships to-day, including both young and old commercial plantations, have almost as great an acreage as they have of plums or pears. (If bushes between rows of trees were considered commercial crops rather than fillers the acreage would be greater.) Good plantations may be found in almost any part of the townships, but in the sections east of Port Dalhousie and both east and west of Jordan Harbor they are made a specialty.

To understand why they are made a specialty in these two localities is quite an easy matter, but to understand why, though both sections should specialize, the one section should choose one variety entirely, and the other another variety almost entirely, is not so easy In the Jordan section the Cuthbert is the choice, while in Port Dalhousie section the Marlboro' is preferred. A few men have some of both varieties, but taken as a whole the facts are as stated above. This would seem to indicate that the Cuthbert and Marlboro' are best adapted to certain conditions, and soils that are distinct; or conditions under which one variety thrives best are not exactly suited to the other. Let us see, if possible, what these conditions are:

It is generally conceded that the Cuthbert is of better quality than the Marlboro', though many do not think so. Usually, too, under the same conditions the Cuthbert is the heavier yielder. But the Marlboro' has the advantage of being a week or ten days the earlier, and this gains for it the top price in the market.

Where the Marlboro' is chiefly grown the soil is a little heavier and apparently has a little drier and heavier subsoil than where the Cuthbert thrives best. This dryness is an advantage in producing the required earliness, although it can be expected to reduce the yield.

Where the Cuthbert thrives best the soil is sand and sandy loam, very deep, with sand or gravel subsoil, which retains the moisture and holds the water table near the surface. This moisture is a very considerable factor in dry seasons. The aim on those soils is to get a large, well ripened berry, full of quality, which sells for an even price throughout the season. The Cuthbert fills this requirement best. Both varieties are grown on the shore of the lake and both are grown some distance from the shore. No explanation is offered why both varieties are not grown largely in both sections, but in the opinion of the writer it is a case of the growers

A Profitable 10 acre Raspberry Patch

adapting themselves to the market demands and conditions, and becoming somewhat prejudiced against the variety not best suited to those conditions. The only other differences noticeable in the two sections are those of the slight differences in the soil and subsoil mentioned previously, and the difference in the moisture content.

Varieties. Cuthbert and Marlboro' are the only two varieties grown largely at present, but the Herbert is coming in very fast. At present this latter variety is represented by a large number of small patches only, but it is highly recommended, and in a few years might be expected to take a leading place, because of its heavy yielding qualities and its extreme hardiness. Other varieties are grown to a small extent, but are not recommended for the inexperienced. A number of them winter-kill very easily, or have some other quality unsuited to the commercial plantation, and consequently are not of the kind for the beginner to experiment with.

Cuthbert: Is the heaviest growing variety with bright crimson fruit, small seeds, first class shipping and dessert quality; it ripens in mid-season, and the bush is medium to very hardy.

Marlboro': Is a medium heavy grower, light red fruit, ripening early, large seeds, good shipping and fair dessert quality; the bush is only medium hardy.

Herbert: Is a good grower, heavy producer, first-class shipping and dessert quality. The experiment stations put it first in productiveness, but some growers do not favor it because of its spreading habit: that is, it is not so upright a grower as the Cuthbert and Marlboro', and the fruit is inclined to be a little soft.

Cuthbert.

Soils. The raspberry is adapted to soils of various grades, but in no case are they doing exceptionally well on heavy clay. They are best adapted to a sand, sandy loam or a loam. A foot of good sand loam with a heavy subsoil seems to give good results, especially with the Marlboro'. Moisture content is a very important factor; so important, indeed, that if the soil is not naturally moist, or if there are not frequent showers during the picking season, the fruit dries up on the bushes. The season of 1911 will long be remembered as an example of this. When planted on a heavy clay the soil must be made mellow by heavy applications of barnyard manure.

While moisture is important, standing water is very hurtful. As in the case of the peach, the soil must be thoroughly drained, tile preferred; or if this is not possible, first-class surface drainage will do. Any standing water weakens the plants, and, if continued, destroys them. Surplus water in the soil is equally hurtful. Do not plant on a *wet* soil; but at the same time it must be retentive of moisture to give good results.

Preparation of the Soil for Planting. It is a very common practice to set the young plants without any consideration of what has been growing on the field previously, or what condition physically and chemically the soil may be in. But such indiscriminate plantings are not recommended. The soil that has previously

Marlboro

been well fertilized and cultivated for one year at least and cleaned of weeds invariably gives the best results, by forcing the immediate growth. A profitable crop is produced in one year earlier this way, and the labor of caring for the plants for that one year is saved. The effect of first-class soil on the young plants is very remarkable, and a number of patches planted thus now show, at one year of age, as great a growth as the majority at two on the poorer soils.

A hoe crop of corn, tomatoes, potatoes, or roots, well fertilized, is recommended as a crop for the year previous to planting.

Plants and Planting. The best plants to use are the young shoots that come up in the fall after the last cultivation, or those that come up in the very early spring if they are strong and healthy. Only the very strongest and best growing of these plants should be used, taking care not to transfer any disease from the old to the young plantations. Reproduction is from the healthy roots, not the canes. The transplanting of the old canes, or even one-year canes, on the new plantations is not recommended. It is only the roots of these that have any value, as the tops die down every year. Also there is much more danger of transferring insect pests and disease when the old canes are used. The transplanting may be done in early fall, but spring seems more suitable. Early spring is preferable, but transplanting may be continued till June.

Herbert.

Distance to Plant. The distance apart to plant is a disputed point. Much depends on the tastes and ambitions of the individual growers and the growing habits of the plants or varieties used. The Cuthbert and Herbert are much stronger and heavier growers than the Marlboro', and consequently must be planted at a greater distance.

For the Marlboro' the hill system is practised almost entirely, and the distance is invariably 3 by 6 feet. This distance may seem a little close, but the best patches and those that are yielding the best returns are almost without exception set at this distance. Where the Cuthbert and Herbert are in hills they are started for the most part at 4 by 8 feet, but it is very seldom that either variety is kept in hills very long, as the heavy growth soon fills up the rows unless thorough and frequent cultivation is practised. Where the row system is followed the distance apart varies from 6 to 9 feet. On a smaller area, or where extremely intensive culture is practised, the writer recommends narrower distances, but where land is more plentiful and help scarcer the greater distance is recommended, as it allows of cultivation with a two-horse cultivator or disc. A distance of 7½ or 8 feet is a good average for all varieties. The hill system is recommended, however, wherever possible because

1. It saves labor in cultivating, and cultivation saves moisture.
2. Sunlight can reach a greater portion of the plant, which is very important for early ripening and lessening of disease; also a diseased hill can be removed entirely.
3. Because they are much easier to pick and there is less likelihood of leaving ripe fruit, as the picker can get on all sides of the bush.
4. It enhances the quality of the fruit.

When setting out the plantation the planting in hills is very strongly recommended, even though the grower may prefer the row system. By setting the plants from three to four feet apart in hills the patch may be cultivated both ways for the first season at least; much longer, usually. When this method is followed, from two to four healthy plants are put in each hill—three is a good number—and in two years' time they will have run together and filled up the row entirely if they have been well cared for and allowed to do so. The planting indiscriminately from eighteen to thirty inches apart in the row is not recommended, as the labor of keeping them clean the first two years will be much greater than when planted as recommended above.

Pruning. In order to be able to prune a raspberry well it is necessary to understand its manner of growth and fruiting. New shoots are sent up from the underground root stocks during the entire growing season of each year. It is on these that the fruit is produced, or in other words it is produced on the new or one year wood. Sometimes the new or early spring shoots produce fruit in late summer or early fall, but this is never in commercial quantity.

Cutting Back. During the growing season keep down the new growth between the rows, by cultivation. By the time the fruit is ripening the new canes in the rows will be as high, and in some seasons much higher, than the old canes. Formerly it was at this season that the greater part of the cutting back, or removing the tops to the heights of the old canes, was done. Excessive growth hides fruit when picking, and sometimes it is so excessive that it causes much inconvenience in passing between the rows. But now that practice is being discarded by many of the best growers and the canes are being left untouched until late winter or the following spring. A few good growers still cut back, because it causes the plants to send out side shoots or laterals and take more of the tree or bush form; also the picking can be done more conveniently when the new canes are thus cut back. But notwithstanding these advantages we have to face:—

1. The risk of a heavy winter and the freezing back of the canes where cut.
2. The freezing and consequent loss of the tender laterals forced out from the cutting back.
3. The risk of small, poor quality fruit on many small branches or laterals.

The freezing back is the greatest risk. The advantage of not cutting back lies in the fact that: (1) Not being cut back no excessive growth or branching is forced out and consequently the bushes are hardier; (2) The tenderest part of the bush is the tip of the branch, and if these do freeze they may be removed in the spring without permanent injury; (3) The fewer good laterals sent out in the spring produce a higher quality of fruit, because they are fewer in number, have not been weakened by the winter, and produce the fruit nearer the main stem or source of food supply.

There are some good advocates of both methods, and good patches under both systems of pruning; but in the colder sections of the Province, especially, it is highly recommended not to cut back till the following spring.

The thinning out of the rows or hills is not usually done until very late winter or early spring. This is best done when the ground is still frozen or before growth starts, leaving only the hardiest and healthiest and only from five to seven good canes in the hills. A few more may be left in the rows but the canes should not be closer than six or eight inches, and the rows more than a foot wide. The grower should, with a little practice, be able to space the plants fairly evenly in the rows. This work should be done sufficiently early to remove all insect pests that have wintered in the old canes. These begin to move with the first growing weather. A great many growers remove the old canes in early fall or late spring, but in the opinion of the writer the spring is preferred.

If the effects of the winter are not plainly noticeable at this time, the cutting back may be left a little later or till growth has started, when the frozen tips are much more easily distinguished. The earlier pruning is recommended, however.

In the colder sections of the province, where winter injury or freezing is common, the practice of thinning out the old canes in the hills in the fall is followed quite largely. The canes, which may be from four to seven feet long are then laid down in the line of the row and covered with earth. This method of protection is expensive, but gives fair results.

Another method is to keep the young plants cut back to about eighteen to twenty-four inches during the summer. This causes them to send out quite strong laterals and then the plants in tree form being quite low are protected by snow during the winter.

In the Niagara Peninsula, however, where the investigation was made, no protection is given except that which follows from good cultivation, manuring, and pruning practice.

Cultivation. The cultivation must be thorough. A few days' delay often gives the grass and weeds a start, and when once they take possession of the rows it is a very difficult task to get rid of them. Many of the best growers cultivate twice a week from early spring up to the picking season, and some cultivate even between the picking. It is best to cease cultivation with the opening of the picking season, or, at most, to give one or two cultivations later. This would be to clean up the patch, loosen the soil and give the young shoots, if they are required for planting the next year, a chance to grow. Loosening the ground between the rows after each picking conserves a great deal of moisture and is advised if it can be done without injury to the fruit and plants. Too late cultivation tends to produce new growth late in the fall, which is not as hardy as the older wood, and is consequently more likely to be injured by the winter. Many good patches have been severely injured by practising late cultivation.

Fall plowing up to the plant and cultivating and hoeing the earth away in the spring as much as is required to remove the weeds and form a mulch is recommended. Quite a number of growers plow away from the plants in the spring as it gives a much better chance to remove the refuse from the row. Also this plowing covers up any manure or mulch that may have been applied in the winter. The plantations of the best growers are not intercropped after the first year; the soil then has all it can do to support the berries and without first-class care and attention it will not do even this.

Ottawa Bulletin No. 56 gives the figures of an experiment conducted to determine the advisability of cutting back in the summer or leaving the plants unpruned. In almost every instance there is a considerable margin in favor of the unpruned rows. This is contrary to the beliefs of many growers, but the experiment shows quite conclusively that it will pay growers to investigate before arriving at conclusions.

There are more patches suffering from poor soil than from soil that is too rich. But the first season—that is, the spring the plants are set—a single row of tomatoes, corn or potatoes may be grown between the rows of raspberries. Strawberries are sometimes used, but as the vines spread out a great deal and require much moisture, and the fruit is not removed till the following summer, when growth has almost ceased, they are not recommended, though some apparently get good results.

Manuring. The scientific manuring of the raspberry is just in the experimental stage. As a rule even in the best patches no regular method is followed. But barnyard manure is the standby of all. There is a danger when this is used in quite large quantities—say twenty tons per acre every year—of producing an excess of cane or wood growth. The general practice, where the land has been built up or is already in good heart, is to apply about ten tons per acre of good manure annually. This adds a sufficient quantity of humus and with commercial preparations keeps the soil in fair condition. Where the soil is poor a much larger quantity must be added at first. This may be applied and plowed under, either in the spring or fall or applied as a mulch in the fall and plowed under in the spring.

Commercial preparations are gradually coming into favor, but it cannot be said that as yet any number of growers have reached a standard and are applying them in regular quantities. Various quantities are applied ranging from two hundred to six hundred pounds or more per acre. This is usually in the proportion of two pounds of bone meal or superphosphate to one of muriate of potash. No quantity of nitrate of soda is used. The growers depend on manure largely for their supply of nitrogen, because, except in special cases, it is much cheaper. The following is recommended for a yearly application on soil that is in good heart, and it will replace in the soil the quantity of fertilizer constituents removed by one hundred crates of fruit

12 tons of barnyard manure,
100 lbs muriate of potash,
200 lbs. bone meal.

The nitrate of soda cannot take the place of barnyard manure, but preparations other than those mentioned containing the same quantities of available potash and phosphorus may be used.

Picking and Packing. The picking and packing is usually done by help obtained in the neighborhood, but where the areas under this fruit are exceptionally large it is necessary to employ much outside labor. The Indians have proved very satisfactory workers where it is possible to get them. The labor question is very acute at times, so much so that in a few cases some berries have gone to waste each year. This fact would lead one to suppose that raspberry production had almost reached its maximum in the Niagara Peninsula, but the well-known law that "demand draws labor" seems to work exceptionally well here: so much so, that though the acreage is increasing rapidly each year, the quantity that wastes each year is not increasing any more proportionately.

The fruit is picked directly into quart boxes, and should be carefully selected and sorted while picking, as nothing is gained in quality and appearance by extra handlings. It is then packed into twenty-four box crates for delivery. The days for picking cannot be fixed. The producer must use his own judgment, as all depends on the variety of berry and the weather during the ripening season. The ripe fruit must not be left too long on the bushes or the least wind will cause it to fall off and waste. Neither should it be picked when hard and green, as it greatly detracts from the attractiveness of the package.

Careful handling is very essential. Jarring on the road to market settles the package and spoils the fruit. Throwing it into or out of the waggon has the same effect. The practice of filling the boxes well with choice red fruit cannot be too highly recommended. Do not allow the picked fruit to stand in a hot or moist place, as it soon spoils.

Selling. There are several methods of disposing of the fruit, but the special order trade and the commission market take the largest quantity. This includes the quantities sold through the co-operative associations. The canning factories take a very large quantity where they are used for making jam, and at present this demand seems to be increasing much faster than the supply.

Returns. Following is a list of patches showing the acreage, yield and returns as quoted to me by the growers. These are not given as an average, but represent some of the very best patches for the season of 1909. The figures are much higher than the general average, but show a possible average under good conditions.

Acreage.	Yield (Crates)	Price (F.O.B.)	Value
1	125	$1 80	$225 00
1	150	1 80	270 00
¾	75	1 80	135 00
1½	190	1 80	342 00
6	350	1 80	630 00
4	350	1 70	595 00
3½	523	1 90	993 70
4	310	1 80	558 00
1	85	1 80	153 00
1½	40	2 12½	85 00
¾	250	1 80	450 00
1	70	1 80	126 00
3½	350	2 00	700 00
2	115	1 82	209 30
1	20	2 00	40 00
½	75	2 00	150 00
2	180	1 80	324 00
1½	200	2 00	400 00
1¼	190	1 80	342 00
1	75	2 30	172 50
2	95	2 15	204 25
5	200	2 00	400 00
2	200	1 65	330 00
3	75	1 68	126 00
3	350	1 74	609 00
1¾	450	1 80	810 00
2½	200	1 80	360 00
1	60	1 80	108 00
5	500	1 65	825 00
1	150	1 80	270 00
2½	200	1 80	360 00
1	150	1 75	262 50
Total..68½	6,353		$11,565 25

Or, each acre in the above patches averaged 92.7 crates, which sold for $1.82 per crate, or $168.83 f.o.b.

Diseases.

Anthracnose (*Glœosporium Venetum*) is distinguished by the drying up of the leaves and the dying of the canes, especially at the tips. Small purplish spots appear at first on both leaves and wood, but later the centre of them becomes gray and sunken, giving a bird's-eye effect.

Remedy: Control measures have not been effective. Prevent from spreading by cutting out and destroying as soon as noticed.

Orange Rust (*Gymnoconia Peckiana*). This is a very serious disease, but it is easily distinguished by the yellowish rust that appears on the leaves and canes. It attacks the plant at all stages, and though the plant may not be killed outright it is so weakened that it is valueless.

Remedy: Control measures are ineffective. The diseased plants *must be cut out and destroyed* as soon as they appear. The least delay only allows the disease to spread still further. Spraying is ineffective.

Crown Gall (*Pseudomonas tumefaciens*). This attacks the roots, producing galls or growths thereon which causes the weakening of the plants and makes them unprofitable. It is the same as that which attacks the peach.

Control: By digging out and destroying. Do not plant in the same field for three or four years.

Injurious Insects.

Snowy Tree Cricket. The only injury done by this insect is in depositing the eggs in the canes. They are noticed in rows from one to two inches running lengthwise of the canes. Otherwise the insect is beneficial, feeding upon injurious plant lice. The cutting out and destroying of the old canes in winter or early spring keeps it under control.

Raspberry Cane Borer. The injury is done by the insect making two girdles around the cane about a half an inch apart between which the eggs are laid. The egg hatches and the larva bores down in the pith of the cane. This causes the top or injured portion to wilt and die.

Control: By cutting off and destroying the wilted parts. Take care to cut well below the girdle.

Root Borer. The injury here is done by the larva or a clear winged moth which bores in the root from the cane just at the surface of the ground. The canes in the spring appear to be winter killed. The damage is worst in the old plantations.

Control: By keeping the plants healthy by exercising good care and cultivation. Dig out and destroy all weakened plants.

Raspberry Saw Fly. The damage is done by the larvae of the fly, green in color, eating the tender green portions of the leaves, leaving only the veins. The fly deposits the eggs on the leaves and the larvae begin feeding as soon as hatched.

Control: If early in the season spray the plants with two pounds of lead arsenate in forty gallons of water. If the fruit is ripe or ripening the larvae may be jarred off by hand on to the hot dust between the rows. It is not well to use the poison on the ripe or ripening fruit, because of discoloration. White hellebore, either dusted over the plants or steeped, one ounce in two gallons of water and sprayed over the foliage, is a very good remedy.

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Ontario Department of Agriculture

FRUIT BRANCH

BULLETIN 211

Fruits Recommended for Planting

In Various Parts of Ontario

TORONTO, ONTARIO, MARCH, 1913

BULLETIN 211] [FEBRUARY, 1913

Ontario Department of Agriculture

FRUIT BRANCH

(A Revision of No. 179)

Fruits Recommended for Planting

In Various Parts of the Province of Ontario

Owing to the continual demand for information regarding the best varieties of fruit for planting, the Department has found it necessary to prepare a list which will serve to the best advantage all those interested. The tendency of all commercial orchardists is to reduce the number of varieties planted to the smaller number, which will ripen so as to cover the season, and some have gone so far as to reduce their number of varieties even less, so as to specialize in those best adapted to their locality and soils. This practice is highly to be commended, and in the lists given, only varieties that have proven their merits are mentioned. The growers are recommended to choose those varieties which they may prefer, and not necessarily to plant all that are suggested for their district.

The general list has been prepared from the actual work of the experimentalist under Department supervision. The district lists have been submitted by the various experimenters and successful growers, and contain those varieties which seem to be especially adapted in the section for which they are recommended.

The boundaries given for the various districts are merely suggestive, as it is impossible to define these definitely, one merging gradually into the other.

There are many varieties not mentioned in the lists which may do well under special conditions, but are not generally considered so desirable as those mentioned.

Finally, in selecting a list of varieties from those recommended in this publication, we would draw the attention of the grower to the importance of limiting the number of varieties as closely as possible, and also to study his soil and the market conditions. This can easily be done by going to one or two of the growers in his section and asking him for his opinion as to most successful varieties. It cannot be too highly impressed upon one's mind that the effect of soil conditions on varieties is very important, and cannot be watched too closely if the greatest results are aimed at. The markets to which one intends to cater should ever be borne in mind, as the days are fast ending when the grower can promiscuously pick his fruit and ship to any commission house and expect a good price. Varieties that have characteristics which lend themselves to the more up-to-date methods and long distance shipments, must be chosen in those districts which have and are developing distant markets. The above suggestions are mainly for commercial fruit growers. Those who are only planting a few trees for their own use will find no difficulty in selecting varieties from the domestic list given in this Bulletin.

APPLES.

General Lists of the Most Valuable Varieties for Market Approved by the Board of Control.

SUMMER: Astrachan, Duchess.
FALL: Gravenstein, Wealthy, Alexander, McIntosh, Fameuse, Blenheim.
WINTER: King, Hubbardston, Greening, Cranberry, Baldwin, Spy, Stark.

Varieties especially adapted to Home Use.

SUMMER: Transparent, Primate, Sweet Bough, Duchess.
FALL: Chenango, Gravenstein, Wealthy, McIntosh, Fameuse, Blenheim.
WINTER: King, Wagener, Swayzie, Greening, Tolman, Spy.

Hardy Apples Recommended for Sections North of Latitude 46 Degrees, or Approximately in a Line with the Ottawa River.

SUMMER: Transparent, Lowland Raspberry, Charlamoff.
FALL AND WINTER: Duchess, Wealthy, Hibernal, Longfield, Patten, Whitney, Hyslop, Milwaukee.

CRAB APPLES.

WHITNEY: A large crab of high quality, suitable for planting in the extreme north where other apples will not succeed. May be used for dessert or cooking.
MARTHA: An early crab of fair quality.
TRANSCENDENT: Yellowish crab, season early autumn.
HYSLOP: Dark, rich, red crab, of late season, quality only fair.

CHERRIES.

Hardy varieties suitable for any portion of the Province bounded by Lakes Ontario, Erie, Huron and the Georgian Bay: Orel, Richmond, Montmorency, Russian 207. For southern sections see district lists.

PEACHES.

General List for Niagara District Only.

St. John, Early Crawford, Greensboro, Champion, *Brigdon or Garfield, Fitzgerald, *Reeves, *Niagara, Elberta, Carmen, Beers Smock.

*Very similar and any of these varieties may be set, but all are not needed to cover the season.

PEARS.

Giffard, Clapp, Bartlett, Boussock, Flemish (hardy, subject to spot), Howell, Louise, Duchess, Bosc, Clairgeau, Anjou, Kieffer.

PLUMS.

Americana: These are extremely hardy and desirable where the European and Japanese varieties cannot be grown. Aitken, Cheney, Bixby, Mankato, Wolf, Hawkeye, Stoddard.
European: Bradshaw, Imperial Gage, Gueii, Shipper Pride, Lombard (liable to overbear, requires thinning), Quackenboss, Yellow Egg, Grand Duke, Golden Drop (Coe), Reine Claude (one of the best for canning).

Japanese: These are apparently quite as hardy as the European varieties: Red June, Abundance, Burbank, Climax.

QUINCES.

Fuller, Orange (the leading market variety in Ontario), Champion (for southern Ontario only, as it ripens too late for other sections).

GRAPES.

Black: Moore, Campbell, Worden, Concord, Wilder.
Red: Delaware, Lindley, Agawam, Vergennes.
White: Diamond, Niagara.

For Northern Sections:
Black: Champion, Moore, Campbell, Worden.
Red: Moyer, Brighton, Delaware, Lindley.
White: Winchell, Diamond.

BLACKBERRIES.

Agawam, Snyder, and for southern sections, Kittatinny.

CURRANTS.

Black: Black Victoria, Champion, Lee, Boskoop Giant, Saunders.
Red: Cherry, Fay, Red Cross, Victoria, Wilder.
White: Grape.

GOOSEBERRIES.

American Varieties: Pearl, Downing, Red Jacket.
English Varieties: Crown Bob, Whitesmith, Industry, Keepsake. Not recommended on account of mildew, unless to be thoroughly sprayed with the lime sulphur mixture.

RASPBERRIES.

Black: Hilborn, Older, Gregg, Smith Giant.
Purple: Columbian, Shaffer.
Red: Marlboro, Herbert, Cuthbert.
White: Golden Queen.

STRAWBERRIES.

Commercial: Bederwood (P.), Splendid (P.), Warfield (Imp.), not suited to light sandy soil, Greenville (Imp.), Williams (Imp.), Saunders (P.), Sample (Imp.), Irene (Imp.), Buster (Imp.), Parsons Beauty (P.).

Note.—These varieties vary somewhat in order of their ripening season. In selecting varieties for planting, perfect-flowered varieties should be included to fertilize those having imperfect flowers.

NIAGARA DISTRICT.

(Including the Niagara Peninsula from the Niagara River to Hamilton and north to the escarpment.)

Robert Thompson, St. Catharines.

Apples:

Commercial: Astrachan, Duchess, Gravenstein, Blenheim, Wealthy, Wagener, McIntosh, Hubbardston, King, Greening, Baldwin, Spy.

Pears: Gifford, Clapp, Bartlett, Bosc. Duchess (Dwarf), Anjou, Kieffer.

Plums: Red June, Climax, Shiro, Burbank, Arctic, German Prune, Shropshire Damson, Grand Duke, Monarch, Reine Claude.

Strawberries (For long distance shipments): Williams, Brandywine.

E. D. Smith, Winona.

Cherries:

Sour: Richmond, Montmorency, English Morello.

Sweet: White—Gov. Wood, Napoleon.

Black—Knight, Tartarian, Mezel, Windsor, Schmidt Bigarreau (for clay only).

Egbert M. Smith.

Pears: Giffard, Bartlett, Howell, Louise, Flemish, Duchess (dwarf), Anjou, Kieffer.

Plums: Burbank, Bradshaw, Lombard, Grand Duke, Monarch, Reine Claude, Shropshire Damson, German Prune, Fallenburg, Washington for deep, dry soil.

Grapes:

Black: Champion, Worden, Wilder, Concord.

Red: Delaware, Lindley, Agawam, Vergennes.

White: Diamond, Niagara.

S. H. Rittenhouse, Jordan Harbour.

Peaches: St. John, Early Crawford, Fitzgerald, Elberta. Lemon Free, Beers Smock.

Raspberries:

Red: Marlboro, Cuthbert.

Black: Gregg.

Blackberries: Kittatinny.

Strawberries: Dunlap, Ozark, Sample, Williams, Stevens.

F. G. Stewart, Homer.

Cherries:

Sour: Richmond, Montmorency. (The English Morello, Ostheim and Wragg ripen late here, and are apt to be stung before they are harvested.)

Sweet: White—Gov. Wood, Elton, Napoleon, Spanish. Black—Tartarian, Elkhorn, Windsor.

J. W. Smith & Sons, Winona.

Peaches: Triumph (5); Leamington (5); St. John (15); Early Crawford (10); New Prolific (10); Champion (5); Rareripe (10); Elberta (20); Late Crawford (5); Lemon Free (10); Beers Smock (5).

The figures refer to the percentage of each variety that this firm recommends for planting.

C. E. Fisher & Sons, Queenston.

Peaches:

Sneed (White), Triumph, Carman (White), St. John, Fitzgerald, Jacques, Reeves, Niagara, Elberta, Late Crawford, Beers Smock.

Note:—The Triumph requires a rich, sandy loam well fertilized every year with well-rotted compost manure applied during early winter, and in spring just before plowing a heavy application of muriate of potash and pure bone. Proper pruning of tree and thinning of fruit are essential.

FONTHILL DISTRICT.

(Including Townships of Pelham, Stamford and Thorold.)

G. C. Brown, Fonthill.

Apples: Astrachan, Duchess, Greening, Fameuse, King, Baldwin, Spy.

Cherries:

Sour: Richmond, Montmorency.

Sweet: Tartarian, Knight, Napoleon, Gov. Wood, Windsor.

Peaches: Triumph, Greensboro, St. John, Fitzgerald, Elberta, Golden Drop or Banner, Lemon Free, Smock.

Grapes: Moore, Worden, Niagara, Delaware, Concord, Lindley.

Currants:

Red: Cherry, Perfection, Prince Albert.

Raspberries:

Red: Cuthbert.

Blackberries: Eldorado, Snyder.

Strawberries: Lovett, Williams, Sample, Parsons.

BURLINGTON-OAKVILLE DISTRICT.

(Including the southern part of the counties bordering on Lake Ontario between Hamilton and Toronto.)

A. W. Peart, Burlington.

Apples:

Duchess, Wealthy, Ribston, Greening, Blenheim, King, Baldwin, Spy.

CHERRIES:
Dyehouse, Richmond, Windsor, Montmorency, English Morello.

PEARS:
Wilder, Clapp, Bartlett, Boussock, Louise, Duchess (dwarf), Anjou, Kieffer, Lawrence, Nelis.

PLUMS:
European: Bradshaw, Niagara, Imperial Gage, Lombard, Prince of Wales, Yellow Egg, Reine Claude, Staunton.
Japanese: Red June, Abundance, Burbank.

GRAPES:
Black: Moore, Wordem, Concord.
Red: Moyer, Delaware, Lindley, Massassoit.
White: Diamond, Niagara.

BLACKBERRIES: Snyder, Western Triumph, Agawam.

CURRANTS:
Black: Lee, Naples, Saunders, Champion, Victoria.
Red: Cherry, Fay, Pomona, Wilder, Victoria.
White: Grape, Imperial.

GOOSEBERRIES: Pearl, Downing, Red Jacket.

RASPBERRIES:
Red: Marlboro, Herbert, Cuthbert.

STRAWBERRIES: Bederwood, Dunlap, Williams, Gibson, Glen Mary, Leader.

W. F. W. FISHER, BURLINGTON.

APPLES: Duchess, Wealthy, McIntosh, Fameuse, Ribston, King, Baldwin, Spy.

PEARS: Lawson, Clapp, Bartlett, Duchess, Anjou, Nelis.

PLUMS:
European: Bradshaw, Imperial Gage, Lombard, Reine Claude, Grand Duke.
Japanese: Red June, Abundance, Burbank.

CURRANTS:
Black: Champion, Victoria, Boskoop Giant.
Red: Cherry, Fay, Wilder.

GOOSEBERRIES: Downing, Josselyn or Red Jacket.

RASPBERRIES Marlboro, Herbert, Cuthbert.

STRAWBERRIES: Dunlap, Gibson, Haverland, Bubach, Glen Mary, Williams.

W. G. HORNE, CLARKSON.

APPLES: Early Harvest, Astrachan, Duchess, Wealthy, Blenheim, Greening, Fameuse, Spy, Baldwin, Golden Russett, Tolman.

PEARS: Clapps, Bartlett, Anjou, Clairgeau, Kieffer.

CHERRIES:
Sour: Dyehouse, Richmond, Montmorency, Morello.

GRAPES: Moore, Worden, Concord, Delaware.

BLACKBERRIES: Snyder, Western Triumph.

RASPBERRIES: Cuthbert, Herbert.

STRAWBERRIES: Sample, Williams, Glen Mary.

LAKE ERIE DISTRICT.

(Including approximately the Counties of Haldimand, Norfolk, Elgin, Welland, excluding Fonthill District.)

Jas. E. Johnson, Simcoe.

Apples: Wealthy, Fameuse, McIntosh, Baldwin, Greening, King, Spy.
Strawberries: Warfield, Dunlap, Splendid, Sample, Enhance.
Cherries: Richmond, Montmorency.
Peaches: St. John, Fitzgerald, Crosby, Elberta, Smock.

ESSEX PENINSULA.

(Including Essex, Kent and Pelee Island.)

J. L. Hilborn, Leamington.

Apples: Duchess, Blenheim, Baldwin, Stark, Hubbardston, Spy.
Cherries: Richmond, Montmorency, Windsor.
Peaches: Dewey, St. John, New Prolific, Engle, Kalamazoo, Elberta, Banner, Golden Drop, Lemon, Free.
Pears: Bartlett, Anjou, Duchess.
Plums: Burbank, Lombard, Imperial Gage, Yellow Egg, Reine Claude.
Grapes:
Black: Champion. Moore, Concord.
Red: Brighton, Vergennes, Catawba.
White: Diamond, Niagara.
Blackberries: Mersereau, Eldorado, Kittatinny.
Currants:
Black: Victoria, Champion.
Red: Cherry, Fay, Wilder.
White: Grape.
Gooseberries: Pearl, Downing, Whitesmith.
Raspberries:
Black: Kansas, Hilborn, Gregg.
Red: Marlboro, Cuthbert.
Yellow: Golden Queen.
Purple: Columbian.

J. Atkin & Son, Leamington.

Apples: Red Astrachan, Duchess, Blenheim, King, Hubbardston, Baldwin.
Pears: Bartlett, Duchess, Keiffer.
Plums: Burbank, Grand Duke, Lombard, Reine Claude.
Cherries: Montmorency, Windsor, Napoleon, Tartarian.
Peaches: Dewey, St. Johns, New Prolific, Champion, Kalamazoo, Engle, Banner, Late Crawford, Lemon Free, Smock, Salway.
Currants:
Red: Fay, Red Cross, Perfection, Loudon.
Black: Victoria, Saunders, Lee.

BRANT DISTRICT.

(Including Counties of Brant, Oxford, Middlesex and south-western part of Perth.)

J. C. Harris, Ingersoll.

Apples: Duchess, Gravenstein, Blenheim, Ribston, Alexander, Greening, Baldwin, King (top grafted), Spy.
Raspberries: Cuthbert, Columbian.
Strawberries: Warfield, Dunlap, Bederwood, Haverland, Williams, Sample, Enhance.

C. W. Gurney, Paris.

Apples: Blenheim, King, Baldwin, Spy, Greening.

FOREST DISTRICT.

(Including the County of Lambton.)

D. Johnson, Forest.

Apples: Duchess, Greening, Baldwin, Hubbardston, Golden Russet, and (if grafted on Tolman) King and Spy.
Cherries: Richmond, Montmorency.
Peaches: For those parts of the County influenced by the lake: St. John, Fitzgerald, Late Crawford, Engle, Kalamazoo, Elberta, Smock.
Plums: Bradshaw, Imperial Gage, Reine Claude.
Raspberries: Marlboro, Cuthbert.
Strawberries: Dunlap, Warfield, Williams, Belt, Bederwood.

LAKE HURON DISTRICT.

(Including Counties of Huron and Bruce.)

D. F. Hamlink, Goderich.

Apples: Astrachan, Duchess, Greening, Blenheim, McIntosh, Fameuse, King, Tolman, Baldwin, Spy, Stark, North Star.
Peaches: St. John, Early Crawford, Fitzgerald, Elberta, Longhurst and Smock.
Cherries: Richmond, Olivet, Montmorency.
Pears: Clapp, Bartlett, Louise, Clairgeau, Anjou.
Plums:
Japanese: Burbank.
European: Bradshaw, Imperial Gage, Shipper Pride, Lombard, Monarch, Grand Duke.
Grapes: Champion, Moore, Worden, Niagara, Concord.
Blackberries: Agawam, Eldorado.
Currants:
Black: Champion, Naples, Saunders, Victoria.
Red: Fay, Cherry, Perfection, Albert.
White: Grape.

GOOSEBERRIES: Pearl, Downing.
RASPBERRIES:
Black: Conrath, Hilborn.
Red: Marlboro, Herbert, Cuthbert.
White: Golden Queen.
STRAWBERRIES: Brandywine, Glen Mary, Williams, Dunlap.

GEORGIAN BAY DISTRICT.

(Including northern portions of the Counties of Grey and Simcoe, bordering on the Georgian Bay.)

J. G. MITCHELL, CLARKSBURG.

APPLES: Astrachan, Duchess, Gravenstein, St. Lawrence, Alexander, Wealthy, Twenty-Oz., McIntosh, Greening, King, Baldwin, Spy.
CHERRIES: Richmond, May Duke, Montmorency, Olivet.
PEACHES: Triumph, Fitzgerald, Early Crawford, Tyhurst, Crosby.
PEARS: Clapp, Bartlett, Flemish, Duchess, Anjou, Clairgeau.
PLUMS: Red June, Lombard, Archduke, Yellow Egg, Golden Drop, Reine Claude.
GRAPES:
Black: Champion, Campbell, Worden.
Red: Delaware, Brighton, Vergennes, Salem.
White: Winchell, Diamond, Niagara.
CURRANT:
Black: Lee, Champion.
Red: Cherry, Fay.
White: Grape.
GOOSEBERRIES: Houghton, Pearl, Downing, Red Jacket, Industry.
RASPBERRIES:
Red: Marlboro, Herbert, Cuthbert.
Black: Hilborn, Older, Gregg.

LAKE SIMCOE DISTRICT.

(Including the northern and eastern section of Simcoe and northern sections of York and Ontario bordering on Lake Simcoe.)

G. C. CASTON, CRAIGHURST.

APPLES: Duchess, Peerless, Alexander, Wolf, Blenheim, Pewaukee, Stark, Baxter, Fallawater, Fameuse, Seek, and the following if topworked on hardy stocks: Greening, King, Ontario, Baldwin, Spy.
CHERRIES: Orel 24, Ostheim, Montmorency, Dyehouse, English Morello.
PEARS: Clapp, Bartlett.
PLUMS: Burbank, Staunton.
GRAPES: Campbell, Moyer, Moore, Diamond, Winchell.
BLACKBERRIES: Agawam, Eldorado.
CURRANTS:
Black: Naples, Victoria.

Red: Fay, Versaillaise, Cherry.
White: Grape.
GOOSEBERRIES: Pearl, Downing.
RASPBERRIES: Marlboro, Herbert, Cuthbert.

GUELPH DISTRICT.

(Including the high inland Counties of southwestern Ontario, i.e., Wellington, Waterloo, northwestern section of Perth, south part of Grey, Dufferin, and northwest section of Peel and Halton.)

PROF. J. W. CROW, O.A.C., GUELPH.

APPLES: Duchess, Alexander, Wealthy, Fameuse, McIntosh.
CRAB APPLES: Whitney, Martha.
CHERRIES: Richmond, Montmorency.
PEARS: Clapp, Flemish, Seckel, Sheldon, Anjou.
PLUMS: Bradshaw, Imperial Gage, Shipper Pride, Lombard, Reine Claude, Glass.
GRAPES:
Black: Moore.
Red: Moyer.
White: Winchell.
CURRANTS:
Black: Victoria, Champion, Saunders.
Red: Red Cross, Victoria, Fay.
White: Grape.
GOOSEBERRIES:
American: Pearl, Downing.
English: Whitesmith, Industry.
RASPBERRIES:
Black: Older, Smith Giant.
Red: Marlboro, Herbert, Cuthbert.
Purple: Columbian.
White: Golden Queen.
STRAWBERRIES: Bederwood (P.), Splendid (P.), Warfield (Imp.), Williams (P.), Parsons (P.).

LAKE ONTARIO DISTRICT.

(Including the southern portions of the Counties bordering on the Lake Ontario shore from Toronto to Trenton.)

ELMER LICK, OSHAWA.

APPLES: Gravenstein, McIntosh, Fameuse, Blenheim, Greening, Baldwin, Spy.
(If further varieties are required add Golden Russet (for wet spots), Cranberry, Fallawater, Stark (liable to be overplanted).

W. H. DEMPSEY, TRENTON.

APPLES: Duchess, Gravenstein, Alexander, Fameuse, McIntosh, Greening, Baldwin, Spy, Ben Davis, Stark.

Cherries: Richmond, Montmorency.
Pears: Giffard, Clapp, Boussock, Hardy, Bosc, Clairgeau, Lawrence.

P. A. Greer, Wellington.

Raspberries: Cuthbert, Columbian.
Strawberries: Dunlap, Sample, Parson.

A. B. Arnott, Trenton.

Blackberries: Snyder.
Grapes:
Black: Moore, Worden, Concord.
Red: Brighton, Lindley, Agawam, Massasoit.
White: Niagara, Pocklington.

ST. LAWRENCE VALLEY DISTRICT.

(Including the valley of the St. Lawrence River from Kingston to the eastern boundary of the Province.)

Harold Jones, Maitland.

Apples: Duchess, St. Lawrence, Alexander, Wolf, Wealthy, Scarlet Pippin, Fameuse, McIntosh, Baxter, Tolman, Golden Russet.
Cherries: Richmond, Montmorency, Orel, English Morello.
Pears: Flemish (if grown in sod), Ritson (not so hardy in fruit bud as Flemish).
Plums:
American: Aitkin, Bixby, Mankato, Cheney, Wolf, Schley, Brackett, Hawkeye, Stoddard.
European: Glass, Raynes, Mount Royal, Lunn.
Gooseberries: Golden Prolific, Downing.
Raspberries: Herbert.
Strawberries: Belt, Williams, Wolverton, Climax, Saunders, Miller.

OTTAWA DISTRICT.

(Including the Ottawa Valley and the eastern portion of the Province not elsewhere enumerated, south of latitude 46 deg.).

W. T. Macoun, Horticulturist, Central Experimental Farm, Ottawa.

Apples: Transparent, Lowland Raspberry, Duchess, St. Lawrence, Wealthy, Alexander, McIntosh, Fameuse, Wolf, Milwaukee, Baxter, Scott.
Crab Apples: Whitney, Martha, Hyslop.
Cherries: Orel 25, Vladimir, Minnesota, Ostheim, Cerise d'Ostheim.
Pears: Flemish in most favored parts.

PLUMS:

Americana and Nigra: Aitkin, Bixby, Mankato, Cheney, Wolf, Schley, Brackett, Hawkeye, Stoddard.

European: Early Red (Russian), Mount Royal, Glass, Montmorency, Raynes, Perdrigon.

GRAPES:

Black: Early Daisy, Mamito, Worden, Merrimac, Wilder.

Red: Moyer, Brighton, Delaware, Lindley.

White: Winchell, Diamond.

BLACKBERRIES: Agawam, Snyder.

CURRANTS:

Black: Saunders, Collins, Prolific, Black Victoria; Boskoop Giant is very promising.

Red: Pomona, Victoria, Dutch and Wilder in the most favored parts.

White: Grape.

GOOSEBERRIES: Pearl, Downing and Red Jacket.

RASPBERRIES:

Black: Hilborn, Older, Cumberland.

Red: Marlboro, Herbert.

Yellow: Golden Queen.

STRAWBERRIES: Bederwood (P.), Splendid (P.), Warfield (Imp.), not suited to light soil; Greenville (Imp.), Parson Beauty (P.), Pocomoke (P.), Sample (Imp.), Buster (Imp.).

ALGOMA DISTRICT.

(Including the islands of Manitoulin and St. Joseph, and a limited portion of the northern and eastern shore of the Georgian Bay.)

CHAS. YOUNG, RICHARD'S LANDING.

APPLES: Transparent, Charlamoff, Astrachan, Duchess, Peach, St. Lawrence, Alexander, North Star, Colvert, Gideon, McIntosh, Winter St. Lawrence, Wolf, Baxter, Longfield, Louise, Wealthy, Patten.

CRAB APPLES: Whitney, Hyslop, Isham.

CHERRIES: If near the influence of the water, Richmond, Montmorency, English Morello, Orel 25 and Ostheim.

PLUMS:

European: Glass, Lombard, Pond, Trabesh (Russian), Goliath (Russian).

Americana: Cheney, Wolf, Hawkeye, Stoddard, City.

GRAPES: Campbell, Moore, Winchell, Janesville.

CURRANTS:

Black: Saunders, Champion, Victoria.

Red: Dutch, Versaillaise.

White: Grape.

GOOSEBERRIES: Golden Prolific, Pearl, Downing, Red Jacket, Champion.

RASPBERRIES:

Red: Marlboro, Louden.

White: Brinckle Orange (for quantity only).

STRAWBERRIES: Clyde, Haverland, Glen Mary, Brandywine.

LIST OF BULLETINS

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168	Oct.	1908	The Perennial Sow Thistle and some other Weed Pests	J. E. Howitt.
169	Feb.	1909	Legume Bacteria: Further Studies of Nitrogen Accumulation in the Leguminosæ	S. F. Edwards. B. Barlow.
170	Mar.	1909	Mitchell-Walker Test Bottle	J. W. Mitchell. W. O. Walker.
171	April	1909	Insects Affecting Vegetables	C. J. S. Bethune.
			Fungus Diseases Affecting Vegetables	J. E Howitt. J. W. Eastham.
172	May	1909	Dairy School Bulletin (No. 143 Revised)	Dairy School.
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175	Dec.	1909	Farm Drainage Operations	W. H. Day.
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177	Dec.	1909	Lime-Sulphur Wash	H. L. Fulmer. L. Caesar.
178	Dec.	1909	Character and Treatment of Swamp or Muck Soils	W. P. Gamble. A. E. Slater.
179	Feb.	1910	Fruits Recommended for Ontario Planters (No. 147 revised)	Fruit Branch
180	April	1910	Flour and Breadmaking	R. Harcourt. M. A. Purdy.
181	June	1910	The Teeth and Their Care	Ont. Dental Society.
182	July	1910	Bee-keeping in Ontario	Fruit Branch.
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184	Nov.	1910	Uses of Vegetables, Fruits and Honey	....
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187	Jan.	1911	The Codling Moth	L. Caesar.
188	April	1911	Weeds of Ontario (No. 128 revised)	J. E. Howitt.
189	May	1911	Farm Poultry (151 revised)	W. R. Graham.
190	May	1911	Bee Diseases in Ontario	Fruit Branch.
191	June	1911	Bee-keeping in Ontario	Fruit Branch.
192	July	1911	Agricultural Co-operation	S. E. Todd.
193	Nov.	1911	Tuberculosis of Fowls	S. F. Edwards.
194	Dec.	1911	Apple Orcharding	Fruit Branch.
195	Jan.	1912	Insectides and Fungicides. (No. 154 revised	R. Harcourt. H. L. Fulmer.
196	Jan.	1912	Tomatoes	A. G. Turney.
197	Feb.	1912	Bee Diseases in Ontario	Morley Pettit.
198	Feb.	1912	Lime-Sulphur Wash	L. Caesar.
199	Feb.	1912	Onions	A. McMeans.
200	April	1912	Fruit Juices	L. Meunier.
201	May	1912	Peach Diseases	F. M. Clement.
			Peach Growing in Ontario	L. Caesar.
202	May	1912	Grape Growing in Niagara Peninsula	T. B. Revett.
203	May	1912	Cabbage and Cauliflower	A. McMeans.
204	June	1912	Decay of the Teeth	Ont. Dental Society.
205	Sept.	1912	Dairy School Bulletin (No. 172 revised) .. Part I. Cheese-making and Butter-making	Staff of Dairy School.
206	Nov.	1912	Dairy School Bulletin (No. 172 revised) .. Part II. Dairying on the Farm	Dairy School.
207	Dec.	1912	Ice Cold Storage on the Farm	R. R. Graham.
208	Jan.	1913	Farm Poultry and Egg Marketing Conditions in Ontario County	J. H. Hare. T. A. Benson.
209	March	1913	Farm Forestry (No. 155 revised)	E. J. Zavitz.
210	March	1913	Strawberry Culture and The Red Raspberry.	F. M. Clement.
211	March	1913	Fruits Recommended for Ontario Planters... (No. 179 revised.)	Fruit Branch

Ontario Department of Agriculture

FRUIT BRANCH

BULLETIN 212

An Orchard Survey
of Dundas, Stormont and Glengarry

By

F. S. REEVES, B.S.A.

TORONTO, ONTARIO, APRIL, 1913

BULLETIN 212] [APRIL, 1913

Ontario Department of Agriculture

FRUIT BRANCH

An Orchard Survey of Dundas, Stormont and Glengarry

F. S. REEVES

Recognizing the importance of developing the apple industry in these and neighboring counties, the Department deemed it advantageous to prepare this survey in order to show what had been accomplished, and, if possible, to more strongly demonstrate what may be achieved by developing orchards of varieties of apples which seem to be especially adapted to this section, and which at the same time are commanding the highest prices on our Canadian markets. To do this every apple orchard was visited and careful notes made and the whole information compiled for the use of the farmers in this section.

In order to obtain explicit information as to the existing orchard conditions, a farm-to-farm survey was made. Individual forms for each orchard were used and contained the following information: Owner's name, post-office, county, location, township, acres in farm, acres in fruit, number and age of bearing trees, acres bearing, distances of planting, number and age of non-bearing trees, acres non-bearing, site, aspect, planting plan, nature of other crops in the orchard, varieties, type of soil, depth, sub-soil, drainage, tillage—kind and frequency, cover crop, number of years tillage and sowing of cover crop has been practised, kind of sod, number of years in sod, method of treatment of sod; fertilizers,—kind, quantity and frequency applied; pruning—time, method, frequency, severity, thinning; spraying—machinery, mixtures and times of applying, diseases, insects, present condition of orchard, packages used, where and by whom packing was done, yields, prices, income per acre, where and how sold, and remarks on any subject pertaining to the orchard not contained in the above. Most of the farmers were able to supply fairly accurate information, so that the data gathered can be relied upon. With but few exceptions, no farmers kept any records or accounts of their orchards, and for this reason prices and yields for two years back only were obtainable, as beyond that it would be merely guess work and unreliable as subject matter for this survey. In all, about two hundred and fifty orchards were visited, and as much time as was required was spent with all farmers who showed a disposition to seek any information, or could be induced to talk of their experiences, both favorable and adverse, of the apple industry.

TERRITORY COVERED.

The territory covered is the first concession bordering along the north bank of the St. Lawrence River from Summerstown in Glengarry County to the western boundary of Dundas County, a distance of about forty-five miles, and a portion of Matilda Township, in Dundas County, extending back from the river four or five miles. This territory was chosen because it was the most accessible, and where the greatest number of orchards could be visited in the least time. It is not to be inferred that this district is better for the growing of apples, because fruit of the best quality is being produced fifteen to twenty miles from the St. Lawrence River; in fact, all the well-drained lands throughout the whole three counties are equally well adapted to the culture of apples.

Results in the Best Orchards.

Some idea of the profits of fruit growing in this section may be gathered from the examples of a few orchards: Ernest Farlinger, Morrisburg, sold his crop on the trees from one and one-third acres of orchard containing forty-three McIntosh Red trees and three Wealthys, for $400 in 1910, and for $225 in 1911. Elory Casselman, Dundela, sold his crop on the trees from four acres of orchard containing all McIntosh Red trees for $350 in 1910 and for $550 in 1911. Harold Willard, Morrisburg, sold his crop from two acres of orchard for $350 in 1910. W. G. Robertson, of Iroquois, has an orchard of three acres, and the varieties grown are Fameuse, McIntosh Red, Russet and Ben Davis. Prior to 1900, when Mr. Robertson came to the place, the orchard had been neglected, but after being pruned and sprayed it soon became profitable. In 1908 he sold his crop for $290, in 1909 for $516, and in 1910 for $340. The 1911 crop at this date is not sold. These orchards the past two years have been sprayed systematically with lime-sulphur. Previous to 1910, Mr. Robertson sprayed with Bordeaux Mixture. Dr. Harkness, of Irena, has a six acre orchard of Fameuse and McIntosh Red set out by himself in 1871 and 1872. This orchard is thoroughly sprayed each year. The returns for several years back are as follows: 1905. $1,293; 1906, $1,233; 1907, $1,720; 1908, $948; 1909, $1,383. In each case this is after paying freight and commission. Barrels and work average from $300 to $400 a year. Andrew Fawcett, Inkerman, who has five acres of orchard, sold his crop on the trees for $900 in 1911, but in 1910 he sold scarcely any, as his crop was ruined by the apple scab. This orchard was sprayed with lime-sulphur in 1911.

The table below compares the results from the best 11 sprayed and pruned orchards, against the best 11 unsprayed and unpruned orchards.

Average per acre.	1910.			1909.			Number of orchards.	Number of acres.
	Bbls.	Price per bbl.	Price per acre.	Bbls.	Price per bbl.	Price per acre.		
		$ c.	$ c.		$ c.	$ c.		
Unsprayed and unpruned orchards...	24	2.22	53.34	39	1.60	62.20	11	51
Sprayed and pruned orchards	52	3.30	172.00	58	2.87	165.46	11	38

Possibilities.

Climatic and Topographical.—There is no question about the fact that the climate and topography is suited to the production of apples of first-class quality, of certain varieties. It is beyond the experimental stage. Some few orchards where good cultural methods are practised are producing good crops annually, and have been doing so for a large number of years. This is the home of the McIntosh Red apple, and nowhere in the world is it grown to greater perfection and of better quality.

In the portions of Dundas County covered by this survey, the land lies fairly level or gently undulating; while in the portions of Stormont and Glengarry it is of a rolling nature, the country being traversed east and west by gravelly glacial moraines. The slopes of these ridges offer ideal sites for apple orchards, but in the more level parts of the counties a good deal of care must be exercised in the selection of the site for an orchard.

Transportation.—There is no lack of transportation facilities east and west. The Grand Trunk railroad traverses the whole three counties about a mile north of the river, and the Canadian Pacific railroad about eighteen miles further north. The St. Lawrence river affords an excellent means of transportation by water, being in direct communication with Montreal, itself a large market, and the port for direct ocean trans-shipment to the Old Country markets. Fruit could be loaded at various points every four or five miles along the river and taken direct to Montreal, landing there in from twelve to twenty-four hours after shipment. The New York and Ottawa railroad traverses Stormont County north and south, here opening up a good deal of country and giving better communication with the east and west lines and with Ottawa. There are great possibilities for an electric railroad running in the same direction further west in Dundas County, and should such an undertaking be consummated it would have a great influence in reviving orchard culture in that part of the county. But the best and cheapest transportation is by water, and no doubt were fruit shipped in larger quantities an excellent service would be developed on the St. Lawrence River, for at the present time there are many local freight and passenger boats plying up and down the river which would welcome an opportunity of handling fruit to Montreal if it were offered in large enough quantities. The New York and Ottawa railroad opens up a line of communication directly into the heart of New York State and to New York City. Waddington in New York State is connected with Morrisburg by ferry, and is in direct communication with the New York Central lines.

Labor.—This problem is one of the most perplexing questions confronting the farmers of Ontario, and is no less acute in this district than elsewhere. The farms have been depleted of their youth by the rapid growth of Western Canada, and the general exodus cityward. Perhaps this is a good sign of the prosperity of Canada, and a good thing for the country as a whole, as it signifies good opportunities for young men and the rapid growth of the country. But it has worked havoc on the farms of this district. Everywhere is heard the same plaint, "The boys have gone west or to the city and we cannot get help." In consequence, something must be neglected, and invariably the first thing neglected is the orchard. There is a remedy for this state of affairs, and it must be approached in an unbiased state of mind. Men can procure higher wages in other parts of the country, and naturally they go there. In the first place, they should receive better pay on the Ontario farms so that they would not be so easily enticed away. Most farmers expect the men to work very long hours for a wage much below that paid in other lines of business. Farmers are receiving more for their produce now than formerly, and especially is this true of the fruit products; therefore they should be able to pay better wages. The more progressive farmers, however, find that it pays them to pay better wages and treat their men well; they get more intelligent work, done with a better spirit and feeling towards the employer. But the greatest difficulty seems to be in getting men at all; therefore, an effort should be made to get men from elsewhere. The system of building cottages and employing more married men—men who are less roving in their disposition, and hence will not leave for every little difficulty that arises—is a system worthy of trial and one that should be encouraged, as it partly solves the social side of the problem, besides having other advantages both for the employer and employee.

Fruit culture works well in connection with dairying, a good deal of the work coming at a time when other farm work is not so pressing. The pruning can all be done in the late winter, when the weather is not too disagreeable. Thus it has a tendency to provide work all the year round on the farm, the lack of which is partly responsible for the system of hiring men for the summer only and leaving them to seek other employment during the winter. The consequence of this practice is felt in the spring, by the reluctance of men to engage to work on the farm when they know that as the next winter approaches they will have to turn to the town again for work.

Markets.—Most of the fruit that is not consumed locally goes to Montreal or Ottawa, while a small percentage is shipped direct to Europe. In Montreal and Ottawa there is an ever extending and growing market, close at home, with easy and quick transportation facilities. These are the natural markets for this district, and besides there are excellent shipping facilities at the port of Montreal for the Old Country markets. There are also great possibilities for building up United States markets for the best grade of winter apples. New York, Boston, and all the New England manufacturing towns are within easy reach, and as yet the Canadian apple is almost unknown in those markets.

Land Values.—Along the river front, the value of improved land varies from $60 to $100 per acre, and about the same price prevails in the back concessions.

The whole of this land is not adapted for the location of apple orchards, but an average of twenty-five per cent. of the land is so adapted; and taking the farm as a whole the price is very reasonable, and perhaps may be considered a little low if the possibilities of fruit growing are taken into consideration. From the results of the well-managed orchards quoted in the opening of this report, farms with good orchards may be, with a very conservative estimate, valued at four or five times their present value.

Recommendations.

Size of Orchards.—The average size of the orchards is about an acre in extent, very rarely was one encountered of four or five acres, while there are a few about eight or ten acres, and two orchards only of fourteen acres. These two are young orchards partly one and partly two years old. The majority of the orchards are not full, and very little attempt is made to replace dead trees, so that in a few years a great many orchards will become fields with a few trees scattered about them, unless a revival of the orchard industry takes place. There are approximately 19,396 bearing trees and 6,368 non-bearing trees in this district.

In order to make orcharding profitable and interesting, it should be taken up on a scale that will give the grower good returns and make it profitable to install all the latest improvements for its handling. Also, he should grow fruit of one variety in large enough quantities that he can demand the attention of buyers as a factor in the market. This means that shipping must be done by the car-load, and wherever possible they should be of one variety. This does not necessarily mean that one variety only should be grown, but that the varieties should be grown in large enough quantities to ship each by the car load. These ends will best be gained by an orchard of at least five acres in extent, and the larger they are, the better, up to a reasonable size for the management of one individual, and that limit depends upon the business ability of the grower.

Soils and Locations.—The apple thrives on a variety of types of soil. In this section they are thriving and giving good results on all gradations from heavy clay to light sandy and gravelly soils. But they must be all well underdrained, either naturally or artificially. To use a common expression, "An apple tree will not thrive with wet feet," and this will soon become evident where a grower tries to grow an orchard on poorly drained soil.

Air drainage is also a very important factor in location, and for these reasons it will be wise to select land that lies high and dry, and if the soil is in the least retentive of moisture in its character it should be underdrained. Air drainage is important because the trees will not thrive in stagnant air and because of the danger of late spring and early fall frosts; therefore it may be emphasized that the location should have good air as well as water drainage. Along the St. Lawrence River front the air drainage is good, as the proximity of the water and the rapid current serves to keep the air always in motion; even on the stillest nights there will always be a current of air towards the water and flowing along with the current.

Varieties.—There is a great number of varieties planted in this district, but the majority of them have little or no commercial value.

The following is a list found growing in this section: Salome, Bietigheimer, Pine, Tolman, Fall Pippin, Russet, McIntosh, Duchess, Fameuse, Astrachan, St. Lawrence, Ben Davis, Greening, Wealthy, Alexander, Mann, Tetosky, Stark, Twenty Ounce, Peach, Baxter, Spitzenburg, Maiden Blush, Gideon, Haas, Yellow Transparent, Spy, Blue Pearmain, Blenheim, Langford, Brockville Beauty, Bellflower, Canada Red, Pewaukee, Baldwin, Early Harvest, Milwaukee, Wagener, Seek, Wolf River, Whitney.

It will easily be seen on glancing at the above list that these varieties must have only been planted in very small numbers. Nevertheless it bears out the fact that there must be a great future for the production of apples of suitable varieties which have been found to be the best in this section.

A list is hereby given of the varieties recommended for this section by the Department of Agriculture:—

Transparent, Lowland-Raspberry, Duchess, St. Lawrence, Wealthy, Alexander, McIntosh, Fameuse, Wolf, Milwaukee, Baxter, Scott, Scarlet Pippin, Tolman.

Crab Apples: Whitney, Martha, Hyslop.

The best varieties for the district are: McIntosh Red, Fameuse or Snow, Scarlet Pippin, and Wealthy for commercial purposes, while a few other select varieties may be grown in small quantities for domestic use. The McIntosh Red is the best apple suited to this climate and locality. It is an early winter apple of good color, large size, excellent quality, good packer, good shipper, and keeps until March and April. It is well known in all markets and commands the highest price. The Fameuse is perhaps the best known apple in eastern Ontario. The Scarlet Pippin is not so well known, but is highly recommended by successful fruit growers of this locality. It is a good shipper and keeper, being at its best in January. These three varieties are early winter apples. The Wealthy, a fall apple, is well known on the markets. It is large, of good color, a good shipper and packer and of good quality; its season is from October to January. The Duchess is another good fall variety, ripening in the latter part of August, but its keeping qualities are not good, it being rather a precarious crop to handle, although its beauty in color commands for it the top prices on the market.

Nursery Stock.—The nursery stock planted the last few years has been of rather poor quality, with crooked and ill-shaped trunks and poorly formed heads, and a great percentage of them three or four year old trees. But that has been the least of its faults. Much bitter reproach has been hurled at the nursery stock peddlers who sold trees for standard varieties, and when they came into bearing they turned out to be anything but what was ordered, and invariably were common, worthless trash of no commercial value whatever. The orchard business has lost many good supporters on this account, who, through lack of knowledge of reliable firms and of details with regard to the purchase of nursery stock, have become disgusted and neglected their opportunities in apple-growing.

A few farmers should act together to buy nursery-stock. They should make investigations as to the best and most reliable firms, and then send a man to the nursery to inspect the stock he is buying and make a bargain for a large quantity; thus the farmers will be sure of getting good trees and in good condition. By buying co-operatively, a cheaper rate will be secured, the freight will be comparatively less, and with large shipments packing will be done better and delivery will be more prompt. But most important of all, they will be able to rely upon the trees being true to name.

Strong unbranched whips are the best trees to plant, but they must have diligent and intelligent care, because they are young and almost invisible, one might say, after they are planted in the field, and will suffer more from neglect than other trees. Two year old trees are very good, but older trees should not be bought, as they are frequently culls and left-over stock of a nursery. Good nursery stock should be healthy, well-grown, free from all insects or insect injury and disease. The straight whip should be five or six feet in height with a good, well-branched root system, and a large percentage of small fibrous roots. The two year old tree should have a well branched and evenly balanced head, formed between two and three feet above the roots, so that when it is planted the head will be one and a half to two and a half feet above the ground, and it should have the same character of root system as the unbranched whip.

Distance Apart for Planting.

The greatest objection to the old orchards throughout this section is that they were planted too closely together, the distance varying from 15 x 15 to 20 x 24, with a few exceptions where the trees were planted 30 x 30. Th result of this close planting has been to force the trees up, making the operations of picking, spraying and pruning more expensive and inadequate, and at the same time lessening the production of marketable fruit. The trees in an apple orchard should be set far enough apart to allow the full development of the tree without crowding, and in no case should standard long lived trees be planted less than 35 feet apart both ways. Varieties which are slow growing and do not attain such a growth as the McIntosh, and are more like the Wealthy and Duchess, may be planted at a lesser distance, and even then must be kept in bounds by means of pruning.

Management of Young Orchards.

Planting.—Over the portion of Dundas County covered by this survey there has been a great revival of orchard planting in the past year or two, and at the present time there is a large number of young trees sold for next year's planting.

This in a large measure, in the writer's opinion, is the result of the stimulus started by the demonstration work done by the Department of Agriculture near and around Morrisburg during the last two years. In the other two counties only one or two new orchards have been planted, and they are of small extent. The planting as a rule has been poorly done, although a few of the planters understood their work. Many trees have been planted too shallow, and very little or no pruning has been done at the time of planting.

The trees should be planted in the spring as soon as the weather and soil conditions will permit. A large hole two feet in diameter and a foot deep should be dug, placing the top soil in one pile and the bottom soil in another. The roots should be all pruned back to about six inches long and all dead and injured roots taken off back to healthy tissue; they should be spread out evenly in the hole and a little top soil work in around them by hand. The soil should be tramped in around the tree as firmly as possible, and the tops pruned back to balance them up with the roots. If the tree is a straight whip, the top should be cut off about two feet above the ground, and the two year old trees should be pruned back to three or four main limbs, and these again pruned to six or eight inches long. No watering should be necessary, but if the planting season should be unseasonably hot and dry, as the past one has been, water should be used. Apply it just above the roots and not on top of the ground. See that surface soil around the tree is left loose.

Cultivation.—Fifty-five per cent. of the young orchards have been cropped with corn or potatoes between the trees, eight per cent. were sown to grain, while thirty-seven per cent. were planted in sod. With young orchards, it is in the interest of economy to raise other crops between the rows of trees, but upon no consideration should these crops be allowed to encroach upon the trees. The young trees when first planted should have at least three feet each side of them which should be kept cultivated so as to secure a dust mulch that will conserve the moisture. This distance should be increased yearly as the trees increase in size and require the ground. Cultivation should continue once a week or after every rain during the summer up until the 15th of June, when it should cease and a cover crop be sown at the last cultivation. Those trees that were cultivated with the corn or potatoes have made an average of a foot and a half growth during the season; those in the sod grew about half as much. Those planted amongst the grain have made a little growth, and in some cases no more than kept alive, while a larger percentage of them have died. A cultivated crop is best to grow in the young orchard, as then there will be a better chance to give the trees thorough cultivation; and about once in three or four years clover or some other leguminous crop should be grown as a cover crop to add humus and nitrogen to the soil, unless liberal coatings of manure are worked in annually or biennially.

It has been strongly recommended by the largest growers, and by Professor Macoun, of Ottawa, that bearing orchards should be kept in sod, which should be occasionally broken up and then re-seeded. This practice is to ensure necessary protection from winter injury, which is a great factor in this section.

Fertilizing.—The majority of orchards have had ample manure applied to them, but it has not been applied in the right manner. In a great many cases it is piled around the trees and up against them, and is sometimes taken from the trunks and sometimes left there over winter. Most farmers, however, realize the danger from mice in this latter practice, although they pile against the tree in summer. Their arguments are that it retains moisture around the tree and saves hand-hoeing the weeds from around the trunks.

The manure should be spread around the same way as for any other crop and worked into the soil, but, of course, it must be applied within reach of the roots of the young tree. The roots usually extend farther than the branches. It is a mistaken idea that the manure should be applied close around the trunks, because the most of the feeding roots of the tree are at the ends of the larger roots, although a small proportion of them are distributed all along the main roots.

Artificial fertilizers, with the exception of wood ashes, are not used at all. A few farmers are using their wood ashes on the orchard, but they apply them the same way as they do the barnyard manure. Wood ashes should be applied about the rate of fifty bushels per acre and should be spread and worked in the same way as the manure. Young trees should not require heavy fertilizing every year. If they are making good growth of two or three feet of new wood and look healthy, with a dark green hue to their foliage, they have sufficient of the elements available in the soil for their immediate use.

Pruning.—This is a feature of orchard work that has been absolutely neglected in the care of young orchards, with the exception of the little pruning some of the trees receive at planting time.

The young trees should be carefully pruned and trained each year. A few principles may be in place here, but there is no stated rule to lay down, and the pruner must rely largely upon his own judgment. In the first place he must have an ideal and prune intelligently, always with that ideal in view. All crossing, weak and ill-formed limbs should be taken out, and no weak crotches left that will in after years break down with the load of fruit. The head should be kept fairly well thinned, so that there may be free circulation of air and sun through, and so that the tree will not be induced to grow too high, as it will surely do if allowed to become too dense, when the lower limbs will die from lack of sun and air. The height of heading a tree is a point for much controversy, but, if the fact that the limbs of a low-headed tree will tend to grow upward, is borne in mind, it will easily be seen that the limbs of a low-headed tree will interfere with cultivation no more than those of a high-headed tree, as these latter will grow out and tend to droop to the ground. The advantages are obviously greater in performing every other operation on the low-headed tree than on the high-headed tree.

Effect of Winds.—Many of the young trees have become badly distorted by the prevailing winds where they are exposed to its full force. The whole tree becomes lop-sided and leans badly to the east, and the new growth each year is blown up and turned towards the centre of the tree, thus making the top unbalanced and the centre too dense. If the orchard is not naturally sheltered from the prevailing wind, a wind-break of spruce, pine, or cedar should be planted on the north and west sides, about the same time the apple trees are planted; these will grow at the same rate or a little faster than the apple trees, and will protect them from the full fury of the north-west and westerly gales. It is a good practice when planting the orchard to slightly lean the trees against the prevailing wind, and they will straighten up later under the influence of the wind.

Pests.—Most of the young orchards were badly attacked with the Oyster-shell scale or Oyster-shell bark louse, the apple aphis, and in some cases, the Buffalo tree hopper. The disease known as the apple tree canker was also found, even in one year planted orchards. Young trees attacked by the Oyster-shell scale should be sprayed with lime-sulphur, either commercial or home-made, of a strength of one gallon to nine or ten of water, before the leaf buds burst. The Buffalo tree hopper is best controlled by cultivation, and any diseased areas should be cut out and destroyed by burning.

Management of Bearing Orchards.

Every orchard should be sprayed at least four times each season:—

1. With lime-sulphur, commercial or home-made, diluted 1 to 9 or 10 of water, and applied just before the leaf buds open. *No poison is necessary.* This application kills oyster-shell scale, blistermite, bud moth, and helps to ward off cankers and apple scab.

2. With lime-sulphur, commercial or home-made, diluted 1 to 40 of water and two pounds of arsenate of lead per barrel as a poison, applied just before the blossoms open. This application destroys all feeding caterpillars, such as American tent caterpillars, canker worms, case bearers, and bud moths, and helps to control apple scab and cankers.

3. Immediately after the blossoms fall and before the calyces close, using the same mixture as in No. 2. This application is chiefly for the control of the codling moth and apple scab, but also helps control the lesser apple worm and curculio.

4. The fourth application about two weeks after No. 3, using the same mixture. This application is chiefly for the control of the apple scab, and also for any leaf-eating insects that may have escaped the other sprays.

Fuller information on spraying can be obtained from Mr. E. P. Bradt, B.S.A., District Representative of the Ontario Department of Agriculture at Morrisburg.

Diseases.—The apple tree canker is found in every orchard and a few cases of nectaria canker and collar rot have also been found. These cankered areas should be cut out back to good healthy bark and tissue, the wound disinfected with corrosive sublimate—1 to 1,000—or carbolic acid, and then covered with a coat of pure paint. If the canker has girdled a whole limb or is on a small limb it may be cut off. All cankered wood should be destroyed by burning.

Pruning.—This is probably the first thing that should be improved in orchard practice in these three counties. Practically all the pruning has amounted to is the cutting out of dead limbs and those that interfere with cultivation. In those orchards that are in sod the lower limbs are destroyed by stock. As a consequence of this method of pruning a great majority of the trees have become very high, with long scaffold branches, and with only a small fruit-bearing area over the top.

A little judgment is all that is necessary in pruning a bearing orchard. The tree should be kept fairly thin in the top to allow a free circulation of sun and air through it, and to produce full maturity of the fruit on all parts of the tree. Narrow and weak crotches should not be left wherever it can be avoided, as they often break down under their load of fruit, causing a bad gap in that part of the tree which will take many years to fill up again with new wood. All crossing, diseased and deformed limbs should be taken out and the pruner should always endeavor to keep the top of the tree well balanced and symmetrical in form.

Culture.—It might be said that most all the bearing orchards are in sod, as only seven per cent. of them are cultivated, and of those only two or three in the whole district covered by the survey are clean cultivated and a cover crop sown.

Nevertheless, one successful orchardist of this district prefers to have his orchard in sod after it is ten years of age, although he frankly admits that a cultivated orchard will yield larger crops than an uncultivated one, and strongly advocates the cultivation of young orchards. His reasons are that an orchard that is well manured, sprayed and pruned will give good yields while in sod, and that about once in every twenty years we get a severe winter which will injure the trees if the orchard is cultivated.

The cover crops usually sown are clover, hairy vetch, common vetch, peas, rye, and buckwheat. The clover, peas, common vetch, and hairy vetch are plants of the legume family, and add nitrogen as well as humus to the soil; while rye and buckwheat serve the purpose of retarding the wood growth of the trees in the fall and add humus, they are not nitrogen-producing plants and do not supply any actual fertility. The common vetch is recommended as the best cover crop to grow. It makes a dense matted growth over the ground and serves to help hold the snow in winter, which protects the roots from severe freezing. Common vetch must not be confused with hairy vetch, as the latter lives over the winter, and should it not be plowed in the spring immediately the soil conditions will permit, will commence to grow and rob the trees of the nourishment that they require early in the spring.

Fertilizers.—It is unnecessary to impress the importance of fertilizers, as every farmer appreciates the necessity of applying manure to the trees, but it is done in these three counties in a very haphazard manner. Some have applied a little annually, and a great many biennially, while a few men have applied it not quite so frequently. The manure, and wood ashes in the few cases where the latter has been used, is thrown in a heap around and close to the trunks of the trees. The manure when heaped in this way around the tree starts to ferment and generates heat, and besides the danger of harboring mice, will cause an unhealthy condition of the bark around the root collar, which provides an entrance for that form of the canker disease known as collar rot.

For these bearing orchards the manure and wood ashes should be spread evenly over the ground the same way as for any other crop, as the feeding roots of these large trees extend out around as far and farther than the limbs, while only a small proportion of them are upon the main roots near the trunk. If the orchard is in sod, a liberal coating of manure should be applied every year. But if it is cultivated, a leguminous cover crop plowed down every third year and a coat of manure every second or third year will be a good system of manuring. In this section of country, where dairying is practised on an extensive scale, there is an abundance of manure on nearly every farm, and liberal applications could be applied to the orchard annually without fear of depleting the fertility of the farm for the benefit of the orchard.

The use of artificial fertilizers should be undertaken very carefully, and too much emphasis cannot be put upon the fact that artificial fertilizers will give their best results only when used along with farmyard manure, and that it should never be entirely replaced with fertilizers; rather, they should be used in conjunction with farmyard manure. Furthermore, the full results of fertilizers can be obtained only when they are used in conjunction with the best of cultivation, consequently, the presence of humus and thorough cultivation should always be associated with the use of artificial fertilizers.

In those orchards that are receiving liberal applications of farmyard manure annually, and where leguminous cover crops are sown, there will scarcely be any need to add nitrogen in any other form. Too much nitrogen will produce a strong, succulent growth of wood and leaves too late in the fall and will tend to retard the maturity of the fruit and to lessen its quality.

Phosphoric acid and potash are the only other two constituents of plant food liable to be deficient in the soil. Potash in the form of muriate of potash or sulphate of potash should be applied at the rate of from 150 to 200 pounds per acre, and phosphoric acid in the form of superphosphate, or Thomas phosphate or basic slag, should be applied at the rate of from 300 to 400 pounds per acre. A good plan would be to divide the orchard into four parts and apply the potash and phosphoric acid mixed to one part, the potash alone to one part, the phosphoric alone to one part, and no artificial fertilizer on the other part. By this means some idea of the requirements of the soil may be learnt and the beneficial results from each fertilizer together and separately may be studied. The fertilizer should be applied broadcast over the ground, preferably immediately after plowing, and cultivated in with a disc, spring-toothed cultivator or spike-tooth harrow. Potash and phosphoric acid fertilizers may be applied at any time through the season.

Ready mixed fertilizers are not recommended at all.

Thinning.—This is an item of orchard practice unheard of in this district. The Department of Agriculture has thinned the apples on a few trees in several places near Morrisburg this season (1911) as a demonstration and experiment. The apples were left one to a spur and four or five inches apart, and results have shown a more even quality, larger size and better coloring of fruit. The other advantages of thinning the fruit on the trees are:—

1. It regulates the crop that the tree has to mature, and lessens the liability of splitting and breaking of limbs.

2. It gives the tree a better chance to mature its fruit buds for next season's crop, and so has a tendency to produce crops every year, instead of a heavy crop one year and none the next.

3. It lessens the labor of handling culls at picking time.

4. It relieves the tree of the work of maturing these culls.

The price of thinning has been computed at five cents per barrel, and this price alone is saved in the reduced number of culls to handle.

The thinning may be done at any time during the summer, but is best done when the apples are about an inch in diameter, as then the dormant fruit buds have a good chance to develop. The fall apples may be left until they have developed, so that the fruit taken off can be sold as early cooking apples, and in this way a little remuneration may be obtained to pay for the work of thinning. The method is to first take off all the injured, small and ill-formed fruit, then to leave only one apple to a spur and to thin them to from four to five inches apart; or to leave two apples on one spur and none on the next, and not leave the clusters of two closer than at least six inches to the next cluster.

Picking and Packing.

Here is a vital point in the upbuilding of the fruit industry. The respect and confidence of the market is gained only by the quality of the picking, packing and grading, and according to such will the reputation of a fruit district as a whole be established. The picking should be done by careful and intelligent men. Long ladders should be dispensed with as much as possible and step-ladders used in their place. A specially constructed apple basket should be used, and in the picking the welfare of the tree must be borne in mind as well as the gathering of the fruit in the quickest possible manner. Care must be taken not to pull off or knock off any more fruit spurs than is absolutely unavoidable, nor to break down branches, and a good deal of care is always necessary in putting a ladder up into a tree.

Nearly all the fruit in this district that is sold for local consumption is not packed at all, but simply put into some receptacle and taken to town. The most of the packing for shipment is done by apple buyers who realize the value of good packing and try to conform to the laws regarding packing and grading. The barrel is the only package used here. It was the first kind of package used, and the markets have been built up by it, and all the facilities for handling have become adapted to its use, so that it will be hard to displace. There is a permanent place for the barrel package, although the box package should be introduced for high grade and fancy fruit of the McIntosh and Fameuse types. For these varieties the box package is specially adapted, as it gives a distinctive feature to this class of fruit, and a trade may be catered to which is not ordinarily reached by the barrel.

Co-operation.

Purchasing Supplies.—The purchasing of nursery stock heretofore has been done through agents. Up to the present all the spray material used was either made at home or purchased through the District Representative, but no doubt as soon as large quantities are used agents will be sent into the field to solicit orders.

Co-operation is a remedy for many of the ills of this method of purchase. The advantages of buying nursery stock under a system of co-operation was explained under the head of Nursery Stock. The advantages of buying co-operatively, other orchard supplies, such as spraying machinery, spray material, boxes, barrels, and other orchard appliances, are just as great. A body of farmers of one community can get a cheaper rate by buying in large quantities, can get a uniform article, and when buying an article about the merits or demerits of which they are not familiar, can employ a man who understands the commodity in question, and thus save them many dollars by buying the exact thing they require.

Selling.—Co-operation in the selling end is a sound business proposition, both to the grower and to the buyer. As stated previously, uniformity in grade and pack is most important, and with a community of small fruit-growers this is impossible to get unless the work is done under the supervision and control of an association.

The following are a few of the advantages in co-operation for selling purposes:

1. A better price can be realized, and for the following reasons.
2. A better and more uniform grade of quality and packing is put up.
3. Large quantities of an even grade can be put on the market which will attract the attention of buyers, most of whom find it more profitable to buy in large quantities.
4. A good deal of the middle-men's profit will find its way to the producer, by the elimination of many small buyers and jobbers.
5. A good deal of time, trouble and worry is saved to the individual grower by having one man to find the market for a lot of fruit instead of many men looking for a market, each with a small amount of fruit.
6. An association brings the growers into closer touch with each other where they can compare notes, and discuss their individual troubles and experiences to the mutual benefit of all.

Co-operation cannot be too strongly emphasized, as the experiences of associations in the handling of fruit in other parts of Ontario has definitely proven that it is a good thing in practice and will work out to the advantage of the entire district.

Most of the fruit shipped from this district is handled by independent buyers who buy for as low as they possibly can, and some irresponsible men have bought more fruit than they can handle, have let it fall off the trees, and then refused to pay for it. Therefore let it be urged upon the farmers of Dundas, Stormont and Glengarry Counties that co-operation in the fruit business is one of the essentials of success and a foundation for a thriving apple industry.

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171	April	1909	Insects Affecting Vegetables	C. J. S. Bethune.
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Ontario Department of Agriculture

FRUIT BRANCH

BULLETIN 213

(A Revised Edition of No. 197)

BEE DISEASES

In Ontario

By

MORLEY PETTIT, Provincial Apiarist

TORONTO, ONTARIO, APRIL 1913

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FRUIT BRANCH

(A Revised Edition of No. 197)

Bee Diseases in Ontario

By MORLEY PETTIT
Provincial Apiarist

Much dissatisfaction with bee-keeping as a business is caused by so-called "bad luck," really due to a definite bee disease which any beekeeper can learn to cure. Bees are quite as liable to disease as any other live stock, and to be able to treat such disease intelligently is quite necessary to success.

A Healthy Colony.

Bee-moths are often blamed for the ravages due to disease; but moths never destroy a healthy, normal colony, as they only feed on the deserted combs after the bees are nearly all gone. Heavy winter losses can often be attributed to disease. In fact, whenever a colony is not doing well the exact cause of its failure should be carefully sought.

On the other hand, disease often makes its appearance in the best colonies in the apiary, because infection is usually carried by robbing, and that is generally done by strong colonies. If not checked on the start it soon spreads through the whole apiary, and from it to other apiaries in the neighborhood.

The inspectors of apiaries can do a great deal for the health of bees in Ontario; but to be of real value their work must be supplemented by the earnest efforts of individual beekeepers. Every one should be his own inspector, carefully examining every comb of every colony in the apiary at least once a year, remembering that it is far better to detect it on the start in strong colonies than to wait until they are practically ruined and the disease has spread through the whole neighborhood. Only one cell of infectious disease makes it necessary to treat even the best colony in the apiary.

A Simcoe County Apiary.

When a case of infectious disease is suspected the beekeeper must notify the Minister of Agriculture, Toronto, or the Provincial Apiarist, Ontario Agricultural College, Guelph, who will see that the case is attended to as soon as possible.

In writing it is best to give full particulars, such as township, concession and lot, number of colonies, names and addresses of neighbor beekeepers and size of their apiaries, probable extent of disease territory, etc., so the Provincial Apiarist can judge the amount of time inspector will need to spend in the neighborhood. Personal information will be considered strictly confidential. If the case cannot have immediate attention by the Inspector, the beekeeper should go ahead and treat the diseased colonies according to directions given in this bulletin.

Examining an Apiary for Disease.

The diseases which cause the most damage in Ontario attack the developing brood, causing much of it to die in the comb, and so reducing it that the colony soon dwindles from lack of young bees to replace the old.

When examining an apiary for disease the prime consideration is to avoid robbing. The best time is during a good honey flow as early as possible in the season.

It is necessary to have a good smoker, a hive tool for taking out combs, and a supply of wooden toothpicks for testing the brood.

In opening the hive just enough smoke should be used to keep the bees in subjection. Remove each comb in turn from the brood-chamber and examine the brood. It is best to sit on a box close to the hive with your back to the sun, and hold the comb so that it will shine into the cells, and throw a strong light directly on the lower sides and bottoms of the cells. If there is no disease, the empty cells will be bright and clean, and the uncapped larvae will be plump in form and of a pearly white color. At first a number of cells of capped brood should be opened with the pick, until you are ouite familiar with the outward appearance of healthy capped brood. Cappings which to any but the best-trained eye appear quite healthy often cover dead larvae. When diseased cells are present they are quite frequently found around the lower edge of the comb. If any of the brood cappings appear darker than the rest, or are flat, sunken, or perforated, they should be opened to see whether the brood they cover is dead. Healthy brood is sometimes found under flat, or perforated cappings; but there is a difference in appearance which experience soon teaches one to detect. Brood sometimes develops without ever being fully capped. This is no indication of disease. When each hive is finished the pick used there should be left in the hive, and if any honey is daubed on hands or tools they must be washed thoroughly before opening the next hive.

There are three brood diseases prevalent in the apiaries of Ontario; American Foul Brood, European Foul Brood, and Sacbrood, formerly called Starved or Pickled Brood. All three are infectious. The first two will spread and do great damage if not checked; the last does no serious harm in Ontario apiaries.

Distribution.

American Foul Brood is pretty evenly distributed all over that portion of Ontario lying south and west of the Trent Valley. European Foul Brood is spreading rapidly from three main centres of infection, so that the following counties are now more or less diseased: Carleton, Russell, Prescott, Renfrew, Lanark, Northumberland, Hastings, Prince Edward and Welland, with a few cases in Peterboro and Lincoln.

These two diseases are costing the Province of Ontario hundreds of thousands of dollars annually, not only in loss of bees and honey and of fruit, clover seed and buckwheat, but also in their disheartening effect on the men engaged in the industries concerned.

Much, however, is being done by the Department of Agriculture towards restoring a well-grounded confidence in beekeeping as a business by various methods of instruction. To be effectual this government work must be supplemented by an earnest effort on the part of beekeepers themselves to keep their bees in a healthy condition. American Foul Brood must be reported and treated whenever discovered. So far as is known the race of bees does not affect the virulence of this disease. It is different with European Foul Brood, which simply cannot be cured in common black bees. Those who introduce Italian queens to their colonies ahead of the disease, or even at the time of treating, are saved heavy loss and are able to build up a good business. It is no more possible to check the spread of European Foul Brood among black bees than it is to stop a fire that is sweeping over a town of dry wooden buildings. But, as in a fire-swept town, progressive men will rebuild better than before, so in the disease-swept counties progressive beekeepers are now making more money than ever by the use of the well-bred Italian bees which they were compelled to adopt.

American Foul Brood.

This disease is caused by bacteria known to scientists as *Bacillus Larvae* (not *B. Alvei,* as was formerly supposed). It reaches the healthy young larvae by means of infected food unsuspectingly fed to them by the nurse bees. In most cases the larva dies when nearly ready to seal up, and most of the cells containing infected larvae are capped. The dead larva softens, settles to the lower side of the cell in a shapeless mass, at first white or yellow, changing to coffee-color and brown. At this stage it becomes glutinous, so that if it is picked with a toothpick the con-

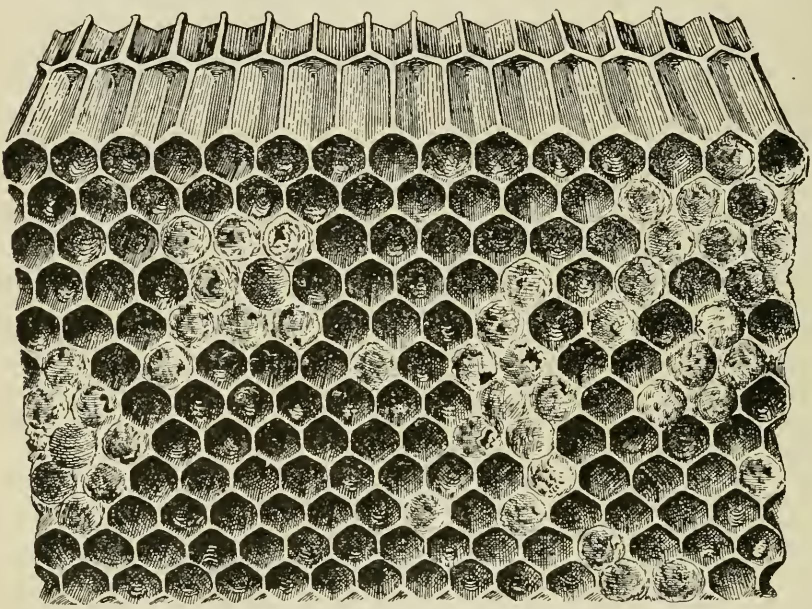


Fig. 1.—American Foul-Brood comb, showing irregular patches of sunken cappings and scales. The position of the comb indicates the best way to view the scales. (U.S. Dept. of Ag. Far. Bul. 442.)

tents will rope out half an inch or so when the pick is slowly withdrawn. It adheres to the cell so it cannot be lifted out entire. It has the odor of a poor quality of glue. When the larva dries it forms a tightly adhesive scale, of very dark brown color.

"Pupae also may die of this disease, in which case they, too, dry down (fig. 2, *o, d*), became ropy, and have the characteristic odor and color. The tongue frequently adheres to the upper side wall, and often remains there even after the pupa has dried down to a scale. Younger unsealed larvae are sometimes affected. Usually the disease attacks only worker brood, but occasional cases are found in which queen and drone brood are diseased."—(*U. S. Dept. of Ag. Farmers' Bul.* 442.)

Where the infected larvae are capped the cappings turn a darker color and become flat or sunken; the workers, perceiving that something is wrong, usually start to tear off the capping, but, discovering the condition of the contents, they generally leave it with a small perforation in the centre until quite dry, then the capping is removed, and in time honey may be stored in the cells containing the scales of disease. The millions of disease spores then float out into the honey, which becomes a medium for carrying the disease to other healthy larvae by robbing, in the same or some other apiary. Some of the honey is also carried into the supers, to make room for alterations in the brood nest, and is marketed in the form of bottled or section honey. It goes into many homes especially in towns and cities. The wooden sides of the sections, and many of the empty bottles, or washings from them, are thrown out by housekeepers and cleaned up by bees of the neighborhood, and the disease is carried home to their healthy brood. This is why our inspectors find more disease in the apiaries around towns and cities than elsewhere.

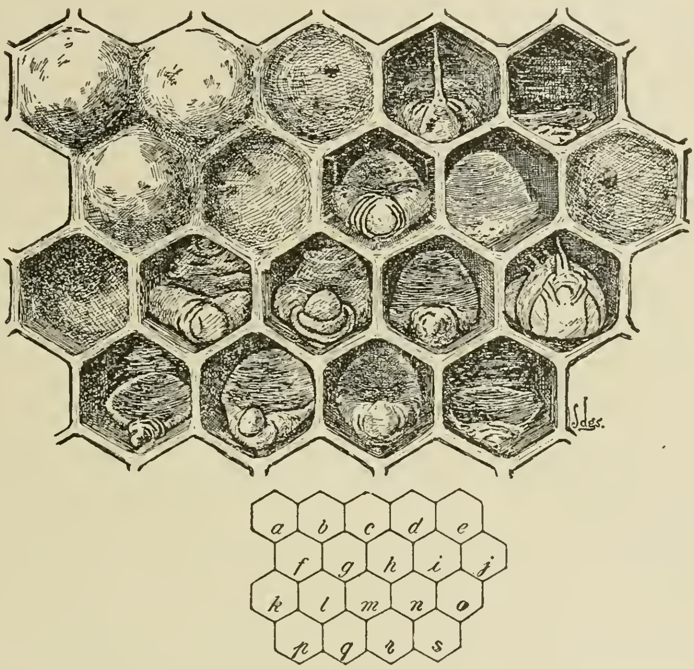


FIG. 2.—American Foul Brood: *a*, *b*, *f*, normal sealed cells; *c*, *j*, sunken cappings, showing perforations; *g*, sunken capping not perforated; *h*, *l*, *m*, *n*, *q*, *r*, larvæ affected by disease; *e*, *i*, *p*, *s*, scales formed from dried-down larvæ; *d*, *o*, pupæ affected by disease. Three times natural size. (U.S. Dept. Ag. Far. Bul. 442.)

THE TREATMENT.

Now, to be cured of this disease a colony must be freed from all this infected brood, comb and honey. To do this we simply take it away. But in the operation some precautions are necessary. We must see that the colony will get healthy food as soon as the unhealthy food is taken away, and have means for building new comb at once. So the operation should be performed during a honey flow, and to make it perfectly sure it is a good plan to insert a division board feeder of sugar syrup. We must take precautions against starting robbing, or causing the treated colony to scatter to other hives or swarm out, be lost, and carry infection to other places. So the operation should be performed in the evening, when the bees are settling down for the night, and the entrance should be covered with queen-excluding metal to hold the queen in case of swarming out the next morning. A regular queen-excluder laid on the bottom board under the brood chamber will answer the latter purpose. It would be even better to clip the queen so she cannot fly, then leave the excluder off. They should also be given a clustering space to occupy, as in the case of a natural swarm. Whenever bees are disturbed in their hives they will fill their honey sacs with honey from the comb. As this will happen when the hive is being treated, and some of this diseased honey might be stored in the new combs, it is necessary to make them eat it before they can find a place to put it. To make sure of this, not one bit of comb of any kind can be left in the hive. Even sheets of foundation are unsafe, as some cells can be so quickly drawn out, enough to deposit a little infected honey. The hive must be quite empty so far as comb or foundation is concerned, except that very narrow starters of foundation, not more than one-half inch wide, may be placed in the frames to indicate where the combs are to be built. Thus the diseased honey will be consumed in wax secretion before any of it can be deposited in the hive.

Method of Treatment.

When there is a good honey flow on, the colonies should first be prepared for treating by removing from the hive every comb which does not contain brood. This

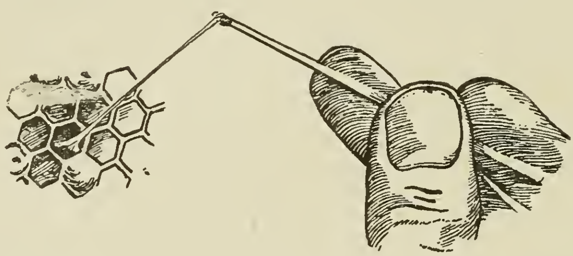


Fig. 3.—The ropiness of American Foul Brood. (U.S. Dept. Ag. Far. Bul. 442.)

will include all the super combs and probably two or more next the walls in the brood chamber. These must be put under cover immediately and destroyed as soon as possible. The remaining brood combs should be loosened and spread apart to facilitate rapid handling later. When all diseased colonies are thus prepared during the day it will be a short matter to finish the treatment in the evening.

When bees have nearly stopped flying for the night, each prepared colony is treated as follows: First remove it from its stand, then set in its place a clean, disinfected hive containing clean frames with half-inch starters, and, if convenient, a division board feeder with thin sugar syrup. If the queen is not clipped the entrance of this hive must be covered with queen-excluding metal. Now shake the bees from the combs of the old hive into the new; but if any fresh nectar flies out in shaking it will be necessary to brush instead of shaking. Get these combs immediately under cover, and clean up very carefully any honey that may be around, so that robbers from healthy colonies cannot carry home disease.

When the diseased colonies are weak in bees, two or three of them should be united to form one good colony with which to start the cure. But in doing this, diseased colonies must be united with their next door neighbor, and not carried to another part of the apiary, as flying bees will be sure to return and may enter adjoining healthy colonies, carrying disease.

You have now made an artificial swarm, which must be given the conditions a new swarm likes, or it will leave and carry its disease to parts unknown, or perhaps into some healthy hive in the apiary. A new swarm likes plenty of ventilation and shade and also plenty of clustering room. To satisfy this natural desire it is sometimes necessary to place an empty hive under the one containing the starters for a few days. This simple precaution will generally prevent the swarming out which so often happens in treating foul brood.

All combs from the supers as well as from the brood-chamber of the diseased colony must be either burned or melted and boiled thoroughly before the wax is fit to use again. The honey that is removed is entirely unfit for bee feed, and should be burned or buried deep enough to be out of the reach of any bees.

On the third evening after the first operation the starters and what combs have been built must all be removed. This time the bees should be given full sheets of foundation, and the cure is complete.

If directions have been followed carefully and thoroughly, the above treatment should be successful. To make sure, however, the brood must be examined again in about three weeks and again the following season.

If the disease reappears in any colonies they must be treated again.

Saving Brood.

Brood from badly diseased colonies is of no value, and dangerous, and should be burned, buried or otherwise destroyed at once. Brood from colonies having only a few cells diseased may be placed over an average colony slightly diseased, and the queen caged. In ten days treat as given above.

Saving Combs.

It is never safe to use super-combs that have been on diseased colonies. Even though they may appear white and clean, germs of the disease are apt to lurk in them from year to year. To melt these down is no serious loss, as the wax will more than make foundation for new ones.

Disinfecting.

Hives which have formerly contained diseased colonies, or in which diseased combs have been stored or carried, should be burned over inside with a gasoline or oil torch.

Fall Treatment.

If the disease is discovered late in the season, and the colony is still strong, leave it until November, take the diseased combs away, and supply honey from a healthy colony, in full sealed combs. *Be sure that the combs are all sealed, and that they are from a colony which has no disease.*

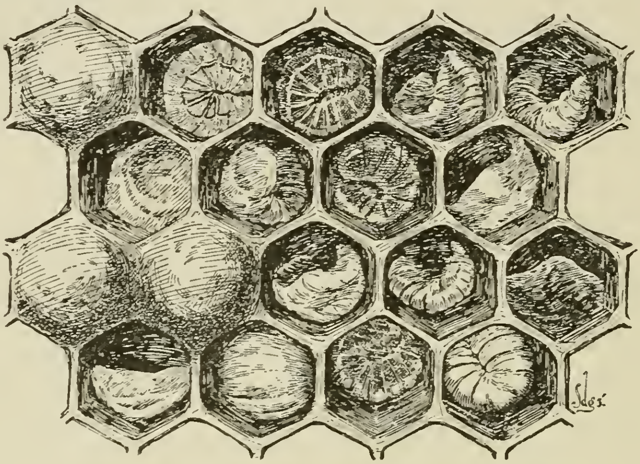
If the colony is not strong enough to be worth this treatment it should be destroyed at once, as one great source of spread is the spring robbing out of combs left by the winter death of such colonies.

EUROPEAN FOUL BROOD.

Until 1907 the only infectious brood disease known to exist in Ontario was the one already described. But another then made its appearance. It is called European Foul Brood (Sometimes "Black Brood").

European Foul Brood has destroyed the apiaries in great areas of different states in the Republic to the south of us. It is now known to be rampant in at least nine counties of Ontario. In one way it is much more to be dreaded than American Foul Brood, because it runs its course and destroys an apiary much more rapidly, and because the method of spread is not fully understood.

As was stated above, nothing but the introduction of Italian queens by the beekeepers concerned will check its spread.



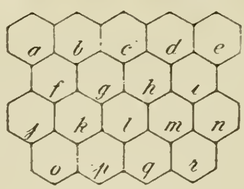


FIG. 4.—European Foul Brood: *a, j, k*, normal sealed cells; *b, c, d, e, g, i, l, m, p, q*, larvæ affected by disease; *f, h, n,* o, dried-down larvæ or scales. Three times natural size. (U.S. Dept. Ag. Far. Bul. 442.)

The best description of this disease which has been published is found in U. S. Department of Agriculture Farmers' Bulletin 442, "The Treatment of Bee Diseases," by E. F. Phillips, Ph.D. It is as follows: "European foul brood was formerly called 'black brood,' or 'New York bee disease.' The name 'black brood' was a poor one, for the color of the dead brood is rarely black, or even very dark brown. European foul brood usually attacks the larva at an earlier stage of its development than American foul brood, and while it is still curled up at the base of the cell (Fig . 4, *r*). A small percentage of larvae dies after capping, but sometimes quite young larvae are attacked (Fig. 4, *e, m*). Sunken and perforated cappings are sometimes observed, just as in American foul brood (Fig. 2, *c, g, j*). The earliest indication of the disease is a slight yellow or gray discoloration and uneasy movement of the larva in the cell. The larva loses its well-rounded, opaque appearance and becomes slightly translucent, so that the tracheae may become prominent (Fig. 4, *b*), giving the larva a clearly segmented appearance. The larva is usually flattened against the base of the cell, but may turn so that the ends of the larva are to the rear of the cell (Fig. 4 *p.*), or may fall away from the base (Fig. 4, *e, g, l*). Later the color changes to a decided yellow or gray and the translucency is lost (Fig. 4, *q, h*). The yellow color may be taken as the chief characteristic of this disease. The dead larva appears as a moist, somewhat collapsed mass, giving the appearance of being melted. When the remains have become almost dry (Fig. 4, *c*), the tracheae sometimes become conspicuous again, this time by retaining their shape, while the rest of the body content dries around them. Finally, all that is left of the larva is a grayish-brown scale against the base of the cell (Fig. 4, *f, h*), or a shapeless mass on the lower side wall if the larva did not retain its normal position (Fig. 4, *n, o*). Very few scales are black. The scales are not adhesive, but are easily removed, and the bees carry out a great many in their efforts to clean house.

"Decaying larvae which have died of this disease are usually not ropy as in American foul brood, but a slight ropiness is sometimes observed. There is usually little odor in European foul brood, but sometimes a sour odor is present, which reminds one of yeast fermentation. This disease attacks drone and queen larvae* almost as quickly as those of the workers.

"European foul brood is more destructive during the spring and early summer than at other times, often entirely disappearing during late summer and autumn, or during a heavy honey flow. Italian bees seem to be better able to resist the ravages of this disease than any other race. The disease at times spreads with startling rapidity and is most destructive. Where it is prevalent a considerably larger percentage of colonies is affected than is usual for American foul brood. This disease is very variable in its symptoms and other manifestations and is often a puzzle to the beekeeper."

One exception, however, will be taken to the above description. In most cases examined in Ontario the odor is found to be very pronounced and offensive, like decayed fish; in fact, on a warm, moist morning it is noticed on entering the apiary, and, when a diseased comb is held up for inspection, is almost sickening.

Use Same Treatment and Italianize.

The same treatment already described for American Foul Brood is effectual, if applied to the whole apiary at once. But the cure is only permanent when pure-bred Italian queens are introduced to all black or hybrid stocks. It is quite impossible to cure an apiary of black bees of European Foul Brood without introducing pure Italian queens to all colonies.

We know of no reason why this plague should not sweep over Ontario as it has over most of the United States. If it does all apiaries of black bees will be practically destroyed within the next few years. Its progress in the districts mentioned above has been appalling. No Government expenditure can touch the situation without the co-operation of the men themselves whose property is in danger. There is a remedy, however, right to hand. Pure-bred leather-colored Italian bees are almost immune to European Foul Brood.

It is very important, then, that all apiaries, especially in or near infected neighborhoods, should be Italianized at once, without waiting for a destructive outbreak of disease.

* The tendency of this disease to attack queen larvæ is a serious drawback in treatment. Frequently the bees of a diseased colony attempt to supersede their queen, but the larvæ in the queen cells often die, leaving the colony hopelessly queenless. The colony is thus depleted very rapidly.

SACBROOD.

A disease slightly resembling Foul Brood is called by some "Starved Brood," and by others "Pickled Brood." It has recently been described and named by White "Sacbrood." The most positive difference in the diagnosis of this disease is the absence of ropiness and of the glue-pot smell, which are always found in American Foul Brood. In Sacbrood the larva decays from the inside, leaving the skin tough and in its natural shape; in European Foul Brood or American Foul Brood, the skin of the larva softens as the contents become glutinous, and all the natural wrinkles become smooth as the mass settles to the lower side of the cell. In Sacbrood the larva often dries up so as to become loose in the cell and fall out when the comb is inverted. In American Foul Brood it always cements fast to the lower cell wall, so it cannot be removed without tearing the cell. European Foul Brood attacks the larva generally at an earlier stage in its existence than Sacbrood.

"Sacbrood is an infectious disease of the brood of bees caused by an infecting agent that is so small, or of such a nature, that it will pass through the pores of a Berkefeld filter." (U.S. Dept. of Ag., Bureau of Ent., Cir. No. 169.)

Re-queening with vigorous queens from other apiaries will often effect a cure and it often disappears of its own accord.

Some Precautions.

Since disease is so widely distributed some precautions should be observed by all beekeepers.

1. Great care should be taken in spring to prevent robbing, particularly if any diseased colonies are in the apiary or neighborhood.

2. Since honey is the means of transmitting disease it is a safe rule to never feed honey to the bees. Syrup made from granulated sugar is quite as good as the best of honey for winter stores.

3. So far as possible supply your home market with honey, to avoid the danger of infected honey being shipped in.

4. When buying queens it is a safe rule to destroy the cages, candy, and worker bees that accompany them, using a fresh cage for introducing.

5. Persons buying bees from any beekeeper in Ontario can get information from the Provincial Apiarist as to the condition of the apiary in question.

INSPECTION OF APIARIES.

The Inspection of Apiaries is provided for by an Act passed by the Legislative Assembly of the Province of Ontario which allows the appointment of what inspectors are required by the Lieutenant-Governor in Council upon the recommendation of the Minister of Agriculture. The duties and powers of these inspectors are also defined, and provision is made to ensure the prompt reporting and careful treatment of cases of disease.

The following is a copy of the Act:

An Act for the Suppression of Foul Brood Among Bees.

1. This Act may be known as *The Foul Brood Act.*

2.—(1) The Lieutenant-Governor in Council upon the recommendation of the Minister of Agriculture may from time to time appoint one or more Inspectors of Apiaries to enforce this Act.

(2) The Inspector shall, if so required, produce the certificate of his appointment on entering upon any premises in the discharge of his duties.

(3) The remuneration to be paid to an Inspector under this Act shall be determined by order of the Lieutenant-Governor in Council, and shall be payable out of any sum appropriated by the Legislature for the enforcement of this Act.

3.—(1) The Inspector shall, whenever so directed by the Minister, visit any locality in Ontario and examine any apiary to which the Minister directs him, for the purpose of ascertaining if the disease known as "foul brood" exists in such apiary.

(2) If the Inspector finds that foul brood exists in a virulent or malignant type, he shall order all colonies of bees so affected, together with the hives occupied by them, and the contents of such hives and all tainted appurtenances that cannot be disinfected to be immediately destroyed by fire under his personal direction and superintendence.

(3) Where the Inspector who shall be the sole judge thereof finds that the disease exists, but only in a milder type and in its incipient stage, and is being or may be treated successfully, and the Inspector has reason to believe that it may be entirely cured, then he may omit to destroy or order the destruction of such colonies and hives.

4. The Inspector may order the owner or possessor of any bees dwelling in box or immovable frame hives to transfer them to movable frame hives within a specified time, and in default the Inspector may destroy, or order the destruction of such hives and the bees dwelling therein.

5. Any owner or possessor of diseased colonies of bees, or of any infected appliances for bee-keeping, who knowingly sells or barters or gives away such diseased colonies or infected appliances shall incur a penalty of not less than $50 or more than $100, or he may be imprisoned for any term not exceeding two months.

6. Any person whose bees have been destroyed or treated for foul brood, who sells or offers for sale any bees, hives or appurtenances of any kind, after such destruction or treatment, and before being authorized by the Inspector so to do or who exposes in his bee-yard, or elsewhere, any infected comb, honey, or other infected thing, or conceals the fact that said disease exists among his bees, shall incur a penalty of not less than $20 and not more than $50, or he may be imprisoned for a term not exceeding two months.

7. Any owner or possessor of bees who refuses to allow the Inspector to freely examine bees, or the premises in which they are kept, or who refuses to destroy the infected bees and appurtenances, or to permit them to be destroyed when so directed by the Inspector, shall, on the complaint of the Inspector, incur a penalty of not less than $25 and not more than $50 for the first offence, and not less than $50 and not more than $100 for the second and any subsequent offence, and the convicting Justice shall by the conviction order the said owner or possessor forthwith to carry out the directions of the Inspector.

8. Where such owner or possessor of bees disobeys the directions of the said Inspector, or offers resistance to or obstructs him, a Justice of the Peace may, upon the complaint of the Inspector cause a sufficient number of special constables to be sworn in, who shall, under the directions of the Inspector, proceed to the premises of such owner or possessor and assist the Inspector to seize all the diseased colonies and infected appurtenances and burn them forthwith, and if necessary the Inspector or constables may arrest the owner or possessor and bring him before a Justice of the Peace to be dealt with according to the provisions of the preceding section.

9. Before proceeding against any person before a Justice of the Peace, the Inspector shall read over to such person the provisions of this Act or shall cause a copy thereof to be delivered to him.

10. Every owner or possessor of bees and any other person who is aware of the existence of foul brood either in his own apiary or elsewhere shall immediately notify the Minister of the existence of such disease and in default of so doing shall incur a penalty of $5.

11. Each Inspector shall report to the Minister as to the inspection of any apiary in such form and manner as the Minister may direct, and all reports shall be filed in the Department of Agriculture, and shall be made public as the Minister may direct or upon order of the Assembly.

12. *The Ontario Summary Convictions Act* shall apply to all prosecutions for offences against this Act.

13. The Act passed in the 6th year of the reign of His late Majesty King Edward the Seventh, and section 27 of the Act passed in the 10th year of the said reign, chaptered 26, are repealed.

Inspectors' Duties.

It will be seen by Sec. 3 that it is an inspector's duty to work under the direction of the Minister of Agriculture or the one he may appoint to administer the Act. Where foul brood is found he is to destroy by fire the worst cases, especially where the beekeeper is not making a successful effort to cure. It is only in cases where "the inspector has reason to believe that it may be entirely cured" that he "may, in his discretion, omit to destroy."

Transferring Bees.

Persons having bees in the kind of hives described in Sec. 4, will make it easier for the inspectors and themselves as well by making preparations for transferring as soon as possible. The following is one method of performing this operation:

The best time to transfer bees out of box hives into frame hives is at the beginning of the swarming season. Choose a time when as many bees as possible are in the field and nicely out of the way. About 10 a.m. will probably be the best time if it is a warm, still day. The following appliance will be needed: a good smoker, a bee veil, a hive tool of some sort such as a screwdriver or a wall scraper used by paperhangers, and the new hive, preferably ten-frame Langstroth with wired frames filled with sheets of foundation.

Blow a little smoke in at the entrance to the hive, tip the old hive over sideways and blow in more smoke to drive the bees down among the combs; let it stand upside down to one side and place the new hive where it formerly stood, with the entrance exactly in the place of the old one. Put down a newspaper in front of the new hive with one edge under the entrance. The bees returning with pollen and honey now alight and go into the empty hive. Place a small box over the inverted hive large enough to receive the whole cluster of bees. Now drum on the sides of the hive with a couple of sticks until the bees run into the box above, which should be removed as soon as a majority of them have gone up into it and placed to one side until the bees cluster like a swarm; then dump the bees down on the newspaper in front of the new hive and let them run in in the same manner that a new swarm is hived. It will be best to watch for the queen, because if the queen is not with them they will all return to the old hive. Set the old hive upright on its bottom board just to one side of the new hive and let it stand there for two weeks until nearly all the brood is hatched, then transfer the bees from it again into the new hive. At that time the old combs can be taken out and melted down into beeswax.

Disposing of Bees or Appliances.

Section 5 puts a heavy penalty on disposing of diseased bees or appliances in any way, and, according to Section 6, persons whose bees have been treated or destroyed for disease shall not dispose of any bees or appliances whatever without permission from the inspector, or expose in the apiary or elsewhere any infected material or honey on penalty of fine or imprisonment.

Information Concerning Location of Disease.

Sections 7, 8 and 9 give inspectors power to act. Section 10 requires every person who is aware of the existence of foul brood to report the same to the Minister of Agriculture, and Section 11 requires the inspectors to report on all their work to the same authority.

AMERICAN FOUL BROOD.

From the reports of the inspectors of apiaries of recent years, we find that American Foul Brood is prevalent in the following townships. This does not mean that townships not mentioned in this list are guaranteed to be free from this disease, because the apiaries of Ontario have not all been inspected as yet:

BRANT: Brantford, Dumfries South.

BRUCE: Arran, Brant, Bruce, Carrick, Culross, Elderslie, Greenock, Kincardine, Kinloss, Paisley, Saugeen.

DUFFERIN: Garafraxa East, Luther East, Mono.

DUNDAS: Winchester.

DURHAM: Darlington.

ELGIN: Dorchester South, Malahide.

ESSEX: Maidstone, Rochester, Sandwich East, Sandwich West.

FRONTENAC: Kingston Township.

GREY: Artemesia, Collingwood, Derby, Euphrasia, Glenelg, Keppel, Normanby, Osprey, St. Vincent, Sullivan, Sydenham.

HALDIMAND: Cayuga, Dunn, Rainham, Walpole.

HALTON: Esquesing, Nelson, Trafalgar.

HURON: Grey, Morris, Turnberry, Wawanosh West.

KENT: Harwich, Howard, Romney, Tilbury East.

LAMBTON: Bosanquet, Moore, Warwick.

LANARK: Lanark.

LEEDS: Bastard, Kitley, Yonge.

LINCOLN: Grantham, Grimsby.

MANITOULIN: Bidwell, Gordon.

MIDDLESEX: Adelaide, Delaware, Lobo, London, McGillivray, Westminster, Williams East, Williams West.

MUSKOKA: Draper, Muskoka.

NORFOLK: Charlotteville, Townsend, Walsingham, Windham, Woodhouse.

ONTARIO: Brock, Pickering, Reach, Scott, Thorah, Uxbridge, Whitby East.

OXFORD: Blenheim, Dereham, Norwich North, Norwich South, Zorra East.

PEEL: Albion, Caledon, Chinguacousy, Toronto.

PERTH: Blanshard, Downie, Easthope North, Easthope South, Ellice, Elma, Fullarton, Mornington, Wallace.

SIMCOE: Adjala, Essa, Gwillimbury West, Innisfail, Nottawasaga, Orillia, Sunnidale, Tay, Tecumseh, Tiny, Vespra.

STORMONT: Cornwall.

VICTORIA: Bexley, Eldon, Mariposa.

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Ontario Department of Agriculture

LIVE STOCK BRANCH

BULLETIN 214

Sheep Raising in Ontario

Does It Pay?

By LIVE STOCK BRANCH

TORONTO, ONTARIO, MAY, 1913

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Ontario Department of Agriculture

LIVE STOCK BRANCH

Sheep Raising in Ontario

DOES IT PAY?

"Sheep Raising in Ontario—Does it Pay?" was the question which the Ontario Sheep Breeders' Association wished to have answered in a manner which would be satisfactory to all concerned. While every other class of live stock was increasing and receiving increased attention from the farmers of the Province, sheep were receiving less attention each succeeding year, and were decreasing in numbers, having decreased from 1,797,213 in 1900 to 1,040,245 in 1911.

To be able to give a satisfactory answer to this question and to promote a greater interest in sheep raising throughout the Province, it was felt that it would be an advantage to have a number of Illustration Stations located at different points throughout the Province, with the object of demonstrating the profits which could reasonably be expected under ordinary conditions from a small flock of grade ewes. The co-operation of the Live Stock Branch of the Ontario Department of Agriculture was obtained in this work and a grant received to defray the cost of supervising the work.

The following is the general outline of the work which was recommended:

1. That there should be eight demonstration stations as follows: (*a*) Six stations located at different points throughout the Province where lambs should be dropped not earlier than April 20th, and marketed during the following winter; (*b*) one station located in Muskoka devoted to raising of summer lambs, and (*c*) one station located near Toronto devoted to raising early lambs.

2. That the flock at each station should consist of from ten to twelve good grade ewes to be owned and supplied by the person in charge of the station, and a pure-bred ram to be supplied by the Department.

3. That each station should be in charge of a good average farmer with experience in the handling of grade sheep, and who was able to supply suitable accommodation for the flock, and who would agree to keep accurate account of all expenses of feeding and care, and make detailed report of same as required.

4. That the person in charge of the work should be encouraged to keep some of his best ewe lambs for the improvement of the flock.

5. That the rams should represent Shropshire, Southdown, Dorset Horn, Hampshire, Oxford, Leicester, Lincoln, and Cotswold.

6. That the general supervision of the work should be placed in the hands of two inspectors who should be expert sheep men.

7. The farmers in charge of stations should be required to refer all questions of feeding, breeding, care, and marketing to the inspectors.

Nine stations were finally located in the following Counties: Brant, Middlesex, York, Huron, Simcoe, Muskoka, Victoria, Lanark and Leeds, and the flocks and rams selected. In locating the stations the aim was, as far as possible, to have represented the different conditions throughout the Province.

Mr. John Campbell, of Woodville, and Lt.-Col. Robert McEwen, of Byron, were appointed as Inspectors to supervise the work. Before the experiments were commenced, they inspected and valued the flocks.

The following tables and summary show the results obtained. In this financial statement the expenses for the year are the cost of feeding the flock of ewes and ram from the beginning of the breeding season in the fall of one year to the beginning of the breeding season in the fall of the succeeding year, plus the cost of feeding the lambs from weaning time until they were marketed. Each flock was charged with six per cent. on the investment represented by the Inspectors' valuation, and where any losses occurred the full cost was charged against the flock. In no case was credit given for the bonus of $3 per head, this was given simply as an inducement to the farmer to keep accurate accounts. The results shown here are what any farmer might reasonably expect.

REPORT OF SHEEP-FEEDING EXPERIMENTS.

During the first year the lambs raised at all Stations, except Brown's Corners and Windermere, were sold when about one year old. The lambs from the Station at Brown's Corners were intended to be marketed as early spring lambs, while those from Windermere were to be sold during the summer to hotels in the neighborhood doing a tourist trade. At Brown's Corners some of the lambs were not dropped early enough to be sold at the highest price, and some were carried over until the following spring, the Station being credited with the price of the lambs when sold and charged with the expense of feeding during the winter.

During the second year the lambs at six of the Stations were sold when about one year old. The lambs from the Station at Brown's Corners were marketed as early spring lambs. Those at Windermere were sold for the summer hotel trade. The lambs at Paris were sold at various dates in the fall, for, as good prices were offered for them at that date, it was not considered that it would be profitable to feed them over winter.

PERTH.

This Station was in charge of Isaac M. Kenyon, who had ten grade ewes and a Southdown ram.

First Year. The sheep were brought to the barn on December 20th. During the winter they were fed 500 pounds of hay valued at $3.25; 4,000 pounds of unthreshed peas, $12; 2,000 pounds turnips, $5; 150 pounds mixed bran and grain, $1.50. Total value of the winter feed for ewes and ram $23.75 or an average cost per head of $2.16. Fifteen lambs were dropped. All lambs were docked and the wethers castrated on May 10th. The eleven fleeces weighed 69 pounds after being washed, and sold at 24 cents per pound, value $16.56.

On May 1st the sheep and lambs were turned out to pasture on cheap rough land and the pasture for the season was valued at $2. In the fall the lambs had the run of a field of rape and also in some well cobbed corn. The winter feeding of the lambs began on December 20th, and consisted of a daily ration of 60 pounds clover, green peas and oats, 30 pounds turnips, and 12 pounds bran and oats, the feed costing 40 cents per day or a total up to March 6th of $30.40, an average of $2.03. On this date 12 of the lambs were sold at $6.25 per hundred and 3 were kept for breeding purposes at the same valuation. The weight of the 15 lambs was 1,500 pounds, realizing $93.75. Total receipts of lambs and wool, $110.31; expenses $59.55; profit, $50.75.

Second Year. The sheep were brought to the barn on December 15th. During the winter they were fed 700 pounds of hay, valued at $2.80; 4,000 pounds green peas and 600 pounds green oats, valued at $15; 2,000 pounds roots, valued at $5; 175 pounds grain, valued at $1.75; total value of winter feed for ewes and ram, $24.55, an average cost per head of $2.23. 16 lambs were dropped and 15 lived. Dogs worried the flock in September, causing a loss of two ewes and two lambs for which nothing was recovered. The eleven fleeces, after washing, weighed 71 pounds and sold at 23 cents per pound, value $16.33. On April 26th, the sheep and lambs were turned out to pasture on cheap rough land, pasture for the season being valued at $2. On May 10th, the lambs were docked and the males castrated. The winter feeding of the lambs commenced on January 1st. They were fed 3,700 pounds of hay, valued at $14.80; 1,000 pounds green oats, valued at $5; 1,800 pounds of roots, valued at $3; 120 pounds of bran, valued at $1.20. $2 was charged for pasturing lambs from time of weaning until winter feeding commenced, a total of $26, or $2 per head. On March 11th, the 13 lambs were sold at $7.50 per hundred; the weight of lambs was 1,170 pounds, realizing $87.70. Total receipts, wool and lambs, $104.03; total expenses, including $13.00 for two ewes worried by dogs, $70.95; profit, $33.08. Profit for two years, $83.83.

Fairfield East.

Edwin Johns had charge of this Station. The flock consisted of 10 grade Leicester ewes, valued at $6.50 per head and a Cotswold ram.

First Year. The feed for the ewes and ram during the winter consisted of 3,050 pounds of hay, $18.35; 1,500 pounds pea straw, $2.50; 2,775 pounds roots, $4.62; 10 bushels oats, $4.05; 150 pounds bran, $1.65. The pasture for the summer was valued at $12. This makes a total cost of feed during the year, $43.42, or $3.95 per head. Two of the ewes in this flock were lost. One died shortly before lambing, and the other about two weeks after. The cause was not discovered in either case. The ram also died in the spring. He had been ailing all winter with what appeared to be paralysis of the throat. The sheep were not dipped. The clip amounted to 85 pounds, and sold at 13½ cents, $11.47.

The flock produced 15 lambs. Two of these were injured during the summer by a train and had to be slaughtered. The railway company allowed a claim of $12 for the two. Thirteen lambs went into winter quarters and were fed 3,440 pounds mixed clover, green peas and oats, worth $14.56; 962 pounds of straw, 96 cents; 1,365 pounds mangles, $1.60; 1,950 pounds mixed bran, oats and peas, $19.50, total, $36.62, or an average cost of $2.82. The lambs were sold on April 25th at 7 cents per pound. The total weight was 1,707 pounds at $7, or a total of $119.49. Including the $12 for the two lambs, the total receipts were $131.49, or an average of $8.77. Total receipts, lambs and wool, $142.96; expenses, $123.39; profit, $19.57.

Second Year. The flock was taken off pasture on November 25th. During the winter they were fed 3,430 pounds of hay, valued at $13.74; 4,445 pounds straw, valued at $6.84; 234 pounds of roots, valued at 28c.; 576 pounds grain valued at $6.12. Total winter feed, $36.98, an average of $3.36. Thirteen lambs were dropped and 11 lived. The eleven fleeces weighed 97 pounds, and sold for 14c. per pound, bringing $13.58. On May 1st the sheep and lambs were turned out to pasture, which was valued at $10 for the summer. On May 20th, the lambs were docked and the rams castrated. The lambs were weaned in August, and were put to winter feed on December 1st. They were fed 3,500 pounds of clover hay, worth $14; 1,060 pounds of turnips, valued at $1.77, and 1,985 pounds bran, peas and oats, valued at $1 per hundred, a total cost of $35.62, an average of $3.23 per head for winter feeding. On April 20th, nine of the lambs were sold, the other two being kept for breeding, and valued the same as those sold. The total weight of the 11 lambs was 1,282 pounds, at $6.50 per hundred, $83.33. Total receipts for lambs and wool, $96.91; total expenses, which include feed of ewes and ram, feed of lambs, pasture and interest on investment at 6 per cent., $80.63; profit, $16.28. Profit for two years, $35.85.

Woodville.

D. C. Ross was in charge of this Station. He started with 12 grade Leicester ewes, valued at $8 each, and a Leicester ram.

First Year. The feed for the winter consisted of 3,000 pounds hay, $15; 3,000 pounds straw, $5; 125 bushels turnips, $7.50; 420 pounds oats, $4.20; some unthreshed peas, valued at $2; $10 was charged for the pasture. Total, $43.70; average per head, $3.36. 130 pounds of unwashed wool was sold at 13½ cents per pound for $17.55. The sheep were not dipped. During the year one of the ewes died and was replaced.

Eighteen lambs were dropped. After weaning, their feed cost $39.11, or $2.30 per head. It consisted of 3,375 pounds hay, $11.81; 270 bushels turnips, $16.20; 21 bushels oats, $6.30; 1,860 pounds unthreshed peas, $4.80. One of the lambs was sold in November and 13 on March 27th. Four of the ewe lambs were kept in the flock. These were weighed at the time the others were sold, and charged for at the same price. The selling price was $6.65, and the weight 2,339 pounds, making $156.54. The November lambs sold for $6.32, total, $162.86, or $9.05 per head. Total receipts, lambs and wool, $180.41; expenses, $98.07; profit, $82.34.

Second Year. The feed for the winter consisted of 6,370 pounds hay, worth $22.29, and 10,920 pounds roots, valued at $10.92, total $33.21, an average of $2.55 for winter feeding. Fifteen lambs were dropped and 14 lived. On May 10th, all lambs were docked, and the rams castrated on June 1st. The 13 fleeces weighed 135 pounds and sold for 13½c. per pound, bringing $18.22. Summer pasture for the flock was valued at $9. The lambs were weaned in August and put into winter feeding November 17th. During the feeding period they were fed 1,500 pounds of hay, worth $9; 230 bushels turnips charged at 6 cents per bushel, $13.80; a quantity of straw worth $4.50; 994 pounds of grain, valued at $12.42, a total of $39.72, averaging $2.84. On March 17th, 12 of them were sold and the two which were kept for breeding valued the same as those sold. The weight of the 14 was 1,720 pounds, at $7 per hundred, brought $120.40. Total receipts, lambs and wool, $138.62, expenses, including dip and interest on investment, $90.02; profit, $48.60. Profit for two years, $130.94.

Duntroon.

John McKee had at this Station 10 grade Leicester ewes, valued at $8 per head, and a Shropshire ram.

First Year. Winter feeding consisted of 1,100 pounds of Alfalfa hay and 1,430 pounds of clover hay, value, $14.08. A quantity of straw fed was valued at $5. They also got 7 bushels of oats, $2.52; 70 pounds bran, 77 cents. The pasture for the summer was worth $13.75, and zenoleum dip 75 cents, making the cost of the year's feed $36.87, an average of $3.35. The castrating and docking was done on May 25th. The clip of unwashed wool was 109 pounds, which sold at 13 cents per pound, realizing $14.17. Zenoleum solution was used for dipping. One of the ewes died during the fall.

There were 11 lambs in the flock. The winter feeding of these started on October 28th and continued until March 17th, when they were sold. The winter feeding cost $29.10, or $2.65 per head. The feed consisted of 4,200 pounds of Alfalfa at $8 per ton, $16.80; and 1,230 pounds of oats and barley at $1 per hundred, $12.30. The 11 lambs weighed 1,365 pounds, and sold at $7, or $95.55, an average of $8.69. Total receipts, lambs and wool, $109.72; expenses, $80.27; profit, $29.45.

Second Year. The flock was fed in the barn 2,300 pounds of hay, valued at $12.80, and were allowed pea straw at will, which is put in at a nominal charge of $5; roots valued at $1.56, and 264 pounds grain, worth $2.82, a total of $22.18, an average of $2.01 for winter feeding. Ten lambs were dropped, of which 9 lived. The flock went to pasture April 20th, for which $12 is charged. The shearing was done May 23rd. The eleven fleeces weighed 90 pounds and brought 14 cents per pound, $12.60. After weaning, the lambs were allowed the roughage of the farm. During the feeding period, they were fed 2,400 pounds hay, worth $9.60, and 540 pounds grain, valued at $6.75. On March 5th they were sold for 8 cents per pound. The weight of the nine was 915 pounds, bringing $73.20. Total receipts, $85.80; expenses, $57.58; profit, $28.22. Profit for two years, $57.67.

Paris.

This Station was in charge of W. A. Crichton, who started with 10 grade Shropshire ewes, worth $8 each, and a Hampshire ram.

First Year. The flock was fed during the winter 5,120 pounds of hay, $23.04; 82 bushels roots, $8.20; 9 bushels oats, $3.60. The pasture for this flock was valued at $17.50, making a total cost for the year of $52.34, or $4.76 per head. The sheep were not dipped. Seventy-seven pounds of wool was sold at 14 cents amounting to $10.78. The ewes were in particularly good health in the spring, and considerable credit for this was thought to be due to the exercise they got. This was attained by having a feed rack at each end of the yard, and with feed in both, the sheep were continually running back and forth.

The lambs numbered 16. One was sold in November and the balance kept until May 1st. The winter feeding of the lambs consisted of 2,250 pounds of hay, $9; 13,500 pounds roots, $18; 3,000 pounds oats, $30; and 2,250 pounds ensilage, $3; total, $60, or $4 per head. The lamb sold in the fall went away before feeding commenced, and brought $8. The remaining 15 when sold weighed 2,150 pounds, and sold at 7 cents per pound, bringing in $150.50. Total receipts for lambs, $158.50, an average per head of $9.91. It should be noted that at this Station the charges for pasture and also for some of the feed are high. Total receipts, $169.28; expenses, $118.64; profit, $50.64.

Second Year. During the Winter the flock was fed 4,915 pounds of hay, valued at $18.40; 4,680 pounds roots, $5.46; and $3.60 was allowed for 360 pounds grain, making a total of $27.46, an average of $2.49 for winter feeding. The pasture for the flock was valued at $15.75. In all 18 lambs were dropped, one ewe raising two pair of twins during the year. In January she dropped a pair, which were sold for Easter, bringing $11. In October she dropped another pair, which were sold in February for $15. The other lambs were not fed over winter, but sold at various times in the fall, $97 being received in all. The flock yielded 73 pounds of wool, which sold for 15 cents per pound, $10.95. Total receipts, $107.95; total expenses, which include $8 for a ewe which died, and $2, which is the difference between the value and insurance received on one killed by lightning, were $60.11; profit, $47.84. Profits for two years, $110.75.

Redgrave.

This flock was in charge of John Pritchard, and the first year consisted of 9 grade Leicester ewes and an Oxford ram. An extra ewe was put in for the second year.

First Year. During the winter the ewes and ram were fed 5,000 pounds hay, $24.75; 73½ bushels turnips, $4.41; 149 pounds oats, $1.50; 147 pounds bran, $1.65. The summer pasture was valued at $10, and dip and salt, 72 cents, making the total cost for the year's feed $43.03; average per head, $4.30. The sheep produced 65 pounds of wool. This was washed and sold at 21 cents per pound, or $13.65. One of the ewes died on July 17th from an unknown cause. She was replaced by a ewe valued at $5.25. $4.80 was received from neighbors for the use of the ram.

Twelve lambs were raised. After weaning they were allowed the run of 1½ acres of orchard sown with rape. As this land had been cultivated and would not have been used for any other crop, the value of $5 was placed on what the lambs used. The lambs were given 2,400 pounds of hay, $7.20; pea straw, valued at $4; 120 bushels of turnips, $7.20; 1,440 pounds mixed grain, $14.40, total, $37.80; average per head, $3.15. The lambs were shipped to the Toronto market on March 15th. They weighed at Toronto 1,225 pounds, and the net price was $6.80, totalling $83.36; per head, $6.95. Receipts, $101.81; expenses, $92.34; profit, $9.47.

Second Year. The feed for the winter consisted of 4,950 pounds hay, $14.85; 4,500 pounds roots, worth $4.50; 330 pounds of grain at a cent a pound. Pasture for the summer was $15. Total for the year, including 75 cents for dip, $38.40, an average of $3.49 for the year's feeding. Sixty-two pounds of wool sold for $12.60. One ewe died, evidently from an affection of the lungs. Ten lambs were raised, all of which were fed through the winter, their feed consisting of 1,500 pounds of hay, valued at $6; 4,400 pounds of roots, valued at $4.44; 1,099 pounds of grain, worth $12.58. Total, $32.97. They were sold March 5th, at $7.50 per hundred and weighed 1,370 pounds, bringing $102.75. Total receipts, lambs and wool, $114.75. Expenses, including loss of $6.50 for ewe which died, $83.65: profit, $31.09. Profit for two years, $40.56.

Hyde Park.

A. M. Dickie had under his charge 12 grade Lincoln ewes, which were valued at $8 per head and a Lincoln ram.

First Year. The winter feeding for the flock amounted to 6,032 pounds of hay, $30.16; 1,625 pounds straw, $4.00; 110 bushels roots, $13.20; 370 pounds grain, $4.62; salt, 50 cents. The flock pastured on the roadside during the summer. Zenoleum was used for the dip, and cost $1.50. The total cost of feeding the ewes and ram was $53.98, an average of $4.16. A considerable quantity of the hay charged to ewes was removed in cleaning racks each day and fed to cattle. As no record was made of the amount taken no allowance could be made. The wool clip weighed 132 pounds and sold at 13 cents per pound, $17.16.

One of the ewes was not with lamb. The balance produced 15 lambs. The winter feeding of these included 4,865 pounds of hay, $19.46; 116 bushels mangles, $11.60, and 2,502 pounds bran, $27.52, total, $58.58; per head, $3.91. They were all sold on April 6th at $6.50 per hundred, 1,980 pounds, $128.70; per head, $8.58. Total receipts, $145.86; expenses, $119.82; profit, $26.04.

Second Year. The winter feed for this flock consisted of 4,360 pounds hay, worth $19.62; 6,000 pounds straw, valued at $6; 4,200 pounds roots, worth $7; 430 pounds grain at a cent a pound. Pasture for the summer was $3. Total for the year, including 50 cents for dip, $40.42, averaging $3.11. The clip amounted to 138 pounds and sold for 13 cents per pound, $17.94. Fourteen lambs were raised, they were charged $5 for pasture from time of weaning to start of winter feeding. They were fed 3,520 pounds of hay, worth $21.12; 5,700 pounds of roots, valued at $9.50; 1,690 pounds grain, worth $21.12; total $56.74. They were sold March 18th for $7.25 per hundred, bringing $114.27. Total receipts, $162.21; expenses, $104.42; profit, $57.79. Profits for two years, $83.83.

WINDERMERE.

Wm. Aitkins was in charge of this Station, where he had 12 grade Shropshire and Oxford ewes and a Dorset ram. The ewes were valued at $6.50 per head. At this Station it was decided to have the lambs marketed during the first summer.

First Year. The winter feeding of the flock consisted of 3,480 pounds hay, $26.10; 50½ bushels turnips, $3.03; 10 bushels oats, $4.20; 304 pounds bran, $3.80, and a quantity of ensilage, valued at $1. The flock was allowed to run on the road side so that no charge was made for pasture. Zenoleum dip was used. It cost 75 cents. The total cost for feed was $38.88, an average per head of $2.99. The wool from the flock weighed 100½ pounds and sold at 13 cents, bringing in $13.06.

Fifteen lambs were raised and as they were sold before being weaned no charge was made for feed. Twelve lambs were sold for $5 each, and the remaining 3 were kept in the flock at a valuation of $6 each. The total return from the lambs was, therefore, $78, an average of $5.20. Total receipts, $91.06; expenses, $45.06; profit, $46.

Second Year. He fed during the winter 6,550 pounds hay worth $24.00, straw valued at 50 cents and ensilage the same value, with a quantity of grain, $7.50. The flock pastured on the road and nothing is charged for it. Feed for the year, including 75 cents for dip amounted to $33.25, average, $2.56. Twelve lambs were raised and sold for $5 each during the summer before weaning, so that nothing is charged for feeding them, over and above feed of the ewes. Receipts, 98 pounds of wool at 12½ cents per pound, $12.25; lambs, $60. Total, $72.25; total expenses, $39.43; profit, $32.82. Profits for two years, $78.82.

Brown's Corners.

This Station was in charge of Wm. Little. The flock consisted of 12 ewes, one being a Cotswold grade, 3 Shropshire grades, 3 Oxford grades, one Lincoln Grade, and 4 Dorset grades, and a Southdown ram. The ewes were considered to be worth $8.00 each.

First Year. They were fed during the winter, 3,100 pounds hay, $15.50; 1,000 pounds straw, $1; 90 bushels turnips, $5.40; 22 bushels oats, $8.80; 700 pounds bran, $8.20, clover chaff and oil cake, 75 cents; total, $39.65; average, $3.05 The wool weighed 80 pounds and sold at 15 cents for $12. It was intended that the lambs from this Station should be placed on the Easter market. As Easter came unusually early in the spring, and plans had not been made long enough ahead the previous fall, it was found impossible to get any of the lambs ready before Easter. The first lamb was dropped on February 11th. During the spring, 6 lambs were sold for $46. Two were taken into the flock for breeding purposes at that time at an average of $7.50 each. The remaining 5 lambs were held over and marketed in the spring of 1911. These were dressed by Mr. Little and sold for $48.07. This makes the total receipts from the lambs, $109.07; average per head, $8.39. The 5 lambs that were kept until 1911 were placed on the road during the summer of 1910, were fed one-half ton threshed alsike, $3.00; 323 pounds oats, $3.42; 65 pounds pease, 87 cents; 60 bushels roots, $4.80; total, $12.09; average per head, $2.42. Total receipts, $121.07; expenses, $59.00; profit, $62.07.

Second Year. The flock was fed 2,700 pounds hay, $16.20; 2,250 pounds clover chaff valued at $6.75; 6,720 pounds roots worth, $8.96; 2,154 pounds grain, valued at $24.26. They pastured on the road and were only charged 50 cents for summer with 50 cents added for dip. The cost for the year was $57.17, an average of $4.76. The lambs were sold for the spring trade and received no feed which is not charged in the feed of the ewes. 22 of them were raised, which indicates that this flock is very prolific. They were sold at various times and at various prices, realizing in all $168. 103 pounds of wool brought $14.99. The total receipts were $182.99; expenses, $64.43; profit, $118.56. Profit for two years, $180.63.

TABLE No. 1.—NAME AND ADDRESS OF PERSON IN CHARGE OF EACH STATION, BREED OF RAM, NUMBER OF EWES IN THE FLOCK AND THEIR VALUE PER HEAD, VALUE OF FLOCK AND INTEREST ON INVESTMENT.

In charge of Station	Address	Breed of Ram.	No. of Ewes.	Value per Head	Value of flock including Ram at $25.00	Interest on Investment at 6%
		FIRST YEAR				
Isaac M Kenyon	Perth	Southdown	10	$6 50	$90 00	$5 40
Edwin Johns	Fairfield East	Cotswold	10	6 50	90 00	5 40
D. C. Ross	Woodville	Leicester	12	8 00	121 00	7 26
John McKee	Duntroon	Shropshire	10	8 00	105 00	6 30
W. A. Crichton	Paris	Hampshire	10	8 00	105 00	6 30
John Pritchard	Redgrave	Oxford	9	6 50	83 50	5 01
A. M. Dickie	Hyde Park	Lincoln	12	8 00	121 00	7 26
Wm. Aitkins	Windermere	Dorset Horn	12	6 50	103 00	6 18
Wm. Little	Brown's Corners	Southdown	12	8 00	121 00	7 25
		SECOND YEAR				
Isaac M. Kenyon	Perth	Southdown	10	$6 50	$90 00	$5 40
Edwin Johns	Fairfield East	Cotswold	10	6 50	128 00	7 68
D. C. Ross	Woodville	Leicester	12	8 00	129 00	7 74
John McKee	Duntroon	Shropshire	10	8 00	105 00	6 30
W. A. Crichton	Paris	Hampshire	10	8 00	105 00	6 30
John Pritchard	Redgrave	Oxford	10	6 50	96 50	5 79
A. M. Dickie	Hyde Park	Lincoln	12	8 00	121 00	7 26
Wm. Aitkins	Windermere	Dorset Horn	12	6 50	103 00	6 18
Wm. Little	Brown's Corners	Southdown	12	8 00	121 00	7 26

At Fairfield East, two ewes and ram were lost and replaced during the first year, which increases investment.
At Woodville, one ewe was lost during the first year and was replaced.
At Redgrave, one ewe was lost during the first year, and two were put in for the second year.

TABLE No. 2.—QUANTITIES AND COST OF FEED FOR EWES AND RAM.

Station.	Pasture	Hay Lbs.	Value	Straw Lbs	Value	Roots Lbs	Value	Grain Lbs.	Value	Total cost of Feed	Cost per Head
FIRST YEAR											
Perth	$2.00	500	$3.25	(a)4000	$12.00	2000	$5.00	150	$1.50	$23.75	$2.16
Fairfield East	12.00	3050	18.35	1500	2.50	2775	4.62	495	5.70	(b)43.42	3.95
Woodville	10.00	3000	15.00	3000	(c)7.00	7500	7.50	420	4.20	43.70	3.36
Duntroon	13.75	2530	14.08	......	5.00	....	....	308	3.29	(d)36.87	3.35
Paris	17,50,	5120	23.04	......	......	4920	8.20	306	3.60	52.34	4.76
Redgrave	10.00	5000	24.75	......	......	4410	4.41	296	3.15	(e)43.03	4.30
Hyde Park	......	6032	30.16	1625	4.00	6600	13.20	370	4.62	(f)53.98	4.16
Windermere	......	3480	26.10	......	(g)1.00	3030	3.03	644	8.00	(h)38.88	2.99
Brown's Corners	......	3100	15.50	1000	1.00	5400	5.40	1448	17.75	39.65	3.05
SECOND YEAR											
Perth	$2.00	700	$2.80	(a)4600	$15.00	2000	$5.00	175	$1.75	$26.55	$2.41
Fairfield East	10.00	3430	13.74	4445	6.84	234	.28	576	6.12	37.33	3.39
Woodville	9.00	6370	22.29	......	......	10920	10.92	....	....	42.56	3.27
Duntroon	12.00	2300	12.80	at will	5.00	Quantity	1.56	264	2.82	34.93	3.17
Paris	15.75	4915	18.40	......	......	4680	5.46	360	3.60	43.81	(b)4.38
Redgrave	15.00	4950	14.85	......	......	4500	4.50	330	3.30	38.40	3.49
Hyde Park	3.00	4360	19.62	6000	6.00	4200	7.00	430	4.30	40.42	3.11
Windermere	......	6550	24.00	......	.50	....	(c) .50	....	7.50	33.25	2.56
Brown's Corners	.50	2700	16.20	(d)2250	6.75	6720	8.96	2154	24.26	57.17	4.76

First Year.

(a) Unthreshed Peas.
(b) Includes 25c. for dipping solution.
(c) Includes unthreshed peas worth $2.00.
(d) Includes 75c. for dipping solution.
(e) Includes 72c. for dipping solution and salt.
(f) Includes $1.50 for dipping solution and 50c. for salt.
(g) Ensilage.
(h) Includes 75c. for dipping solution.

Second Year.

(a) Consisted of 4,000 lbs. green peas and 600 lbs. green oats.
(b) Lambs in this flock were not fed over Winter, but received a little extra in Fall, which is included in feed of ewes.
(c) Small quantity of Silage, no roots fed.
(d) Clover Chaff.

Amounts included for dip:—

Fairfield East	35	Redgrave	75
Woodville	35	Hyde Park	50
Duntroon	75	Windermere	75
Paris	60	Brown's Corners	50

TABLE No. 3.—QUANTITIES AND COST OF FEED FOR LAMBS.

Station.	Hay.		Straw.		Roots.		Grain.		Total Cost of Feed.	Cost per Head.
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.		
FIRST YEAR.										
Perth	4560	$16 72	....	....	2280	$1 90	912	$11 88	$30 40	$2 03
Fairfield East	3440	14 56	962	$ 96	1365	1 60	1950	19 50	36 62	2 82
Woodville	3375	11 81	(a) 1860	4 80	16200	16 20	714	6 30	39 11	2 30
Duntroon	4200	16 80	....	....	....	....	1230	12 30	29 10	2 65
Paris	2250	9 00	(b) 2250	3 00	13500	18 00	3000	30 00	60 00	4 00
Redgrave	2400	7 20	....	4 00	7200	(c) 12 20	1440	14 40	37 80	3 15
Hyde Park	4865	19 46	....	....	6960	11 60	2502	27 52	58 58	3 91
Windermere	....	....	....	....	....	....	....	....	....	....
Brown's Corners	....	....	(d) 1000	3 00	3600	4 80	388	4 29	12 09	2 42
SECOND YEAR.										
Perth	(a) 3700	$14 80	(b) 1000	$5 00	1800	$3 00	120	(c) $3 20	$26 00	$2 00
Fairfield East	3500	14 00	....	....	1060	1 77	1985	19 85	35 62	3 23
Woodville	1500	9 00	....	(d) 4 50	13300	13 80	994	12 42	39 72	2 84
Duntroon	2400	9 60	....	....	....	....	540	6 75	16 35	1 82
Paris (g)	....	....	....	....	....	....	....	....	....	....
Redgrave	1500	6 00	....	(e) 9 95	4440	4 44	1099	12 58	32 97	3 29
Hyde Park	3520	21 12	....	(f) 5 00	5700	9 50	1690	21 12	56 74	4 05
Windermere (h)	....	....	....	....	....	....	....	....	....	....
Brown's Corners (h)	....	....	....	....	....	....	....	....	....	....

First Year.

(a) Unthreshed Peas.
(b) Ensilage.
(c) Includes $5.00 for rape.
(d) Threshed Alsike.

Second Year.

(a) Includes green peas, valued with hay.
(b) Green oats.
(c) Includes 120 lbs. bran and $2.00 for pasture from weaning until start of Winter feeding.
(d) They were allowed pea straw at will, and this, with pasture before Winter, estimated at $4.50.
(e) A quantity of unthreshed peas, estimated value, $4.95; pasture, valued at $5.00.
(f) Pasture from weaning until Winter feeding commenced.
(g) Not fed over Winter; sold in October.
(h) Sold for Spring trade.

TABLE No. 4.—RECEIPTS FOR LAMBS.

Station.	Date Sold.	No. Sold.	No. not Sold.	Total Weight.	Price per cwt.	Value.	Average value per Head.
FIRST YEAR.							
Perth	March 6th	12	3	1500	$6 25	$93 75	$6 25
Fairfield East	April 25th	(13)	..	1707	7 00	119 49	8 77
		((a) 2)	..	....	......	12 00	......
Woodville	(March 27th)	13	4	2339	6 65	156 54	9 05
	(November)	1	..	115	5 50	6 32	......
Duntroon	March 17th	11	..	1365	7 00	95 55	8 69
Paris	(May 1st)	15	..	2150	7 00	150 50	9 91
	(Fall)	1	..	....	......	8 00	......
Redgrave	March 15th	12	..	1225	6 80	83 36	6 95
Hyde Park	April 6th	15	..	1980	6 50	128 70	8 58
Windermere	....	12	(..)	....	(b) 5 00	78·00	5 20
			(3)	....	(b) 6 00	......	......
Brown's Corners	(Spring, 1910)	6	..	....	......	46 00	......
	....	..	2	....	7 50	15 00	......
	(Spring, 1911)	5	..	....	......	48 07	8 39
SECOND YEAR.							
Perth	March 11th	13	(a) 2	1170	7 50	$87 20	$6 74
Fairfield East	April 20th	9	2	1282	6 50	83 33	7 57
Woodville	March 11th	12	2	1720	7 00	120 40	8 60
Duntroon	March 5th	9	..	915	8 00	73 20	8 14
Paris	Various	15	..	1355	(b) 6 46	97 00	6 46
Redgrave	March 5th	10	..	1370	7 50	102 75	10 27
Hyde Park	March 18th	14	..	1990	7 25	144 27	10 30
Windermere	''ly and August	12	..	....	(c) 5 00	60 00	5 00
Brown's Corners	rious	22	..	....	......	168 00	7 63

First Year.

(a) Killed on railway.
(b) Price per head.

Second Year.

(a) Two killed in September, valued at $8.60.
(b) Average per head.
(c) Price per head.

TABLE No. 5.—SUMMARY OF RECEIPTS AND EXPENSES.

Station.	Receipts. Wool. Lbs.	Wool. Price.	Wool. Value.	Lambs.	Total.	Expenses. Feed Ewes and Ram.	Feed Lambs.	Losses.	Interest on Investment.	Total.	Profit.
FIRST YEAR.											
Perth	69	(1) $0 24	$16 56	$ 93 75	$110 31	$23 75	$30 40	....	$5 40	$59 55	$50 76
Fairfield East	85	13½	11 47	131 49	142 96	43 42	36 62	$38 00	5 40	123 39	19 57
Woodville	130	13½	17 55	162 86	180 41	43 70	39 11	8 00	7 26	98 07	82 34
Duntroon	109	13	14 17	95 55	109 72	36 87	29 10	8 00	6 30	80 27	29 45
Paris	77	14	10 78	158 50	169 28	52 34	60 00	....	6 30	118 64	50 64
Redgrave	65	(1) 21	13 65	83 36	(a) 101 81	43 03	37 80	6 50	5 01	92 34	9 47
Hyde Park	132	13	17 16	128 70	145 86	53 98	58 58	....	7 26	119 82	26 04
Windermere	100½	13	13 06	78 00	91 06	38 88	....	....	6 18	45 06	46 00
Brown's Corners	80	15	12 00	109 07	121 07	39 65	12 09	....	7 26	59 00	62 07
SECOND YEAR.											
Perth	71	$0 23	$16 33	$87 70	$104 03	$26 55	$26 00	(a)13 00	$5 40	$70 95	$33.08
Fairfield East	97	14	13 58	83 33	96 91	37 33	35 62	......	7 68	80 63	16 28
Woodville	135	13½	18 22	120 40	138 62	42 56	39 72	......	7 74	90 02	48 60
Duntroon	90	14	12 60	73 20	85 80	34 93	16 35	......	6 30	57 58	28 22
Paris	73	15	10 95	97 00	107 95	43 81	......	(b)10 00	6 30	60 11	47 84
Redgrave	62	5— 12 (1)57— 20	12 00	102 75	144 75	38 40	32 97	(c) 6 50	5 79	83 66	31 09
Hyde Park	138	13	17 94	144 27	162 21	40 42	56 74	......	7 26	104 42	57 79
Windermere	98	12½	12 25	60 00	72 25	33 25	......	......	6 18	39 43	32 82
Brown's Corners	103	80— 15 23— 13	14 99	168 00	182 99	57 17	......	......	7 26	64 43	118 56

First Year.

At Fairfield East Station losses included ram and two ewes. In each of the other cases one ewe was lost.

(1) Washed.

(a) Includes $4.80 for service of ram.

Second Year.

(1) Washed.

(a) Two ewes worried by dogs.

(b) One ewe died and one ewe was killed by lightning, on which $6.00 insurance was received, leaving a loss of $2.00.

(c) One ewe died.

When we consider the results of these experiments we are bound to agree with the Sheep Breeders who claim that "Sheep Raising in Ontario Pays."

The flocks in this set of experiments were handled under ordinary farm conditions and under every condition likely to be met with throughout the Province, and every one of them showed a reasonable and some of them a remarkably gratifying surplus in each of the two years during which the experiment was carried on. It would appear from the report of the Station at Brown's Corners that where a farmer is so situated that he can cater to the early spring or Easter trade, that it is an unusually profitable line to follow, this flock in the second year giving almost as much profit as the value of the flock. The flock at Windermere, where the lambs were sold for the summer hotel trade, was also very profitable, giving an average profit of $39.41 per year. While these two flocks may have had especially favorable conditions, the other seven flocks which were kept under conditions no more favorable than any farmer in the Province enjoys, gave a total profit for two years of $543.43, an average of $38.81 per year per flock.

"Sheep Raising in Ontario Pays." Try it with a flock of ten or twelve grade ewes and a pure bred ram and increase the profits from your farm.

HANDLING AND MARKETING WOOL.

Some years ago one of the reasons given for sheep raising not being more profitable than it was, was the comparatively poor price paid for wool, and no doubt there was a great deal of truth in it. If a better price had been obtained for wool, it would have increased the profits from sheep raising and thus induced the farmers of the Province to keep more sheep. This is not true to the same extent to-day, and buyers claim that if the clip of wool was properly handled they would be able to pay still higher prices.

With the object of determining what improvements in the marketing of wool would be most likely to have the desired result, inquiries were made of a large number of firms throughout the Province manufacturing woolen goods asking them what classes of goods they manufactured, the kinds of wool used, where they purchased it, the amount of Canadian wool used, and what criticisms they had to offer with reference to it, and what suggestions, if any, they would make with reference to the marketing of it. From the replies received from these various manufacturers the following conclusions are drawn:

London rules the wool markets of the world, and when our manufacturers cannot obtain what they want nearer home, they buy their supplies there. If we do not supply their demands and they go to London, we will suffer to a certain extent because our wool is constantly in competition with wools produced in Australia and other parts of the world, where proper care is taken to place it upon the market in the very best condition. We have no wool market nor any system of selling. We do not offer large enough amounts for sale at a time to make it worth while for a buyer to go any distance. This can be remedied if more sheep were to be raised.

That almost every known breed of sheep is kept in Ontario, with the exception of the Merino, and no two breeds of sheep produce exactly the same kinds of wool, although the Lincolns and Cotswolds produce very similar wools.

Roughly speaking, there are three great classes of wools:

(1) Clothing wool—short.
(2) Delaine—fine, strong, short wools (Worsteds).
(3) Combing—long wools.

That for the fine classes of goods the wools have to be imported, but for the coarser clothings, blankets, etc., for which there is a large and growing market, our Canadian wools cannot be outclassed. The rapid growth of some of our establishments manufacturing such goods and using Canadian wool only is sufficient proof of this. The "Cornwall" blanket, which had a world-wide reputation for its quality was made entirely of Canadian wool and would still be famous but for the use of cheaper materials.

The question of breeds of sheep and kinds of wool is not so important as the proper care of the wool while it is on the sheep and at shearing time; uses can be found for the wool from every breed of sheep, provided it is properly cared for. In many cases the weeds are not combatted and the sheep are allowed to wander all over the farm, gathering up burrs and bootjacks as trophies. After these, too, often comes a straw or hay stack, which adds its quota of foreign material to the wool.

While many provide proper places and take care of their sheep, a great many more do not. In many cases the sheep are underfed during the winter, which causes them to lose flesh. When this occurs, a weak spot in the wool fibre can be found which detracts greatly from its value as the wool will become clotted and will not divide, making it impossible to properly comb or card it. To provide wool of good quality, the sheep must be kept in clean quarters and fed well enough to be in a healthy condition.

Breeds should not be crossed, as it produces a nondescript wool which is not well suited for any particular purpose and consequently is not very marketable. Excessive inbreeding or anything which weakens the constitution of the flock will have a bad effect on the quality of the wool.

Though the producer may not always take proper care of the wool while it is on the sheep, there should be no excuse for not delivering it in better shape. A great many fleeces are rolled up without being trimmed in any way, including all the burrs and dirt which they originally contained. Too often the fleece is tied up with binder twine and it is next to impossible to prevent strands of the hemp from being mixed with the wool. This vegetable material will not take the dye which is used for the wool, and it therefore detracts greatly from the value of any piece of cloth into which it happens to find its way. The manufacturer prefers to obtain unwashed wool, as he has to furnish machinery for washing and scouring anyway and they do it more thoroughly than the farmer can do it with the means at his disposal. It is also better for the sheep as there is no delay in shearing due to waiting for warmer water.

The producer, however, is not altogether to blame; the practice of selling to small dealers is a great drawback. They pay an average price, and if a man has only a small quantity, no matter what the quality, he cannot command any higher price. Too often the dealers cannot distinguish between the various wools, and cases are on record where they have bought unwashed wool for washed wool.

There is now some encouragement for the farmer to take better care of the wool, but he must in most cases change his system of marketing to obtain the full benefit which might be obtained by taking better care of his product. There is no money in it under the system of marketing generally practiced unless he produces sufficient to attract a manufacturer. There is no business in Ontario where the inexperienced middleman is doing more harm than in the wool business. The farmers should deal directly with the consumer or large wool merchant. This is being done in some districts. Around Lindsay, where the producers have been selling directly to the manufacturers according to quality, the standard of wools has risen considerably. The small dealers sell by bulk and no large dealer can afford to give them the best price because there can be no guarantee given as to the quality, cleanliness, etc., of the wool. This class of dealer should be eliminated. It is not a business, but a sideline with most of them.

It is estimated that there is an average loss of 17 per cent. in all Ontario wool due to dirt, poor wool, etc. Were it possible to have every sheep owner visit some mill and have the various processes pointed out to him and shown how, with the most up to date processes and machinery, it is impossible to prevent some dirt occasionally finding its way into the manufactured article, he would no doubt take greater care to prevent dirt getting into the wool.

The farmers can individually do a great deal to improve the quality of the wool placed on the market by taking care to prevent dirt getting into the wool while on the sheep and by being more careful at shearing time in trimming the fleeces. Instead of using twine to tie them, a small strand of wool from the fleece itself should be twisted and used for this purpose. It is not necessary to have the fleeces tied up tightly so long as they are tied neatly enough to keep each fleece by itself, it is all that is required.

In marketing, some scheme of co-operation as practised by the fruit men should greatly help to solve the question. In Tennessee, great benefit has been derived from Wool Clubs. The clubs were formed for the purpose of helping each other in the matter of selling only. Each member of the club furnishes an estimate of the amount of wool which he will have for sale to the Secretary of the club. Arrangements are made to have the wool delivered at a sorting shed and an expert sorter secured for a time to sort the wool. The wool from each farmer is sorted and he is credited with so many pounds of each grade. When the clip is all in, the club is able to say to buyers we have so many pounds of wool of each grade, what will you pay? The manufacturer or large wool merchant knows the quality of wool, and, as he is buying in fairly large quantities, he is enabled to offer the highest possible price. This scheme eliminates the middleman and gives the farmer all there is in his wool. Then there is encouragement offered to produce the best grade of wool.

If clubs of this sort were formed in districts throughout the Province, it would help to increase the profits from sheep-raising and also create more interest in the industry. This would be a step towards establishing a market, each club centre would be a market on a small scale, and afterward, if it appeared to be advisable, co-operation among a number of clubs would make larger markets and attract more buyers.

LIST OF BULLETINS

Published by the Ontario Department of Agriculture, Toronto.

Serial No.	Date.		Title.	Author.
168	Oct.	1908	The Perennial Sow Thistle and some other Weed Pests	J. E. Howitt.
169	Feb.	1909	Legume Bacteria: Further Studies of Nitrogen Accumulation in the Leguminosæ	S. F. Edwards. B. Barlow.
170	Mar.	1909	Mitchell-Walker Test Bottle	J. W. Mitchell. W. O. Walker.
171	April	1909	Insects Affecting Vegetables	C. J. S. Bethune.
			Fungus Diseases Affecting Vegetables	J. E Howitt. J. W. Eastham.
172	May	1909	Dairy School Bulletin (No. 143 Revised)	Dairy School.
173	Oct.	1909	Birds of Ontario	C. W. Nash.
174	Dec.	1909	Farm Underdrainage: Does it Pay?	W. H. Day.
175	Dec.	1909	Farm Drainage Operations	W. H. Day.
176	Dec.	1909	Bacterial Blight of Apple, Pear and Quince Trees	D. H. Jones.
177	Dec.	1909	Lime-Sulphur Wash	H. L. Fulmer. L. Caesar.
178	Dec.	1909	Character and Treatment of Swamp or Muck Soils	W. P. Gamble. A. E. Slater.
179	Feb.	1910	Fruits Recommended for Ontario Planters (No. 147 revised)	Fruit Branch
180	April	1910	Flour and Breadmaking	R. Harcourt. M. A. Purdy.
181	June	1910	The Teeth and Their Care	Ont. Dental Society.
182	July	1910	Bee-keeping in Ontario	Fruit Branch.
183	Aug.	1910	Notes on Cheddar Cheese-making	Dairy Branch.
184	Nov.	1910	Uses of Vegetables, Fruits and Honey	..................,
185	Nov.	1910	Little Peach Disease	L. Caesar.
186	Dec.	1910	Children: Care and Training	J. J. Kelso.
187	Jan.	1911	The Codling Moth	L. Caesar.
188	April	1911	Weeds of Ontario (No. 128 revised)	J. E. Howitt.
189	May	1911	Farm Poultry (151 revised)	W. R. Graham.
190	May	1911	Bee Diseases in Ontario	Fruit Branch.
191	June	1911	Bee-keeping in Ontario	Fruit Branch.
192	July	1911	Agricultural Co-operation	S. E. Todd.
193	Nov.	1911	Tuberculosis of Fowls	S. F. Edwards.
194	Dec.	1911	Apple Orcharding	Fruit Branch.
195	Jan.	1912	Insectides and Fungicides. (No. 154 revised	R. Harcourt. H. L. Fulmer.
196	Jan.	1912	Tomatoes	A. G. Turney.
197	Feb.	1912	Bee Diseases in Ontario	Morley Pettit.
198	Feb.	1912	Lime-Sulphur Wash	L. Caesar.
199	Feb.	1912	Onions	A. McMeans.
200	April	1912	Fruit Juices	L. Meunier.
201	May	1912	Peach Diseases	F. M. Clement.
			Peach Growing in Ontario	L. Caesar.
202	May	1912	Grape Growing in Niagara Peninsula	T. B. Revett.
203	May	1912	Cabbage and Cauliflower	A. McMeans.
204	June	1912	Decay of the Teeth	Ont. Dental Society.
205	Sept.	1912	Dairy School Bulletin (No. 172 revised) Part I. Cheese-making and Butter-making	Staff of Dairy School.
206	Nov.	1912	Dairy School Bulletin (No. 172 revised) Part II. Dairying on the Farm	Dairy School.
207	Dec.	1912	Ice Cold Storage on the Farm	R. R. Graham.
208	Jan.	1913	Farm Poultry and Egg Marketing Conditions in Ontario County	J. H. Hare. T. A. Benson.
209	March	1913	Farm Forestry (No. 155 revised)	E. J. Zavitz.
210	March	1913	Strawberry Culture and The Red Raspberry.	F. M. Clement.
211	March	1913	Fruits Recommended for Ontario Planters... (No. 179 revised.)	Fruit Branch
212	April	1913	Orchard Surveys in Dundas, Stormont and Glengarry	F. S. Reeves.
213	April	1913	Bee Diseases in Ontario	Morley Pettit.
214	May	1913	Sheep Raising in Ontario: Does it Pay?	Live Stock Branch.

Ontario Department of Agriculture

INSTITUTES BRANCH

BULLETIN 215

Demonstration-Lectures in Domestic Science (Foods and Cooking) Sewing and Home Nursing

TORONTO, ONTARIO, AUGUST, 1913

BULLETIN 215] [AUGUST, 1913

Ontario Department of Agriculture

INSTITUTES BRANCH

Demonstration Lectures in Domestic Science, (Cooking) Sewing and Home Nursing

Courses, each consisting of ten Demonstration-Lectures, will be held as follows: 1. September 29 to December 6, 1913; 2. January 5 to March 14; 3. March 16 to May 23, 1914.

Similar courses given under the direction of the Institutes Branch of the Department of Agriculture during the winter of 1912-13 proved most successful, and a liberal appropriation from the Federal Grant has been set apart for an extension of the work during the season of 1913-14.

The Institutes desiring to take advantage of the offer will please fill out the application form, found in the back of this book, and forward the same either to the superintendent, or to the district secretary of the riding in which the branch is located. The district and branch officers will be expected to confer in planning for the courses and if possible send applications from groups of institutes conveniently located, so that the instructor may readily travel from place to place, holding a course at a different point each day, from Monday to Friday inclusive, covering the same route from week to week. The classes, will, for the most part, be held in the afternoon, beginning at 2 or 2.30 o'clock. Arrangements will be made in special cases for the holding of classes in the evening, if desired. The institute officers are at liberty to form classes of High School Girls for the study of Domestic Science (cooking) and Home Nursing, instruction to such classes being given either in the late afternoon or in the evening. Where High School classes are formed, the Institute and the class concerned will be expected to furnish all supplies and provide a hall or a class room free of cost to the Department. A charge of 25c. for the course will be made for each pupil, ten cents to be paid to the instructor, and fifteen cents to be used to defray incidental expenses.

There should be no difficulty in securing suitable halls in which to hold classes. In some cases public buildings are placed at the disposal of the Institute, free of cost, while at other points, Sunday School rooms, or other rooms in connection with churches, are available, and occasionally the school trustees place a room at the disposal of the Institute for the regular class as well as the High School class.

The contract forms found on the succeeding pages will indicate the nature of the work to be undertaken. Following these contract forms, is a brief report of what has already been done in Demonstration-Lecture work, together with statements from some of the Instructors and those who have taken advantage of the classes. Blank application form will be found at the end of the book, and applications should be in the hands of the Department as soon as possible, and not later than September 15th for courses which are to begin early in October. Applications for courses to be held in January, February and March, will be received up to the middle of October; and for March, April and May, up to the middle of January.

TYPICAL CONTRACT.

Between the Institutes Branch of the Department of Agriculture and the........................Institute
(Name of)

Demonstration-Lecture Course in

FOODS and COOKING.

The Department of Agriculture agrees to:—

1. Provide all portable equipment, except the necessary tables, chairs and one cookstove.
2. Provide a teacher who will:
   (*a*) Give ten Demonstration-Lectures in Domestic Science (Foods and Cooking), one each week, to each of the places included in the itinerary.
   (*b*) Furnish such person as the Institute may appoint with written directions for any local marketing or special preparations at least one week before they are needed.

Each local Institute agrees to:—

1. Advertise the course and solicit members for the class with a view of securing as large classes as possible.
2. Provide a room or hall suitable for the lectures and demonstrations, equipped with the necessary chairs, tables, cookstove, etc., also to see that the hall is properly cleaned, lighted, heated and ventilated.
3. Provide all materials for demonstration work.
4. Provide an assistant who will become responsible for the opening of the room, do the necessary local marketing, and clear up and clean the demonstration tables, dishes, etc. (It is usually possible to find some girl willing to pay for her attendance on the course in this way.)
5. Guarantee the sale of twenty-five (25) course tickets at $1.25 per ticket.
6. Appoint some person who will be required to keep an exact record of the attendance of those holding course tickets as well as occasionals, at each session and report the same to the teacher at the close of the course.
7. Pay the $25.00 charged for the course within 3 weeks of the commencement of the course, and one-half of the receipts above $25.00, whether payments be on account of course tickets or single admissions, either during or at the conclusion of the course. Payments are to be made to the instructor and receipts secured at time of payment.
8. The Institute concerned is at liberty to sell course tickets in addition to the twenty-five required and also to admit members to single lectures at 15 cents per lesson.

Signed by;

................................,representing the Department of Agriculture.
................................,representing..................Institute.
................................, teacher.
Dated at ...., this .... day of .... 1913.

REGULATIONS COVERING COURSE IN DOMESTIC SCIENCE (FOODS AND COOKING).

Each Institute concerned may select ten lectures from the following list.

If any Institute wishes to enlarge any one subject into two lectures in order to cover the ground more thoroughly, it may be so arranged.

The sequence of the lectures should be left to the lecturer to arrange. She will, however, defer to the wishes of the Institutes as far as the proper development of the whole series will permit.

The lecturer will place especial emphasis in all lectures upon the food value of the foodstuffs used, and upon the comparison of money value of the different foodstuffs, as related to food value.

Regular List.

Lecture No.

1. Fruit—Typical methods of cooking: combinations; different ways of serving fresh fruit.
2. Vegetables—Fresh, starchy and dried.
3. Milk—Soups, puddings and combinations, with especial relation to infant, children and invalid diet. Invalid cookery.
4. Cereals and Cheese—Various methods of cooking: their high food value compared with other more expensive foods.
5. Eggs—Correct methods of cooking; variations in methods; storage. Substitutes for meat.
6. Tender Meats—Roasting and broiling; the correct cuts; food value compared with other meat cuts and other foods. Tough Meat—Braised dishes, stews and soups.
7. Baking-powder breads. Yeast Bread and Fancy Breads.
8. Cake and little cakes.
9. Puddings and Desserts.
10. Salads—Preparation of the ingredients, dressings, etc.

Optional List.

1. Made-over Dishes.
2. Fireless Cookery.
3. Poultry.
4. Breakfast Dishes.
5. Table Service.

The Department prefers to have the Institutes choose the Demonstration lectures indicated in the "regular list." If, however, there is a strong preference for one or more of the topics given in the "optional list" in place of some of the "regular" subjects, they may be substituted.

Domestic Science (Cooking) Class—Thamesville Institute.

TYPICAL CONTACT.

Between the Institutes Branch of the Department of Agriculture and the.....................Institute.

(Name of)

DEMONSTRATION-LECTURE COURSE IN

SEWING.

The Department of Agriculture agrees to:

1. Furnish an instructor to give ten demonstration lectures as follows:—
   Two lessons on plain and fancy stitches.
   Three lessons on skirt waists.
   Two lessons on skirts.
   Three lessons on one-piece dresses.

   Each lesson to continue for two hours. (If necessary, the instructor will devote considerably more time to each lesson.)
2. Have the instructor give the necessary directions to the members of the class from time to time as to the materials required and announcements regarding the work to be undertaken.

Each local Institute agrees to:—

1. Form classes of twenty to twenty-five for which a charge of $2.00 for each person will be made.
2. Provide a room or hall properly cleaned, lighted, heated and ventilated, and furnished with the necessary tables and chairs. The room to be used should contain 400 square feet floor space.
3. Provide at least three sewing machines (these can be secured through the co-operation of the demonstrator free of cost).

4. Each person will be expected to supply materials to make the garments indicated in the lesson list.

   Each person must also provide:

   1 twelve-inch rule; 1 spool of thread No. 60; 1 spool of thread No. 40; Needles Long Sharp No. 7; Mixed crewel 1 to 6; D. M. C. Cotton for fancy stitches.

5. Provide in addition to the items mentioned, a roll of paper for drafting patterns, 22 in. wide, a light, thin quality preferred. Each person receives a shirt waist and skirt pattern cut to measure.

6. Appoint some person who will be required to keep an exact record of the attendance and to collect the fees from the members of the class as well as those who take only occasional lectures. Payment for the course ($40.00) must be made not later than the third week of the course, and one half the receipts above $40.00 either during or at the conclusion of the course. The charge for single lessons in the Sewing course will be twenty-five cents. Payments are to be made to the instructor by the class secretary and receipts secured at time of payment.

Where the Institutes desire it, the Department is willing that two sewing classes be formed in the one centre, or, if those taking advantage of this course prefer to cover the ground in five weeks, they may arrange to have two lessons on the one day, *i.e.* one in the forenoon and one in the afternoon.

Class in Sewing—Ancaster Institute.

Note.—In the Sewing classes conducted by Mrs. N. H. Altenburg, it will be impossible to instruct to advantage more than twenty-five. So the Institutes are not at liberty to allow occasionals to attend, except where this can be done without making the attendance greater than twenty-five.

Signed by:

.... representing the Department of Agriculture.
.............................., representing ....Institute.
.............................., teacher.
Dated at .... this .... day of .... 1913.

TYPICAL CONTRACT.

Between the Institutes branch of the Department of Agriculture and the..................Institute.

Demonstration Lecture Course in

HOME NURSING.

The Department of Agriculture agrees to:—

1. Provide the necessary equipment for general instruction, such as bandages, etc.
2. Provide an instructor to give ten demonstration-lectures in Home Nursing, including:—
    1. Sick Room—Sanitation, ventilation, care, etc.
    2. Bed-making for various forms of sickness.
    3. The Bath.
    4. Emergencies.
    5. Hot and Cold Applications.
    6. Bandaging.
    7. Disinfectants and observations of symptoms.
    8. The administration of Food and Medicine.
    9. Baby Hygiene.
    10. Review and General Discussion.

The Local Institute agrees to:—

1. Secure as large a class as possible through advertising and soliciting.
2. Provide a suitable room or hall for the Demonstration-Lectures, equipped with the necessary chairs and table, also to see that the hall is properly cleaned, lighted, heated and ventilated.
3. Guarantee the sale of twenty-five (25) course tickets at $1.25 per ticket.
4. Appoint some person who will be required to keep an exact record of attendance of regular course students as well as those who take advantage of occasional lectures.
5. Pay the $25.00 charged for the course within three weeks of the commencement of the course, and one half of the receipts above $25.00, whether payment be made on account of course tickets or single admission, either during or at the conclusion of the course. Payments are to be made to the instructor and receipts secured at time of payment.

The Institute is at liberty to sell tickets in addition to the twenty-five required, and also to admit members of the Institute to single lectures at fifteen cents per lesson.

Signed by:

.............................., representing the Department of Agriculture.
.............................., representing...............Institute.
.............................., teacher.
Dated at ...., this.................day of................1913.

HOME NURSING.

The importance of this work cannot be over estimated. Almost every woman is called upon at sometime during her life to minister to the sick. As there is no time after the emergency arises to prepare for it, every woman should be forearmed with some definite knowledge of how to care for the sick. That is briefly the object of this course—to enable women to easily obtain a knowledge of how to care for the sick in the home, what to do in an emergency and how to do it, how to render at all times the best possible assistance to the doctor or to the nurse, when her services are necessary, although very often that expense can be saved because of the ability of the woman of the home to handle the situation.

MISS D. I. HUGHES,
Demonstration Lecturer in Home Nursing.

Throughout the course the women are given lots of experience in reading the clinical thermometer, counting pulse and respirations. The keeping of a chart is also taken up: This consists in keeping a simple exact record of the various things mentioned thereon.

The first lesson is a lecture on the sick room. Then follows a demonstration on bed-making—that is the making of the sick bed, the various ways of making it for various kinds of cases, changing the bed with the patient in it, changing the mattress with the patient in bed, etc.

The next lesson is on the bath given in bed for the comfort and cleanliness of the patient. During this lesson a talk is given upon the various other baths given in sickness, how and why they are given. The foot bath given in bed and the hot pack are also demonstrated.

Then emergency work is taken up—the regular instruction in First Aid. In this work is included treatment of such things as: Burns and scalds, contusions, dislocations, foreign bodies in the ears, eyes, nose, trachea: fractures, hemorrhage, shock, sprains, wounds, how to distinguish and treat the various forms of unconsciousness as apoplexy, asphyxia, collapse, convulsions, drowning, epilepsy, fainting, hysteria, intoxication, poison, sunstroke, etc.

The next lesson is devoted to external applications and the following will give an idea of what is treated under this head: Inflamation, counter-irritants, poultices, fomentations, iodine, liniments, application of cold, ice poultices, ice caps, compresses, antiphlogistine, starch poultices, ointments.

Bandaging is also taken up. Under this comes: Use, nature, sizes and construction of bandages; points to remember in bandaging, application of circular, spiral, spiral reverse, recurrent, and figure 8 bandages, bandages for head, eyes, jaw, hand, arm, elbow, knee, leg, foot and heel. Tailed bandages, binders, slings and handkerchief bandages.

Disinfectants and observation of symptoms are included in the same lesson—the latter is very important. Some of the things dealt with are: Temperature, pulse, respiration, tongue, urine, vomiting, fæces and other excreta, color, pain, position, restlessness, etc.

Then comes a lesson on the administration of food and medicine.

This is followed by a lesson on Baby Hygiene, and the last lesson is devoted to review and general discussion.

It will be necessary for the classes to provide bed and bedding, towels, basin, etc., for lessons 2 and 3.

The Home Nursing classes can very well be held in the homes of the members.

Comments upon the Home Nursing Course.

One woman of 70, in discussing the course after the final lesson, said, "I don't think I need say what I think about the course. The fact that at my age I have attended, in all kinds of weather, surely speaks of the value I place on these lectures. I have only missed one and that day I was sick in bed, and to tell the truth I did not mind being sick half as much as I minded missing that class."

In one class, three generations were represented—the daughter, her mother, and her grandmother. The grandmother was heard to say one day before class: "We have all got a lot of good out of these lessons. I won't have as long to make use of what I've learned as my daughter and granddaughter, but I'm sure they have not enjoyed the course a bit more than I have."

Demonstration-Lectures in

DOMESTIC SCIENCE (COOKING), SEWING AND HOME NURSING.

While the study of Domestic Science in its broadest sense and its practical application to the every-day activities of the rural home has for many years been a matter of interest and great importance, its usefulness has been intensified as a result of the change in economic and social conditions in the country districts. With the scarcity of labour and the increasing value of the products of the farm, it becomes the women of the farm, as well as the city residents, to study the food values and prices of the various products at their disposal, methods of cooking, labour saving devices, clothing, care of the sick, etc., etc.

Opportunities for systematic instruction along Domestic Science lines have been provided only in a limited number of our larger centres of population, with the result that a very small proportion of the girls from our rural districts have taken advantage of the instruction offered.

Directors of education in our schools and colleges are attaching more and more importance to Domestic Science. The special efforts along this line, by the Y.W.C.A., technical schools, ladies' colleges and private schools, have, for the most part, benefited only our young women. What about the great band of women, (young, middle aged and old) who cannot take advantage of the above mentioned facilities, but who are desirous of learning something of that science which has made such great progress during recent years and which can be made of great value even to women who have had many years of experience in directing the activities of a household and in performing the numerous tasks associated with homemaking.

The chief aim of those who have had to do with the work of the Women"s Institutes in the Province of Ontario has been to direct the women of the country, town and village as to how best to utilize the forces at their command:—standard works, reports, bulletins, and periodicals; practical experience; healthful sociability, etc.—to the best advantage, and also to *instruct* them to a limited extent in domestic science, home nursing, child welfare, etc.

A survey of the Institute work in this Province will be of interest at this point.

Some thirty years ago, systematic instruction for farmers—the giving of lectures by agricultural scientists and practical farmers in the rural districts—was inaugurated. From the beginning, the women living on the farm took more or less interest in these lectures and read some of the articles appearing in the Departmental publications, especially those bearing upon dairying, fruit growing, poultry raising, gardening and other activities in which the women on the farm were specially interested. An evidence of their appreciation was shown in the request for a separate organization to deal with only those features of work with which women are directly concerned. As a result, what is know as the Women's Institutes of Ontario had their beginning some seventeen years ago, and in 1900 there were 33 institutes with a membership of 1,600, while to-day we have nearly 800 separate organizations with a membership of over 25,000.

While the activities from the first embraced all that is implied in the constitution,—"The objects of Women's Institutes shall be the dissemination of knowledge relating to domestic economy, including household architecture, with special attention to home sanitation; a better understanding of the economic and hygienic value of foods, clothing and fuel, and a more scientific care and training of children with a view to raising the general standard of the health and morals of our people—" much has been added thereto in recent years. Food values, cooking, preserving, hygiene, feeding of invalids and children, training of children, literature in the home, beautifying the home, etc., were embraced from the first, but of recent years child welfare in its broadest sense, social questions, civic improvement, business methods for women, laws governing women and children, school improvement, rest rooms for women, philanthropic work, in fact all matters which have for their object the betterment of home and community conditions have been added to the list of their good works.

Having taken up Domestic Science to a limited extent by isolated lectures, occasional demonstrations, and by unsystematic study, the members became impressed with its value and asked that provision be made for giving them systematic instruction along these lines. The first attempt to give groups of women living in the rural district such instruction was undertaken in the fall of 1911 at the following places where classes of at least twenty-five were formed, and at two points, Caledonia and Dunnville, evening classes were held for the benefit of the High School girls:—Cayuga, Dunnville, Delhi, Hagersville, Caledonia, Canfield. The average attendance at the classes was thirty-five, and at one point the attendance was over seventy-five. The lecturer, Mrs. C. H. Burns, a graduate of MacDonald Institute, Guelph, spent one day a week at each point for a period of fifteen weeks.

The success which attended this first effort indicates the interest which mature women of responsibility take in efforts towards their instruction along Domestic Science lines.

The Department was encouraged to extend this new and promising form of instruction during the season of 1912-13. The institutes accepted the announcement with great enthusiasm and responded by applying for instruction at more points than could be served.

The following table indicates the nature and extent of the work done:

Nature of Course	District	No. of places	No. of lessons in course	No. of persons who took course
Foods and their preparation......	Northumberland.....	5	15	136
" "	Lambton and Kent ..	5	15	154
" "	Middlesex and Lambton	4	15	349
" "	Lanark	4	15	265
Sewing	Lincoln, Welland, Wentworth, Brant and Waterloo.....	13	10	491
"	Wentworth	2	4	31
Combination courses in Sewing, Foods and Home Nursing......	York	9	8 to 12	241
				1,667

Besides those who took the regular course of lectures a number attended and paid for only *occasional* lectures.

The Work Appreciated.

In order that our readers may be informed regarding the appreciation of this work on the part of those who took the course, and the views of the lecturers engaged, we print below extracts from communications received.

MISS GERTRUDE GRAY,
Demonstrator in Cooking.

COURSE IN FOODS AND COOKING.

By Gertrude Gray, Demonstration Lecturer, Toronto.

One thing that the Women's Institutes stand for—par excellence—is progress, progress in thought, in self-development, in efficiency.

In the crusade which modern business now wages for efficiency and conservation of energy we have an example worthy of imitation in the home.

The latest use to which the moving picture machine has been put is in manufacturing plants where employers are seeking to eliminate useless and time consuming movements on the part of their employees, for example: Motion pictures, carefully timed, were taken of a worker as he did his work. These films were developed, thrown on a screen, and carefully studied. The result was that superfluous motion was at once detected, eliminated from the screen, and the consequent pictures used to instruct younger, unskilled workers.

A similar scrutiny of household operations reveals the need for greater efficiency and more time and energy conserving methods there, where skilled labour is the exception rather than the rule. As the result of the lack of technical education in our schools, until fairly recent years, many present-day home-makers find themselves without the scientific knowledge which, coupled with practical experience, marks the competent worker.

Purely mechanical ability will not suffice to-day, and intelligent understanding of the underlying principles of one's work is necessary to make of that work the greatest success.

A realization of this fact has led to a request from women in our institutes for systematic instruction in different branches of home work. As a result, there are now being given in our Province, to different groups of Institutes, Demonstration-Lecture Courses. These aim to bring to the home-makers and the girls who attend, the information of our Household Science Schools in an abbreviated form. Anything new has to demonstrate its claim to recognition and support. Last year's work has done that. A number of courses have already been given and the hearty support and co-operation of the members of the classes seem to justify a continuance of the work on more comprehensive lines.

Having had charge of two courses in Food Preparation, one in Northumberland and one in Lambton and Kent, I can write more definitely of them than of the others. Three weeks before the work started I visited the counties. became acquainted with the officers at each place and made arrangements for transportation. The directions sent out by the Department beforehand. however. were so explicit that everything was pretty well understood by the officers and it was comparatively easy to start the work. Arrangements were made for halls or other suitable places to be used throughout the course. In two places kitchens were used. The advertising is also done by the local people and much of the success of the work, so far as the size of the classes is concerned, depends on the way it is advertised. It should be definitely stated in all press notices that anyone is welcome to attend and a personal invitation is most effective with some. A secretary of one of the branches told many ladies of the work by phone and asked them to join. and as a result that class is the largest in the district.

In each demonstration, special emphasis is laid on the food value of the foodstuffs used, their costs as related to nutritive value, and a practical demonstration given by preparing several dishes. The ladies bring note-books and pencils, and many of them come early in order to copy the recipes. Many of the younger members, in particular, write down facts given concerning the food used, and each member brings a spoon or fork that she may taste the food prepared. Eating or drinking always increases sociability, even if the food be but small in amount, as it invariably is when but "a taste" for each person is reckoned on. However, it seemed to produce the desired effect. It stimulates the timid to challenge the method followed or to ask for further information on some point and tempts all to linger at the conclusion of the afternoon's work for a visit with neighbor or friend. The supplies used in the cooking demonstrations are paid for by the local Institute or different ladies take turns in supplying part of them each day, thus materially lessening the cost to the Institute.

At most of the places assistants are provided, many of whom are young girls who are getting the course free for the help they give. They assist with the work of preparation and washing up the dishes. At many places classes are held for the school girls, but in my district this has not been feasible. The attendance at the classes varies somewhat, owing to unfavorable weather or unusually busy times. This applies more to occasionals than to course members. In two or three places in Lambton the members have to drive or walk long distances, yet the attendance maintains a good average. The smallest class has twenty-seven course members. and the largest class has fifty-two.

It is rather a remarkable fact, yet true. nevertheless. that those most proficient in this branch of home work are the most interested in the demonstrations, perhaps because they are finding out for the first time the reason "why" for a familiar process. or perhaps because new hints or new methods are an incentive to experimenting at home.

The aim throughout is not to teach fancy cooking, but plain serviceable dishes, giving basic recipes which are capable of variation, and to combine with these such facts as will bring a realization of the importance of the work and its vast influence on human well-being.

Life makes numberless demands upon the system which cooking can assist it to meet. The more civilized we become the more unexpected and severe is the wear and tear of daily existence. The art of cooking lies in providing such a food supply that, while containing the elements essential to good nutrition it shall be suited to the requirements of season, work and age, and shall combine economy with due variety of flavour.

Cooking is a science as well as an art, because it has laws of its own which it is our duty to discover, to learn and to apply.

It is also a service often despised and left in the hands of the ignorant or the careless. No other art or science is so little understood, so lightly esteemed or so casually performed, and there is no service the dignity and worth of which are less perceived.

AN APPRECIATION OF THE DOMESTIC SCIENCE COURSE: (FOODS AND COOKING).

By Ethel M. Chapman, Demonstration Lecturer, Toronto.

In the earlier days of Women's Institute work, the programmes consisted almost entirely of demonstrations and discussions along the lines of cookery and housekeeping. There was usually no system in the arrangement of the topics to be taken up; the programmes were necessarily outlined under difficulties so far as procuring just the right person to take up the subject desired was concerned, and yet, these, I am sure were always more or less helpful. Now, a few organizations are going to the other extreme and subjects pertaining to practical cooking and housekeeping are almost entirely eliminated, giving place to problems of education, social life, and philanthropy in general. This we feel is a serious mistake. These questions certainly should have their place, and possibly the first place, but the greater part of every homemaker's time is spent in feeding her family and caring for her home. Few women can escape it even if they should want to, and we are proud to know that our Institute women realize that they could find no higher profession. Anyway cooking has an ethical as well as a practical value, for "a hungry man is an angry man," and the well-nourished individual is more likely to be normal mentally and morally as well as physically. This is why the Demonstration Lecture Courses have been so popular with the progressive women of the province.

When this course of demonstration lectures in domestic science was first talked about, some people seemed to get the idea that a demonstrator would be sent out to teach the preparation of several fancy impractical and expensive dishes. They were even worried about the cost of materials to be supplied by the Institute. However, they soon found that this averaged only sixty cents a week, and that the dishes prepared, far from being elaborate, were made to illustrate how to serve the common foods in the most attractive palatable and wholesome way. This necessarily involves a systematic, scientific study of foods and nutrition. Every other line of work is conducted along scientific lines to-day, and why not housekeeping? Even the farmer makes a study of what foods will make the best balanced ration for his stock, and what variety is necessary to keep them in the best possible condition, while we who are feeding not merely animals but human beings, often give the subject little consideration. We may feed the working man and old people and children practically the same diet without intelligently taking thought of their respective needs. We may feed our families whatever they like without knowing whether it is best for them, and we may—although these cases are rare—serve what is least trouble to ourselves without considering whether we are "starving" them. Every intelligent homemaker, nowadays is more or less interested in food values, but there is, I believe, no subject more difficult to study alone, from bulletins. Getting the information from a demonstrated lecture gives it color and makes it stick.

Especially are these lessons valuable and interesting to young women and girls. I firmly believe that every girl should have an opportunity to study a certain amount of domestic science, but I know just as well that at present it is impossible for the great majority of our girls to go to college. But the Demonstration Lecture Course brings the college to them, and they seldom fail to appreciate it. Last fall I had several girls driving a distance of from seven to ten miles to attend the classes, and they never missed a meeting either. I had one night class of thirty girls who were busy in stores and offices during the day, and their enthusiasm was a never failing inspiration. Of the High School classes there were very few indeed who did not come to me regularly to report their experiences in "trying the things" at home, and their mothers unanimously testified that nothing before had ever created in them such an interest in housework. This is where the courses are going to do their best work. This is the first step in introducing Domestic Science into the High Schools of the smaller towns.

But the younger people are not the only members who take the work seriously. One Institute member finding her social duties too pressing to attend the class for an afternoon each week, said to her neighbor, "I really haven't time to go, but I'll get the recipes from you."

"The recipes!" her friend replied indignantly, "it isn't recipes. You can get recipes in your cook book. It's how to do things and why you do them."

One very bright little woman who supported her family by taking in washing and catering for parties and weddings, said to me, "You know people wonder how I can afford to spend a dollar on the lessons, but it has paid me several times over already, and you learn so many little ways of making things look nice and tasty."

And what I am sure will appeal to many of the wives in our Institute is that the men of the households almost universally agree that the "Cooking Class" is the best thing the Institute has undertaken yet. Only once did I hear this criticism from the head of a house, "You'll never know what I've suffered since you came to town," but he did not look as though he were telling the truth.

AN APPRECIATION OF THE COOKING COURSE.

Probably I can best give an appreciation of the Demonstration Lecture Course by stating some of the benefits that we in Thamesville are deriving from our course.

First: It seems to me that the greatest good of the course is the "creation of a conscience," the realization that comes to us as we learn the uses of different foods in the system and what combinations are necessary that we who cook have a sacred obligation properly to develop the bodies of those whom we feed.

Second: We are receiving practical assistance in our methods of cooking, and are learning to be economical not only as to money, but also as to the nutritive value of our foods. In addition, probably every one has been shown how to overcome some of her difficulties. One member told me that to have learned to prepare gelatine by softening the powder in cold water before adding boiling water is worth a dollar to her, and several claim to have got the worth of their money in discovering that cooking cabbage will make no odor if it be left uncovered and the water be changed once or twice, and these are but two of many useful hints given.

Third: Tastefulness is a subject on which our Demonstrator, Miss Gray, has been silently eloquent. Each day by means of a candied cherry or two, a little jelly, a bit of parsley or something equally simple and inexpensive she makes her dishes look most attractive.

Fourth: "With knowledge comes interest," as one of our members remarked the other day. "One of the best things about our classes is that we get interested in our own work and when we meet we discuss our methods with one another."

Fifth: The Demonstration Lecture Course is furthering the good work of the Women's Institutes in breaking down sectarian and class prejudices.

"It is the way to make us better friends more known"

And in our large weekly gatherings many who had scarcely met before are becoming "more known."

Thamesville has a membership of fifty-two, and a good attendance of occasionals as well. As only half of the course has been given it is impossible to speak fully of its merits, but the concensus of opinion is that the Demonstration Lecture Course is proving an unqualified success.

Anna J. Coutts,
Secretary of the Thamesville Branch Women's Institute.

April 30, 1913.

Extract from Letter Received from Miss Nellie Allely, Demonstration Lecturer, Norland.

Yet in its infancy the Demonstration Lecture work of the Women's Institute is proving to be a grand movement and one that is bound to grow. In my work as a Demonstrator, I found unusual interest displayed. Not only were the women anxious to acquire new ideas in cookery—new recipes, etc.—but the majority of the listeners were thoroughly interested in the reasons for the various processes, and that is what we want. I admit that I was surprised at the very evident desire for knowledge concerning the value, composition and digestibility of our food-stuffs. A sympathy like this brings out the best in a teacher, and it results in an exchange of ideas which must be a benefit to all, and in the creation of an interest which is bound to grow. Very little in the great home economic movement can be accomplished, seemingly, in the few lectures and demonstrations given, yet it fulfils its aim, which is to arouse an interest, then start the "seekers" in the right direction. Undoubtedly, many will broaden their study until it includes the science of all the duties of the home.

Extract from Communication Received from Miss Annie MacDonald, Demonstration Lecturer, Lanark.

Although the work was new to me, in a way, yet I feel from the marks of appreciation shown that my work was not in vain. People, especially the younger set, seemed to be most interested in the classes, and, from the splendid attendance, evidently felt the good of them.

As for the theory part of the lessons, it seems to be of interest as well as the practical. Another point of very much importance is simplicity. Simple recipes with new combinations in food stuffs and dainty serving seem to be much appreciated. In this district only one town had attendance from school girls. When the classes are being formed it would be well to try hard for the school class, because the girls seem to like the classes. As the course finished in this district, there were remarks of regret that the classes were over, as they afforded a place of meeting and something to do, apart from the beneficial side.

DEMONSTRATION LECTURE COURSE IN SEWING.

By Miss E. D. Watson, Ayr.

The course was most successful. We feel it one of the most satisfactory things yet undertaken by the Institute. We ran three classes, two afternoon and one evening. You will see that the attendance for the full course was 729, making an average weekly attendance of nearly 73. This is, I think, unusually high, considering the miserable roads, the heavy storms and the fact that the great majority of the women were driving one, two and some five and six miles. They were most enthusiastic from start to finish. Besides taking the evening class myself, I saw all the classes at work at least part of the lesson, and I feel that too much praise cannot be given Mrs. Altenburg for the way she handled her work; for the individual attention each got, for what she made them do, and for her patience. They were difficult classes, all sorts and conditions, all ages from fourteen to fifty, from women who knew absolutely nothing about sewing to a few who made some of their plainer dresses. The great majority of them made a shirt-waist, a skirt and a one-piece dress, and I am still astonished at the high average of the work.

More ought to be charged for the lessons. With a good teacher, they are worth more. You will be interested to know that we have had since Christmas five University Extension lectures in connection with the Institute. Prof. Horning, on "England and Germany," and the "Balkan" question; Dr. Amyot on "Natural Defences of the Body against Infection," and Principal Hutton, on "Canada's place in the Empire."

BENEFITS DERIVED FROM MRS. ALTENBURG'S CLASS.

Miss Margaret Kyle, Ayr.

Early in January, it was announced under the auspices of the Women's Institute that if a class of twenty-five could be formed a Demonstrator in sewing would be sent to Ayr. There was no difficulty in securing twenty-five, and before the Demonstrator, Mrs. Altenburg, came to make final arrangements for the class the number had increased to seventy, making it necessary to form three classes, one to meet on Friday afternoon, one on Friday evening and a third on Saturday afternoon. There were ten lessons in four divisions: the first two on plain and fancy stitches, three on a shirt waist, two on a skirt and the last three on a one-piece dress. The lessons were supposed to be an hour and a half in length, but Mrs. Altenburg generously extended the time to three hours.

We were asked to bring to the first lesson half yard of lawn, two white spools, a 12 inch ruler, a pair of scissors, and a needle number 7, long, sharp; and thus armed we betook ourselves to the library hall, where under the careful attentions of Mrs. Altenburg we were instructed in the art of plain stitches, hemming, running, back stitching, overcasting, rolled hem, gathered ruffle, button holes, decorative stitches, chain (plain and fancy), braiding, birdseye, bias stitch (single, double, fancy), herringbone, French knot, crowtacks. Quite a number of these operations were not new to us, but Mrs. Altenburg had new and improved methods for many of them, for instance, her method of making a button-hole was different from the one in general favor here. She told us also that in making a button-hole in cloth of a coarse loose weave, to stitch with the machine on each side before cutting the hole. At this first lesson she took the measurement of each member of the

MRS. N. H. ALTENBURG
Demonstration Lecturer in Sewing.

class. Her French knot was a great improvement on the old way of making it.

But the real business seemed to begin with the shirt waist. To know exactly how to put a plaquet on a shirt waist sleeve is information which no amateur dressmaker will despise and Mrs. Altenburg's method required no pattern, which seemed a special recommendation. Since then we have heard that a member of Mrs. Altenburg's Burford Class has said that she considers the lesson on the plaquet alone worth her fee. Then with our shirt waist fitted on, some one pinned the shaped collar closely to its place without putting her fingers inside the neck band, and we in turn performed this duty for some one else. Besides learning how to pin on the collar we learned to preserve a calm exterior although suffering considerable anxiety as to the ultimate fate of our neck. We also learned where to cut the armhole if it chanced to require trimming, where to place the seam of the sleeve in relation to the shirt waist and how to reduce the gathers in the sleeve to the vanishing point, a feat of no mean order. Mrs. A. does not approve of French seams in shirt waists and she says all seams to look well should be of a good width, an inch or three-quarters of an inch at least.

When we began the skirts, each one was given a pattern which could be used for a 2, 3, or 4 piece skirt, and we used this pattern with a panel for our separate skirts, and are using it again as a 3 or 4 piece skirt in the one-piece dress. We were given very clear directions for cutting the panel and had no difficulty in doing it without the pattern. When basted up the skirts fitted perfectly. We were shown how to pin the belt on and how to get the length, each member of the class doing this for some other member. Mrs. A. gathers the edge of the hem, distributing the fulness so as to do away with all plaits.

The kimona waist seemed to be the object of the greatest interest and many were the conversations on the relative merits of a kimona and a waist of the set-in sleeve variety. We were given no pattern for the kimona waist, but Mrs. A's. instructions, as in the draughting of the panel, were most explicit and under her watchful eye there were no mishaps. The little 3 inch square which she used under the arm was a surprise to most of us, and being placed so as to draw on the bias will prevent tearing which has always been a serious defect in the kimona waist. When through we each had a shirt waist, a skirt, a one-piece dress and perfect fitting patterns for each of these, which we shall be able to use for ourselves with profit and pleasure; for surely we must be better qualified after our course with Mrs. Altenburg to meet the difficulties that so often present themselves in dress-making.

Extract from Communication Received from Miss Frances Bevan, Ancaster.

Our Branch his just finished the class in dressmaking under Mrs. Altenburg, and everyone is more than pleased with it.

Each woman has such pretty new things and so beautifully made, quite elaborate silk dresses and some muslins, but one and all are satisfied, with the one exception; one woman who made a print dress has been so angry with herself for not making up better stuff. She was rather skeptical about the class and thought any old thing would do, but when she saw the lovely dresses of the others she wished she had something better.

The class has done the Institute a world of good. We charged each non-member 25c. extra, so they should become members, and already they are showing great interest in the work of the W. I., and attend the meetings.

Ontario Department of Agriculture

WOMEN'S INSTITUTES

Application for Special Course of Lectures 1913-14

Name of Institute ....
Course chosen (Cooking, Home Nursing, or Sewing) ....
(make X through the Course chosen)
Number who have definitely promised to take advantage of the Course, if arranged for ....
Number of additional persons who will probably take advantage of the full Course ....
Probable number who will take advantage of occasional lectures ....
Prospects for class of school girls ....
....
Place where regular class will be held ....
Place where school girls' class will be held ....
Day of week preferred ....
Accommodation for board and lodging for demonstrator ....
....

Time chosen for Course, October 6th to December 13th ....

January 5th to March 14th ....

March 16th to May 23rd ....

(make X opposite time preferred)

Remarks ....

....

....

....

....

Branch President ....

Branch Secretary ....

Place ....

Date ....

Note——This form to be filled in and forwarded to the District Secretary or Geo. A. Putnam, Superintendent of Institutes, Parliament Buildings, Toronto, Ont. at as early a date as possible If application is sent direct to the Department, the District Secretary should be notified.

LIST OF BULLETINS

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170	Mar.	1909	Mitchell-Walker Test Bottle	J. W. Mitchell. W. O. Walker.
171	April	1909	Insects Affecting Vegetables	C. J. S. Bethune.
			Fungus Diseases Affecting Vegetables	J. E Howitt. J. W. Eastham.
172	May	1909	Dairy School Bulletin (No. 143 Revised) ...	Dairy School.
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174	Dec.	1909	Farm Underdrainage: Does it Pay?	W. H. Day.
175	Dec.	1909	Farm Drainage Operations	W. H. Day.
176	Dec.	1909	Bacterial Blight of Apple, Pear and Quince Trees	D. H. Jones.
177	Dec.	1909	Lime-Sulphur Wash	H. L. Fulmer. L. Caesar.
178	Dec.	1909	Character and Treatment of Swamp or Muck Soils	W. P. Gamble. A. E. Slater.
179	Feb.	1910	Fruits Recommended for Ontario Planters (No. 147 revised)	Fruit Branch
180	April	1910	Flour and Breadmaking	R. Harcourt. M. A. Purdy.
181	June	1910	The Teeth and Their Care	Ont. Dental Society.
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183	Aug.	1910	Notes on Cheddar Cheese-making	Dairy Branch.
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186	Dec.	1910	Children: Care and Training	J. J. Kelso.
187	Jan.	1911	The Codling Moth	L. Caesar.
188	April	1911	Weeds of Ontario (No. 128 revised)	J. E. Howitt.
189	May	1911	Farm Poultry (151 revised)	W. R. Graham.
190	May	1911	Bee Diseases in Ontario	Fruit Branch.
191	June	1911	Bee-keeping in Ontario	Fruit Branch.
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193	Nov.	1911	Tuberculosis of Fowls	S. F. Edwards.
194	Dec.	1911	Apple Orcharding	Fruit Branch.
195	Jan.	1912	Insectides and Fungicides. (No. 154 revised	R. Harcourt. H. L. Fulmer.
196	Jan.	1912	Tomatoes	A. G. Turney.
197	Feb.	1912	Bee Diseases in Ontario	Morley Pettit.
198	Feb.	1912	Lime-Sulphur Wash	L. Caesar.
199	Feb.	1912	Onions	A. McMeans.
200	April	1912	Fruit Juices	L. Meunier.
201	May	1912	Peach Diseases	F. M. Clement.
			Peach Growing in Ontario	L. Caesar.
202	May	1912	Grape Growing in Niagara Peninsula	T. B. Revett.
203	May	1912	Cabbage and Cauliflower	A. McMeans.
204	June	1912	Decay of the Teeth	Ont. Dental Society.
205	Sept.	1912	Dairy School Bulletin (No. 172 revised) .. Part I. Cheese-making and Butter-making	Staff of Dairy School.
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207	Dec.	1912	Ice Cold Storage on the Farm	R. R. Graham.
208	Jan.	1913	Farm Poultry and Egg Marketing Conditions in Ontario County	J. H. Hare. T. A. Benson.
209	March	1913	Farm Forestry (No. 155 revised)	E. J. Zavitz.
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Ontario Department of Agriculture

FRUIT BRANCH

BULLETIN 216

BOX-PACKING

OF

APPLES

By
E. F. PALMER, B.S.A.

TORONTO, ONTARIO, OCTOBER, 1913

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Ontario Department of Agriculture

FRUIT BRANCH

Box-Packing of Apples

E. F. PALMER

INTRODUCTION.

The packing of apples in boxes is an established custom in British Columbia and the Pacific States. In Ontario, box packing is, as yet, comparatively in its infancy. With every year, however, it is attaining to greater prominence, and rightly so, as no matter how good a product may be, unless it is packed in such a way as to reach the market in good condition, and at the same time be attractive, it will not bring the highest prices. But a good product handled in an attractive package is sure to be the first in demand and to command a good price, even when the market is glutted.

It is almost a crime to handle some of the choice fruit in the way it is being handled. Of course, a certain percentage of the fruit is too small, too imperfect to warrant the extra outlay. Nevertheless, an attractive package will often sell fruit that is not of the highest quality; that is, second-grade fruit, if well packed, will often bring a profit where there might otherwise have been a loss; but what we should strive to do is to pack quality fruit in quality packages. In the very beginning, it must be clearly understood that to receive the best returns we must not only understand the details of packing, which, after all, are matters of experience, but we must be strictly honest and scrupulously clean. These factors, coupled with methods approved as correct, will bring success in apple packing.

Box packing is destined to become a more important factor each year. For, though the day of high prices is probably gone forever, this fact in itself brings the box-packed fruit in more direct competition with barrel-packed fruit. The result is that the market for barreled fruit will become more and more restricted each year, and there will be a demand for larger and larger quantities of boxed apples.

The barrel undoubtedly encourages carelessness in grading for quality and size. It has been the package, not so much of inferior grades of apples, as ungraded apples. Let the top and bottom of the barrel be nicely "faced," and the space between invites ungraded fruit. The box, on the contrary, requires close grading for size, as the apples must be uniform to pack properly. This close grading further insures that all defective fruit will be found and culled out.

BOX *vs.* BARREL.

The question of boxes versus barrels has been discussed in Eastern Canada for a number of years. In British Columbia, no barrels are used at the present time. In Ontario, however, conditions are such that it would seem neither package possesses all the virtues. The package used must be dependent largely on the grade of fruit, the variety, and the market.

Regarding the small package, the following points have been pretty well established:—

1. All fancy high-priced apples should be shipped in boxes.
2. Only the best grades are preferred.
3. The box is the only practical package in which an apple can be transported with any reasonable degree of economy, in a fit condition for the highest export trade.

As already stated, box packing is still in its infancy in Ontario. For several years past, a few shippers have been using the box regularly, while others have merely experimented with it. Those who use the box regularly, pack their better grade of fruit in it, and consider it the better package, while the experimenters have, in only a few cases, pronounced the box a success. This is doubtless due to the fact that nearly all those using the box on trial did so with unexperienced packers. In some cases, the boxes were packed like barrels; that is, the box was faced as in barrel packing, and the remainder of the apples simply rolled in on top of this. The package was then finished in every respect like barrel packing, with no attempt at arranging the apples in tiers. Naturally, the results were not in accord with what these men had doubtless heard about box-packed fruit, and it would obviously be unfair to draw conclusions regarding box versus barrel from such experiments. Undoubtedly both packages have a place—the box for the high-class trade and the barrel for the other.

PACKING.

The following paragraph taken from an article by Roy C. Brock, in the September issue of *Better Fruit* for 1911, gives a comprehensive idea of the underlying principles of box-packing.

" Packing is the classification of fruit in the proper sizes by placing fruit of the same size solidly into boxes in such a manner as to insure uniformity of appearance, neatness, and protection from bruising. The purpose of careful packing is to make the box of fruit as attractive as possible to the purchaser, and obtain thereby for it the highest possible price."

Following out the idea contained in these few words, the essentials of a good pack may be briefly stated as follows:—

1. The pack must be so firm that there is no chance for the fruit to shift in any way. To have this possible, it is almost necessary that each apple touch all those surrounding it in the proper way.

2. Bulge probably ranks next to firmness in importance. The purpose of the bulge is that as the packed apples shrink during storage, the cover will contract, and thus continue to hold the apples firm. While this is the primary reason for a bulge, it probably has a beneficial influence on the purchaser also.

A bulge of 1¼ to 1½ inches, counting both top and bottom of the box, is sufficient. A bulge of 2 inches or more is unnecessary and undesirable, as the fruit is more liable to be bruised.

3. Regularity of pack is very important. On no account should a box be started with one size of apple and finished with another, or the style of pack

changed. Bruising is very liable to result where such changes in size of fruit or style of pack are made.

4. Smoothness and finish to a pack are very essential. Contrary to a pretty general belief in some sections, the box will *not* sell the apples. The high prices received for box apples rely in a large measure on the appearance of the pack. The finished pack should be regular in size and perfect in alignment, and, if the fruit is wrapped, smoothness of wrap is of great importance.

5. Grading of the fruit to color, as well as size, is essential. In other words, uniformity of color is desirable.

Packing Houses.

A well-equipped packing house is essential to good packing. There should be an abundance of light, thorough ventilation, just the right amount of room, handy arrangement and cleanliness. Plenty of light is very important, as no packer, however expert, can do high-grade work in a poorly lighted room. He needs light to aid in selecting fruit as to size and freedom from blemishes, as well as in the actual operation of packing.

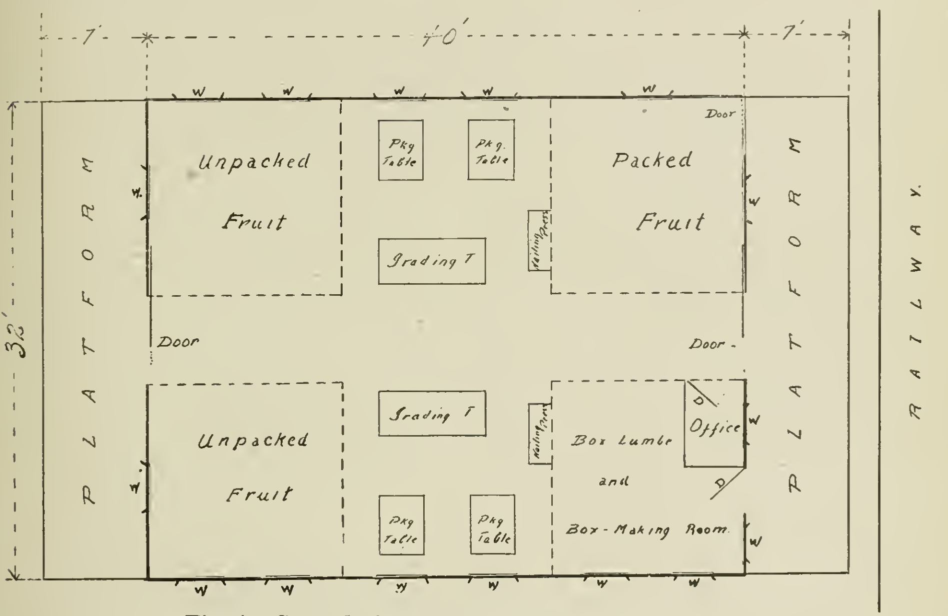


Fig. 1. Ground plan of a Packing House, 32′ x 40′.

The packing house should be large enough to accommodate the maximum crop, but no larger, as it is almost as inconvenient to have a house too large as too small. "A place for everything and everything in its place" will materially decrease the amount of floor space required. Have a well-lighted portion equipped with sufficient packing tables; a place for the fruit before packing; for the packed products; for the culls; and a good loft or other room for storing packing materials. Everything should be so arranged that the fruit will be continually moving from the receiving door to the store-room for the packed product. That is, the unpacked should be stored at one end of the house as it is received from the orchard. Next should come the grading tables, then the packing tables, the nailing press, and finally the store-room. In other words, a system should be developed which will do away with all unnecessary handling. The more perfect the system, the less the cost of packing.

Central Packing House.

Where the central packing house method is employed, the packing is, on the average, much superior to other methods. When a grower packs his own fruit, experience has shown that he is very liable to grade considerable quantities of No. 2 fruit as No. 1. The practice should be: *When in doubt as to the grade of an apple, place it in the grade below.* With disinterested packers, this is possible, but, in the other case, human nature usually prevails.

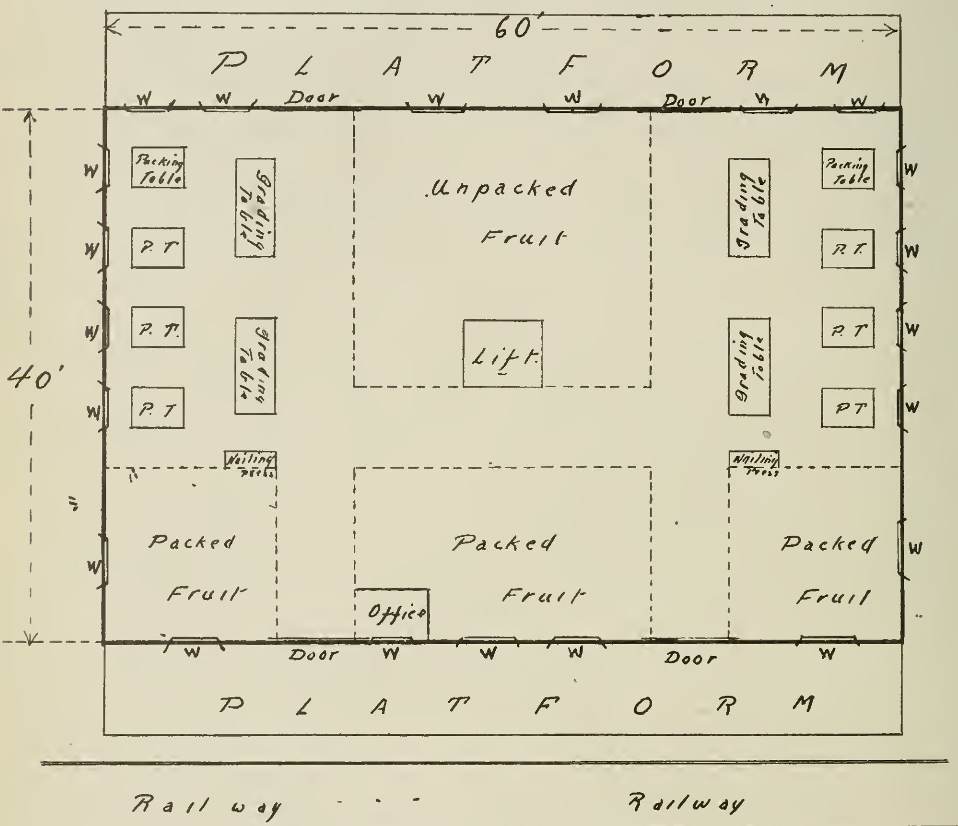


Fig. 2. Ground plan of a Packing House, 40′ x 60′.

The following extract from an article by A. McNeill, Chief Fruit Division, Ottawa, published in the September issue of *Better Fruit* for 1910, will serve to bear out the above remarks:—

"In the enforcement of the Canadian Fruit Marks Act, it has been found necessary to make an average of about fifty prosecutions a year.

"There are now between fifty and sixty co-operative apple-selling associations in the Dominion of Canada, and in no instance has a co-operative association been fined. The interpretation of this fact is that the co-operative system removes very largely all temptation to mark or pack fraudulently; but perhaps even a more potent influence is in the closer supervision which can be given to the workman by those in authority under the co-operative mode of work. Instead of sending out gangs of men into isolated orchards, the co-operative associations are gathering the fruit into packing houses and having the work done under the supervision of competent and responsible men."

That the central packing house method is the best one is thus readily seen. For, owing to employment of experienced packers, and the close supervision of all the packing operations, a much better and a more uniform pack is usually obtained. The cost, too, of packing is considerably reduced through division of labor and handy equipment.

Another point in favor of the central packing house is that carload lots can be made up more easily and with greater economy, especially if the packing house is built alongside a railroad, as it should be. Fruit can then be loaded directly from the packing house into cars at a great saving in cost.

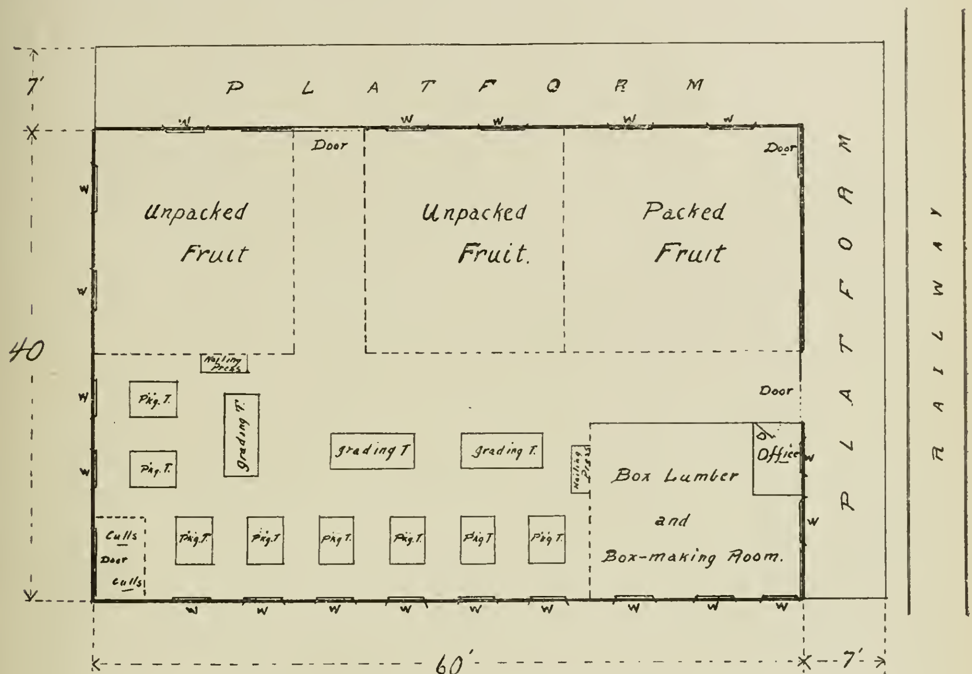


Fig. 3. Ground plan of a Packing House, 40′ x 60′.

Lastly, the fruit can be kept under far better conditions of storage until shipment than are possible by the grower.

Against the central packing house method, it may be said that ordinarily the fruit is subjected to more handling than where it is packed in the orchard. Also when packing in the orchard the grower can personally see that the fruit which he thought would pack largely No. 1 is really nearly all No. 2. Thus he is prevented from kicking and further taught to grow a higher grade of fruit.

However, the many evident advantages serve to more than counterbalance these two disadvantages. Also if the fruit is handled carefully at all times, as it should be, there will be little, if any, extra bruising of the fruit resulting from the extra handling necessary in the central packing house method. And if the growers are progressive, the second disadvantage will carry little weight.

Grading.

Without good, even grading, rapid box-packing is impossible. To do good work and do it rapidly, the packer must have before him an even run of apples in point of size and quality. In fact, packing, simplified, is simply *grading* and *sizing*, then placing the fruit in the box so that it fits systematically and snugly. Unless the fruit is sized properly, it cannot be made to fit systematically. It is essential that a man be able to size an apple properly, else he will never make a packer.

Regarding the best time to grade, some prefer to do part or most of it in the orchard as the fruit is picked, while others prefer to do it all in the packing house. The latter method is probably the better, as it entails less handling of the fruit. The apples can be graded directly on to the packing tables. For this same reason, grading in the packing house is probably more economical.

In grading, remove all culls, that is, fruit with broken skins, worm holes, and other bad blemishes, and at the same time grade to color.

As yet, it would hardly pay in Ontario to adopt the complicated system of assorting to sizes used in various sections of the Northwest States. Undoubtedly, it would be less difficult for packers, especially inexperienced ones, to pack properly if all the apples were assorted and graded beforehand. And it may also be presumed that a sorter, having only the one thing to perform, might be able to do it better and quicker than the packer, who would have to pack the apples at the same time. However, the sizing need not be carried to extremes.

If the packers are required to do the grading as they pack, much better work can be done if they have a large amount of fruit to pick from. In packing, this would mean a modification of the bench system or else the adoption of tables. Of the two, the bench method is to be preferred here, as there will be less handling over of the fruit; but the packers must be expert.

Grading Machines.

The need for mechanical help to get apples perfectly graded as to size has brought out many inventions which are distinct aids. The fruit is automatically sized and delivered to the packing table. However, these machines appear to have one fault in common; tender varieties of apples are very often bruised to some extent. Also the mechanical graders cannot of course be made so as to grade for color and freedom from blemishes. It therefore becomes necessary to grade the fruit for these qualities before using the machine, or else have the packer do it.

Another objection to the grading machine is that they grade the fruit almost too uniformly, and the apples being all of one size the packer finds difficulty in securing the proper bulge. It then becomes necessary to use two or possibly three of the grades as sized by the machine.

For the small grower the price of a good machine is probably out of reason. The proper place for a grading machine is in a packing house where large quantities of the harder varieties of apples are being packed.

Wiping.

Regarding the wiping of apples there has been more or less discussion. The advent of the codling moth has made spraying imperative, and it is this spray that is chiefly objectionable. But, by many, the advisability of wiping has been seriously questioned, as the natural bloom on the fruit undoubtedly aids in keeping quality. On the other hand, packers of fancy fruit can show good reasons why all spraying effects, etc., should be removed, for it must be admitted that an apple, after being wiped, presents a better appearance, to the average buyer at least, than one that has not been wiped.

The expense is small and the wiping is easily done if the fruit is wiped immediately after being picked. Some varieties of apples, if allowed to stand for any length of time after being picked, are very difficult to wipe, as a sweat or oil gathers on the surface of the fruit.

In wiping an apple it should not be rubbed hard. The object is not to polish the apple, but simply to remove what dust there may be, and more particularly the dabs of spray which a great many people are afraid of on account of their poisonous nature. However, an analysis of the quantity of spray on an apple has shown that it would take the spray from 600 apples to make a minimum dose of poison dangerous to a human being.

A pair of cheap cotton gloves is much superior to a rag for wiping, as the operation is not only more quickly performed, but the hands do not become numb from handling the cold fruit. Wiping and grading may be conveniently done at the same time.

Stemming.

To prevent the stem of the apple being bent over by the top and bottom of the box and puncturing the fruit, stemming is practised to some extent. Part of the stem is simply removed by small pincers especially made for the purpose. It is questionable whether stemming is practical in commercial box-packing. In barrel packing, where only a small percentage of the apples have to be stemmed, namely, the face layer, it is quite possibly an economic operation. With boxes, however, two layers, the top and the bottom, or half the apples in the box, are stemmed. For exhibition fruit this may be permissable, but there seems to be a fairly general impression in Ontario that all box-packed fruit should be stemmed. It would be far more economical to pack those varieties of apples that require stemming *calyx-end up* or *on their side,* for stemming must add considerably to the cost of packing. A good packer will pack half a box in the time required to stem the fruit for the top and bottom layers of a box. Thus where he would pack a box and a half when not stemming, he would only pack a box if he were required to stem the fruit. This means an increase of practically one-third in the cost of packing, which is far too big an expense to overlook. Of course if an extra price can be secured for stemmed fruit, well and good, but the way markets are tending now, the cost of production has to be decreased rather than increased in order to meet their demands.

Wrapped fruit needs no stemming, as the wrappers prevent any puncturing by the stems. The apples give more when the pressure of the lid is brought to bear, tending to obviate any danger. Furthermore, since the fruit is wrapped, it matters very little whether the fruit is packed stem-end up, calyx-end up, or on its side. In varieties of apples, therefore, in which puncturing is to be expected, the top and bottom layers may be packed calyx-end up or on their cheeks. *There is no serious objection to packing apples on their sides even when unwrapped, and there certainly is no serious objection to packing wrapped fruit so.* It is better however, to pack the apples on their ends whenever possible and use the side pack only when necessary.

Packing Tables and Benches.

Packing on benches instead of tables is gaining in favor in some districts of the West. The packer stands in front of a sloping bench on which are placed four or five apple boxes on his left-hand side and an orchard box of ungraded fruit on his right. Taking the apples as they come he packs them into their proper box, making four or five sizes. Over, or undersized fruit is put in boxes placed conveniently near. Culls are run down to a box on the floor. With expert packers *who can size the apples at a glance* this system is very good, as the fruit receives a minimum of handling and hence of bruising. However, for the beginner, and for a poor run of fruit, the table is preferable, as only one size is packed at a time and there is a larger quantity of apples to select from.

To make a convenient packing table four uprights of two-by-four material, three feet long, are taken. These four legs are joined with one-by-six lumber, making the table about three feet wide and four feet long. Care should be taken to have the legs well braced. The top is then covered with strong burlap, which is allowed to hang rather loosely. The legs are bevelled off where they stick up through the burlap so as to leave no sharp edges to bruise the fruit. With this same idea in mind rubber hose is usually nailed around the edge of the table. Two of the diagonally opposite one-by-six sides are allowed to project a foot or so beyond the edge of the table so as to serve as a shelf on which to rest one end of the box while it is being packed. Another board is projected from underneath in such a way as to serve as a support for the other end of the box.

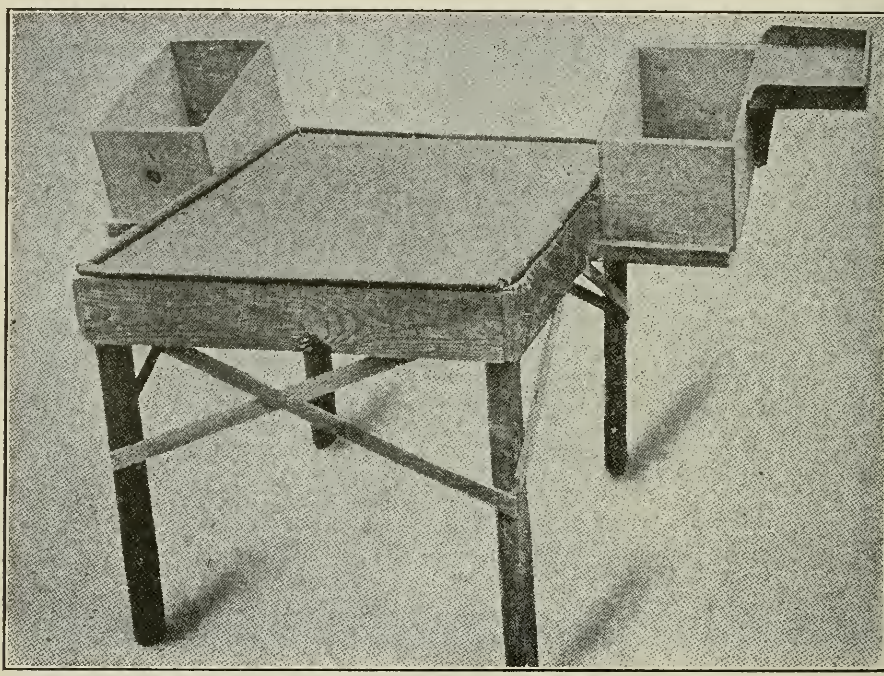


Fig. 4. Packing Table.

The height of the tables suggested above is only relative, the point being to have the height suit the packer. Back bending should be avoided. A height of about three feet is generally found to be about right.

The surface area of the table should not, as a rule, be greater than three feet by four feet, as anything larger will not allow two packers to reach all points of it without unnecessary stretching. Larger tables may be used if there are four packers to a table, but as a general rule their use is to be avoided. There is too much fruit in one pile, and furthermore, two packers at one table will work to better advantage than will four.

Materials for Packing.

Boxes. The first item in a perfect pack is a clean box. Clean white material should be bought to start with, and the boxes never used for any other purpose than packing. The best available material for boxes is spruce, being whiter and neater in appearance than fir and so soft that it is not easily split when nailed.

The proper thickness for box materials is as follows: Ends three-quarters of an inch, sides three-eights, and top and bottom one-quarter. Thinner ends are apt to split, thinner sides to bulge, resulting in bruising in transportation, and thicker tops not to bulge enough, hence crushing the fruit. For the same reasons sides should be of one solid piece and tops of two pieces.

The use of rosin coated nails is to be strongly advocated, as they hold far better than the ordinary nail. Also being thinner, they are more easily driven in, and do not split the box lumber as readily as do other kinds.

Size of Box. Two sizes of box, the Northwest Standard, 10½ by 11½ by 18¼ inches, and the Northwest Special 10 by 11 by 20 inches, inside measurements, have been generally adopted throughout the western apple growing districts. The one used in Canada, the Northwest Special, will pack practically all sizes and shapes of apples likely to be found in Ontario. The deeper and wider box might be employed, but if all the packing can be done satisfactorily in one size of box it is, of course, better to use the one size altogether. It avoids confusion. Also, it is as easy to pack in the one box as in the other, it being simply a matter of which size of box the packer is used to.

There are other factors relative to the size of box, however, which are probably of more importance than convenience in packing. Mr. R. M. Winslow, Provincial Horticulturist for British Columbia, in an article in the *Canadian Horticulturist* for September, 1913, writes:

"The box at present in use has in its favor law, custom, and the favor of certain markets. The short box is commended to us by reason of its uniformity with other standard fruit packages, with consequent convenience in manufacturing, warehousing, and in loading cars. It is a more attractive package and possibly a cheaper one, and, above all, it has the favor of the coast and prairie provinces."

Lining Paper. This serves to give the package a more finished appearance and also to keep dirt and odors away from the fruit. Lining paper is necessary only when the fruit is not wrapped, as wrapping more than accomplishes the same object.

The size of the paper is approximately twenty by twenty-six inches. This allows for generous overlapping on both top and bottom of the box. In lining the box a sheet of paper is placed over one side, letting one end come a little past the centre of the bottom. Either hand is then placed flat on the bottom of the box on top of the sheet of paper and sufficient force applied to put a bulge in the bottom. This makes an opening or extended gap between the side and the bottom of the box. The paper is then pressed out with the side of the hand a little way in the opening so made. As the hand is raised this opening closes up and catches a pleat or fold in the lining paper, which is needed to keep the bulge of the packed and nailed box from bursting the paper. The other side of the box is lined similarly.

The method of folding a pleat in the lining paper before putting in the box is a slow process, as it takes as long to put the lining in after it is folded as it does to put the paper in and catch the fold as described above.

Lining the ends of the boxes, if the lumber is dressed, is unnecessary, and therefore a needless expense. For exhibition purposes it is perhaps admissable to use it; otherwise never.

Layer Paper. This should be used only for exhibition fruit and that intended for long distance shipment, as to Great Britain. Its use should be confined to these purposes and perhaps also to the highest dessert trade.

Styles of Packs.

The style of packing has changed considerably in the last few years. The old style straight four-tier has practically given way to the diagonal pack for several reasons. With the straight pack each apple rests directly on the one below it and there is therefore great danger of bruising. With the diagonal pack, no one apple rests directly on another, but cushions in between the apples below, thus greatly reducing any chance of bruising. The diagonal pack lends itself to a much greater variety of sizes and shapes of apples. It is far easier to make a good commercial pack with the diagonal and more weight of apples is secured to the box as the apples fit more into the crevices, making less waste space.

The third system of packing—the off-set—is generally considered inferior to the diagonal. However, it is sometimes desirable to use it with inexperienced and unscrupulous packers, as a single apple of improper size will bring about a condition through the general pack and on the surface layer that cannot be covered up. Any defect in the pack is easily seen. With the diagonal system it is much easier to vary the size of the fruit in the bottom and centre layers without materially spoiling the appearance on top. Only on opening the box at its final destination will the poor work be discovered. On the other hand, when both systems are properly used, the diagonal is more to be desired for the reason that fewer of the apples come in the straight pack sizes. Again, in the off-set pack the spaces show at the sides, giving the box an unfilled appearance, whereas, in the diagonal, only small spaces occur, and these at the ends of the box. Another point against the off-set is that it contains from four to twelve apples less than the diagonal, making the box light in weight.

Straight Pack. In this pack the rows run straight across the box and parallel to the sides. It includes all the three, four, and five tier apples. The straight pack is very neat in appearance, but, as stated before, it is rather severe on the fruit as each apple tends to press directly against surrounding apples rather than into the crevices or spaces.

The apples are placed in the box in various ways, depending on the shape and variety, and whether the fruit is wrapped or not. Thus sometimes they are packed on their sides and sometimes flat. As a general rule it is better to have the top and bottom layers with stems towards the outside, if possible, in unwrapped fruit. In this way the apples do not tend to bruise so easily, as a greater bearing space is given for the lid. Even if they do bruise, the apples are not so badly disfigured for the retail trade where they are generally arranged calyx-end up.

The straight pack is so simple, in theory at least, as to require very little explanation concerning the theory of packing. It is necessary to remember only one thing; the apples must fit snugly both across the box and lengthwise. In packing some varieties on their sides it will sometimes be found necessary to turn the end rows flat in order to make the apples fit tight. When it becomes necessary to do this, the ends of two layers at one end of the box and the ends of the other two at the other end of the box should be turned, otherwise one end will be too high and the other too low.

Diagonal Pack. The most important style of pack, all things considered, is the diagonal, or half-tier pack as it is sometimes called. The term diagonal comes from the fact that the rows do not run straight across the box, but go at an angle. The diagonal includes the commonly called 2-1, 2-2 and 3-2 packs.

In beginning the 2-2 pack an apple is placed in the left-hand lower corner of the box and another midway between the cheek of the first apple and the right-hand side of the box. Two spaces of equal size will then be left. Into these spaces two apples are placed, it being understood, of course, that the apples are too large to fit four across the box. The spaces left by the last two apples placed are then filled, and so on until the layer is completed. The second layer is packed in the same manner, except that it is started in the right-hand corner for the half-tier packs. This throws the apples of the second layer into the pockets formed by the first layer. When completed, the third layer will be directly over the first layer and the fourth over the second.

2-2, 6-6 diagonal; 4 layers—96 apples. 2-2, 5-6 diagonal; 4 layers—88 apples.

The 3-2 pack is essentially the same as the 2-2, except that it is started with three apples—one in each lower corner and the third in the centre of the space left. This leaves two spaces, one on either side of the centre apple, into which two apples are placed, and thus three and two until the layer is completed. The second layer is started with two apples in the pockets formed by the first layer, three in the next row, and thus two and three throughout. When the box is completed the third and fifth layers will be directly over the first, and the fourth over the second.

3-3, 4-3 offset pack; 4 layers—84 apples.

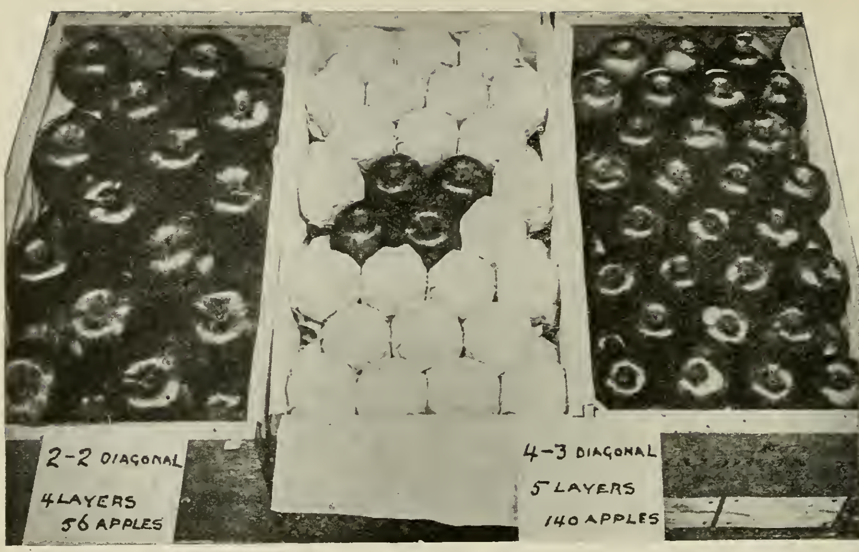
2-2, 4-3 diagonal; 4 layers—56 apples.

3-2 diagonal; apples packed riff-raff.

3-2 diagonal; 4 layers—70 apples.

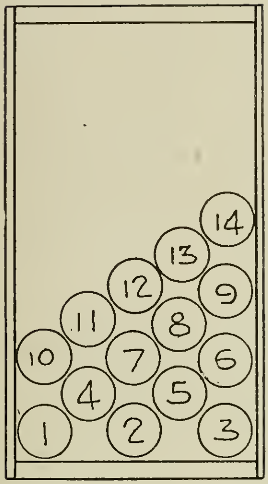
3-2 diagonal; 5 layers—100 apples.

2-2 diagonal; 4 layers—112 apples.

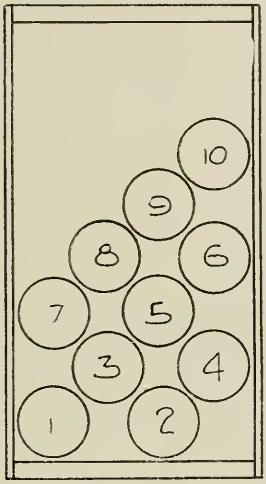


Offset Pack. With ordinary sized apples the offset is started by placing three apples firmly together cheek to cheek in the lower end with the first of the three in this row against the left-hand side of the box. The space left then is all on one side of the box. In this space the first apple of the three constituting the second row is placed. When the remaining two are in, the space will be on the left-hand side. The layer is thus completed, the space alternating from side to side of the box. The second layer is started in the right-hand lower corner by throwing the apples into the crevices formed by the apples of the first layer. In the completed box the alternate layers will be directly over one another.

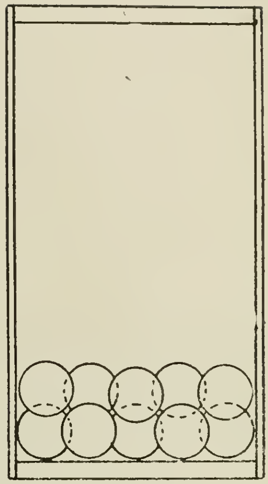
For this pack, as in the diagonal 2-2, it is necessary to have apples too large to fit four across the box. Similarly the 3-2 diagonal requires apples too large to go five across.



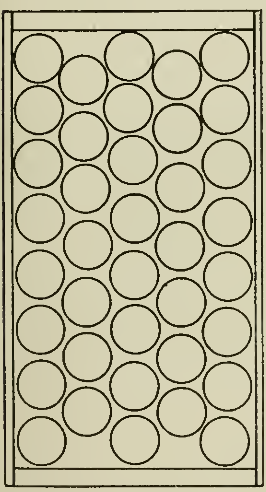
HOW TO START A DIAGONAL 3-2 PACK



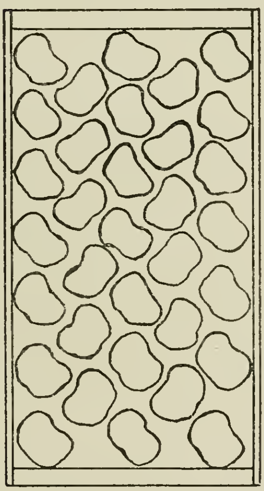
HOW TO START A DIAGONAL 2-2 PACK



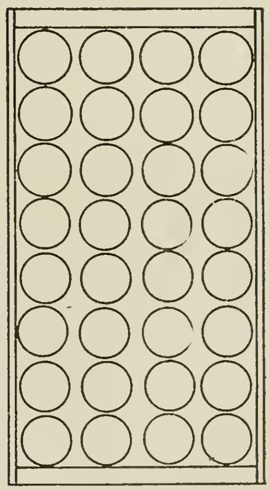
HOW TO PLACE 1ST AND 2ND LAYERS



5 LAYERS
188 APPLES



RIFF RAFF
154 APPLES



4 LAYERS
128 APPLES

But, whatever the style of packing used—whether it be straight, diagonal, or offset—the essentials of a good pack—firmness, regularity, correct bulge, smoothness, and finish, as already discussed—should be kept constantly in mind by the packer. And the packer must bear in mind that *packing* is placing fruit of the same size solidly into boxes in such a manner as to insure uniformity of appearance, neatness, and protection from bruising. *The style of pack is a secondary consideration.* That is, if a certain size or shape of apple packs better offset than diagonal, then the offset is the pack to use. This applies also to the much discussed riff-raff pack.

Nailing Presses.

A box after being packed is taken to the nailing press. There are several good makes of nailing presses, but the best ones are those which press only on the ends of the lids, and which hold cleats and tops firmly in place until nailed. After being nailed up the boxes should always be laid *on their side,* as the sides, having no bulge, do not bruise the fruit.

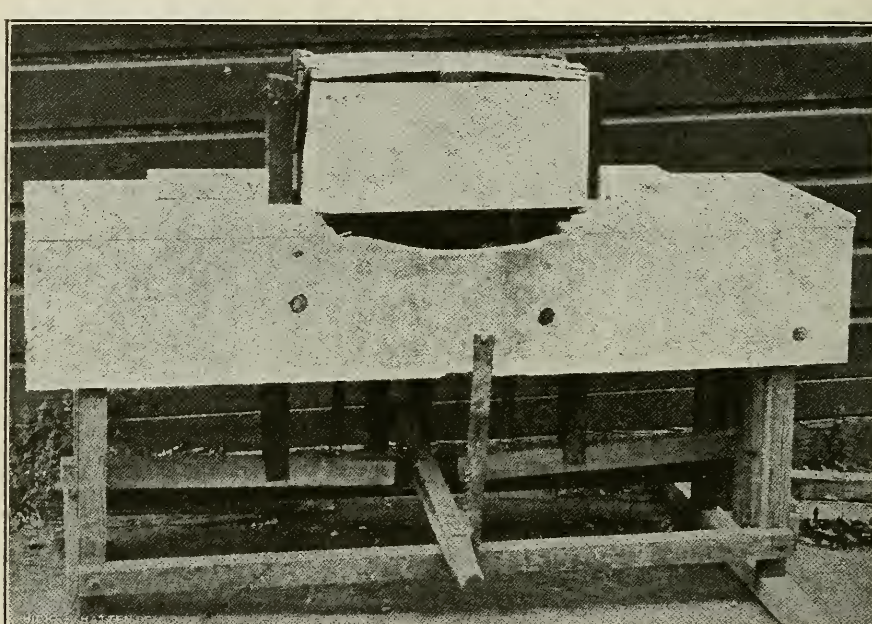


Fig. 5. A Good Type of Box Press.

Tables of Packs.

In the following tables an endeavor has been made to tabulate certain useful information on the more commonly used packs. The make-up of the various packs is clearly indicated.

TABLE 1.—Straight Packs.

No. Apples in Box.	Tier Designation.	Actual Tiers	Position of Apple.	Apples in Top Tier
45	3 tier	3	side	3-5 equals 15
54	3 tier	3	side	3-6 " 18
63	3 tier	3	side	3-7 " 21
96	4 tier	4	side	4-6 " 24
112	4 tier	4	side	4-7 " 28
128	4 tier	4	side	4-8 " 32
144	4 tier	4	side	4-9 " 36
200	5 tier	5	end	5-8 " 40
225	5 tier	5	end	5-9 " 45

TABLE 2.—Offset Packs.

No. of Apples in Box	Tier Designation	Actual Tiers	Position of Apple	Apples in Top Tier
84	3½ tier	4	side	3–3, 4–3 equals 21
96	4 "	4	"	3–3, 4–4 " 24
160	4½ "	5	"	4–4, 4–4 " 32
180	4½ "	5	"	4–4, 5–4 " 36

TABLE 3.—Diagonal Packs.

No. of Apples in Box	Tier Designation	Actual Tiers	Position of Apple	Apples in Top Tier
36	3 tier	3	side	2–1, 4–4 equals 12
41	3 "	3	"	2–1, 5–4 " 14
45	3 "	3	"	2–1, 5–5 " 15
50	3 "	3	"	2–1, 6–5 " 17
48	3½ "	4	end	2–2, 3–3 " 12
56	3½ "	4	"	2–2, 3–4 " 14
64	3½ "	4	"	2–2, 4–4 " 16
72	3½ "	4	"	2–2, 4–5 " 18
80	3½ "	4	"	2–2, 5–5 " 20
88	3½ "	4	"	2–2, 5–6 " 22
96	4 "	4	side usually	2–2, 6–6 " 24
104	4 "	4	" "	2–2, 6–7 " 26
112	4 "	4	" "	2–2, 7–7 " 28
120	4 "	4	side	2–2, 7–8 " 30
128	4 "	4	"	2–2, 8–8 " 32
70	4 "	4	end	3–2, 4–3 " 18
80	4 "	4	"	3–2, 4–4 " 20
113	4 "	5	"	3–2, 5–4 " 23
125	4 "	5	"	3–2, 5–5 " 25
138	4½ "	5	"	3–2, 6–5 " 28
150	4½ "	5	"	3–2, 6–6 " 30
163	4½ "	5	"	3–2, 7–6 " 33
175	4½ "	5	"	3–2, 7–7 " 35
188	5 "	5	"	3–2, 8–7 " 38
200	5 "	5	"	3–2, 8–8 " 40
213	5 "	5	"	3–2, 9–8 " 43
225	5 "	5	"	3–2, 9–9 " 45
238	5 "	5	"	3–2,10–9 " 48
250	5 "	5	"	3–2,10–10 " 50
140	5 "	5	"	4–3, 4–4 " 28

Bulge.

In the straight pack, before the lid is nailed on, the apples at either end of the box should come up a little better than flush with the top. With the diagonal the ends should be a little higher—about one-quarter to three-eighths of an inch in all. Then from either end there should be a gradual bulge amounting at the middle of the box to about one and one-half inches. Thus, when the lid is nailed on, there will be a bulge of practically three-fourths of an inch each on top and bottom. Less bulge is desirable with the straight packs on account of their unyielding nature. There is no settling of the apples into the crevices as in the diagonal.

The proper bulge is obtained, in the straight pack especially, by selecting apples that are a trifle smaller for the ends. With apples that are being packed on the cheek, it sometimes becomes necessary to turn the end rows flat to secure the

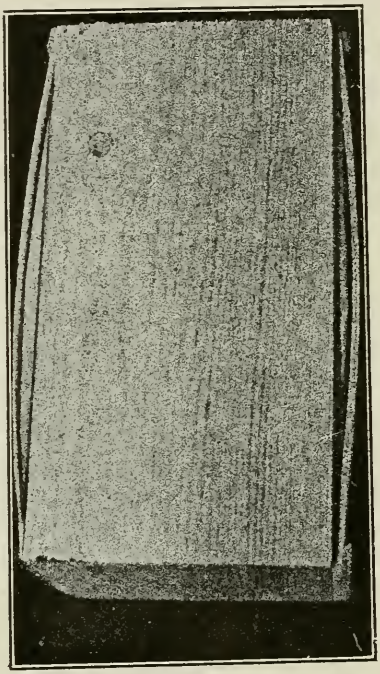


Fig. 6. Showing the proper bulge on box nailed and ready for shipment.

desired bulge, and, at the same time, have the ends low enough. This method of turning has been previously discussed under the heading of "Straight Pack," so needs no further explanation here.

In the diagonal pack the small spaces left at the ends of each layer aid materially in securing the proper bulge. This, and pulling the apples tighter towards the centre of each layer, is sufficient to give the necessary bulge in *wrapped* fruit. By packing closer in the centre you close the pockets between the apples more, and the next layer will not go so deep down in, and therefore builds up the centre. The ends being left a little looser, the pockets are opened a little more and the apples drop in further and therefore do not build up so high. Practice alone will give the knowledge of just how tight to pack the centre or how loose to pack the ends.

When unwrapped, of course this difference in firmness cannot be made and the packer has therefore to take advantage of the small irregularities and differences in the sizes of the apples. This difference in size must not be so great as to attract attention. It is essential to begin the bulge with the first layer of fruit and to pack each layer with the same end in view.

In finding a pack too flat it is usually no use to repack the top layer, as the trouble probably extends right through the box. The bulge should form an unbroken arch when the box is finished, so that the pressure of the lid will be equally distributed over the fruit. A bulge high in the centre and dropping off to the sides will not be held firmly in place by the cover, causing the whole pack to become loose.

Packing Apples Before and After Storing.

There are several points in favor of packing apples after storing, the principal ones being as follows:

1. Packers can be given employment for a longer period of time. The fruit need only be packed as it is required for the market.

2. Unless the fruit can be stored at a sufficiently low temperature, diseases which cannot be noticed at the time of storing are likely to develop. If the fruit is packed before storing, it will go on the market in this state, while if packed only as it is needed all fruit showing any rot or scab can be graded out.

3. There is a much better circulation of air, as orchard boxes are especially constructed to this end. Fungous diseases will spread less rapidly in consequence, other conditions being equal.

In favor of packing before storing, it may be said that much less room is required to store the fruit. This is an important consideration where space is limited. Further, any sudden demand or rise in prices can be more promptly attended to.

If the fruit is wrapped there are of course several other advantages of packing before storing. The spread of fungous diseases is prevented; the fruit keeps longer; and it is protected from changes in temperature.

WRAPPING.

Wrapped vs. Unwrapped.

The question of wrapping fruit is attracting more and more attention each year from eastern growers, and rightly so. In the Western States and British Columbia practically all No. 1 stock is wrapped. Conditions, however, are somewhat different in Ontario, so that wrapping at present should be governed by the variety of apple and the market. Western growers are building up a high class market with this class of product. It is doubtful if it would pay the ordinary grower who has no special market to wrap his fruit at present.

Briefly, the advantages of wrapping are as follows:

1. It improves the keeping quality by preventing disease spreading from fruit to fruit.

2. Apart from the control of disease, it improves the keeping quality, in that wrapped fruit may be firm and in prime condition several weeks after unwrapped fruit has become mealy from over-ripeness. It retards the ripening process by retarding evaporation.

3. It serves as a cushion to the fruit, especially valuable in the case of easily bruised varieties, prolonging its life and good appearance.

4. It protects the fruit from sudden changes of temperature and absorbs surplus moisture.

5. It makes an elastic but firm pack, much less liable to shift than unwrapped fruit.

6. It gives a more finished appearance to the package. It presumes a high grade product, so finding a readier sale and a higher price.

7. Once the knack of wrapping has been acquired, it is much easier in almost every way to pack wrapped fruit. Any packer skilled in both methods will testify to this.

The main disadvantage of wrapping is that, in cases where the fruit is not cooled at the time of packing, the wrapper prevents rapid cooling. There may be a difference in temperature of 10° F. at the end of one day between a box of unwrapped fruit and one wrapped. Wrapping, however, has so many advantages that this one disadvantage may be practically disregarded.

It seems to be the general opinion of those unfamiliar with wrapping that it adds to the cost of packing. As a matter of fact, the cost of paper for wrapping is almost saved by the weight of fruit displaced by the paper. Further, experienced packers can do as quick or even quicker work wrapping than without. Again, it is easier to secure the proper bulge with wrapping, as the firmness of the pack can be varied considerably from the middle of the box to the ends without injuring the pack in any way. The principle of this has already been dealt with in "Bulge." Again, as already noted, there is more latitude in the style of pack.

In wrapped fruit the top of the box should be packed last, while in unwrapped fruit the top is packed first. Packing the top of wrapped fruit first is a poor method and should be discouraged.

Only No. 1 fruit and possibly No. 2 of the winter varieties should be wrapped. All fruit intended for distant markets as Great Britain should be wrapped, unless unwrapped fruit is preferred, as the fruit carries much better. Wrap, too, for markets where there is competition with wrapped fruit from other districts.

Materials for Wrapping.

Wrapping Paper. The kind most commonly used in the west is called the "Duplex," from the fact that one side is calendered and the other rough. This latter side is turned to the fruit as it more readily absorbs any surplus moisture. A white color is decidedly preferable. It looks cleaner and neater than any other.

Using paper with the name or trade mark of the grower or association is an excellent way of advertising. It is not necessary to wrap all the apples in such paper, but if the outside layers are done and the trade mark is neat, it certainly adds much to the attractiveness of the package.

The paper is cut into several sizes to correspond with the different sizes of apples. The following figures give a good idea of the sizes most commonly in use:

8 by 8 inches for 5-tier and the smaller 4½-tier fruit.
8 by 9 and 8 by 10 inches for 4½-tier.
10 by 10 inches for 4-tier and the smaller 3½-tier.
10 by 12 inches for very large fruit.

These sizes should be adhered to fairly closely, as fruit packed with too large a size of paper gives a box light in weight, and also gives the consumer the impression that the price of paper is too high. Using paper too small is equally objectionable in that a great deal of the advantage of wrapping is lost. It also increases the labor of wrapping to a considerable extent.

Unstencilled Duplex, size 10 by 10 inches, costs about 12 cents per ream f.o.b. shipping point, in quantities less than five tons. For larger quantities the price is correspondingly less. Approximately a quarter of a ream (125 sheets of paper) is required to pack a box. The cost per box is therefore three cents.

Tray for Wrapping Paper. For convenience and speed in wrapping, a tray for holding the paper is very necessary. They are made so that they can be placed on the side of the packing box.

To make one, an apple box end is usually taken and strips which project up over the edge about two inches are nailed on three sides of it. On the under side a three cornered block is nailed so that one side of it is even with the open side of the tray. This forms a bracket or brace for supporting the tray when in position on the box.

Two long nails are then driven into the open side of the tray, leaving about three-fourths of an inch of their length out. The heads are then cut off and the nails bent down over a piece of iron or hardwood a trifle thicker than the side of the box. This forms hooks for hanging the tray onto the packing box.

Fig. 4, page 8, shows a paper tray in position on a box.

Method of Wrapping.

Practically no time is lost in the operation of wrapping, as a skilled packer picks up the apples with his right hand while he reaches for the paper with his left. To aid in picking up the paper it is advisable to use a stole on the thumb or first finger. The apple is placed in the centre of the paper in the left hand with the side or end of the fruit down which is to be packed uppermost. The wrap is then made with both hands by a couple of quick half-turns of the wrist, the last of which brings the smooth surface up and the bunch of paper on the bottom. It is practically impossible to give in writing, instructions as to how to wrap an apple. The essential point is to have a smooth wrap, made with as few motions of the hands as possible. An expert packer should wrap and pack fifty to one hundred boxes a day, depending upon the size and grading of the fruit.

MARKING OF PACKAGES.

Marks Required. The Canadian Fruit Marks Act prescribes that all closed packages must be marked, first, with the name and address of the owner of the fruit at the time of packing; second, with the variety of fruit; and third, its grade. One of the four grade marks must be used, namely, Fancy, No. 1, No. 2, or No. 3. Any one of these grade marks may be used together with any other designation that is not contradictory to or more prominently marked than the prescribed grade mark.

The Act also provides that all packages, whether open or closed, must be so packed that the face or shown surface fairly represents the grade of fruit all the way through the package.

Three grades are defined. The Fancy grade consists of fruit practically perfect. The No. 1 grade allows 10 per cent. of imperfect fruit; 90 per cent. must be practically free from serious defects and of good size and color. No. 2 grade consists of 80 per cent. free from defects that would cause material waste; and all apples whether defective or not must be nearly medium in size for the variety. No. 3 grade is not defined.

The workman who packs and marks fruit contrary to the provisions of the Act is subject to a fine of not less than $5 and not more than $40. Anyone changing the marks upon packages after inspection is subject to a fine of not less than $40 nor more than $500.

At present an agitation is being started in Canada to adopt the same grade marks as are used by the Western States. Their grade marks lead Canadian buyers especially to think that American fruit is better, compared to Canadian fruit, than it really is. The generally adopted American grade terms are Extra Fancy, Fancy, and C, corresponding with the Canadian Fancy, No.1, and No. 2. Thus it will be seen that Extra Fancy on American boxes is the same grade of fruit as our Fancy. Similarly our No. 1 grade corresponds with their Fancy grade. Their Fancy grade then is a grade lower than our Fancy marked fruit. The disadvantage which Canadian growers have been at in competitive markets, such as the Canadian Northwest, is therefore very evident.

Tier vs. Number of Apples.

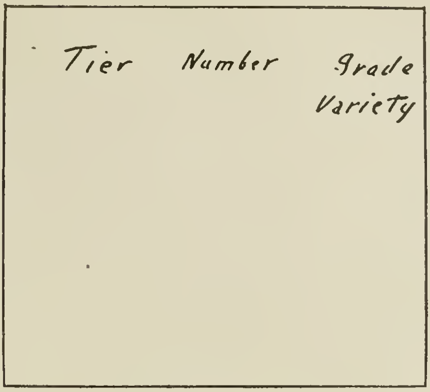
The practice of stamping the exact number of apples contained in the box rather than the tier is rapidly gaining in favor throughout the West. Marking the number has several important advantages, the chief of which are:

1. The adoption of the diagonal pack has made the old description of apples by tiers inaccurate. For example, apples which in a straight pack would be 4-tier, pack five actual tiers in the diagonal. Yet they are marked 4-tier.

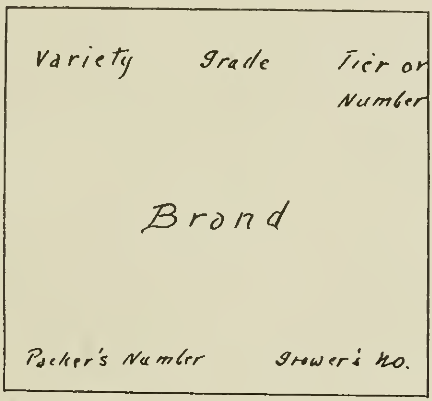
2. The retailer sells by number and naturally prefers to buy in the same way as he can tell at a glance what price he can profitably pay for a box. The consumer also appreciates the information given by the number.

3. The designation by tiers is as misleading to the grower as to the consumer. Boxes are stamped more according to the size of the apple rather than the actual number of tiers contained. They are stamped 4-tier and 4½-tier when they actually contain 5-tiers, and 5-tier when they actually do not have five tiers. Thus only an expert is able to distinguish packs in the terms of tiers.

In marking packages the Dominion Government recommends the following system:—



In the Okanagan the custom is to mark the boxes as below. In this system of marking any complaint can be traced directly to the packer. It is therefore to be recommended strongly.



Lithographing. A neat attractive lithograph placed on the end of the box adds very much to its appearance, and often aids materially in finding a market. A cheap, gaudy label detracts from, rather than adds, to the appearance.

A lithograph should contain the grower's or association's name, the name of the locality, and the Province. The other end of the box will then have marked on it the variety, grade, and number of the apples, and the packer's number.

GENERAL HINTS TO PACKERS.

1. Use only clean boxes neatly made.
2. Use only one size box—the 20 by 11 by 10.
3. The square and offset packs are defective, and should be avoided whenever possible.
4. Keep the pack, if anything, above the requirements of the "Fruit Marks Act."

5. When wrapping use the proper sized paper for the apples.

6. Clear the packing table several times during the day so that no fruit becomes bruised from continually "pawing over."

7. Avoid turning the stem of one apple to the cheek of another, for the stem will puncture the cheek and destroy the apple, especially for storage.

8. The pack must be firm, of proper bulge, and correct alignment.

9. The pack must be attractive. The secret of putting up an attractive pack is to select apples of practically the same size for each box. Any variation in size to secure bulge with unwrapped fruit must be unnoticeable to ordinary inspection.

10. Mark the number of apples on the box, rather than the tier.

11. Consistently try to improve the pack.

12. Remember that the *style of pack* is not so important as having the fruit packed *well.* That is, a uniform, neat and attractive pack with the least amount of bruising possible. Vary the style of pack to suit the shape and size of apple, so that the apple may always be shown to advantage in a good commercial pack. Though packs such as the offset and the riff-raff are defective and should be avoided, yet it becomes almost absolutely necessary to use them at times, as certain sizes and shapes of apples will not pack to advantage any other way.

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Ontario Department of Agriculture

ONTARIO AGRICULTURAL COLLEGE

BULLETIN 217

A Revised Edition of No. 189

Farm Poultry

With the Results of Some Experiments in Poultry Houses and Fattening Chickens

By

W. R. GRAHAM, B.S.A.
Professor of Poultry Husbandry

And

A. C. McCULLOCH, B.S.A.
Demonstrator in Poultry Husbandry

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Ontario Department of Agriculture

ONTARIO AGRICULTURAL COLLEGE

Farm Poultry with the Results of Some Experiments in Poultry Houses and Fattening Chickens.

BY W. R. GRAHAM AND A. C. MCCULLOCH.

This bulletin is intended to give information to farmers and others on general matters pertaining to the keeping of poultry.

It also contains the results of a few experiments which have been conducted at this institution on various matters pertaining to poultry.

CONSTRUCTION OF POULTRY HOUSES.

We find poultry thriving and yielding good returns in so many different styles of houses, that it is very difficult to lay down any hard and fast rules. The tendency at the present time is towards cheaper houses, with better ventilation. The hot-house style of housing poultry during the winter has not been satisfactory, many houses being damp, and the air in them anything but agreeable. Disease has been quite common; and results in many cases have been disappointing.

No. 4. No. 3. No. 2. No. 1.

Fig. 1. Different Styles of Poultry Houses Suitable for an Ordinary Farm.

Every poultry house should be light; at least one-third of the south side should be of glass, or otherwise opened to the sun. It should face the south-east or south. The sun's rays are very beneficial to fowls, especially during the winter months.

College Poultry Houses.

For a number of years we have been trying various styles of house. The first houses constructed were well built, tight and warm. They were fitted with stoves or hot water pipes, so that the fowls could be kept at a comfortable temperature. This plan was not satisfactory; mainly for the reasons that it was difficult to keep the fowls in good health, and furthermore the eggs were low in hatching power. The cost of heating was also considerable, in fact the entire equipment was too expensive to be successful as a business.

It was noticed yearly that the surplus stock held in the cheap houses was much healthier than those fowls kept in the warm houses. During the past eight years we have been trying to evolve a house that could be cheaply constructed, that would keep the fowls in good health, and at the same time get a fair egg yield from the fowls so housed.

Several years ago, four houses, representing different styles of popular poultry houses, were constructed. These houses were stocked with birds representing, as nearly as possible, the same strains of the breed. The breeds used were White Wyandottes and Buff Orpingtons, the one a rose combed breed, the other a single combed breed.

The houses are of equal size as regards floor space. Each house is 24 feet long and 12 feet wide. The house is divided by a wire and board partition, making two pens each 12 feet square. The pens will accommodate from 20 to 25 birds each, or about 50 to the houses. Fig. 1 shows fairly well the appearance as regards windows, etc., of the house. The roosting quarters of each house are very similar in construction. A dropping-board is used which is constructed of matched dressed lumber. The board is placed at the back of the building, and is about three feet above the floor level. The dropping-board is three feet wide. The roosts are made of dressed 3 x 3 scantling, and are placed six inches above the dropping-board. A curtain is arranged to be let down during cold nights, as in No. 1 and No. 2 houses. There is no curtain used in No. 3 or No. 4 houses.

House No. 1 is made of matched boards which are dressed on one side. The front and ends of the house are single-ply. The back is sheeted on the inside, building paper being used under the boards so as to make the wall tight or free from draughts. The windows in this house slide back and forth, so that the ventilation can be adjusted to the weather conditions. The roosting quarters in this house have curtains which can be dropped on very cold nights.

Trap-nests are used in all the houses, and are on the ground level. These take up some floor space that might be used for exercising the fowls were we using other styles of nests.

The second house is what is known as the "Maine State" house. This house is practically open to the weather on the front or south side. There are canvas curtains which can be dropped as a protection against wind and snow on stormy days. On other days these canvas curtains are to be rolled up, and the fowls allowed to exercise in the fresh air. The ends of the house are single-ply matched lumber;

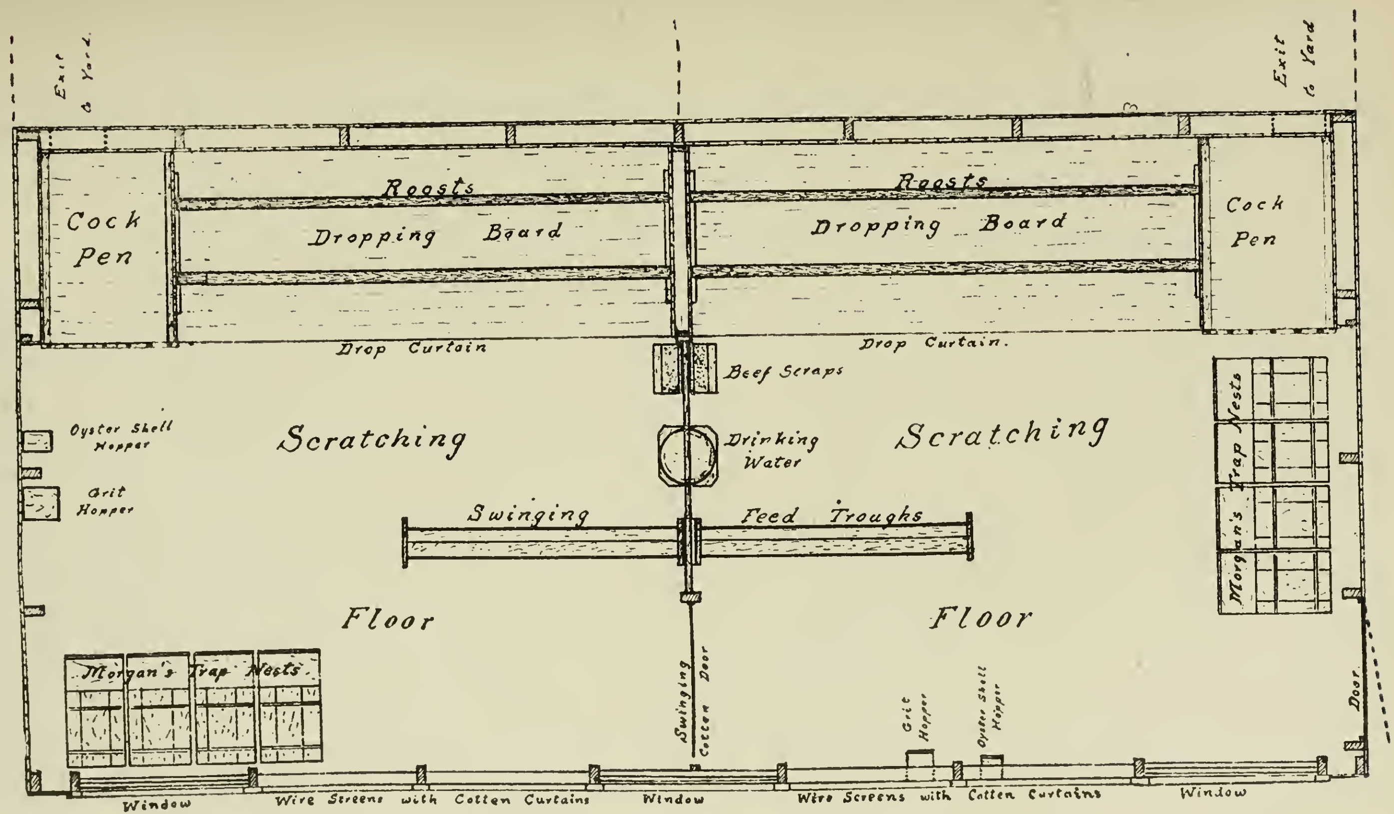


Fig. 2. Ground Plan of House No. 2.

The general arrangement in the other Houses is much the same.

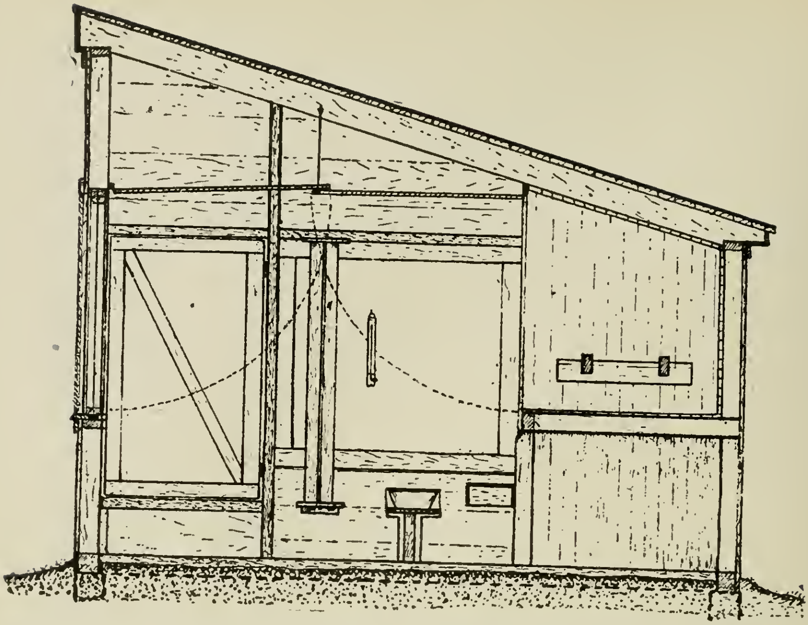


Fig. 3. Cross section of House No. 2, showing the curtains in position for the day, etc.

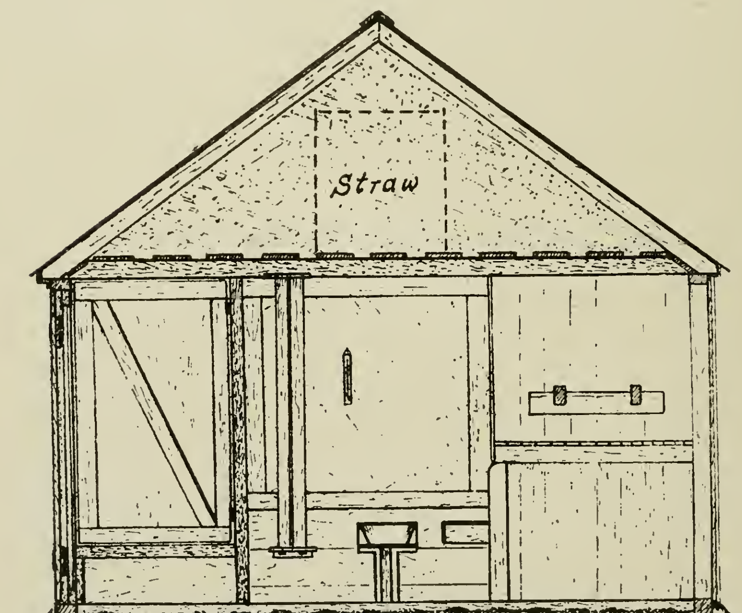


Fig. 4. Cross section of House No. 4.

the back wall of the house is matched lumber lined with paper, and is sheeted again on the inside. This is done in order to make a warm roosting coop, which is protected at night in front by canvas curtains.

The third house is the warmest house of the four and is built of matched lumber and lined with paper. There is a dead air space between the inside and outside walls. The building is made as tight as possible, the windows, doors, etc., all being made to fit tightly.

Many houses built on this plan are moist inside. To do away with the moisture we have a straw loft. The straw is placed on boards, which are from four to six inches apart. These boards are placed on a level with the roof or ceiling. The straw absorbs the moisture and keeps the house dry.

The fourth house is one of the extremely airy ones, being made of boards that are dressed on one side and the cracks battened; about half of the front is open to the weather, but may be closed on stormy days by large doors. There is not any special protection for the roost, the chickens roosting in this house in exactly the same temperature as they worked in during the day. This house, needless to mention, is much cheaper than the other styles.

The following record shows in a concise form the difference in the percentage of egg production in favor of the cold or fresh air house during the five years for the months of December, January, February and March, the first year beginning December, 1904-05, 76 per cent.; 1906, 8 per cent.; 1907, 11.8 per cent.; 1908, 15.6 per cent.; 1909, 12.4 per cent.

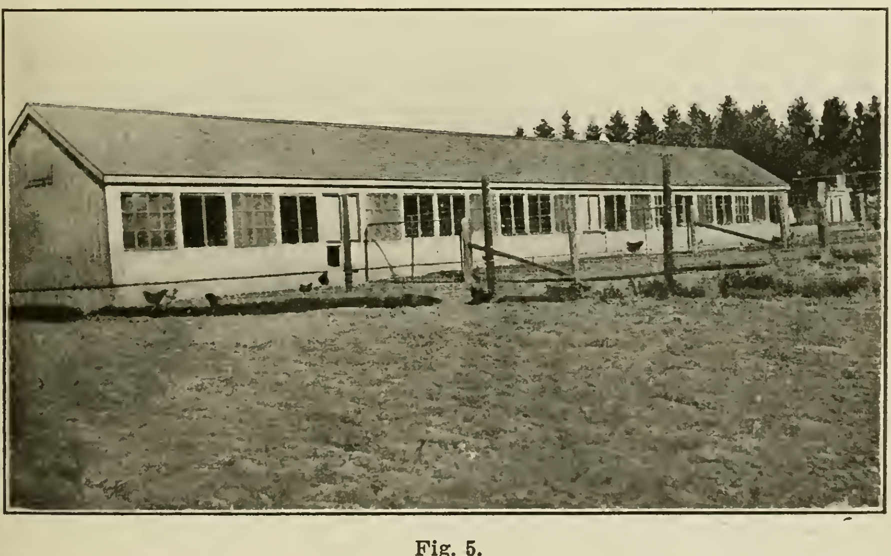


Fig. 5.

The house with the cloth front and the one with the movable windows compare favorably with the cold house. There is probably not enough difference in the actual egg production to warrant a statement that either of these houses is very much inferior to the cold house. They are about three degrees warmer than the coldest house and about fifteen degrees colder than the warm house.

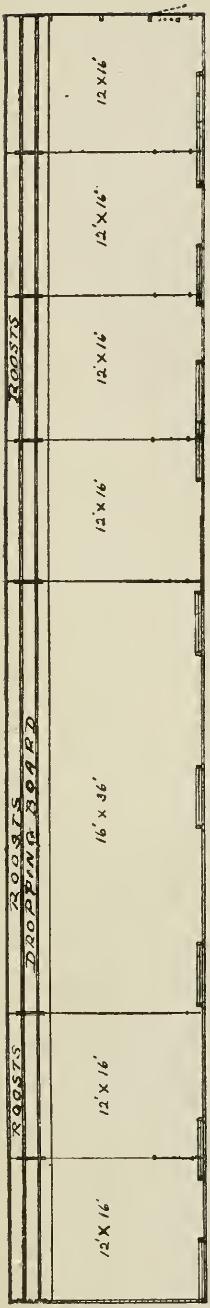


Fig. 6.

These figures must not be taken to mean that hens will lay better in a cold house than in a warm one, but that fresh air is essential to health, and health is a factor in egg production. When one tries to retain the animal heat of the body to maintain the heat of the house, one necessarily allows but little air circulation, hence the air becomes foul or stagnant, which is not healthful.

The above results indicate that the free admission of fresh air is a very essential factor in house construction.

House No. 3 in Fig. 1, which gave the poorest results for each of the five consecutive winters, was operated quite successfully the sixth and seventh winters by introducing more fresh air; that is to say, one-half of the windows were removed until about December 1st, and when these were put in, the openings (about one foot square), where the fowls go out into the yard at the north side were left entirely open. These except during mild days appear to supply sufficient air to keep the birds doing nicely. This statement is made as a means of helping any person who may have a similar house, and who wishes to continue using the same.

Our experience is that all four houses, while fairly satisfactory, especially No. 4, are not all that may be desired, for the reason that they must be adjusted according to weather conditions—that is to say, on bright, sunshiny days, the doors, movable windows, or cloth screens should be opened for nearly all the day, or, again, for but an hour, depending upon the sunshine and temperature.

The slope or shanty roofs on houses Nos. 1 and 2 have not been as satisfactory as the pitched roofs on houses Nos. 3 and 4. The roofs on the latter houses are more durable and the houses themselves much cooler in summer, and furthermore, the straw lofts in these houses are very effectual in preventing dampness in the houses; no frost collects upon the walls or ceilings.

We have tried several houses with curtain fronts, and we are pleased to say they work fairly well, when used in a house as in Figures 5 and 6, which is practically the same style of house as No. 4 in Figure 1, but these require adjusting according to the weather, and if they are not kept brushed, the dust and dirt will gather to such an extent as to prevent free ventilation, so that they will not ventilate very well. Our experience has been that such cloth screens should be of the cheapest cotton; heavy cotton or duck scarcely ventilates at all. There is yet another objection to these cloth screens, in that the hens, especially the lighter breeds, become notionate about trying to lay or roost upon the screens.

To the person who is breeding the tender varieties or those with large combs, some means must be taken to keep them fairly warm at night or their combs will become badly frosted. The females of such breeds as Leghorns or Minorcas will stand a temperature considerably below zero without frosting their combs.

The question naturally arises: can a house be constructed which is nearly self-operating, that will keep the birds in health, and at the same time ensure a fair egg yield.

Open Front House.

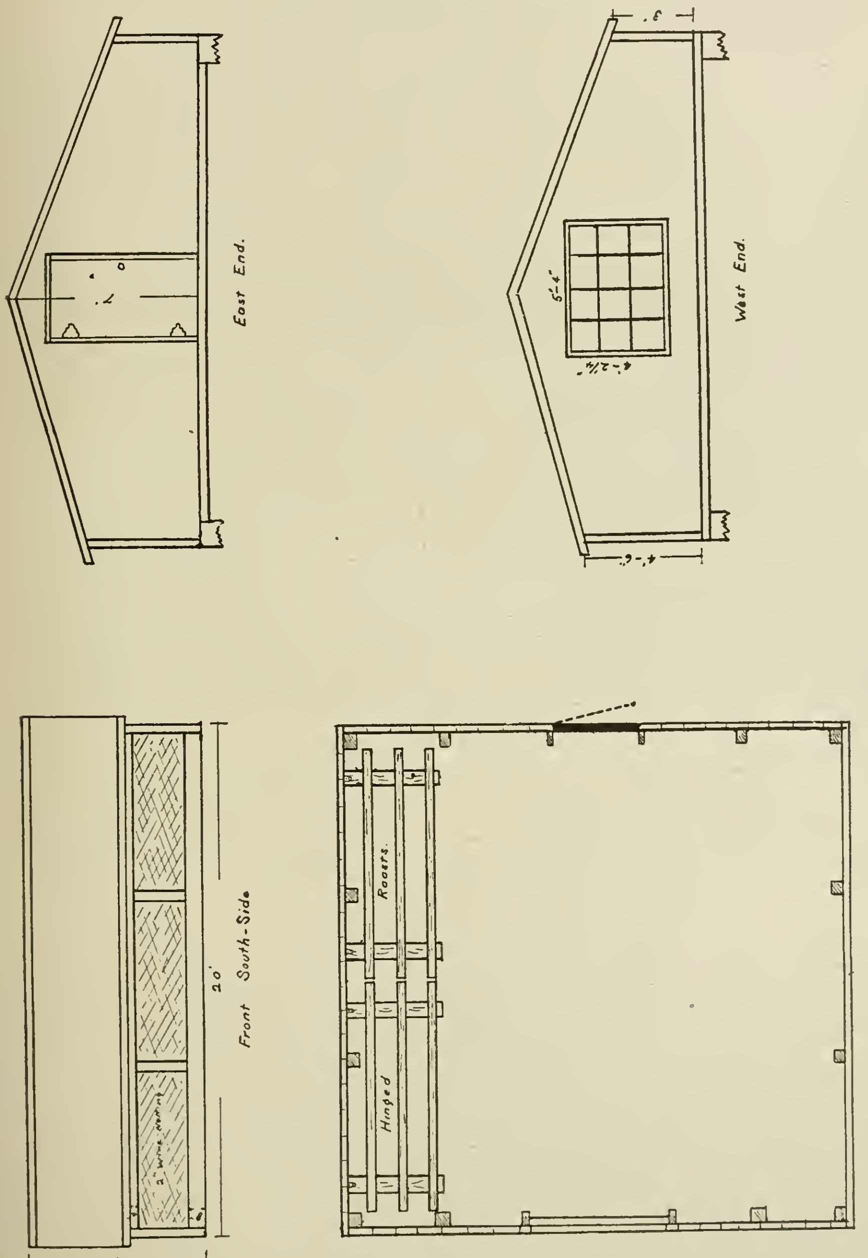


Fig. 7. Open Front Poultry House.

Our experience has been that the fowls thrive best in low-down houses, especially during the winter. We have four houses with the fronts entirely removed, except a two-foot wire netting, which keeps the fowls in, and the sparrows, etc., out. These houses for this climate must be low down, especially in front, to keep out the snow and a portion of the wind. It is the writer's opinion that Fig. 7 will meet the needs of 'the average farmer, where he wishes to keep seventy-five to one hundred hens. The house looks too cold, but the birds do well. They possibly could be made to lay more eggs during the months of January and February with cotton screens properly adjusted to meet the weather conditions; but few farmers would be there at the exact time to do the adjusting, hence we use it entirely open.

The large window in the west, essential for light, should be hinged at the top, so that it may be opened during the summer months, otherwise the house will become too warm in summer.

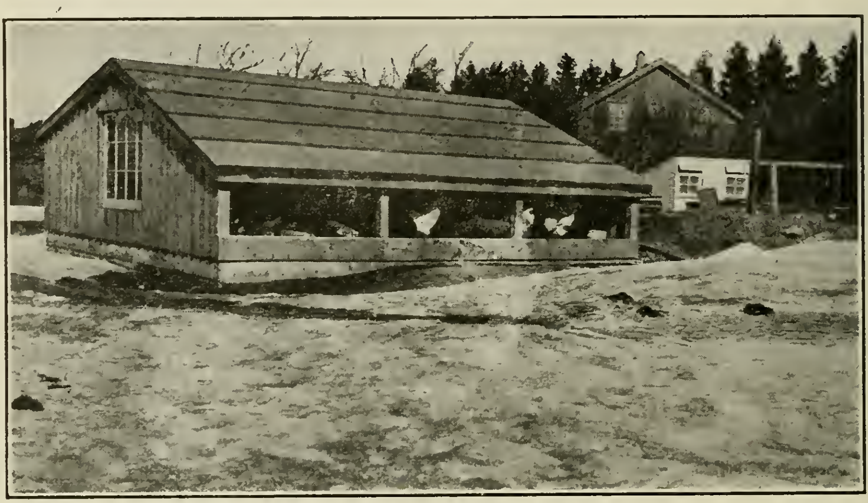


Fig. 8. Open front poultry house in Fig. 7.

It will be noticed that no dropping-boards are used in this building. During the winter the manure freezes almost as soon as it is made, hence no odor or bad results, and if cleaned, say, every two months, it will answer very well. We would rather have this condition than dropping-boards, covered one foot deep with manure, as we so frequently see them.

A number of houses of this style are in operation in various parts of the Province, and they are givng fair results. In some of the colder sections, such as in the districts north of Barrie, the house appears to be too open for severe winter weather. In such cases I would suggest using movable cotton screens on two sections of the front. The illustration shows three sections, one of which should always be open. During the winter months the centre screen may be closed nearly all the time and the end screen moved to either side, depending on the direction from which the wind is blowing. I have seen similar houses, two-thirds of the front of which were covered with a cotton frame which could be thrown on the roof during bright, warm days and let down over the front during the cold nights and stormy weather.

In a few cases, open front houses have been built only twelve or fifteen feet deep and twenty or more feet across the front. This is not advisable, owing to the fact that should there be a direct wind blowing into the house the birds cannot get back far enough to be out of the draught. This house is built to accommodate not less than one hundred birds, and will work well with as many as one hundred and twenty-five during winter weather. If a smaller house than the twenty by twenty is desired it should be built, say, twenty feet deep and ten feet wide rather than ten feet deep and twenty wide. The width across the front should never exceed the depth.

Snow will occasionally blow into the house, but we have had very little trouble in this respect. Having the building deep, low, and narrow tends to prevent this. A rather small opening in front will not allow the wind and snow to blow far back into the house and the depth allows the birds to keep out of the wind. If there is continuous rainy or damp weather for several days the litter will become damp and must be removed at once. Both walls and floor must be kept dry or the birds are likely to suffer from disease of some kind. There should be no opening except that in the front, or there is likely to be a draft through the house, and this should be avoided.

The following is the egg production for 100 April hatched White Leghorn pullets from November, 1912, to June, 1913 (inclusive). These pullets were housed in an open front house (see Figure 7):

			Total Egg Production.
Pullets laying in	November,	71	795
" " "	December,	68	889
" " "	January,	65	753
" " "	February,	74	554
" " "	March,	92	1,765
" " "	April,	99	2,023
" " "	May,	94	1,863
" " "	June,	91	1,688

Note.—The winter of 1912-13 will be remembered as exceptionally mild. We have seen the temperature as low as nine degrees below zero inside the house during other winters. Some males combs will freeze at such temperatures, and, moreover, the egg production is slightly affected for a few days.

In conclusion, we are free to admit that the open-front house apparently keeps the stock in better health, brighter in plumage, and it requires less labor than any house we have yet used. It is not perfect, and no doubt could be improved upon for special, painstaking poultrymen, but this class is very limited, and the house as now used comes most near to meeting the average man's position.

Long, Continuous House.

No doubt some readers will wish for a plan of a long, continuous house, in which a large number of fowls may be housed under one roof, or where a number of different breeds can be kept in the same building.

Fig. 6 gives the ground plan of this building as now used. The partitions are temporary, made of cloth tacked to wooden frames, and can be moved or adjusted to suit almost any sized flock. This house was originally used for flocks of 50, 75 and 100 laying hens, with the idea of testing large and small flocks. The house was used in this manner for three seasons with slightly better results from the flock of 50.

The plan as now given accommodates 25 fowls in each flock, with the exception of the large pen, in which can be kept 75 fowls of such breeds as Rocks or Orpingtons, or 90 of such as Leghorns. The large pen could, of course, be divided into the smaller pens.

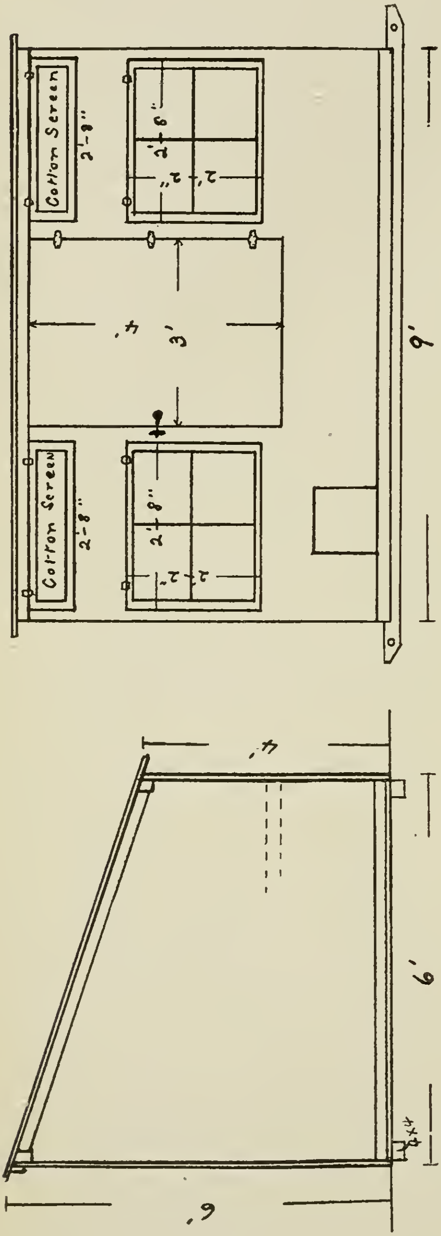


Fig. 8.

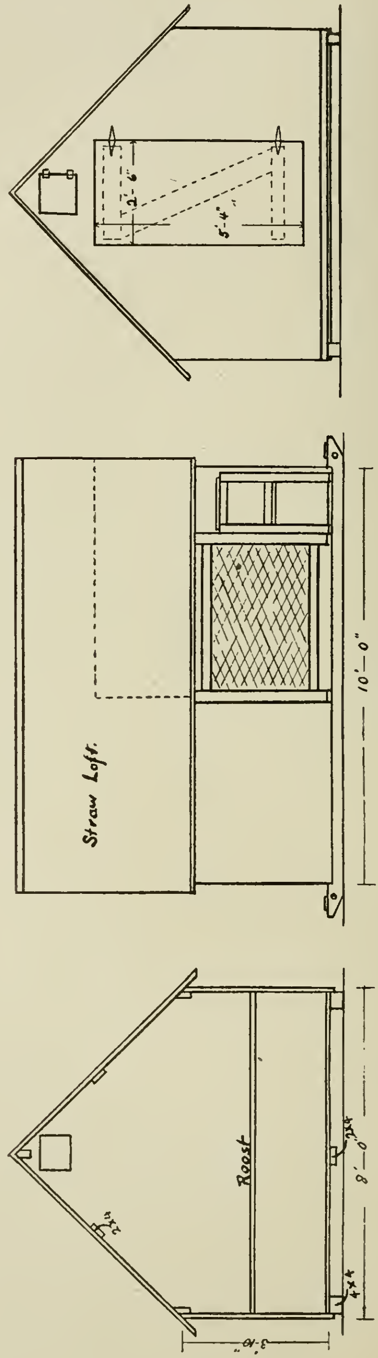


Fig. 9.

For the purpose of carrying on more extensive breeding work a long, continuous house was built in the fall of 1912. This building is 208 feet long, 12 feet wide, 8 feet high in front, and 5 feet high at the back. The house is single boarded with inch lumber, the cracks battened. It rests on a concrete foundation 8 inches wide at the bottom and 6 inches at the top, the floor also being of concrete 3 inches in thickness. Below the floor is at least 8 inches of small stones, on which was placed enough gravel to allow the laying of the floor. Our experience is that it requires at least 8 inches of filling such as small stones, etc., beneath the concrete. The studs are 2 inches by 4 inches placed 3 feet 6 inches apart and the rafters 2 inches by 6 inches each placed 2 feet apart.

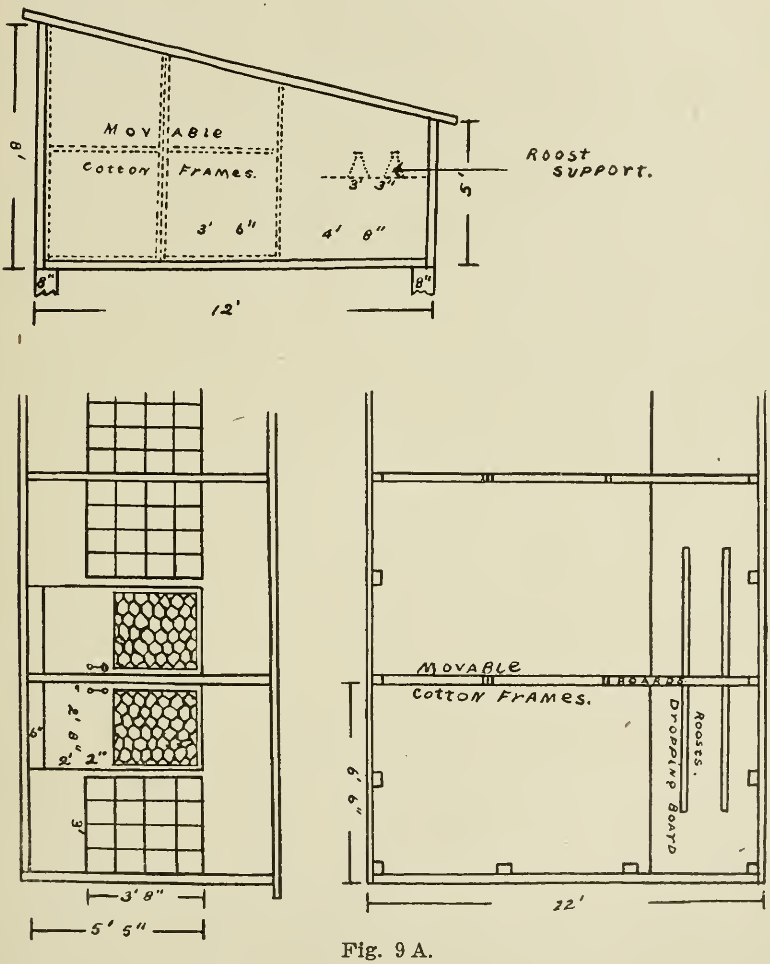


Fig. 9 A.

For breeding work it is often advisable to mate small pens. This house is divided into thirty-two pens each 6 feet 6 inches wide, each pen accommodating about eight or ten birds. A dropping-board three feet from the floor is used. There are two roosts four feet long to each pen.

A portion of each partition is made movable so that larger pens may be had should they be required. Four and one-half feet from the back they are of matched lumber and stationary, the balance being of two wooden frames covered with nine-

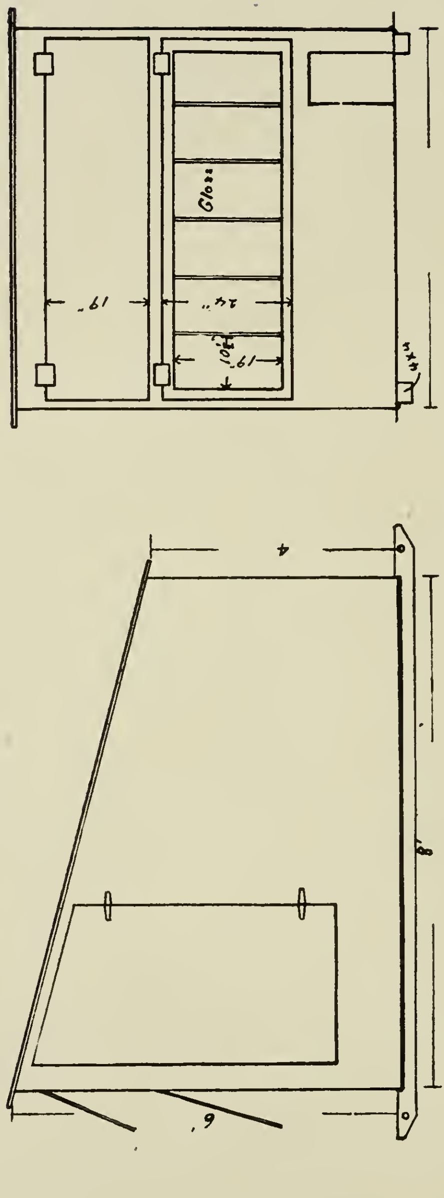


Fig. 10.

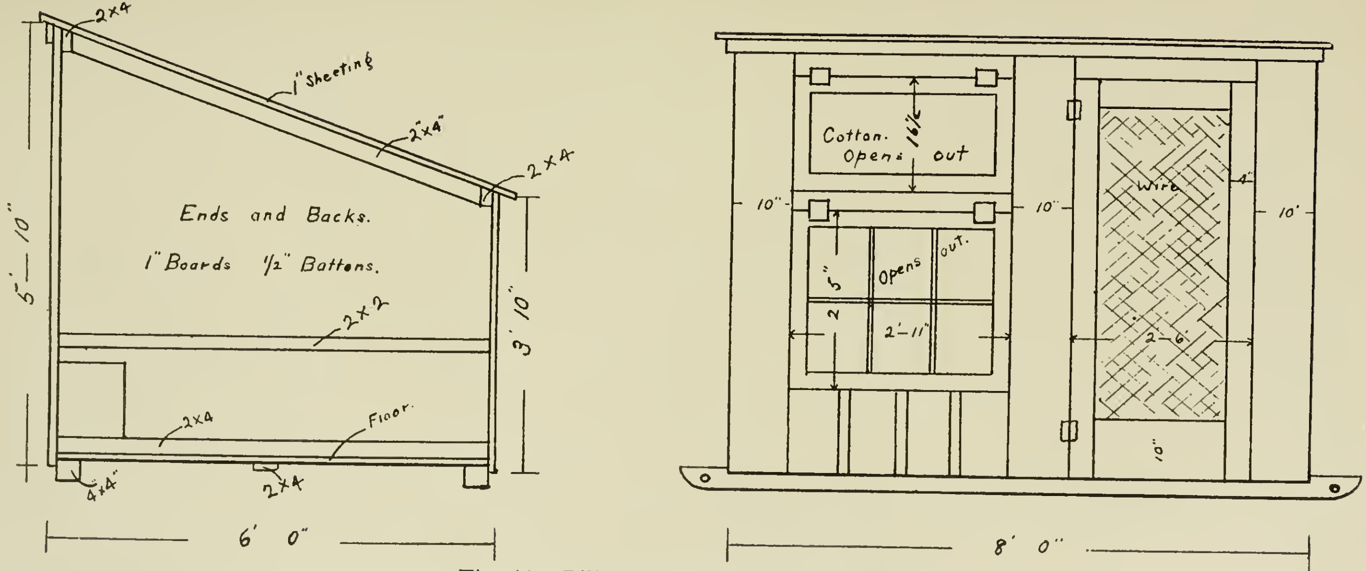


Fig. 11. Bill of Material for Colony House.

2 Pieces 4 in. x 4 in. x 10 ft. Runners.
3 " 2 in. x 4 in. x 7 ft. 10 in., Plates and Cen. Runner.
2 " 2 in. x 4 in. x 5 ft. 10 in., End Sills.
2 " 2 in. x 2 in. x 5 ft. 10 in., Roost Supports.
50 Feet 1 in. Matched Flooring.
50 " 1 in. Roof Boards.
100 Feet Run, ½ in. x 2 in. Battens for ends and sides.

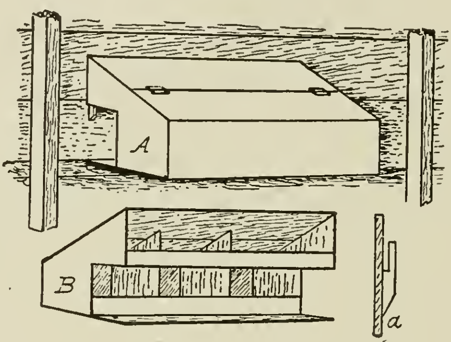
140 Feet 1 in. x 10 in. Outside Boarding: Door, etc.
½ Square Shingles.
1 Sash, 6 lbs., 10 x 12 Glass
1 Cotton Screen, 2 ft. 11 in. x 16½ in.
1 Door, 2 ft. 6 in. x 5 ft. 6 in.
1 Cotton Screen, fits on doors.

ounce duck. These may be removed at any time and a number of pens allowed to run together. If this is done, the solid portion of the partition at the back materially assists in checking drafts, which are common in long, narrow pens.

In the front of each pen is a door and also a window consisting of sixteen lights eight inches by ten inches, as shown in Fig. 9A. The upper part of the door is of wire netting covered with a movable frame in extremely cold or stormy weather. This style of house should prove useful to poultry breeders. During the winter of 1912-13 the cotton frames were not used the greater part of the time and we had little or no trouble with frozen combs.

General Rules for Building.

Every hen should be allowed at least four to six square feet of floor space. Each bird of the Plymouth Rock, Wyandotte, and such breeds, requires about nine inches of perch room; Leghorns, etc., about eight inches; and Brahmas ten inches.



Figs. 12 and 13. Front and Back Views of Nests. (*Poultry Craft.*)

Roosts should be made low, or near the ground. There are several reasons for this. Fowls of the heavier breed cannot fly high, and those of the lighter breeds frequently injure the soles of their feet in jumping from high perches.

When dropping-boards are used, they should be moderately low down, to admit of easy cleaning. Dropping-boards should be made of matched lumber, and should be twenty inches wide for one roost, and three feet for two perches, the first being placed eight to ten inches from the wall.

Most poultrymen prefer roosts two inches by two inches, with edges slightly rounded.

Nests.—Many use only old boxes; but such nests, if near the ground, are apt to induce egg-eating. Dark nests prevent this. (Figs. 12 and 13.)

Nests are usually made from 12 to 15 inches square.

Cement floors are the cleanest and the results are very good. Their cost is a serious objection. Ground floors are more in favor than board floors, and cost much less.

In my own experience, the best results are obtained from keeping 20 to 25 birds in a flock. Some succeed with 60 to 75 in a flock; but these are the minority. We have received fair returns from a flock of 100 hens.

Colony Houses.

Many people living in towns and cities wish for plans of houses suitable for housing a dozen fowls each. In some instances they wish these houses so constructed that they can be moved from place to place.

There is also a demand among farmers for a small house for rearing chickens, or for small special breeding pens. The plans already given are all adaptable to these conditions, and have been used here for the purposes mentioned above. The houses are of sufficient size to accommodate 100 chicks to a two-pound weight, or fifty chickens to a four or five-pound weight; but for winter use I would not advise putting in more than a dozen laying hens. See Figs. 8, 9, 10 and 11.

EGG PRODUCTION.

In considering this subject there are several factors worthy of notice—the housing and the range, the breed and the strain, the kind of feed and the method of feeding, the attendant, the cleanliness of the buildings, their surroundings and the weather.

In the foregoing pages we have discussed houses, and no further mention is needed here.

The question of which is the best breed is rather a delicate one, and, moreover, my experience is that there is as much in strain as there is in breed. However, it can be safely stated that the heavier breeds such as Plymouth Rocks, Wyandottes, Rhode Island Reds, Orpingtons, etc., usually lay better during the winter—if hatched early— than do Leghorns, Hamburgs, etc., or the lighter breeds. The lighter or smaller breeds, with us, are more easily affected by sudden climatic changes during the winter. Usually their egg production declines considerably during a cold snap. Where one has no particular desire to get eggs in winter and does not care for roasting chickens, they would find the lighter breeds most profitable. Where one wants a general purpose chicken, that is a fair layer during both winter and summer, and at the same time a chicken that will make a fair broiler or roaster, such breeds as Plymouth Rocks, Wyandottes, etc., will prove most satisfactory. The light breeds can not be depended upon to hatch and rear their own young, whereas the heavier breeds may be relied upon for this purpose.

We have our best egg production yearly from April and early May hatched pullets. These will commence laying if well reared between September and December, depending upon the strain or family as to whether or not they are late or early in maturing. March hatched pullets usually lay during August and then go into moult some time in November. These, of course, lay but little before March after moulting. They are, however, useful where one must have a constant supply of eggs, as the old hens decline rapidly during September and October, and the April pullets are then just getting started.

We find that Leghorn pullets or pullets of similar breeds hatched before April 15th are apt to moult, so that we usually try and hatch these varieties after the middle of April.

Yearling hens lay fairly well, but older than this they are usually unprofitable, except as breeders when they have shown exceptional merit.

COLLECTIVE RESULTS FOR 138 PULLETS FROM OCTOBER 1ST, 1909, TO SEPTEMBER 1ST, 1910.

Males.	Females.	Breed.	Eggs Laid.	Cost.	Average Eggs per Bird.	Lbs. grain consumed.	Lbs. Milk consumed.
2	23	R.I. Reds	3,318	$29 06	144.2	1,662	2,070
2	23	B. Rocks	3,341	27 90	145.2	1,585	2,070
2	23	R.I. Reds	2,599	25 81	113	1,451	2,027
2	23	B. Rocks.	3,654	28 44	158.8	1,626	2,027
2	23	B. Rocks (weak)	2,182	25 18	94.8	1,374	2,289
2	23	B. Rocks (strong)	2,742	29 62	119.2	1,655	2,401
12	138		17,836	$166 01	....	9,353	12,884

Average cost per dozen eggs for eleven months 11.16c.

Average cost of feeding each bird per month for eleven months 10.06c.

Average number of eggs per bird for eleven months 129.2.

Average amount of food consumed per bird (males included) in eleven months: Grain, 62.35 lbs. or 5.66 lbs. per month; milk, 85.89 lbs. or 7.8 lbs. per month.

COLLECTIVE RESULTS FOR 341 HENS AND PULLETS FROM OCTOBER 1ST, 1910, TO SEPTEMBER 1ST, 1911.

Males.	Females.	Breed.	Eggs Laid.	Cost.	Average Eggs per Bird.	Lbs. Grain consumed.	Lbs. Milk consumed.
2	55	B. Rock Hens.............	5,961	$ 74 92	108.3	4,357	4,787
4	92	B. Rock Pullets	11,928	124 02	129.6	7,042	9,195
5	60	B. Orpington Pullets	6,401	81 26	106.6	4,805	4,597
6	111	White Leghorn Pullets....	13,504	118 49	121.6	6,739	8,704
2	23	Black Minorca Hens and Pullets	1,726	32 34	75.0	1,874	2,118
19	341		39,520	$431 03		24,817	29,401

Average cost per dozen eggs for eleven months 13.08c.

Average cost of feeding each bird per month for eleven months 10.88c.

Average number of eggs per bird for eleven months 115.8.

Average amount of food consumed per bird (males included) in evelen months: Grain, 68.9 lbs. or 6.2 lbs. per month; milk, 81.6 lbs. or 7.4 lbs. per month.

COLLECTIVE RESULTS FOR 266 PULLETS FROM NOVEMBER 1ST, 1912, TO OCTOBER 1ST, 1913.

Males.	Females.	Breed.	Eggs Laid.	Cost.	Average Eggs per Bird.	Lbs. Grain consumed.	Lbs. Milk consumed.
5	105	B. Rock Pullets	13,750	$134 54	130.9	7,860	8,323
1	20	W. Wyandotte Pullets	2,247	27 99	112.3	1,670	1,472
1	19	R.I. Red Pullets..........	2,352	27 26	123.7	1,618	1,499
1	22	B. Orpington Pullets......	2,335	31 70	106.1	1,819	2,214
6	100	W. Leghorn Pullets.......	13,306	107 01	133.0	6,340	5,955
14	266		33,990	$328 50	....	19,307	19,463

Average cost per dozen eggs for eleven months 11.5c.

Average cost of feeding each bird per month for eleven months 10.6c.

Average number of eggs per bird for eleven months 127.7.

Average amount of food consumed per bird (males included) in eleven months: grain, 68.9 lbs. or 6.2 lbs. per month; milk, 69.5 lbs. or 6.3 lbs. per month.

The following are the averages for the three years:

Average cost per dozen eggs for eleven months 12.1c.

Average cost of feeding each bird per month (males included) eleven months 10.6c.

Average number of eggs per bird for eleven months 122.6.

Average amount of food consumed per bird (males included) eleven months: grain, 67.6 lbs. or 6.1 lbs. per month; milk, 78.1 lbs. or 7.1 lbs. per month.

FEEDS AND FEEDING.

A fowl requires grain food, vegetable food, meat food, and grit. These foods should be clean and wholesome, and furthermore a portion of them should be given in some form so as to induce the birds to take exercise, so that the fowls will be healthy. Fowls should be well supplied with water or milk to drink. Many make the serious mistake of not giving sufficient drink or not giving it regularly. The supply should be clean and constant. Dirty water, dirty or slimy drinking dishes, etc., will do more towards making a flock unhealthy and diseased than anything else. Most attendants are inclined to forget to clean the drinking vessels, and to keep them well filled at all times.

Grains.

Wheat with the Ontario people is the most popular feed and is one of the best. It is relished by all classes of poultry. The price of wheat as compared with that of other grains during the past few years, makes it necessary to mix other grains with it. I doubt very much if it is advisable at any time to feed only one kind of grain constantly, as a variety is better; some birds like one grain while others relish another.

Wheat bran is fed dry in hoppers, also in mashes. It has considerable feeding value. It helps materially in adding bulk to the ration, and prevents impaction in the stomach. In other words, it aids the digestive fluids in acting upon the food.

Middlings or shorts is of value in mashes, to all classes. and is one of the good foods to check looseness of the bowels, where an excess of vegetables is given.

Low-grade flour is often a cheap and economical food in mashes for stock birds or for fattening chickens. It also has a tendency to check looseness of the bowels.

Corn is not used so much in Ontario as in the New England States. There it appears to be used quite freely in both summer and winter feeding of fowls. It is used whole, ground, and cracked, the meal being used principally in the mash foods. Cracked corn is used largely for young chicks, and fowls when scattered in the litter. The whole corn is rather large and conspicuous; and when in the litter does not usually give sufficient exercise. I am of the opinion that corn can be used in portions of Ontario, where it is grown extensively, much more freely than it has been heretofore. Corn is a heating and fattening food, and is, therefore, best adapted for winter use. It is considered by many, when fed in large quantities, to make the hens over fat; yet it is used extensively by many progressive poultrymen with little or no evil effects.

Oats should be a first-class poultry food, but owing to the large percentage of hull, they are not relished by chickens when fed whole, and for this reason are somewhat indigestible. When rolled, hull and all, they are an ideal food as a dry mash, and are relished by fowls better than any other dry mash we have yet used. Ground oats without the hull are used extensively for fattening chickens.

Barley, either whole or ground, is very good. It has rather too much hull, but otherwise is a satisfactory food. It is considered by many to be next to wheat in point of value.

Buckwheat is very popular as an egg producer in districts where it is extensively grown. Some difficulty is at times experienced when first feeding it to fowls in getting them to eat it. But this is usually overcome in a day or so, if other feeds are withheld. Boiling the buckwheat will sometimes start the birds to eat it. After they once get accustomed to its appearance, it is much relished by them. Ground buckwheat is an excellent food to use in a fattening ration. It is somewhat like corn in its fattening properties, and, therefore, it is better for winter than for summer use.

Method of Feeding the Winter Laying Stock at the O.A.C.

We try to simplify our methods and use only the common foods, and at the present time are using as whole grains wheat, corn and buckwheat. These grains are fed in equal parts both morning and evening. The morning feed is fed the previous evening after the hens have gone to roost, by sowing it on the litter, and then turning the litter over; the straw is now on top and the grain below, and when the hens get up in the morning, they start to dig out the grain, and are kept busy all forenoon. At noon we feed mangels, cabbage or clover hay. The night feed consists of the whole grain fed in troughs, and what the birds do not eat is taken up. Rolled oats are kept constantly before the hens in hoppers. Buttermilk only is given as drink.

Method of Feeding the Summer Laying Stock at the O.A.C.

At the present time our plan of feeding is to scatter whole grain in the litter both morning and evening. The grains used are wheat, barley, oats, and occasionally buckwheat and corn. Green food is supplied in the form of grass, etc., in the runs. Sour milk is given as drink.

Dry Feeding.

The tendency at the present time is to feed dry grain, and to use no wet mash foods. It has been claimed by some writers that mash foods, while tending to force growth, and possibly egg production, do not tend to produce good eggs for hatching purposes; that is to say, the mash is more or less of a forcing food. In the production of eggs, the number produced is probably as large if not larger where mashes are used, but the hatching power of the eggs in some instances is not as high. During the past two or three years we have not fed any wet mashes to our breeding birds, and have fed in place some sprouted grain, but mostly rolled oats in hoppers. As far as we can see at the present time the sprouting does not improve the feeding qualities of grain very much, with the one exception of oats. The palatability of oats is increased considerably. We have made the oats equally palatable by having them rolled or flattened, that is the hull and all.

Feeding When Wet Mashes are Used.

The general method of feeding is to give a mash of mixed ground grains moistened with water or milk, in the morning; a little whole grain scattered in the straw covering the floor, at noon; and all the whole grain they will eat at night. This latter meal is usually fed in the straw. Some poultry men adopt the plan of not feeding the mash until evening, we have been practising this plan for some time, and we like it very well. The objection to the former plan is that the hen is likely to become gorged with food early in the morning, and thus take to the roost for the rest of the day, which is usually followed by hens becoming too fat, and the egg record becoming small; but, notwithstanding, many successful poultrymen use this method to advantage. The objection to feeding the mash at night is that it becomes quickly digested, and the bird has not sufficient food to last it during the long winter night; but this objection can be overcome by giving a little whole grain after the mash at night.

Some poultrymen feed their fowls but twice a day, morning and evening, and get very good results; but I favor feeding three times a day. Our plan is somewhat as follows:—

Early in the morning the fowls are given half a handful each of whole grain. This is buried in the litter on the floor. Thus the fowls get exercise (a very necessary thing) in searching for it and at the same time keep themselves warm. At noon about two handsful of grain are given to a dozen hens in the litter; they are also given all the roots they will eat, either pulped or whole, as fowl relish mangels, sugar beets and turnips. Cabbages also—a very good green food—is sometimes given. About four o'clock in the afternoon they are fed a mash composed of equal parts of bran, shorts, oat-chop and corn meal (during cold weather); and to this is added about 10 per cent. of animal meal, if we have not cut green bone or cooked meat. These foods are thoroughly mixed together in the dry state, after which is added steeped clover, which has been prepared by getting a bucket of clover leaves, or cut clover hay, and scalding it with boiling water. This is done early in the morning, and the bucket is kept covered with a thick sack throughout the day. This will be quite warm at night, if it has been kept in a warm place. There is usually sufficient liquid to moisten the meal that has been mixed. Our aim is to have about one-third of the ration, in bulk, of clover. After the mash a small amount of whole grain is fed in the straw. There is—and should be—a plentiful supply of good *pure water within easy reach at all times.*

To those who keep but a dozen or so fowls, or to those who wish to economize in the feed bills, by using table refuse such as bread, meat, vegetables, etc., the wet mash system is commendable, in that these cheap by-products, if clean, and cooked, make excellent mashes, when dried off with shorts and bran or other chop. This kind of mash usually gives excellent egg yields, and the labor entailed is not a serious consideration, under the above conditions, but it is, at times, where birds are kept in large numbers.

Animal Foods for Fowls.

The most expensive foods given to fowls are the animal foods. These are used as a substitute for the worms and insects that form a portion of the natural summer food of fowls upon free range. Flocks confined to small runs require to be fed more or less animal foods during the winter, and during very long dry spells in the summer; even where the range is unlimited it frequently pays to feed a little animal food.

Animal foods usually assist very materially in the production of eggs in winter. By some people these foods are considered as a forcing food, that is to say, they will induce heavy laying, which in some instances may be followed by serious sickness, or possibly the injury may be only very slight; in fact unnoticeable, except that the eggs from birds so fed may be of very low hatching power.

It is generally believed, and I think rightly so, that good egg yields cannot annually be secured without the use of such foods as green cut bone, beef scrap, or cooked refuse meat, etc. Many believe that the larger the amount of these foods fed the greater will be the egg production. There is good ground for doubting this statement, in that these foods are expensive, and the extra eggs may cost more than they are worth. Moreover, herein is where serious injury may be done to the hen's digestive and reproductive organs.

Milk is available on many farms, and it is claimed that as an egg producer this food is equal in value to any of the meat foods. Our experience has been that sour milk for fowls has a slightly greater value than sweet milk, and is certainly much more easily obtained.

Three years ago we planned an experiment with the idea of studying what effect various animal foods would have upon the egg production, and the hatching power of the eggs.

Below is given the results of the first three years' work, that of 1909-1910 being carried on with Buff Orpington pullets, that of 1910-1911 with Rhode Island Red hens and pullets, and 1911-1912 with Leghorn pullets.

There were twenty-five females and two males in each pen, and all were housed in the same building. The grain and green food used were the same in each pen.

The animal foods are reckoned at the following prices:

Buttermilk 20c. per 100 lbs. Beef scrap $3 per 100 lbs. Green cut bone $3 per 100 lbs.

Experimental Feeding with Buff Orpingtons.

The following are the results for 7 months, from Oct. 1st, 1909, to April 30th, 1910:

Pen No.	Animal Food used.	Lbs. Whole Grain.	Lbs. Dry Mash.	Lbs. Animal Food.	Total Cost.	Total Eggs Laid.	Cost Dozen Eggs.	Percentage of Eggs Hatched.
1.....	Buttermilk	720	233	1,453	$18 16	2,040	10.68	55.0
2.....	10% dry mash beef scrap..............	840	337	34	19 85	1,670	14.28	50.5
3.....	Beef scrap in hopper .	900	216	141	22 21	1,664	15.84	33.0
4.....	No animal food.......	900	224	....	17 99	1,496	15.48	59.5
5.....	Green cut bone	900	196	127¾	21 37	1,654	15.48	40.5

Experimental Feeding with R. I. Reds.

The following are the results of 8 months, Oct. 1st, 1910, to May 31st, 1911:

Pen No.	Animal Food used.	Lbs. Whole Grain.	Lbs. Dry Mash.	Lbs. Animal Food.	Total Cost.	Total Eggs Laid.	Cost Dozen Eggs	Percentage of Eggs Hatched.
1.....	Buttermilk	973	535	1,760.5	$25 60	1,762	17 43	57.0
2.....	10% dry mash beef scrap..............	898	535	61.5	23 06	1,320	20.96	56.4
3.....	Beef scrap in hopper..	907	510	106.0	23 92	1,625	17.66	51.66
4.....	No animal food	802	405	....	17 70	730	29.09	66.25
5.....	Green cut bone	784	411	182.5	22 44	1,359	19.81	64.5

Experimental Feeding with White Leghorns.

The following are the results for 7 months, Oct. 1st, 1911, to Oct. 30th, 1912:

Pen No.	Animal Food used.	Lbs. Whole Grain.	Lbs. Dry Mash	Lbs. Animal Food.	Total Cost.	Total Eggs Laid.	Cost per Dozen Eggs.	Percentages of Eggs Hatched.
1.....	Buttermilk	785	319	1,453	$19 46	1,508	15.5	68.2
2.....	Beef scrap in hopper..	750	205	81	16 76	1,158	17.3	69.2
3.....	No animal food	925	126	....	15 77	6(2	13.4	74.2
4.....	Green cut bone	781	287	98	18 96	1,193	19.4	68.6

Comments on Above Tables.

With all three breeds buttermilk produced the most and the cheapest eggs.

Where beef scrap was fed in a hopper or where the birds could eat all they desired the Leghorns and Rhode Island Reds did much better than the Orpingtons.

No animal food in all instances gave the best eggs for hatching and the lowest egg yield.

From the results so far obtained it would appear to be a disastrous practice to undertake feeding Leghorns on no meat food ration, or meat food in very small quantities, for the reason that they developed feather eating to such an extent that some of the birds were killed and the males were a sorry sight, in fact, had to be frequently removed from the pen. This was true to a limited extent with the Rhode Island Reds but was not so of the Orpingtons.

Green Foods.

When fowls have free range, they eat a considerable amount of grass, or other green foods. It would appear, therefore, to be desirable that where birds are confined either in small runs during the summer, or in houses when the ground is covered with snow in winter, some effort should be made to supply this food.

Many foods are available, such as waste cabbage, mangels, turnips, rape, clover, hay, or clover leaves, and green food grown especially for the purpose.

Early in the fall we use cabbage or rape; or at times where the runs have been sown to fall rye or wheat, the fowls are allowed to feed upon these. Where rape is extensively fed it frequently will cause the whites of the eggs to have a greenish cast, which renders them unmarketable. This food is relished by the fowls, but must be fed carefully. Cabbage at times will flavor the eggs slightly, and if frozen may cause serious digestive troubles. Both rape and cabbage make good green foods, but good judgment must be exercised in their use.

Mangels are a very succulent food and are relished by the birds during the winter. They can be fed either pulped or whole. When they are fed whole, we usually stick them on a projecting nail, at a convenient height, upon the wall of the pen. When these are fed freely they frequently scour the fowls. For this reason during some seasons we are obliged to feed them not more than twice a week.

Turnips may flavor the eggs. They are not as palatable as mangels, in fact some birds will not eat them at all, but at the same time they have considerable food value.

Clover leaves, either steamed or dry, are relished very much, and upon the whole are the most reliable winter green food. One hundred hens will eat from a peck to a bushel of clover leaves daily. This food upon the farms is cheap and easily procured, and should be fed more than it is.

The growing of green food is becoming quite popular with many, but we have never received sufficient results to warrant our growing it extensively, except for little chicks.

The ordinary plan is to soak the grain—most people use oats—twenty-four hours previous to sowing. The ordinary greenhouse flat is useful for this purpose. Any box from 3 to 4 inches deep will answer. It is necessary that the bottom of the box should have sufficient holes to give good drainage. Place a little damp earth over the bottom of the box, and then put in about ½-inch of soaked grain, and cover this with about 1 inch of sand. Keep the box in a warm place and keep the earth moist. In a few days the grain will begin to germinate. Most feeders allow the grain to grow two or three inches before feeding.

INCUBATION.

This is a very interesting topic. Here we are dealing with the renewal of the flock. This has been to the larger grower a difficult problem, and to most farmers and small growers comparatively easy. (It is apparently easy for the farmer to hatch and rear 100 or more chicks, and very difficult to get hens to lay during the winter. The large grower can usually get a fair production during the winter, if he can get the chicks out and well grown.) There are so many factors that may influence the hatch and the vitality of the chicks, that it is at times an impossibility to say why one fails and another succeeds.

The first essential to successful incubation is good hatchable eggs. The hatching power of eggs is apparently influenced by the parent stock, not only in the present generation, but possibly for generations back. Granting this, we must then use only the strongest and best birds as breeders, and if a rigid culling is followed annually, it is our belief that gradually, but surely, the problem will become less difficult. Then, again, the methods of housing and feeding are factors. Birds kept in ill-ventilated, damp houses, or under any unsanitary conditions, are lowered in vitality or vigor, which of necessity must be more or less imparted to the germ of the egg. It has been shown under the discussion of foods that the hatch is influenced by the feeds.

The farmer's flock is usually strong and rugged; it has plenty of exercise in the fresh air, and, moreover, is seldom kept in such numbers that the ground about the buildings becomes seriously contaminated. There are, of course, some exceptions to the above statement. Fowls upon the farm are very seldom ex-excessively fed upon meat, or what may be termed forcing foods. Then, again, the unlimited range and the great variety of foods available make the conditions upon the farm excellent for the production of good hatchable eggs. If more attention was paid to the selection of the males, the results would be improved. The selling of the largest, and earliest maturing males, and the breeding of the late hatched, immature, ill-nourished males is not conducive to progress, to say the least.

The difficulties of the large growers are mainly due to bad housing, yarding, and feeding. Many houses are poorly ventilated, and the yards are small, and the fowls are on them constantly, and are, therefore, in an unsanitary condition; and, furthermore, the lack of a variety of foods and exercise, and the use of animal foods, are also more or less injurious. All these conditions are largely under our control, and many of the failures in the past appear to be directly due to a too intensified condition. It has been many people's idea to see how many hundreds could be kept on the least acreage of land.

Natural and Artificial Incubation.

Whether it will pay to buy the incubators and brooders depends largely on one's circumstances. Where chicks are wanted in considerable numbers earlier than April 15th, an incubator becomes practically a necessity, as it is seldom that hens become broody in numbers until after the 1st of April. Again, where one wishes to hatch more than 150 chicks, an incubator is in many cases cheaper and better than the natural methods. It is also a necessity where one is breeding from the non-setting varieties.

There are numerous illustrations of chicks being raised in large numbers by the natural method in the States of Rhode Island and Massachusetts, particularly in the former State. Where this method is followed, the chicks are hatched largely during the months of May and June; and where from 500 to 1,500 laying hens are kept, there is little difficulty in getting a sufficient number of broody hens. Those who are keeping large numbers of hens appear to be well satisfied with the natural method; but there can be no doubt that the number of incubators in use is increasing from year to year.

The average hatch is probably one chicken from every two eggs set. This, of course, varies with the different seasons, also with the percentage of fertile eggs, and the strength of the germ. We have found during the months of February and March, when the ground is covered with snow and the fowls are closely housed, that the percentage of fertile eggs is small, and that the germs are very weak. Under such conditions we have very poor hatches and chicks that are very hard to rear. Much better eggs are obtained in December and early January, or when the fowls get out into the fresh air and are able to pick some grass. Thus it will be seen that, as a general rule, as the percentage of fertile eggs increases, the vitality of the germ increases, the percentage hatched is larger and the mortality among the young chicks smaller. For example, we would expect to get a much larger percentage hatch of the fertile eggs from eggs that were 90 per cent. fertile than from those that were 60 per cent. fertile; and, moreover, we would figure on raising a much larger percentage of chicks from the former eggs than from the latter, owing to the chicks being stronger and having greater vitality.

Setting the Hen.—It is generally agreed that, in order to secure a good hatch, the hen must be placed where other hens are not likely to disturb her; for, as a rule, we seldom get good hatches where other hens lay in the nest with the sitter. Some farmers do not set a hen until one becomes broody on a nest where no others lay, which often necessitates late chicks. The difficulty can be overcome by making a new nest for the broody hen. Get a box about twelve inches square and six inches deep; put some earth, or an overturned sod in the bottom, taking care to have the corners very full so that no eggs can roll out from the hen and get chilled; next put on about two inches of straw or chaff; and then put a few earthen eggs into the nest. Place the nest in some pen where nothing can disturb the hen, and put her on after dark. Feed and water must be within easy reach and a dust bath should also be convenient. If the hen is sitting quiet the next day, you will be safe in putting the eggs under her. In our experience we get 90 per cent. of the hens to sit by following this method.

It should be remembered that the hen will be in better condition if dusted with insect powder when set, and also a few days before the hatch comes off. This will usually keep the lice in check, especially if some tansy or mint leaves are used in making the nest.

Artificial Incubation.

During recent years many incubator experiments have been conducted here as well as at other colleges, and some progress has been made. It is our purpose at this time, not so much to go into the details of these, but to give, if possible, the best methods we know, that can be used by the average person.

Selecting an Incubator.—There are many makes of incubators on the market, that do fairly good work; they are not perfect, nor have they the hatching power of a normal hen, but then they are always ready to hatch eggs in any day of the year, and by their use eggs can be incubated in large numbers. They do not get balky, and cease hatching as some hens do—that is, unless the operator fails to do his part. Commercially they are a necessity. To the prospective buyer I would suggest the purchasing of a well built machine, one that is double cased, and that is easily cleaned, and whose fixtures, such as the lamps, etc., are convenient. I do not know which is the best incubator made.

Recent scientific investigations indicate that it is probable, in some instances, that disease organisms, found in dirty incubators, cause serious harm. Our plan—no matter what the type of machine—is to thoroughly wash the entire interior of every machine before putting in the eggs for hatching. We use a ten per cent. solution of a tarry compound, such as Creoline or Zenoleum. This helps to clean the machine, and if applied hot, so much the better. We have obtained best results by using water or moisture during the entire hatch. I have seen good hatches from incubators where no moisture was used. We use a pan beneath the egg-tray, nearly the full size of the machine, and keep this pan covered with water, or wet sand, not more than one inch in depth.

Many incubator thermometers are not reliable, and it is, therefore, advisable each season to have the thermometers tested; any druggist will have a registered thermometer, and can do the testing if the owner does not wish to.

The hatch is made or lost usually during the first week of incubation. Keep the temperature well up to 103 deg., with the thermometer lying on the eggs, and maintain as even a temperature as possible.

Do not set dirty, washed, small or extra large eggs. The shell is porous and disease germs that may be on dirty eggs might infect a number of eggs. Do not turn eggs when your hands are dirty, or immediately after handling lamps or kerosene.

The room in which the machine is operated should be clean and well ventilated. If possible select a room that varies but little in temperature; in such a room it is easier to keep the hatching chamber of the machine at an even temperature. Where there is a strong odor of lamp fumes, or where there are decaying vegetables, or where moulds grow upon bits of boards or upon the walls, an incubator will not usually do good work. The lamp burns brighter, the eggs hatch better, and the chicks have more vitality when the air in the incubator room is pure.

Operating the Machine.

We have obtained the best average hatches and the best chicks, other things being equal, by operating the machines at 103 degrees F., with the bulb of the thermometer resting on the top of an egg, not at the side of the egg, nor at the bottom. This heat is maintained throughout the hatch. We are particular to set clean eggs, usually not over two days old, which have been held at a temperature between 55 and 75 degrees. The eggs are best put in the machine in the morning; then the gradual heating of the eggs goes steadily on during the day and by night we know that the machine is not too hot or cold. Moisture is used from the start; we are more particular about moisture during the first week of the hatch than at any other period. No ventilation is given until after the ninth day of incubation. Our best hatches in nearly all instances are from machines operated at a very even heat, with plenty of moisture, and little or no ventilation up to the ninth day. After this period the eggs need plenty of air and the ventilators opened gradually until wide open at hatching time. The hatch appears to be made or lost during the first week of incubation.

We do not like to let the chicks off the trays or down in the nursery. If they pant, it is nearly always from a lack of air; in such cases we open the door slightly or sufficient to keep the chicks comfortable.

General Symptoms of What is Commonly Called White Diarrhoea in Young Chicks.

When chicks are about twenty-four to ninety-six hours old they resemble each other very much in appearance, with the exception that we have noticed that hen-hatched and chickens hatched in moist incubators were longer in the down, or looked larger and fluffier. The trouble generally begins about the fifth day. Some of the chicks will have a thin white discharge from the vent, the chick is not active, it has a sleepy look; also the head appears to settle back towards the body; one thinks the chick was cold or in great pain. Some of the chicks get in the warmest spot under the hover, others have intense thirst. The white discharge from the vent is not always present. The chicks may die in large numbers between the fifth and tenth days, or there may be a gradual dropping off each day until they are six weeks of age. The disease kills some quickly, others linger for a week or more. A few chicks appear to recover, but seldom, if ever, make good birds. They are small, unthrifty, and are good subjects for roup or any other epidemic.

To the ordinary observer a post-mortem examination may reveal any or all of the following conditions: The lungs will usually show small white spots in them.

These are generally quite hard and cheesy. These spots are not always present, but from our examination I would judge they are in fifty per cent. of the cases. Some lungs have no white spots, but are red, sometimes fleshy. These in our experience are not very common unless the chickens are chilled. The yolk is often hard and cheesy. It varies greatly—some yolks are of a gelatinous nature or almost like the white of the eggs; others are hard and cheesy and very yellow in color, sometimes these are greatly inflamed; other yolks appear like a custard that has curdled, and they usually have a very offensive odor. The ceaca, or blind intestine, is frequently filled with a cheesy substance.

The white spots in the chicks' lungs are generally considered to be due to the growth of a common mould. This may be in the eggs, or more frequently comes from moldy feed or litter. It is much more troublesome in damp, dull weather, when the chicks are most inclined to stay under or near the hover.

REARING CHICKENS.

Experience and observation has led me to believe that chickens, in order to do their best, require to be grown on fairly good land, probably a clay loam or a sandy loam being the best. I have never been successful nor yet have I seen good flocks of chickens grown on very light sand. Chickens require dry ground at times, yet, at the same time, a rather moist location near by renders a good foraging ground.

Young chickens require plenty of ground to range over; some convenient shade, such as fruit trees, or growing corn or artichokes; tender green food and insects. Many growers of large numbers of chickens on limited areas crowd the birds far too much, the result being a large proportion of unthrifty chicks. These last mentioned chickens have been very much in evidence on nearly all the large, intensive poultry plants that I have visited. The chicks frequently outgrow these conditions to such an extent that they are very difficult to pick out when mature, but are readily seen when about one-half grown. Many growers appear to believe that as long as a chicken is alive it is a good one, but this is folly. I believe by breeding from such stock the vitality will gradually decrease until we shall reach a point where eggs are practically unhatchable.

Chickens when taken from the nest or incubator should be placed on ground upon which no other chickens have ranged that season. The range or run for a chick during the first four weeks of its life need not be large, but it should be fresh.

Many make the mistake of putting late hatched chickens on old tough sod, the green grass (if there is any) being so tough that the chicks cannot break it, and often the grass too thick to admit of a chick catching an insect before it is out of reach. I much prefer a cultivated piece of ground. A little tender lettuce, or rape, or even weeds for green food are preferable to summer sod, or grass. But after the middle of May the cultivated land gives better results than grass land.

A corn field well cultivated appears to be nearly an ideal place for raising late hatched chicks.

Chickens hatched in an incubator can be reared either with hens or with a brooder. Some people are able to make good hatches with their incubators; but they are unable to rear the chickens in brooders. In this case I would advise the use of broody hens for mothers; and the same would apply to those who have an incubator, but do not care to invest in a brooder.

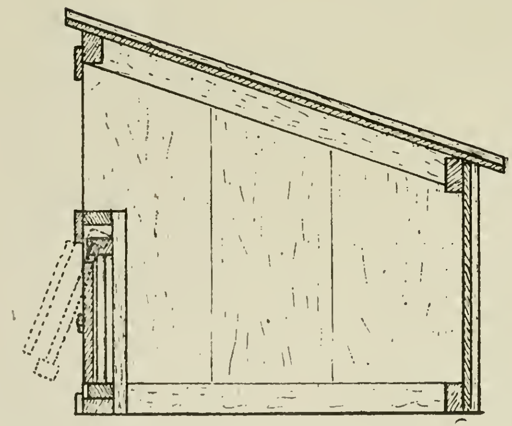


Fig. 15. Cross section.

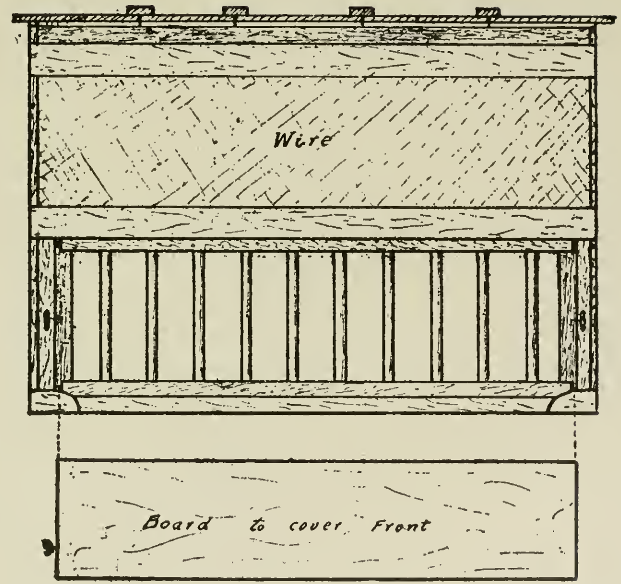


Fig. 14. Front of a convenient coop for hens and chicks.

This coop can be closed at night so as to keep out all animals that might destroy the chicks. The wire front is necessary to supply an abundance of air.

The movable front is a great convenience when the hen is running at large during the day.

The coop is two feet high in front, fifteen inches high at the back, and is two wide by three in length. The wire portion is one foot in width.

The best plan I know of to get the broody hens to take the chicks is to give the hen two or three eggs out of the incubator on the 18th or 19th day and allow her to hatch them. When your incubator hatch is over take a dozen or fifteen chickens and put them under the hen after dark. Even if they happen to differ in color from those she has hatched, she will mother them all the same. If you give them to her in the day time she may not do so. Never neglect to give the hen a thorough dusting before giving her any eggs. If there is one thing more than another that requires careful attention in rearing young chickens, it is to keep them free from

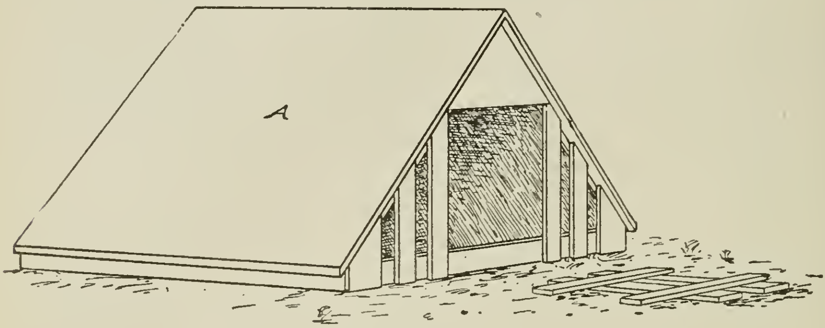


Fig. 16. Coop A.—Each side of roof 24 in. by 30 in.; bottom 2 ft. 4 in.

lice. If lice get upon them, from the hen or elsewhere, a large proportion of them will be almost sure to die.

There are many good brooders upon the market which are well described in the manufacturers' catalogues; hence a description here is unnecessary. The brooder lamp should always be arranged so as to give little chance of fire.

If the brooder can be placed in a small portable house, it is a good plan, as the brooder is thus protected from stormy cold winds in the early spring; also from the heat later on. The house protects the chicks from rain, and serves as a roosting coop after they become too large to stay in the brooder.

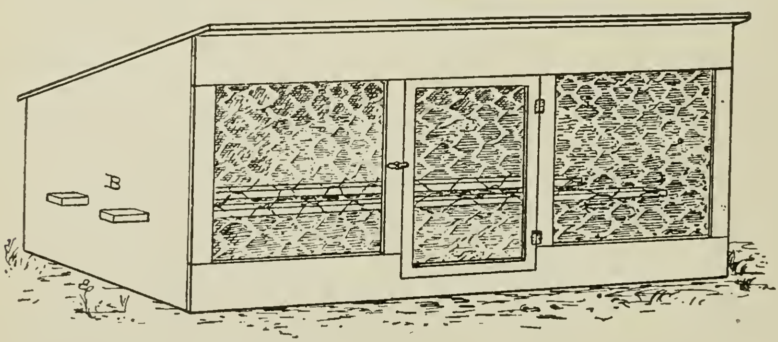


Fig. 17. Coop B.—Length, 6 ft.; width, 2 ft. 6 in.; height in front, 2 ft. 4 in.; height at back, 18 in.

Chicks should not be fed until they are at least 36 hours old. It is a serious mistake to feed them earlier. Too early feeding is the cause of indigestion and bowel trouble in many cases. We try to keep the temperature of the brooder between 90 and 95 degrees (at the chick level) throughout the first week. After the first week the temperature is gradually lowered, generally speaking, about 1 degree a day.

When the chicks are put in the brooder, it is well to remember that every 15 chicks will raise the temperature of the brooder one degree. Be careful not to get your brooder too hot, nor yet so cool as to chill the chicks. This is very important, especially during the first ten days.

The floor should be covered with clover chaff or other clean litter. Be very careful not to use any musty or mouldy material as litter before the chicks are put into the brooder. Lukewarm water should also be put into the brooder for drink before the chickens are taken from the machine. I have had best success in starting young chicks on hard-boiled eggs, finely chopped, shell included, and bread-crumbs about four parts by weight of bread to one of eggs. This is fed dry. After the first two days we begin to give an occasional feed of seed chick-food, which is made as follows:—

Cracked wheat	35	parts.
Granulated oat meal	30	"
Small cracked corn	30	"
Grit (chicken size)	5	"

This can be used for the first feed and continued through the first eight to ten weeks with good results. We aim to feed the chicks five times a day. Generally after the first few days, there are three feeds a day of this chick food, one of bread and milk (the bread being squeezed dry and crumbled), and one of whole wheat, or a mash made of equal parts of bran, shorts and corn meal, to which has been added

Fig. 18. Growing Chickens in the Cornfield.

ten per cent. of animal meal or blood meal. If we can secure fresh liver and get it boiled, this is generally given twice a week, and the animal meal is then omitted from the mash. If the chicks cannot get out to run about, the seed chick-food may be scattered in the chaff, and the little chicks will work away most of the day for it. This gives them exercise, which is a necessity in rearing chicks. If there is no *green food* to reach, it *must be supplied.* Lettuce is excellent. Sprouted grains are very good, as is also root sprout, cabbage, rape, etc.

When the chicks get to be about eight weeks of age, we usually feed three times a day—the mash food in the morning and whole wheat and cracked corn at noon and night. If we are anxious to force the chicks, we give two feeds of mash and increase the animal meal a little.

Chicks hatched at a season of the year when they can range out of doors need not be fed as often or as carefully as described above. During the winter season where chicks are reared indoors too liberal feeding often causes leg weakness, etc. In such cases, sweep away the snow and do your best to get the chicks out on the ground. Feed but very little hard grain and use mostly wet mashes. Use as much cooked or raw vegetables as chicks will eat.

Close confinement, poor ventilation and feeding of large quantities of hard or dry chick foods to winter broods of chicks have given us very poor results. Watch the chicks, and when you notice some of the largest getting weak on their legs, reduce the hard feed and get them out of doors if possible.

We have used for several seasons the hopper plan of feeding chicks during the spring and summer months with good success. We have tried placing a hopper or trough of chick feed, made of grains as previously described (seed chick-feed), in

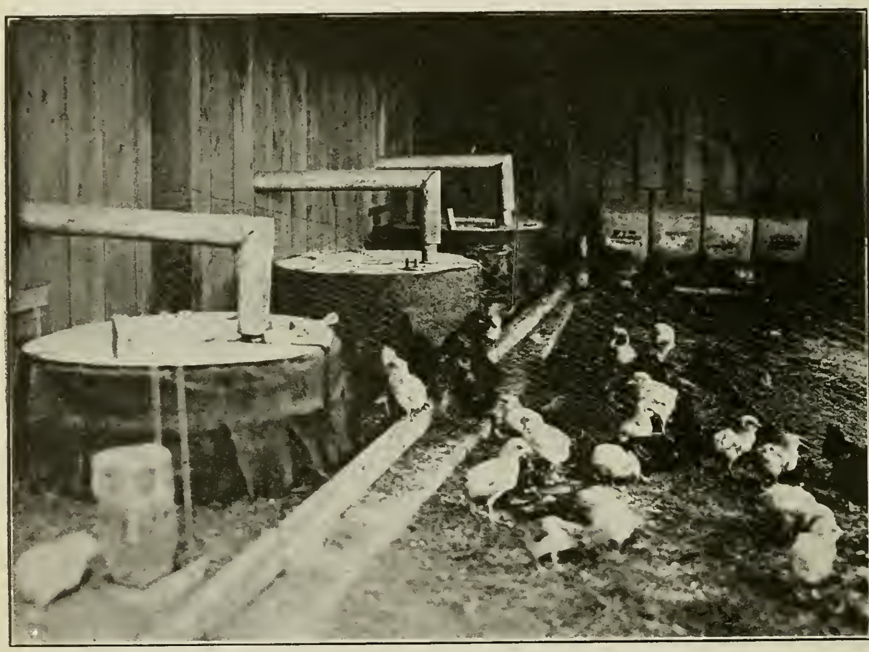
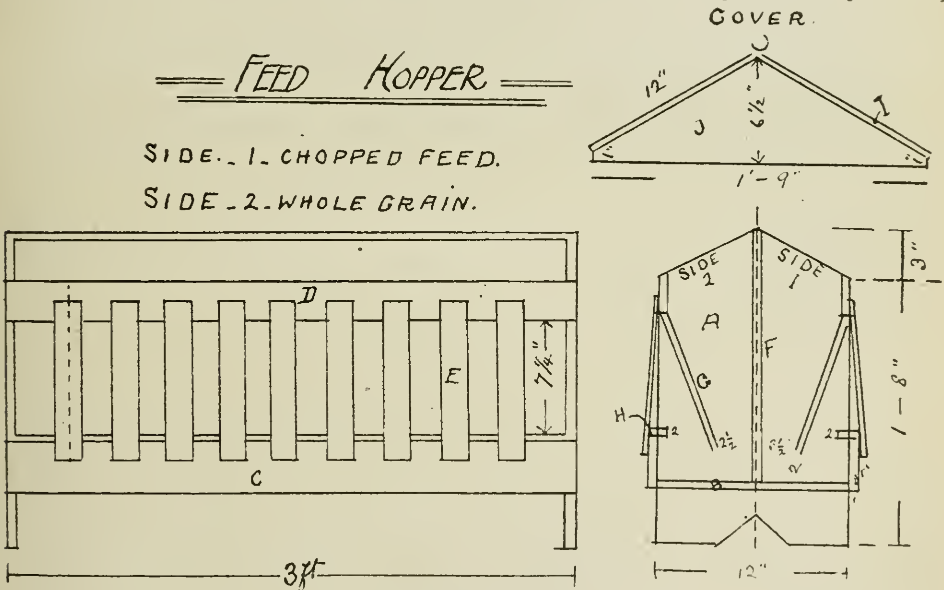


Fig. 19. This cut shows the method of Brooding, etc.

a coop along with the hen and chicks, and keeping the supply constant in or near the coop, from the day the chicks were put out until well grown, with most satisfactory results. Where chickens have a good range about the fields of the average farm I know of no better plan of feeding chicks. The hoppers may be made of any size or shape so long as the supply of grain is constant and the supply large enough to last for about one week. A hopper which slopes from both sides will feed better than one with a slope to but one side.

Where the hopper plan is adopted on the farm, the labor problem is very much reduced. This plan can be carried out with chicks in brooders, but for the first ten days or two weeks I prefer feeding the chicks about five times daily, after which time the hoppers are used. Water should be given daily in a clean dish. We have had chicks with hens do extra well when turned in a large corn field with a hopper of grain constantly near the coop, but no water. These birds were a long distance from a water supply, hence they were tried without water with no bad results. I would prefer giving water if the supply is clean and constant, or better sour milk.

Chicks are taken from the out-door brooders at from six to eight weeks of age, according to the weather. A small coop (Fig. 16) is set in front of the brooder, so that the chickens cannot get to the brooder entrance, the result being that they get into coop A. After a day or two take away your brooder, and the coop can then be moved daily to fresh ground. This will keep the coop clean. When the chicks get too large for the coop A, which will be in about ten weeks, they are put into coop B (Fig. 17). The same process is gone through with coop B. It is set in front of coop A, so as to obstruct the entrance, and the chicks then go into the coop B. and soon take to the roost. Coop B will roost 20 chicks until full grown. Try to keep



Bill of Material.

A. 2 ends $\frac{7}{8}$ x 12" x 1'—8"
B. 1 bottom $\frac{7}{8}$ x 12" x 2'—10$\frac{1}{4}$"
C. 2 sides $\frac{7}{8}$ x 3$\frac{3}{4}$" x 3'—0"
D. 2 sides $\frac{7}{8}$ x 2$\frac{1}{3}$" x 3'—0"
E. 18 pieces $\frac{3}{8}$ x 1$\frac{5}{8}$ x 10"
F. 1 division $\frac{1}{2}$ x 16" x 2—10$\frac{1}{4}$
G. 2 " $\frac{1}{2}$ x 9$\frac{1}{2}$ x 2'—10$\frac{1}{4}$"
H. 2 pieces $\frac{1}{4}$ x 1" x 3'—0"
I. 2 " $\frac{1}{2}$ x 12" x 3'—2" } Cover.
J. 2 ends $\frac{7}{8}$ x 6$\frac{1}{2}$ x 1"—[illegible] } Cover.

Side 1.—Chopped feed. *Side 2.*—Whole grain.

your chickens roosting in the open air as long as possible. Never house them in close, stuffy houses. If you do they will be sure to go wrong, become weak, and be of little or no value, either as breeders or egg-producers. When the indoor brooder is used in a colony house, the brooder is removed from *the house* and the chickens roost in colony house until they are ready to market.

There are many advantages in using several small movable colony houses for rearing chickens.

(1) There is no loss of time in teaching the chicks to go from a small coop to a larger one. Movable brooders are used inside the house, and when no more heat is required these are taken out. About this time low, flat perches are put in the house; the chicks soon commence perching, and thus prevent crowding. A hundred chicks can be put in a house. This house will accommodate fifty chickens of about four or five pounds weight, or until large enough to be fattened or put into laying quarters. Usually some birds are sold as broilers, hence there is not much over-crowding.

(2) The chickens can be reared on a portion of the farm, where a full crop as well as a crop of chickens can be grown. This usually means new land each season for the chickens, which in turn means stronger and better birds reared with less grain. It also may mean the destruction of many injurious insects. We use the corn fields, pasture fields, and orchards, or any similar condition under which a crop of chickens and an additional crop can be obtained from the land during the same season. Chickens grown on the same land year after year do not thrive as well as those grown on new ground each year.

(3) Should the chickens at any time become destructive they can be moved. We have raised chickens in tomato fields, and if they develop the habit of destroying ripe tomatoes, all that is necessary to avoid further trouble is to shut the chickens in at night, and next day draw the house to a new field and open the door. The chickens will come home to the colony house to roost.

(4) Where there has been considerable grain shelled on the field during harvest, the chickens can be easily moved to the field, and there they will gather the grain.

(5) Any vermin that might worry the chickens at night can be easily kept out by shutting the door.

(6) During rainy or bad weather, the chickens have a place for shelter. This is very important early in the spring and late in the fall.

Cost of Rearing.

We were able, during the season of 1909, to keep an exact record of the birds grown in the pasture field, and of those grown in the orchard. The chickens in the pasture field were hatched during the first two weeks in May. Three hundred and forty-five birds were grown to maturity or to a size suitable for fattening. We began to remove the cockerels from the field to the fattening pens on August the 25th. The pullets and cockerels held as breeders were all taken from the field by the 22nd of October. The breeds reared were Orpingtons, Wyandottes, Plymouth Rocks, Leghorns, etc. They consumed 4,304 lbs. of grain; of this about one-third would be dry mash, nearly 300 lbs. chick feed, and the balance wheat, corn and hulled oats in the proportion of two and a half, two and one. There was five per cent. of beef scrap added to the dry mash. The birds were weighed when taken from the field, weighing 3,341 lbs., or one pound of chicken representing 3.2 lbs. of grain. Some of the breeding cockerels weighed over seven pounds, and the Leghorn pullets did not average three pounds in weight. We removed most of the cockerels at about a three and one-half pound weight, or when they would fatten most economically.

The chickens reared in the orchard varied more in age. The first were hatched on the 25th April, and the last on July 6th. Most of the birds were hatched in

May. We sold 218 as broilers from this lot during July. The later cockerels were removed to the fattening crates as was done with those grown in the pasture field. Most of the pullets were taken out about the 1st of October, and by the 1st November practically all had been removed with the exception of about 100; these were cockerels held as breeders, and the July chicks.

The above illustration shows how it is possible to produce two crops in one season, viz.: apples and chickens. This is one of the best places to grow strong, healthy chickens at a very low cost.

We raised in this field 733 chickens at a cost of 8,649 lbs. of grain. A pound of chicken equalled 3.34 lbs. of grain, or nearly the same as the pasture field chickens.

The figures mean that a farmer can in his fields raise a four-pound cockerel for thirteen or fourteen pounds of grain. This amount of grain at $30.00 per ton would be worth twenty-one cents. The cockerel would sell in the market for at least forty cents, and if fattened, would be worth sixty cents. The data we have on hand would indicate that it costs about five to seven cents each to hatch the above birds, that is figuring eggs, oil and losses. Several years figures show that four pounds of grain will produce a pound of gain in live weight.

Breeding Market Fowls.

When looking over dressed poultry in some of our markets, I have often thought how easy it would be to improve the appearance of much of the ordinary poultry, and some of that which is specially fattened, if the birds are bred to a proper type. I have spent much time in examining different types of birds, alive and dressed, and in observing the feeding capacity of certain types; but it would take years to arrive at definite conclusions on these points. I am, however, of the opinion that one of the most important things to be sought after is *constitution*. This may have no actual market value, but it certainly has much to do with the bird's ability to grow and put on flesh. What we want is a good feeder, and an economical producer. Generally, a bird with a short, stout, well-curved beak, a broad head (not too long), and a bright, clear eye, has a good constitution. And I have noticed that when a bird has a long, narrow beak, a thin, long comb and head, and an eye somewhat sunken in the head, it is usually lacking in constitution. Such a bird is likely to

Fig. 20. Colony houses used for rearing chicks. Artichokes growing as shade for the chickens.

have a narrow, long body and long legs, upon which it seldom stands straight. There are some exceptions to this rule; yet, generally speaking, if a bird has a good head the chances are favorable for a good body; and, if it has a poor head the chances are against it. I have frequently noticed in the rose-comb breeds, such as Wyandottes, that a good-shaped one is seldom found with a long, narrow comb.

The neck should be moderately short and stout, indicating vigor. The breast is the most important point in a market chicken. It should be broad, *moderately* deep; and, if broad, it will present a fine appearance and appear well-fleshed. It is quite possible that a broad, deep breast will carry more meat than a moderately deep breast of the same width; yet there is no doubt that the latter will present a much better appearance, and sell more quickly, and at a higher price in the market. The breast bone should be well covered with flesh to the very tip.

When considering the length of breast, we must try to have it come both well forward and backward (See Figs 21 and 22), and not be cut off at an angle, as in Fig 23. The body, in general, should present the appearance of an oblong when the head, neck and tail are removed.

We frequently see birds that are very flat in front, and cut up behind, as in Fig. 24. Chickens of this class have a very short breast; and, if the breast happens to be deep, as it is in this bird, the chicken will have a very poor appearance when dressed, as it will show a marked lack of width and length of breast, with excessive depth. (Notice that the head is narrow and long, the body is narrow, the eye is bright but slightly sunken, the legs are long and not straight under the body.)

In Fig 23 observe the very flat breast, the length of back, the long neck and head, the narrow comb, the sunken eye, and the length of legs. The breast comes fairly well back, but not well forward.

Portable colony houses on edge of pasture-field and woods.

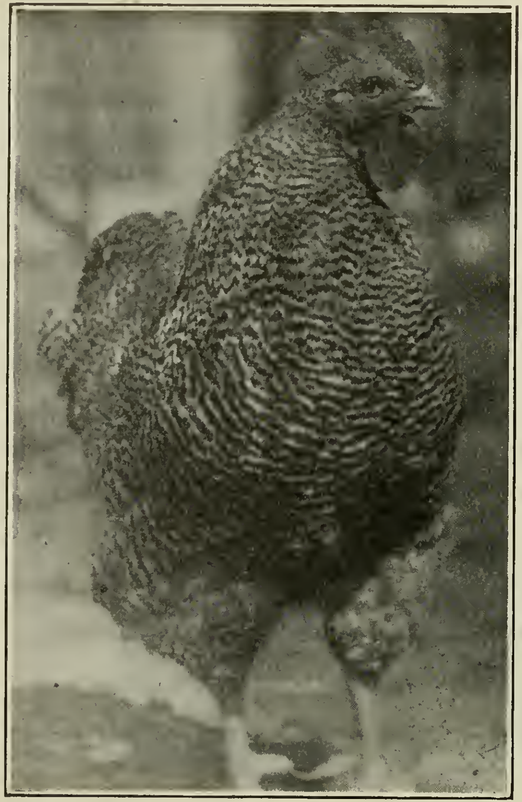


Fig. 21.

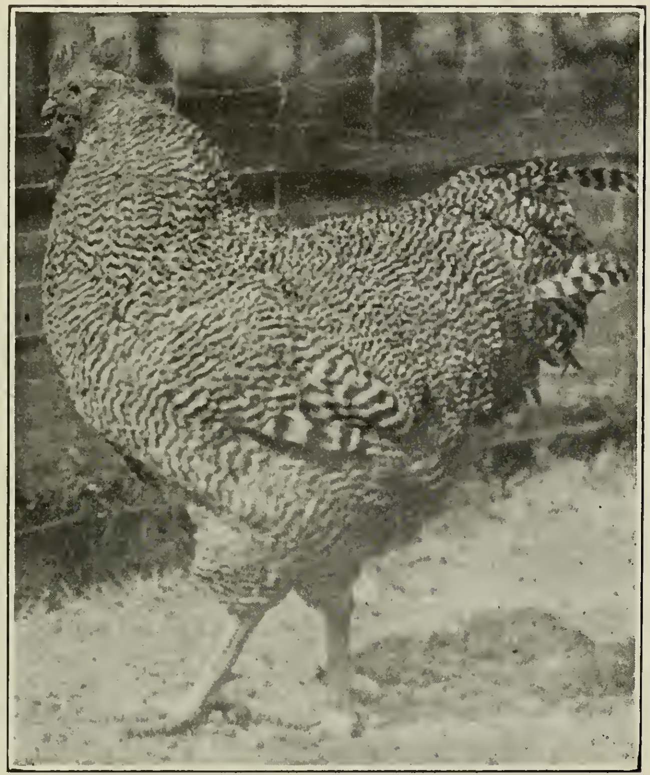


Fig. 22. Side view of Fig. 21.

In Figs 21 and 22, the bill is short and stout, but not so well curved as it should be. Note the breadth of head, the prominence and brightness of the eye, the short, stout neck, the great width of the breast, the fullness caused by the breast bone extending well forward, the short, stout legs (straight under the body), and the width between the legs. There is an expression about this chicken that indicates health and the essence of vigor.

The back should be broad, to give lung and heart capacity; and the width should extend well back to the tail-head. We do not want the wedge-shaped back, as seen in some fowls that have great width at the shoulders and taper rapidly toward the tail-head.

It is much easier to get good-shaped market pullets than good cockerels. The market demands a five-pound bird when dressed, and farmers have gone into rais-

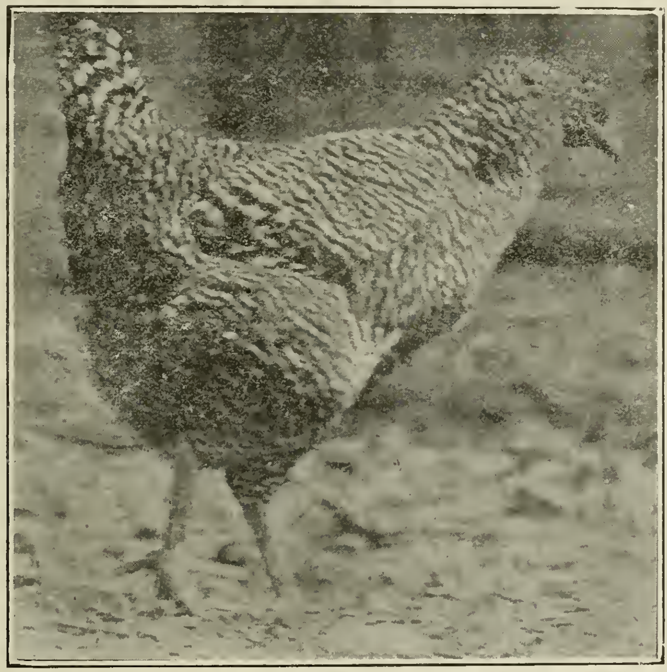


Fig. 24.

ing big chickens. To that end they are asking for large, overgrown cockerels, of excessive depth, for breeders; and the result is that we get dressed chickens weighing four to five pounds each that have immense, high breast-bones and very long legs. These are not attractive to the buyers, and they sell at less per pound than plumper birds. For example, if given two birds of the same width of breast, one is one and one-half inches deeper in the breast than the other. The result will be that one bird will look plump and sell readily, while the other will lack in plumpness and be slow in selling. This lack of plumpness can be bred out by using such males as that shown in Fig. 21.

We like to have birds as well built as we can get them, and Fig 21 is as near the ideal market chicken as we have in the breed which he represents.

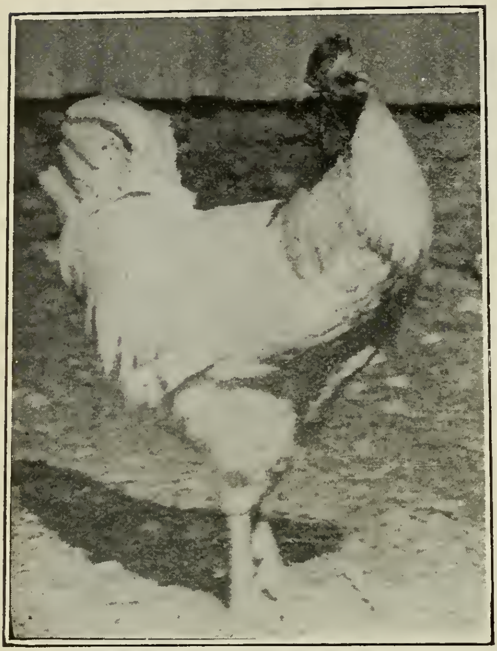


Fig. 23.

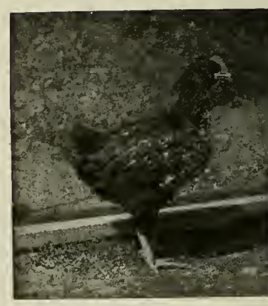


Fig. 26

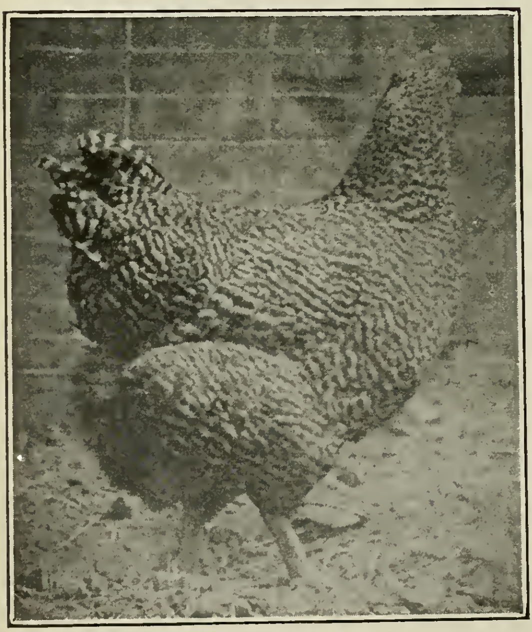


Fig. 25.

Fig. 27.

The hen as seen in Fig. 25 is of a good market type. (Note the width and fullness of breast.) As a breeder, she is a little fine in bone, and rather too small. She has, however, that blocky appearance which is desirable.

Fig 26 is a photo of a cross-bred chick (sire, Buff Orpington; dam, Houdan). Note the length and fullness of the breast; also good beak and eye.

Fig 27 represents the long, narrow sort. (Note the long beak, the narrow head, the sunken eye, the long neck, and long, crooked legs.) When dressed his appearance will not be pleasing.

Fig. 28. Showing the difference in amount of flesh covering the breast bone, due to breeding.

Breeding for Meat Production

Fig. 28 is a photograph of two fattened chickens, and shows very clearly the great difference in the amount of breast meat upon the two individuals. Many people believe that flesh upon the breast is a matter of feeding and not breeding. These two chickens are equally fat, and both have been equally well reared and fattened. The difference in the amount of breast meat is a matter of breeding and not so much of feeding.

Of course it is a well known fact that if birds are improperly nourished or are sick their breasts will become bare of meat, but where judicious feeding is practised one will find a great difference in the amount of flesh or meat upon the breasts of various chickens due, of course, entirely to the individuality of the chicken.

Our experience has been that if we select males with long breast bones, that are well covered with flesh or muscle to the tip of the breast bone, we are able to produce chickens for market purposes that have, on an average, well covered breast bones.

Breeding for Egg Production.

Can the egg yield be increased by breeding from the best producers, or is one just as likely to get as many eggs from any strain, family or breed, provided the birds are strong and vigorous, and hatched at the proper season of the year?

The writer's experience is that there is a difference between families of the same breed or variety as far as egg production is concerned. Some families appear to lay much more readily than others, and a few families that have come under my observation require very careful attention and feeding in order to get a reasonable egg production.

The question naturally arises as to what number of eggs should be expected from a hen. The average over the Province is probably under 100 eggs per hen per year, and many of the good flocks do not average above 120 eggs per hen. Much, of course, depends upon the season of the year in which the eggs are laid. There is an over production of eggs during March, April and May, and an under production during October, November, December, January and February. The writer believes it is within the possibilities of most farmers to produce from 108 to 120 eggs per year from each hen kept, and it is also his opinion that large flocks may be expected to yield 150 eggs per year if well bred, and proper care and attention be given. Many small flocks will probably average much higher, but not in flocks of from 600 to 1,000. A dozen hens might be selected that would lay from 180 to 200 eggs each for one year, but with 500 or 600 similar hens or pullets it would be a very difficult task.

Good, strong, vigorous birds are essential for egg production. The simple fact that a hen has laid 200 or more eggs in her pullet year is not sufficient to warrant her being used as a breeder. The writer has seen a number of 200-egg hens with long narrow heads and sunken eyes, which indicate low vitality, and, moreover, has tested a number of them as breeders, and has yet to see one that was worth while breeding from, judging from the performance and living powers of her offspring.

The selection of breeding stock for the production of good laying pullets, is one of the many problems in poultry keeping of which we are not absolutely sure of the results. We have been pedigreeing chicks from known performers for a number of years. Our work has been mostly with Barred Plymouth Rocks, although other breeds are being used. The results so far indicate much the same as those found at Maine Experiment Station, namely, that the sire has more to do with the laying pullet than has the dam. We select males of strong, vigorous, appearance who grow quickly and whose mother was a good layer, especially of winter eggs. The total year's production is better than 180 eggs, and in nearly all instances over 200 eggs. Not only should the individual be of excellent appearance and pedigree but his brothers and sisters should all be good birds. The females mated with such a male may be hens or pullets, but all should be good winter layers. By this we mean, they should produce three or more dozens of eggs during the period from November first to February twenty-eighth. It naturally follows that long-lived, known breeders of performers are highly prized.

The actual number of eggs laid is but one factor in breeding. We have plenty of evidence that the hatching power and size of the eggs is inherited; also that slow and rapid feathering are inherited characters. Some hens lay a large number of fertile eggs that hatch poorly and the chicks are weak and unthrifty, such, of course, are undesirable and the same may be said of the offspring of certain males. The breeder's problem, besides securing females of high egg production, is to secure an egg of two ounces weight or better and of high hatching power. These are some of the characters we are endeavoring to fix in the birds we are breeding. It is almost impossible for the farmer to keep as careful records as we are doing, but to the breeders of exhibition or high class utility stock I would recommend the practice as one worth while.

We are asked almost daily if as good average results could not be obtained by close observation; or, in other words, are there not certain outward appearances by which one could select the males and females. We cannot give a positive answer, but the following characters have so far been present in nearly all good producers:

1. Strong, vigorous, and early maturing birds of fair size, not exceptionally small nor yet very large.

2. Those that are usually very active, early off the roost, and late to go to roost.

3. Most of the males are quarrelsome.

4. Nearly all heavy laying hens are late in moulting.

The following table gives a comparison of two flocks of twenty-three Barred Rock pullets, that were in every way treated alike, except as to the method of breeding. They are the same age, were hatched and reared by the natural method, and have always lived in the same houses and enjoyed the same range.

The one flock, known as the heavier layers, has been bred for some years for early maturity and winter laying.

The other pullets are bred from birds that have been bred mainly with the idea of producing good specimens of the breed, as to shape, color and size.

The bred-to-lay pullets were larger by October 1st, but the others were larger at February 1st. In other words, the former matured earlier. Their brother's average weight at five months of age was nearly six and one half pounds.

Egg Records of 23 Bred-to-Lay vs. 23 Exhibition Barred Rock Pullets.

—	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April.	May	June	July	Aug.	Sept.	Total.
Exhibition pullets		66	190	132	169	224	354	334	274	265	247	227	2,482
Bred-to-lay pullets.....	101	337	296	179	201	308	396	449	323	324	288	312	3,514
	101	403	486	311	370	532	750	783	597	589	535	539	5,996

Feed Consumed by 23 Bred-to-Lay and 23 Exhibition Barred Rock Pullets.

—	Whole Grain ..	Rolled Oats.	Buttermilk.	Grit.	Oyster Shell.
Exhibition pullets ..	1,324 lbs.	762 lbs.	2,414 lbs.	34½ lbs.	41½ lbs.
Bred-to-lay pullets .	1,238 lbs.	502 lbs.	2,415 lbs.	25 lbs.	40 lbs.
	2,562 lbs.	1,264 lbs.	4,829 lbs.	59½ lbs.	81½ lbs.

The bred-to-lay pullets laid 1,032 more eggs than the exhibition pullets, but it will be noticed that the exhibition females ate more feed. This is probably due to the fact that they were larger birds. The bred-to-lay hens weigh from five to six pounds each, whereas the exhibition hens weigh from six to eight pounds each.

The bred-to-lay family mature earlier and the males reach a six pound weight in less time than the exhibition line, but when nine months old the exhibition males each weigh about one pound more.

In the bred-to-lay pen we lost five females during the year, one during December, one during April, two during May, and one during July. The first four pullets all died from having a yolk burst in the bowels, whether this is an hereditary weakness, or due to injury when being removed from the trap-nest, I am unable to answer. The hen that died in July, succumbed to the excessive heat. All the hens died when they were laying almost daily.

In the exhibition pen, three females were lost, two during April, and one during June. These birds also suffered from ovarian trouble.

A word in reference to the individual records of the hens who completed the year, might not be out of place.

In the exhibition pen not one bird produced over 200 eggs during the twelve months. Five birds laid over 150 eggs each, and 10 birds laid over 100 eggs each, and under 150. Five birds laid less than 100 eggs, each laying, respectively, 95, 40, 21, 21, and 13.

In the bred-to-lay pen four birds laid over 200 eggs each, eleven birds laid over 150 eggs each, and under 200, and the remaining three birds laid respectively 145, 140, and 128 eggs.

Some people might consider that these were some bred-to-lay pullets that were especially selected, but below is given the results of all the bred-to-lay Barred Rock pullets that we had, which completed a year's record.

Egg Production from 53 Barred Rock Pullets, Bred-to-Lay, 1910-1911.

House No.	No. of Birds	Total Eggs Laid.	Average Eggs per Hen.
4. A..................	19	3,405	179.2
4. B..................	16	2,633	164.5
5. A..................	18	3,166	175.8
	53	9,204	173.64

24.5 per cent. of the pullets laid over 200 eggs.						
22.6	"	"	"	180 "	and under	200 eggs.
20.7	"	"	"	160 "	"	180 "
18.8	"	"	"	130 "	"	160 "
3.7	"	"	"	120 "	"	130 "
1.8	"	"	"	110 "	"	120 "
7.8	"	"	under	100 "		

13 of the pullets laid over 200 eggs.			
12	"	" 180 "	
11	"	" 160 "	
10	"	" 130 "	
2	"	" 120 "	
1	"	" 110 "	
4	"	below 100 "	—39, 53, 83 and 93.

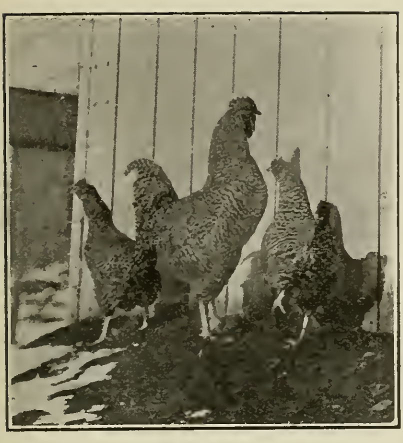


Fig. 29.

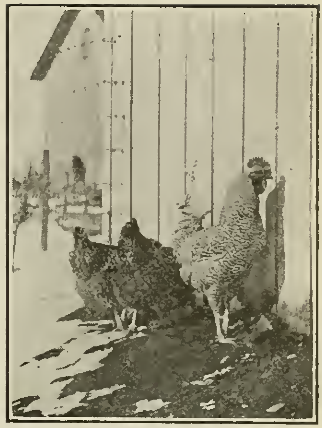


Fig. 30.

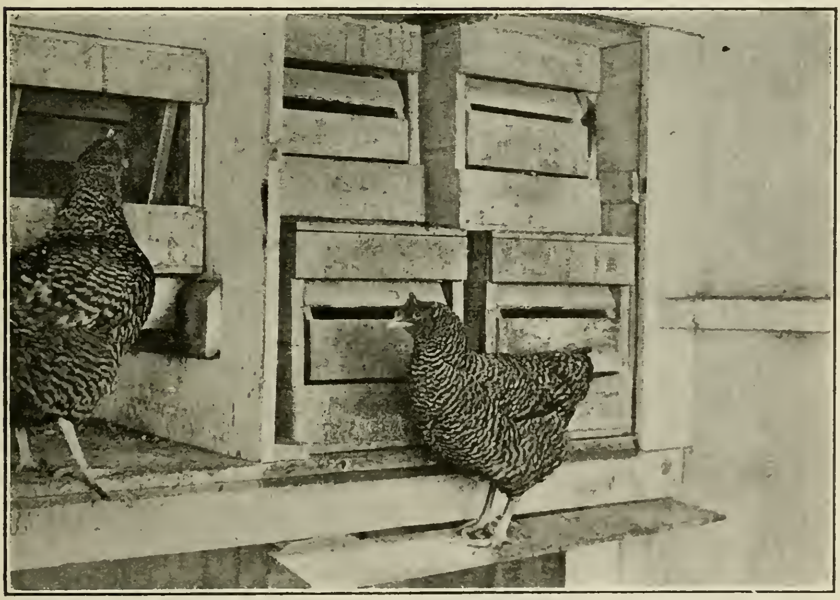


Fig. 31.

Figs 29 and 30. Type and color of Barred Plymouth Rock, males and females, which for several generations have been bred for heavy winter laying and early maturity.

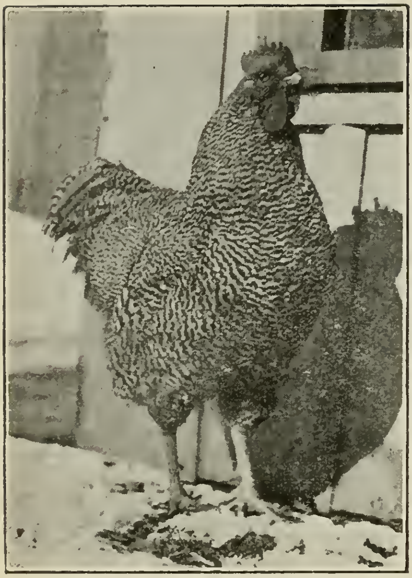


Fig. 32.

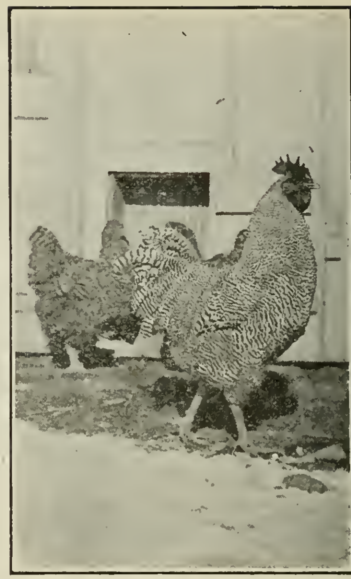


Fig. 33.

Fig. 31. Trap nests as arranged in the pen and two of the bred-to-lay Barred Plymouth Rock hens.

Figs 32 and 33. Type and color of Barred Plymouth Rocks, which have been selected for generations for color and type. No particular attention was paid to egg production.

The writer believes that by careful breeding for a few years a family can be secured that will mature early and lay well, which will have fair to good color and type.

FATTENING CHICKENS.

The selling of lean chickens is wasteful, to say the least. Much more interest is being taken in this branch of the industry year by year, and in districts where buyers discriminate in prices between the well finished and thin chickens, the progress has been very pleasing. There are many buyers who now pay a premium for good chickens. The demand for home consumption has increased to such an extent that the supply falls far short, and more than one wholesale dealer in our large cities is fattening the thin chickens sent to market. Some of the dealers have buildings which they are using this year, where they are fattening hundreds of birds weekly. They know that the farmer or grower can do this work better and more cheaply, but if he will persist in sending lean chickens to market, and the consuming public demand fat chickens, some one must supply the demand. Some dealers have been trying the proposition in what might be termed a small way during the past two or three years. The business has, as I understand, been profitable, even where the milk was brought in by express, and a high rental paid for the building used. Surely if the dealer can buy all the raw materials from the farmer or grower, and make a profit, the producer should do as well or better.

There is ordinarily from three cents to seven cents per pound difference in the price paid for well fleshed or fattened birds, to that paid for birds just off the range or fields. This means a difference of from fifteen to thirty-five cents on a five-pound chicken, depending upon the quality. Not only does the feeder make upon the gain made while the chicken is being fattened, but the original weight is increased in value by the improvement in quality. There is always a market for goods of prime quality, and the poor quality goes at begging prices when the supply is great.

It is not difficult to produce good chickens. Like other lines of live stock, the scrub sort are not desirable. Good thrifty cockerels, either pure-bred, crosses or grades of such breeds as Rocks, Orpingtons, Wyandottes, Rhode Island Reds, Game, Dorking, etc., make economical gains. It is usually not very profitable to feed Leghorns, Minorcas, or birds of similar character. These breeds make medium broilers, but rather poor roasters. The birds usually make the greatest gain when about three to four months of age, or at a weight of three and one-half to four pounds. Should the market demand a chicken of more than five and one-half pounds in weight, then it will be required to allow the birds to range longer, and the gain (in our experience) will be hardly as profitable, unless the price paid is higher, at least one cent per pound.

The average birds make the most economical gains during the first two weeks of feeding. It seldom pays to feed much longer than three weeks or twenty-four days, after this period the added gain is not sufficient.

Chickens can be taught to eat by lamp-light, and where one's time during daylight is otherwise occupied, this feature is very convenient. After November 1st, or even earlier, we feed but few chickens during daylight. They are generally fed twice each day, and not more each time than they will consume quickly.

Construction of Fattening Crates.

Fattening crates are usually made 7 ft. 6 in. long, 18 to 20 in. high, and 18 in. wide. The crate is divided into three compartments, each holding from four to

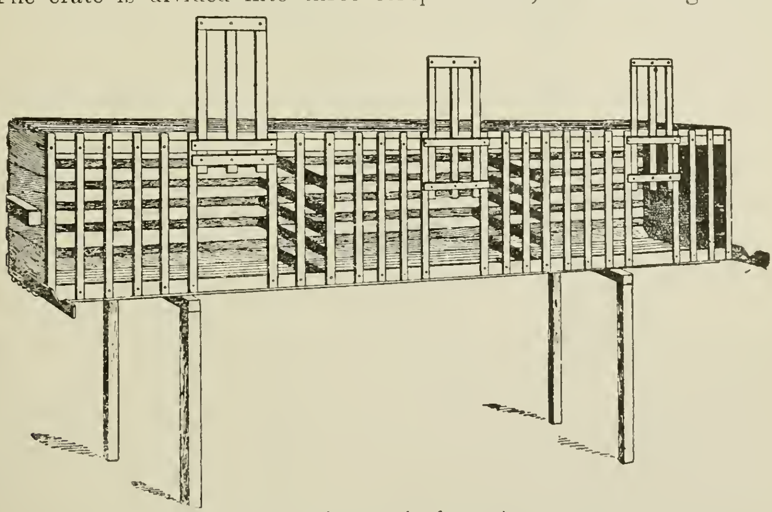


Fig. 34. Showing a single crate or coop.

five birds, according to the size of the chicken. The crate is made of slats, except the ends and partitions between the compartments, which are solid wood—those on the top, bottom and back running lengthwise of the coop, while those on the front run up and down. The slats are usually $1\frac{1}{2}$ inches wide and $\frac{5}{8}$ inch thick. Those in front are placed 2 inches apart to allow the chickens to put their heads through for feeding. The slats on the bottom are placed about $\frac{3}{4}$ inch apart, so as to admit of the droppings passing through to the ground. Care should be taken not to have the first bottom slat at the back fit too closely against the back. An opening between the first slat and the back prevents the droppings from collecting and decomposing. The slats on the top and back are usually two inches apart.

There is a small V-shaped trough arranged in front of the coop for feeding and watering the chickens. This trough is from two to three inches deep and is generally made of $\frac{3}{4}$-inch lumber.

Very fair coops may be made from old packing boxes, by taking off the front and bottom, and substituting slats in their places (see Fig. 34). During warm weather these crates may be placed out of doors. They need to be protected from the rain, which is easily accomplished by placing a few boards over them. In cold weather the crates should be placed in a house or shed where they are protected from raw, cold winds. When fattening chickens inside of a building, it is well to darken the building and keep the birds as quiet as possible.

After each lot of birds is killed, we paint the crates with some liquid lice-killer. Coal-oil and carbolic acid is very good. Use one gallon of coal-oil to one pint of crude acid. We have used some of the prepared mixtures with good results. If the birds (bought from different parties) are very lousy when put

Fig. 35. Cramming machine for the forced feeding of chickens, turkeys, etc.

up, they should be well dusted with sulphur. The birds should be watered at least twice every day in warm weather. Grit should be given them twice a week.

During the first week feed lightly—never quite all the birds will eat. I prefer feeding three times a day during the first week, and twice a day during the succeeding weeks. It seldom pays to feed the birds longer than three to four weeks. Chickens weighing from three to three and one-half pounds each, that are thrifty and of good breeding, appear to be the most profitable for feeding. Large chickens, weighing from five to six pounds, gain less and eat more than the smaller ones.

Should a bird become sick while in the crate, I find that if it is given a teaspoonful of salts and turned out on a grass run it will usually recover.

Cramming Machine.

The crammer consists of a food reservoir, to the bottom of which is attached a small force-pump moved by a lever and treadle which is worked by the foot of the operator.

Communicating with the pump is a nozzle, through which the food passes to the bird.

"A" is the food reservoir, "B" the pump, "E" the pump rod, "O" the lever, which on being depressed at the lettered end causes the pump rod "E," to which it is attached, to move downwards, and to eject the contents of the pump "B" out of nozzle "K." On relieving the pressure at "O" the lever and the parts connected therewith are drawn up by the spring "C" until the motion is arrested by a stop "M," which serves to determine the quantity of food ejected at each depression of the treadle.

The charge may also be varied by arresting the pressure at any point in the downward thrust of the lever at "O."

The illustration (Fig. 35) shows one method of operation with this crammer, and this plan is now largely followed in some parts of Sussex, England.

Kind of Food Used in Cramming Machine.

Not all kinds of foods can be used in the machine. The food must be in a semi-liquid condition in order to pass through the machine. This necessitates the use of some kind of grain that will stay in suspension in the milk, beef broth, or whatever liquid is used in mixing the grain. Finely ground oats, with the hulls removed, or shorts, answer the purpose well. We use almost entirely the former food. Grains, like corn-chop or barley meal, are not suitable.

The food is mixed to the consistency of ordinary gruel, or until it drips from the end of a stick.

Will it Pay to Buy a Cramming Machine?

For the ordinary person, I think not. First-class chickens may be had by feeding in the crate from the trough only; indeed, I have had equally fleshy birds that have been fed for four weeks from the trough as where we have fed them two weeks from the trough and one week from the machine.

Where one has a special trade for high-class poultry, I am of the opinion that a more uniform product can be secured by using the machine. Machine-fed birds should realize at least one cent more per pound than trough-fed birds in order to pay for the extra labor, etc.

Birds that are fairly well fleshed when put into the crate will do better if put at once on the machine, instead of being crate-fed first.

Crate Feeding vs. Loose Pen Fattening of Chickens.

The term "fattening of chickens" has been in use for some time, but it does not exactly convey the meaning intended by the feeders of chickens. The object is to make the chickens more fleshy, with just sufficient fat to make the chicken cook well. The chickens are not intended to be abnormally fat, yet at the same time they carry considerable fat well intermixed with lean meat.

We have, for a number of years, conducted experiments with chickens in crates and in loose pens. We have tried about six different feeders and the results vary. With some feeders we had equally as good results with birds in crates as with them in loose pens. We have had two feeders in particular who could not feed birds to advantage in loose pens as compared with crates. We have had one feeder who could get slightly better returns in some cases, not all, with birds in pens as compared with crates.

In speaking to the buyers of chickens, the majority of them seem to think that the crate-fed birds are much superior to those fed in loose pens. Personally, I would prefer feeding birds in crates, for the reason that it takes less room, and I believe that I can feed them with less expenditure of labor and get a more even product. There are now many people who can get good results from feeding birds in box stalls, etc. No matter which method is followed, cockerels should be fed for two weeks or more before they are killed and sold.

How to Feed.

We receive a number of inquiries as to how we feed the birds that are being fattened. Most inquirers wish to know the exact amounts fed each day.

It will be noticed that we fed very lightly at the beginning—a very important point—and that the amount was gradually increased until such times as the birds refused to eat all that was given them. No feed was left in front of them longer than ten minutes after it was placed in the trough. Any food left after such time was removed.

Crate of 12 Birds.

Ration:—Equal parts of oat meal, corn meal, and barley meal mixed with sour milk.

	Lbs.	Ozs.
Weight at commencement	53	4
Weight at first week	55	0
Weight at second week	66	4
Weight at third week	70	2

Date	Morning		Night	
	Meal	Milk	Meal	Milk
	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.
Oct. 17	12	1 8	12	1 10
" 18	14	1 8	12	1 8
" 19	1 0	1 12	1 0	1 12
" 20	1 2	2 2	1 2	2 4
" 21	1 4	2 8	1 4	2 8
" 22	1 6	2 12	1 6	2 12
" 23	14	1 12	1 8	3 0
" 24	1 10	3 0	1 12	3 4
" 25	2 0	4 0	2 0	4 0
" 26	2 5	4 8	2 8	4 8
" 27	2 0	4 0	2 0	4 0
" 28	2 8	4 8	2 12	5 0
" 29	2 8	4 8	2 8	3 8
" 30	1 4	2 8	2 12	5 0
" 31	2 0	3 8	2 0	3 8
Nov. 1	2 4	4 0	2 8	4 8
" 2	2 0	3 8	2 4	4 0
" 3	2 4	4 0	2 4	4 0
" 4	1 12	3 8	1 12	3 8
" 5	1 12	3 8	1 12	3 8
" 6	1 12	3 8	....	....

Rations for Fattening Chickens.

It is difficult to give a ration suitable for fattening chickens and that meets the requirements of every individual. Many of us have to use whatever foods are available, and for that reason we are giving several rations that have worked fairly well with us in a general way. It may be said that the grains in a ration should be ground as finely as possible; and further, some grit should be fed to the chickens at least once a week, and it is also desirable that the food should be mixed to the consistency of a pancake batter, so it will pour, and, moreover, the best results are procured when the food is mixed twelve hours previous to feeding.

The best ration that we have yet used is one composed of two parts of finely ground oats, two parts of finely ground buckwheat, and one of finely ground corn; to this is added sufficient sour milk to make a batter, or ordinarily about two to two and one-half pounds of milk to one pound of grain. We have gotten very good results from a ration composed of equal parts of corn meal, middlings and buckwheat meal. Frequently barley meal can be substituted for the buckwheat, or oat meal for the middlings. It is desirable, if possible, to always use milk, as much better gains are made with it than with any other food. Where milk is not available, blood meal, and beef scrap can be substituted, but we would not advise more than 15 per cent. of the grain ration to consist of these foods. We would advise soaking the blood meal, or beef scrap, in warm water for twelve hours previous to being mixed with the grain. We have gotten better results in some cases and equally as good in all cases by feeding any of the above mixtures cool or cold rather than warm—that is to say, there were no better gains made by keeping the food at 70 or 80 degrees than at 30 or 35 degrees.

It is of the utmost importance that the birds be kept with keen appetites, as a little over-feeding on the commencement usually means indifferent gains. One should be careful to have the birds free from lice or other insects, and as far as possible to keep them in a cool, comfortable place, rather secluded, so as not to be disturbed by the visiting public or other chickens. The birds should be dusted with a small amount of sulphur or other insect powder in order to keep the lice in check. If the sulphur is used too freely it produces a scaly appearance on the birds when dressed.

We have each year a surplus of cockerels over and above those required for breeding purposes, and the most of these are fattened and killed; a few are sold to farmers or breeders. We also fatten the cull pullets. In 1908, from September to December, we put in the fattening crates 626 birds. The loss by death among these was two birds. The birds weighed (when brought in from the range, usually with full crops) 2,233 pounds. They were fed from four days to three weeks before killing.

We hoped to have fed them all three weeks, but at times the demand for dressed chickens required us to kill the birds shortly after cooping.

Rations.

The main ration consisted of barley meal, low grade flour, middlings and buttermilk. Some other mixed grains were used and a little shredded wheat. The 626 birds ate 2,057 lbs. of ground grain and 4,000 lbs. of milk.

Many farmers and others market their birds in a thin condition. We can, for the time it takes to feed, clean out the pens, etc., make at least 50 cents per hour over and above the cost of feed. We usually feed these birds by lamp-light at night, so that little valuable time is lost.

Financial Statement of Fattening Chickens.

626 chickens weighing 2,233 lbs. at 8c. per pound, live weight	$178 64
2,057 lbs. of grain at $1.50 per cwt.	30 85
4,000 lbs. buttermilk at 10c. per cwt.	4 00
Total cost	$213 49
624 dressed chickens, bled and plucked, but undrawn, 2,358 lbs. at 12½c. per lb.	294 75
Profit	$81 26

Birds that are starved ready to kill shrink 12 per cent, by bleeding and loss of feathers. We have figured frequently that the average profit per bird in three weeks' feeding was about 15 cents each; the above table shows nearly 13 cents. The profit would have been somewhat higher if all the birds had been fed at least two weeks.

Dressing and Shipping Poultry.

All fowls should be fasted from twenty-four to thirty-six hours before killing. Where this is not done, the food decomposes in the crop and intestines, the result being that the flesh becomes tainted and does not keep well.

All birds should be killed by bleeding, preferably through the mouth. A little practice will ordinarily make one fairly handy at this work. For the average person I am of the opinion that they will do the best work by tying the bird's feet by means of a small rope or cord, at a height about level with the picker's shoulders. The rope or cord may be fastened to a small pole or rod. For bleeding, any sharp knife with a blade nearly three inches in length will answer. To bleed, catch the bird's head with the thumb and forefinger just at the juncture of the neck and head or at the ear-lobes, then with the third finger open the chicken's mouth, next insert the knife and put down the throat, practically the length of the blade, turn the knife and cut rather lightly. The bird should bleed freely as this should cut the two large blood vessels just at the end of the neck; following this the knife should be drawn out and inserted in the long opening in the roof of the bird's mouth, and then quickly pushed backward so as to pierce the brain. If the back of the knife is kept on a line at the edge of the bill, the blade will pierce the brain. One can tell when this is done as the chicken will squak. If the bird does not squak, the brain is not pierced, which means tight feathers or hard picking.

The chicken should be plucked immediately, first removing the long wing feathers, and tail feathers, then each side of the breast, then the legs, and lastly the back. Do not try to pull the feathers either forward or backward but more sideways or at an angle. The rough or coarse feathers should be removed in about three minutes or less, do the work quickly and the feathers come out easily, if slowly done, the process is long and tedious. For instance, remove all the coarse wing feathers of each wing at one handful, also all the tail feathers. To remove pin feathers use a dull round bladed knife, similar to the ordinary paring knife. Be careful not to rub or bark the skin. This may be done by rough handling, or by placing the chicken in contact with coarse clothing, hence do not put the chicken on your lap to pluck it. If you should unfortunately tear the skin, hold the skin at the torn part tightly to the body between your fingers and then carefully remove the feathers near the torn part. Anyone with a little practice can remove the rough feathers in from five to ten minutes.

The birds should be plucked clean, the mouth wiped of all blood, and the dirt washed from the feet.

After the chicken has been plucked it should be placed on a shaping board, as seen in Fig. 36. The weight placed on the top of the chicken is used to give it a compact appearance. This weight may be of iron, as seen in the cut, or a brick may be used in its place.

Many good chickens are spoiled by being packed before they are thoroughly cooled. Care should be taken that all the animal heat is out of the body before the fowls are packed. We always cool the birds at least twelve hours before packing them.

The chickens are packed in boxes as seen in Fig. 37. The box is lined with parchment paper; and, if the chickens are to be shipped a long distance, each bird is wrapped in paper. This prevents the chickens from bruising each other, and, at the same time, to a considerable extent, checks decomposition. Do not use ordinary wrapping paper, as it draws dampness, and will cause the chickens to become clammy, which makes them more or less unsaleable.

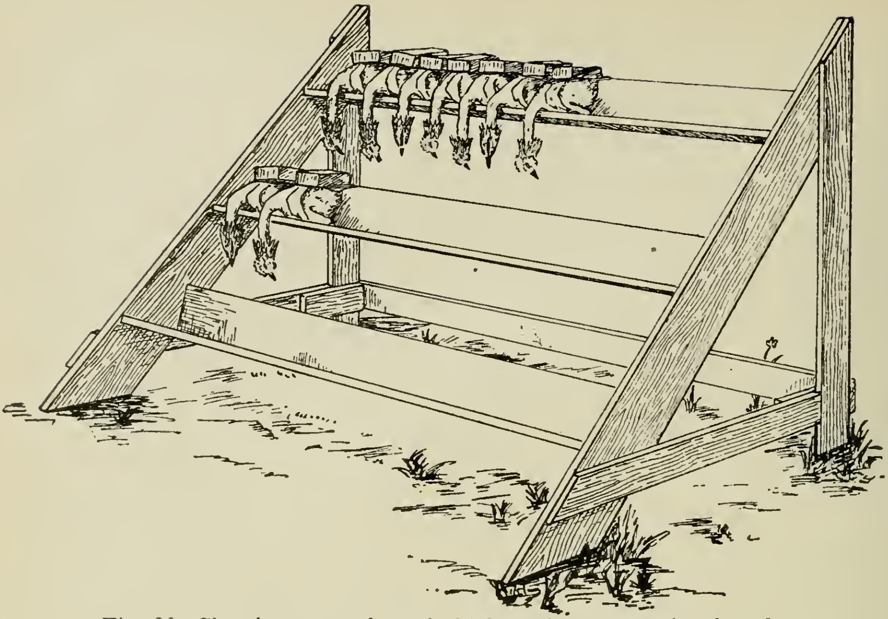


Fig. 36. Showing a number of chickens in the shaping boards.

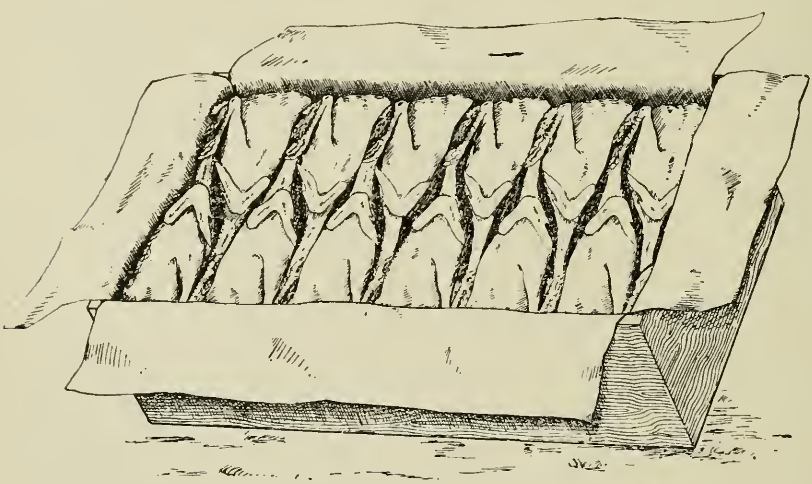


Fig. 37. Showing the top layer of chickens in a shipping case as used for local trade. This is one system of packing dressed poultry. The boxes are usually made 3 feet long, 17 inches wide and 7 inches deep for 24 chickens weighing about 5 pounds each.

There are several kinds of boxes used for shipping poultry. Nearly every exporter has his own shape of box, and his own method of packing. For shipping locally, we use a box three feet long, twelve inches wide, and twelve inches deep. The chickens are packed similar to those seen in Fig. 37. The box will hold thirty-six 4½-pound chickens. The boxes are made strong, so that we can have the dealer return them to be refilled. Do not use cedar in the construction of the boxes, as in some cases it taints the flesh. Basswood or spruce answers well.

EGGS FOR MARKET.

Yearly the egg consumption increases and our exports decrease; in fact we have ceased to be an exporting country in this line of farm produce. During the last year in particular the public have taken more interest in the egg supply, and in the kind of eggs that are consumed. The value of an egg as a food is gradually but surely being recognized. Probably no one food is its equal; it is relished by all, old and young. Few people realize how quickly and how easily an egg deteriorates in flavor or as a food.

There appears to be a general idea that the shell of an egg protects the contents against all kinds of germs and weather; that the outside of the shell may be filthy, but that the interior is not in the least affected by the filth on the outside.

There is nothing more disgusting than at the breakfast table to break a bad egg. No more eggs are wanted for days, perhaps for weeks, and consequently egg consumption decreases; or eggs are looked upon as a doubtful source of food. Many bad eggs are due to ignorance on the part of the producers and consumers, and many dealers are as careless in their methods.

The shell of an egg is porous, or is full of very small holes. The egg is designed to hatch a chick. The chick under favorable conditions grows inside the shell and finally bursts it open. The holes in the shell supply the chick with air as it grows, also allows the bad air to escape. Science has proved this, but we have ample illustration in practical work. Eggs that become badly smeared with broken eggs in the nest during incubation usually rot, owing to the breathing holes becoming plugged or blocked by the broken egg content. Greased eggs will not hatch for the same reason; and we might mention several other examples.

Knowing that the shell is porous we can readily understand how minute animal or plant life, or germs, may enter the eggs. Let us take a common case of mouldy or musty eggs. Frequently the paper fillers of egg boxes will become damp due to the boxes being left in a shower of rain or something of the kind. The fillers are only slightly damp, and we think they will do. If no eggs are put in the boxes, and the boxes with fillers are set aside for, say, a week or so, when they are opened they smell musty, and if the fillers are examined we will see slight developments of moulds here and there. Now in cases where eggs are put in such fillers they soon become musty, and when they are left in for some time they become mouldy, not only on the outside of the shell, but on the inside as well. The writer has taken clean eggs on the day they were laid, and put them in dry paper boxes which were slightly mouldy, and set them aside in a dry cellar for a period of a few weeks, and at the end of this time many of the eggs had well developed mould on the inside of the shell.

Many eggs are spoiled by being partially incubated. Most people believe that an egg must be set under a hen, or put in an incubator before it will start to hatch. Eggs will start to hatch at less than 90 deg. of heat. Many eggs are submitted to this or higher temperatures for several hours, if not days, before reaching the consuming public. When the germ inside the egg commences to develop, the edible qualities of the egg are lessened, or the egg goes off flavor. Eggs may be kept at an incubating temperature for a day, when the chicks will start growing, next day the temperature may be so low that the chick is killed, and from that point decomposition begins, possibly slowly, but, nevertheless, the egg is gradually going bad.

There are almost innumerable ways in which eggs may start hatching during the summer, such as forgetting to gather the eggs daily, and leaving some under broody hens over night, leaving them exposed to the sun or in warm rooms, stores, cars, etc., or even in the kitchen cupboards.

No one can guarantee eggs to their customers during warm weather unless the males are removed from the flock. Unfertilized eggs are essential. We may at home take every precaution, but who knows where or how the cook may keep those eggs, even after they have passed from the dealer's hands. The allowing of males to run with the hens all summer costs the Ontario growers a large sum of money. The writer stood by candlers in a large packing house, and saw over twenty of the thirty dozen eggs in a case that were more or less incubated, most of the eggs being about 48 hours on in incubation. The dealer is thus forced to make prices to meet this shrinkage; at times the public may get "bargain" eggs.

Filthy eggs, or even washed eggs, may be decomposed or rendered useless from the germs in the filth on the eggs. Washed eggs if used immediately are good, but they deteriorate very quickly after washing.

Flavor of Eggs.

Many of us forget that eggs will absorb odors. They will not absorb odors as readily as milk, but, at the same time, care should be taken in keeping the storage room for eggs free of strong odors. For instance, to put eggs alongside of onions, turnips, or similar strong smelling foods would mean that the eggs would absorb more or less of these flavors.

Again, the food that a hen consumes very materially affects the flavor of the eggs. This can be very easily demonstrated by feeding mostly scorched grain, or giving large quantities of pulped onions in a mash food. One demonstration will convince anyone that eggs have been scorched, or taste of onions no matter how cooked.

When hens get but little grain food during the summer and are forced to hunt for their living over manure piles, and catch insects, the yolk will become almost red in color. These eggs make the consumer remark that winter eggs taste better than summer eggs. Frequently feeding as above produces a thin watery white, and the egg has not only a bad flavor, but has poor keeping qualities, and, moreover, is little better if as good as a fair pickled or cold storage egg.

Market Terms Used. A new-laid egg means an egg that is under five days of age. or at least not over one week old. It should be clean, and the boxes should be clean.

Fresh eggs are very hard to define. With some they mean eggs from one day to three weeks or even more of age, while with others they mean eggs just out of cold storage.

There are several other market terms, such as pickled, held, etc., which are used mostly by the dealers, and need no explanation here.

Where and How to Keep Eggs.

The nests in which the hens lay should be clean. These usually need cleaning monthly. The best material we have used for nests is shavings.

Eggs should be gathered twice each day, and placed in clean basket, pails, etc.

The room should be cool, not higher than 60 degrees if possible, and it should be dry. A cool, dry cellar will answer nicely.

The dirties, small, extra large, and found nests of eggs should not be sold. Use them at home. The large ones break in shipping and the smalls and dirties are not wanted on the market. These sell the good eggs at poor prices.

Where one is trying to supply private customers, or a select wholesale trade, it is wise to stamp the eggs with your own initials, or the name of your farm. This is some guarantee to the buyer.

Never Try to Deceive the Dealer.

You may sell bad eggs to the grocers, but the honest people in the district do not get full value for their good eggs.

Some people hold their September and Early October eggs, and then ship them later in the year to a dealer as fresh eggs. They, of course, expect the top price for new laids. Please do not believe you can deceive the dealer. By candling the eggs, which he always does, he can tell fairly close what your eggs are like as to age, etc.

Do not sell infertile eggs that are removed from the incubators as being good eggs or good food.

Do not allow the male bird to run with the hens after June 1st.

Do not keep the eggs in damp or musty cellars, boxes, or baskets.

Do not leave the eggs sitting in the sun, and if your grocer keeps eggs in his store window in which the sun shines, please ask him to remove them, unless he wishes to hatch chickens.

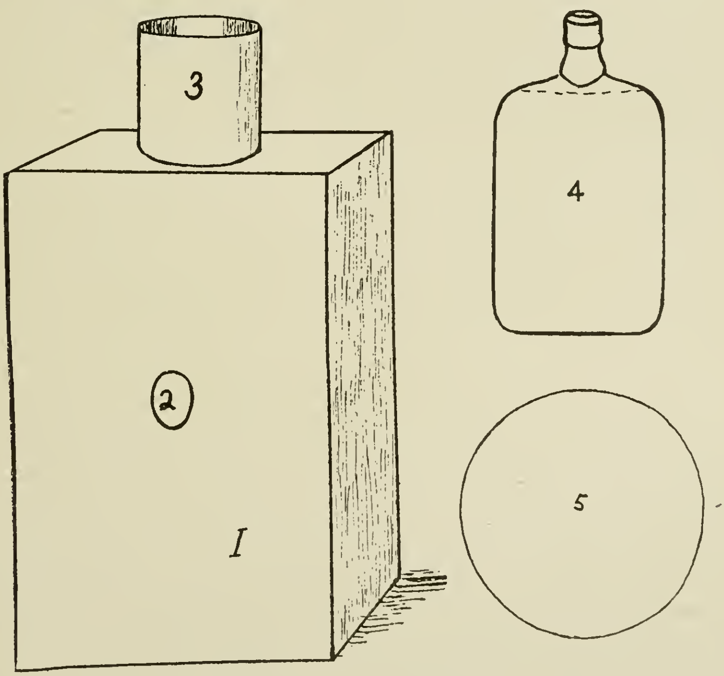


Fig. 38. The egg tester.

1. Egg-testing box.
2. Hole through which light shines and before which egg is held to be tested.
3. Chimney.
4. Bottle of water placed between light and No. 2.
5. Reflector to be placed behind light.

An ordinary lamp or electric light is placed in the box so that the light shines through No. 2. The bottle of water condenses the light, which makes the testing of eggs a comparatively simple matter.

Do not sell eggs from found nests.

Practically all dealers have now agreed to pay for eggs according to quality. If your dealer pays as much for all kinds of eggs as he does for your good, clean, large sized, non-fertile eggs we will try to put you in touch with dealers who buy on a quality basis.

Kill the rooster after June 1st.

Candling Eggs.

Eggs are candled very easily. See Fig. 38. A new-laid egg when held between the eye and the light has a clear appearance, the yolk is practically invisible, and the air cell is about the size of a five-cent piece.

Unless the eggs are put in pickle or held in cold storage, the air cell gradually increases in size, and the yolk becomes visible.

Cold storage and pickled eggs may have small air cells, but the yolks are conspicuous.

Fig. 39 is a photograph of a new-laid egg. It will be noticed that all portions of the egg are similar in appearance. There is a very small air cell at the large end of the egg which does not show in the photo; this air space is not larger than a five cent piece.

Fig. 40 is a photograph of a held egg, or one that is suitable for baking purposes, but not for boiling or packing. Notice that the yolk is conspicuous and the air space is very large. Pickled eggs usually show a conspicuous yolk but a small air space. Eggs that are two weeks of age usually show the yolk, and have an air space about the size of a twenty-five cent piece.

Figs. 41, 42, 43 and 44 are photographs of what the dealers term "spots," as they show various growths of moulds in the egg. These eggs are not rotten, but when opened smell musty. The mouldy portions are usually easily seen.

BREEDS OF POULTRY.

It is not the purpose of the writer to discuss all breeds of poultry in this bulletin, but simply to mention the general characteristics of some of the popular ones. The present high price of eggs and meat has done much to popularize poultry on the farm, and consequently we are frequently asked as to "What is the best breed of poultry?" It is impossible for one to answer this question satisfactorily, as some breeds are special purpose breeds, others general purpose breeds; and, moreover, there is probably more difference in strains of the same breed than there is between breeds.

We shall endeavor to classify these breeds, not according to the usual classification as adopted in various poultry publications, but more or less on utility lines. It may be taken as a general rule that all breeds that lay brown or tinted shelled eggs will set, hatch, and rear their own young, and all breeds which lay white shelled eggs, with the exception of Dorkings, are non-sitters, and the eggs from these breeds have to be hatched artificially or by hens of other varieties. It will, therefore, be seen that the general purpose breeds lay tinted eggs and are good sitters and mothers.

General Purpose Breeds.

Plymouth Rocks. There are five varieties in this breed—three of which are common—Barred, White, and Buff. The Partridges and Columbian are not so common. This breed is undoubtedly the most popular among farmers. The best

Fig. 39.

Fig. 40.

Fig. 41.

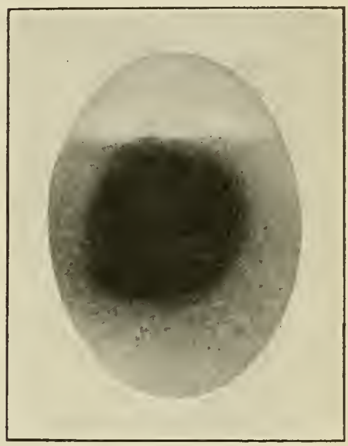


Fig. 42.

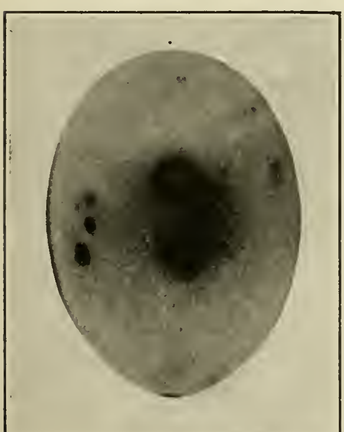


Fig. 43.

Fig. 44.

strains are good winter layers, fair summer layers, and make first-class roasters and fair to good broilers. It is one of the hardiest breeds. The standard weights are: Cock birds, 9½ pounds; cockerels, 8 pounds; hens, 7½ pounds; and pullets, 6½ pounds.

Wyandottes. There are several varieties in this breed, among which might be mentioned White, Buff, Silver Laced, Golden Laced, Black, Columbian, Partridge, and Silver Pencilled. The most popular variety from a commercial standpoint is the White. This breed has practically the same characteristics as the Plymouth Rock, but is more blocky in type and usually longer in the feather. They have rose combs, which to some is supposed to be an advantage in cold climates. Wyandottes make good broilers and roasters. They are also good mothers and good layers. The standard weights of these birds are one pound less than those of the Plymouth Rocks.

Rhode Island Reds. There are two varieties of this breed, Single Comb and Rose Comb. As compared with the Plymouth Rocks and Wyandottes they are longer in appearance and not so massive. They were originated by the farmers of the State of Rhode Island and are very popular in that State. They have also grown in popularity in this country to such an extent that they now rival the Plymouth Rocks and the Wyandottes. They are hardy, good winter layers, and fair summer layers. In color they are a rich, bright red, with black tails, and more or less black in the wings. During warm weather our experience has been that they are more given to incubating than the two breeds mentioned above. The standard weights of this breed are: Cock birds, 8½ pounds; cockerels, 7½ pounds; hens, 6½ pounds, and pullets, 5 pounds.

Orpingtons. This general purpose breed differs from those previously mentioned in that they have white legs and skin, the others breeds having yellow legs and yellow skin. The common varieties of this breed are: Buff, White, Black, and Jubilee. At the present time there are probably more Buff Orpingtons bred than any other variety, but the White may outrival the Buff. The blacks are being bred more by the fanciers than by the farmers, for the reason that their black plumage and dark colored legs are somewhat against them for market purposes. This breed is among the best winter layers; makes good roasters and broilers, but is probably more given to incubating during warm weather than either the Rocks or the Wyandottes. The standard weights are about one pound per bird above the Plymouth Rocks. For general farm use they might be more profitably bred with less weight, for the reason that the largest birds are usually somewhat leggy and rough in appearance when weighing 4 to 5 pounds. When one wants very large roasters, weighing from 7 to 8 pounds each or better, the larger birds, of course, would be better.

Dorkings. This is one of the oldest English breeds and is popular in some districts. They are a large breed, long in the body and short in the legs. By many they are considered to be weak in constitution, although our experience would not bear this out entirely. They lay large white eggs and are good sitters and mothers. They are white fleshed and white legged. Their peculiarity is that they have five toes. This is, at times, a disadvantage, especially when the fowls have to scratch in straw where there is more or less binder twine, which is apt to get around the extra toe, and thereby occasionally fastening both feet together. This is not a very serious objection. Where there is high, dry ground and plenty of range and a person fancies the Dorking color or type, they are worthy of consideration.

Meat Breeds.

Brahmas. The feathered legged breeds are not very extensively kept. The most popular of these is the Brahma. This breed is very hardy, and lays very large brown eggs. They are rather slow to mature and the feathers on the legs are not altogether desirable from a farmer's standpoint, in that they are apt to get wet and freeze readily. Brahmas make the best roasters, but are somewhat slow to mature, and the females, in our experience, have not been very good layers, although there are some females that do well. This breed is yellow skinned.

Langshans. Langshans are also of the feathered leg breed, but have white skin. They are longer in the legs than the Brahmas and are not so heavy.

Games. By many the Game would not be considered a chicken suitable to farmers. The exhibition Games, as they are known in the standard, are altogether too long in the legs and head, and too weak in constitution for the ordinary farmer, but the Cornish Games and what is known as the Old English Game are worthy of consideration. The Cornish Game is a very large, tight-feathered, full-breasted chicken, and probably carries more meat on its breast than any other breed. The objection to the Cornish Game is that it is a poor layer. The English Game, sometimes termed "Pit Game," is a hardy bird. They are fair layers and make fair roasters. The most serious objection to this breed from a farmer's standpoint is that there is a great tendency among the young cockerels to be very pugnacious. This is sometimes carried to such an extent that they kill one another. Other than this, they make a fairly good farm chicken, especially where the mothers are required to protect their young.

Special Purpose White Egg Breeds.

The high price of eggs during the last few years has increased the popularity of this class of chicken very much. Of all breeds in this class the Leghorns are the most popular, and of the Leghorn breed the White variety is bred more extensively than any other. Leghorns probably mature a little earlier, and eat less food than the heavier breeds; they make fair broilers, but are comparatively useless as roasters. They lay a large number of good-sized eggs during the natural laying period. As winter layers they are fair, but in our experience more susceptible to changes in temperature than are the heavier breeds. This much must be said in their favor, than their eggs usually hatch better than those of the heavier breeds, and the chickens are very hardy. Of the other Leghorn varieties, the most popular ones are the Brown, Buff, and Black, these varieties not being so popular from a market poultryman's standpoint, owing to the color.

Minorcas. There are three varieties of Minorcas. The Rose Comb Black and the Single Comb Black are more commonly bred than is the White Variety. This breed is larger than the Leghorn, and also lays a larger egg. They have very large combs and wattles.

Anconas. This breed might be termed a speckled or mottled Leghorn. They have all the characteristics of the Leghorn, and are black and white in color. This breed is gaining in popularity among the practical poultrymen.

Hamburgs. There are several varieties of this breed. The black is the most popular. They are inclined to lay an undersized egg. We have found the blacks to be good layers, and to lay a fair-sized egg. They have rose combs and are neat and active in appearance.

SHORT NOTES ON POULTRY WORK IN IRELAND, SCOTLAND, ENGLAND, AND DENMARK.

During the summer of 1912, the writer was permitted to investigate a portion of the poultry work in the above-mentioned countries, with the particular object of learning, as far as possible, in the limited time at his disposal, the general practice of co-operative marketing of poultry products and of giving instruction to the producers, also as to the methods of stock improvement.

In general terms the marketing of eggs by means of egg circles or the co-operative method is successful in the outlying districts, but where it has been tried near large cities, so far as the writer could learn, the movement had not been a pronounced success in most instances. All members must be loyal to the movement if success is to be permanent. In several instances the writer learned of various schemes that had been tried to break up the circle, even to paying far more than the eggs were worth and to paying an extra price to prominent members. Many of the egg circles have passed through trying times, caused by the lack of information on the part of the producers and by bad management, also inflated prices. The writer visited several collecting depots in Ireland which at some time had almost failed. In nearly all instances the trouble had been removed when a change was made in managers. So much depends on the manager, that the success or failure of the proposition appeared to rest largely with him.

Nearly all the societies visited collected the eggs by means of wagons, which travelled about the country, in some instances the eggs were handled by the co-operative creamery. Most of the co-operative societies sell such goods as are needed by the people, not only groceries, etc., but farm implements and fertilizers.

The markets demand not only goods of high standard, but of constant *uniform quality.* In a word, the success of Denmark appeared to be that they were putting on the market large quantities of a uniform product. Each pound of butter was like the previous one as to flavor, etc., and the same was true of eggs as to size, freshness, etc.

The co-operative marketing is beyond the experimental stage in all these countries, and, naturally, is more successful in some districts than others. The writer recalls one instance in which the producer would not sell the eggs of the farm through the local co-operative society because the eggs were smaller than the neighbors, and consequently the price received was less per egg. Another party could receive six cents per 120 eggs more in a town twelve miles distant than the local co-operative paid, hence the eggs were driven to the town and sold.

The size of the eggs received much more attention than here, also the care of the egg after taking from the nest.

The educational schemes and the breeding stations were of particular interest and worthy of serious consideration. Where the market demands a uniform product, the stock must be as far as possible fairly uniform as to breeds, as also must the methods of feeding, etc.

Education of Producer. In Ireland there are two main features in the education of the producer. The employment of one or more qualified teachers in each county, and the establishment of small flocks of poultry on selected farms to serve as object lessons and as centres for the distribution of settings of eggs. For the purposes of the scheme each county is usually divided into circuits, in each of which there are five centres, where it is the duty of the teacher to spend some weeks giving lectures on poultry keeping in the evenings, and during the day visiting farms near the centre for the purpose of instructing individuals in all that pertains to the management of poultry. Instructors also inspect the poultry stations under their charge and assist the holders in procuring suitable changes of birds. They see that the stations are properly kept and that the Department's rules and regulations are being kept. It is required by the Department that winter lectures to adults must be followed—if not ultimately superseded—by systematic tutorial and practical instruction to small classes of younger pupils who are prepared to attend daily for a number of weeks at local centres. Local classes are usually held in spring and summer. The instruction thus given includes, besides the rearing and management of poultry, such subjects as fattening, killing, and trussing, egg grading and packing, and the keeping of accounts and egg records.

The second feature of the scheme is the establishment of poultry farms or stations at suitable centres in the county farms, the owners of which undertake to do away with all the poultry on the premises, and, with or without financial assistance from the Department and the County Committee, stock the farm anew with pure bred selected birds of a type suitable to the neighborhood, and approved of for the purpose by the Department's Inspectors. It is a condition strictly enforced that no other birds, unless in exceptional cases where enclosed runs are provided, shall be allowed on the farm. The owner undertakes to sell settings of eggs to persons in the district at a fixed charge per setting (usually about 50 cents per dozen) and to manage the poultry in accordance with the directions of the county instructor. The owner is usually supplied with a portable house, the object being to disseminate among the people of the district the advantages of better housing and of keeping the birds more in the fields than is generally the custom. Those who comply with these conditions receive a small premium at the end of each season.

It has been found in Ireland that only by a system of itinerant instruction and by numerous practical demonstrations could satisfactory results be accomplished.

The other European countries have not worked so directly as has Ireland in the education of producers, but have depended more upon the co-operative requirements to exert an influence in this direction.

In order to further educate the producer in Ireland some counties introduced "portable poultry schools." These are equipped with simple but adequate plants and provided with stock and all the necessary appliances. Such a school is located at a centre where a field is obtained for the pens of birds, with houses and runs, and a room adjoining is utilized for working the incubators and such appliances as are used indoors. The school may remain four weeks in a locality and is then moved to another centre. This Portable School is cumbersome to move, and takes up a great amount of the time of the instructor.

The writer was surprised to learn that there were thirty-three instructors in poultry. When one considers the size of the country, it is evident that everybody should know how to care for poultry.

Denmark has established in different parts of the country breeding plants or centres where special attention is given to the trap-nesting of stock and to the selection and mating of the breeding stock for egg production. From these centres eggs for hatching and breeding stock are sold to the surrounding farmers at reduced rates. In most cases but a single variety of fowl is maintained at one of these centres, but in some instances ducks, geese, and sometimes turkeys are kept in conjunction with the fowl. In some stations a system of exchange of breeding stock, principally males, between the different centres is followed. For this reason there is seldom any need for introducing blood from outside sources, the system of breeding approaching nearer to line breeding, and, in many cases, in-breeding.

Denmark has a splendid system of co-operative marketing of eggs. Here a central organization is supreme, and the sub-societies located throughout the country are ruled and regulated by it. The regulations made by the federation are very stringent, and heavy fines are imposed when they are disregarded or broken. These are:

(1) That a member must only deliver to the local society eggs laid by his own hens.

(2) He must undertake to collect from the nests every day, and in the breeding season or when the weather is hot, twice a day, and keep them under suitable conditions so long as they remain in his possession.

(3) Must have clean nests, so that the shells shall not be stained or tainted.

(4) They must be protected against rain, sunshine, and frost.

(5) All eggs produced must be delivered to the local society, except those required for hatching and household purposes.

Upon the last named point the very greatest stress is laid, and any member infringing that rule would be fined for the first offence, and be expelled from the society if the practice was continued.

In the organization of co-operative egg and poultry societies abroad the by-laws of organization and for governing the working of the societies are very few and simple.

In Ireland co-operative work is conducted on the conditions which prevail with the National Poultry Organization Society, which has its headquarters in England. These conditions or by-laws state that:—

(a) Eggs shall be received from each member at least three times a week.

(b) Eggs shall be tested for freshness and quality.

(c) Only such eggs as can be guaranteed as new-laid, are branded, are clean, and that weigh two ounces will be taken.

(d) Eggs shall be forwarded so as to reach the shops when not more than three days old.

Co-operative work in Scotland and England is conducted under much the same rules and regulations as those given for Ireland.

Rules. In Ireland, where selling eggs through Central Society, the following conditions must be observed:

1. Societies shall carefully grade, test, and pack, in approved boxes, so that eggs can be guaranteed and sold under the registered Trade Mark.

2. The local society undertakes:

(a) To grade, test, and pack as instructed.

(b) To be responsible to the I.A.W.S., Ltd., for the quality of eggs offered.

(c) To advise daily as to stock on hands and forthcoming.

(d) To see that the packing slips are placed in the approved position in all cases for export.

(e) In order to insure uniformity in style and method of packing, the local society undertakes to purchase boxes and packing material through the Federation, unless it can be shown that suitable material can be procured at lower rates.

Methods of Financing. The financing of Co-operative Societies, while varying slightly in different countries, is much the same in general principle. In all cases a membership fee or share is called for, the amount depending upon the country in which the Society is operating, and ranges from 13 cents in Denmark to approximately $5 in Ireland. With some the payment of this fee may be made in cash or with eggs. Any shortage of necessary working capital is obtained by means of a guaranteed overdraft from the Society's bankers. This accommodation is granted usually at 4 per cent. on the joint and several security of a number of the members, who are counter-secured by "loan guarantee shares," of the same value as the original shares, only a part of which is paid up, unless the bank requires the overdraft to be paid off and the assets of the Society are insufficient for that purpose.

In Ireland the capital is raised by subscribed shares usually of £1 each. These shares are paid in the following manner:

On application 2s. 6d.

On commencing business 2s. 6d., and the balance in such calls as the committee may find it necessary to make from time to time and of which a fortnight's notice must be given.

The liability of the members is limited to the amount of their shares.

If any further capital is wanted it is borrowed from a local bank: and sometimes people who are not themselves poultrymen are found quite willing to invest money in such undertakings.

In addition to taking shares, members must agree (legally) to sell all marketable eggs and poultry to the Society and deliver the goods according to the rules laid down by the Committee.

How and When Producer is Paid. The method and time of paying for the eggs differs considerably in the different countries. They are alike in one respect. *i.e.,* that all eggs are bought by weight rather than by count, as is the case in America.

The co-operative societies in Ireland follow the practice of paying for the eggs as they are delivered at the collecting or receiving depot. All dirty or stale eggs are rejected. English societies differ from the above in some respects. When the eggs are received at the depot they are counted into a separate box and a "back" note given stating when received, the number and price, and signed by the receiver. The eggs then go to the candler or tester, and the member delivering the eggs credited with the amounts in each class which he has, which is recorded in the analysis book. The chief tester is held responsible for this book, which is headed thus:

Name.	Date Collected.	Total.	Good.	Small.	Cookers.	Bad.	When Tested.
Jno. Jones	June 1st.	160	150	7	3	—	June 1st.

Two cents are deducted for every ten "smalls" or "cookers," and the bad are returned to the producer. Payment is made monthly by cheque, and the cheque being accompanied by a complete statement of the month's deliveries by the member is recorded in the analysis book.

In Denmark the co-operative societies are conducted differently from those of Ireland and England with respect to making returns to the producer. Paid collectors gather the eggs from the farms at regular intervals. The collector pays for the eggs received at the rate set by the central federation, entering in the member's book the weight and amount. Any dividends which the central federation accumulates from selling at increased prices is divided among the local societies from time to time and is distributed from them to the members on a *pro rata* basis. In this way, not only do the members receive the best market prices for their products, but they also share in any profits that may come from the business.

Pay of Manager. In many cases the manager is paid on a percentage basis of business done, which is the most satisfactory for many reasons. In some societies in Ireland the manager receives £2 per week.

Branding. In Ireland and Scotland, branding eggs with date, etc., is not so commonly done as in Denmark and elsewhere. Stamped eggs are sometimes viewed as foreign eggs in Great Britain.

Cost of Collecting. This varies greatly, but, as near as the writer could gather from the managers of the societies visited, it cost in Ireland about half a cent. per dozen during the summer months and a cent and a half per dozen during the winter months. The cost of packing, cases, grading, etc., is from a cent to a cent and a half per dozen additional to the above.

Size of Flocks. The size of the flocks vary, but on practically all the farms visited the poultry could not be considered as a special business. The fowls, generally speaking, were given fairly good care and attention. The average size of the flock would not be much more than 50 or 100 birds, or about 1 fowl per acre.

Prices. Prices vary as here. The books of the societies as seen by the writer showed a price in December of practically 50 cents per dozen, which was the highest, and the lowest price was 22 cents for May, the average for the season being about 29 cents.

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BULLETIN 218

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Birds of Ontario

in

Relation to Agriculture

By

CHARLES W. NASH

TORONTO, ONTARIO, DECEMBER, 1913

BULLETIN 218] [DECEMBER, 1913

Ontario Department of Agriculture

Birds of Ontario in Relation to Agriculture

By Charles W. Nash

When white men first began to settle this Province, it was a vast forest, broken only by its rivers, lakes, and marshes. Its birds consisted of such species as were adapted for life among trees, or were waterfowl. As the country became cleared and population increased, some of these birds were driven from their ancient haunts and are now only found in the wooded country of the north, while the Wild Turkey and Passenger Pigeon have become extinct.

The changes brought about by settlement and cultivation, however, have produced conditions better adapted to the requirements of certain other forms of bird life, and so we now find in our orchards, fields and gardens a variety of feathered friends whose range was formerly restricted to natural meadows or thickets bordering rivers and marsh land. The range of many of these birds is being extended northward as cultivation progresses in that direction, so that it is now a common thing to hear of the appearance of Meadowlarks, Orioles, Bobolinks, and Bluebirds in the new settlements of Northern Ontario where they were previously unknown. Many of our birds have also changed their habits so as to better adapt themselves to modern conditions. Thus we find that all the Swallows, except the Bank Swallow, have abandoned their former nesting places in caves or hollowed trees and now occupy our buildings. The Chimney Swift and Phœbe do the same thing, while Bluebirds and House Wrens will readily take possession of any box placed for them in the garden or orchard, if out of the reach of their deadly enemy the house cat. Robins and Chipping Sparrows apparently find the presence of human beings beneficial to them, for they build their nests with no pretence at concealment in the most frequented places, and the Flicker often finds a safe nesting place in an old tree trunk or even a telegraph pole in a city. Of all wild creatures, birds will most readily adapt themselves to conditions created by human agency. If not persecuted they will attach themselves to the farm, garden, and orchard, where their services are of the greatest value.

In all about thirteen thousand species of birds are known to science: of this number only three hundred and twenty-five have been found in Ontario. Many of these are very rare and not likely to be noticed by ordinary observers, others are merely accidental visitors which may never be seen again.

Birds may be studied from three points of view: The scientific, the sentimental, and the economic. The first includes their origin, development, structure, and relationship to other forms of life, past and present. As a matter of sentiment, all lovers of nature are interested in birds; their beauties of form and colour, their intelligence, sociability and musical powers excite both wonder and admiration in the minds of all who give them even casual attention. It is, however, from the economic standpoint, chiefly, that I propose to deal with the subject in this work, and the economic value of our familiar birds will, to some extent, be pointed out in the succeeding pages.

The economic value of birds to man lies in the service the birds render by keeping within proper limits the various forms of insects which are injurious to our crops or animals, in preying upon rats, mice, and other destroyers of our grain and fruit trees, in devouring weed seeds, in acting as scavengers, and in the case of game birds and wildfowl furnishing sport and food.

No reliable estimate has ever been made of the annual loss to the farmers of Ontario by the depredations of insects. In the United States much careful attention has been given to the subject, and in a report of the Department of Agriculture at Washington, issued in 1912, Dr. Henshaw estimates the loss to the agricultural interests of that country at upwards of $700,000,000. Our losses will certainly be as large proportionately. This loss is caused chiefly by reason of an insufficiency of bird life on our cultivated lands; experience the world over has shown that as bird life decreases insects increase; also, that birds are more efficient in keeping down insect pests than are all other agencies, natural and artificial, combined.

Under ordinary conditions the number of birds required to keep plant-eating insects in proper check need not be extraordinarily great, for in order to maintain their active bodies adult birds require an enormous amount of food in proportion to their size and weight, while the quantity consumed by the young in the nest is far greater yet. In the case of nestlings their food supply must necessarily be great, for their growth is very rapid; birds like the Sparrows, Warblers, Thrushes, &c., attaining nearly full-size and becoming sufficiently well-fledged to leave the nest in about eleven days from the time they were hatched.

The power of flight possessed by birds enables them to act more efficiently as a check upon any abnormal increase of insects, or small animals, than any other force in nature. Should an unusual abundance of any insect, or of field mice, occur in any locality, birds which feed upon them will soon be attracted to the spot, and there they will remain until usual conditions are restored and the plague abated. In other lands this habit of the birds which act as scavengers renders good service in disposing of animal matter which would otherwise decompose and poison both air and water.

Migration of Birds.

Ever since men first began to make records of natural phenomena the arrival and departure of migratory birds have arrested attention. The Greek and Roman philosophers remarked it, and the writers of the Old Testament commented upon it. As yet, however, no satisfactory explanation of the origin of the habit of migration has been given. Some modern naturalists think that change of climate such as that which took place during the glacial period affords a rational and certain explanation of the phenomenon. When examined closely, however, under the light of recent research this theory is open to many objections. At any rate, if the general habit of migration originated by reason of the violent climatic changes which occurred during the glacial period, it has been and is still being so greatly modified both in the case of species and of individuals as to render it certain that the habit of making the extended northward migrations now undertaken by certain of our American birds has been acquired recently and by degrees. We know that until about thirty years ago such birds as the Meadowlark, Bobolink, Baltimore Oriole and others did not extend their flight beyond our southern borders, because the interior and northern part of the province was then heavily wooded and unsuitable to their requirements, but now these birds migrate in increasing numbers every year as far north as and even beyond the Ottawa River. They have taken advantage of the clearing of the forest and the cultivation of the land to disperse themselves over an area which was previously not adapted to their way of living. In the early eighties I noticed a similar movement in Manitoba. As the land there was brought under cultivation and the prairies were peopled, Bluebirds, Purple Martins, Cliff Swallows, and other birds which were previously unknown came in as migrants and established themselves as regular summer residents. Failure of the food supply and the severe cold of these northern regions drive these birds southward for the winter, where they remain until returning spring gives the impulse for their return flight to the north.

If all the individuals of the so-called migratory species were in the habit of entirely leaving their winter quarters and resorting to some northern region peculiarly adapted to their requirements during the breeding season, we might well assume that migration was an inherited instinct transmitted from remote ancestors who had acquired it by reason of climatic changes, which had forced them at certain seasons to leave what had been originally their permanent habitat. This is true, however, of only a few American species, the majority of which, in greater or lesser numbers, breed almost all through their range.

It seems to me, therefore, that the impulse to migrate is the result of a natural law which provides for the dispersal of birds over the world during the season when their services are most required in maintaining the balance in nature, and that when the physical features of a country are changed, as ours have been, from heavy forests to open fields, the species of birds which migrate into it will change also, so that the land will be occupied by those best specialized to perform the functions required of them in nature's economy.

As the study of migratory birds has progressed and the peculiarities of method adopted by each species have been traced the difficulty of assigning any general cause for the habit except that already stated becomes greater. The movement from the north in the autumn presents many instances showing that various species act upon an impulse which differs from that of others closely allied to them. Generally speaking, it is assumed that birds leave the northern regions, where they have nested, at the approach of winter; when cold weather is imminent and their food supply is failing. Many species do linger in their summer homes, until it would seem as if they required to be driven out, but others again leave while food is most abundant and the temperature at its highest. Among the Thrushes this difference is very marked. Wilson's Thrush, the Hermit Thrush, and the Olive-backed Thrush resemble each other very much in appearance and in all their habits except their migration. Wilson's Thrush arrives here early in May and breeds abundantly from our southern border northward. About the middle of August their return flight begins and by the twenty-fifth of the month they have all gone. The Hermit arrives early in April, breeds sparingly in Southern Ontario and remains until the beginning of November. The food of these two species is exactly the same, consisting of insects and such small berries as are to be found in the woods. The Olive-backed Thrush moves at the same time as the Hermit, but goes further north to breed. It seems quite impossible to discover any reason for the difference in the migration of these closely allied forms. Failure of food cannot be the cause of the early migration of the Wilson Thrush, for at no time in the year are insects and wild fruit more abundant than in August and September; nor can it be attributed to cold, these two months being the warmest of the year. The same difference is found between the Nighthawk and the Whip-Poor-Will. These birds are much alike in everything and would seem to be adapted to the same conditions, yet the Whip-Poor-Will remains here for a month or five weeks after the Night Hawk has gone, the bulk of the Nighthawks leaving about the end of August. Among the shore birds (Plovers and Sandpipers) the difference in the time of their departure is still more noticeable, many species commencing their southern migration early in July and leaving us entirely by the beginning of September, while closely allied forms do not appear here until October and remain until the first hard frost. Instances of this difference between closely allied species may be found in so many groups of our birds as to render it certain that neither failure of food supply nor unfavourable climatic conditions can be accepted as the immediate influence which governs migration in all species.

When the spring migration from the south northward is studied the difference in method and range between allied species and of individuals composing the species is very great. Among the warblers are some interesting examples of variation in the extent of migration. The Yellow Warbler, Black-throated Green Warbler, Black and White Warbler, and some others, winter south of the United States. On their return they do not travel far before they begin to select summer quarters and they breed from the southern states all through their range to Northern Ontario. The Magnolia, Myrtle, Blackburnian, and Black-throated Blue Warblers winter in the same region as the others, but they pass over the United States entirely and with few individual exceptions go to the north of this province before nesting, while the Blackpoll Warbler undertakes a most extended migration, the equator and the Arctic Ocean being the extreme points of its journeys. The same difference in extent of migration of the species is to be found in almost every group of our land birds. Not only is there a great difference in the extent of the migration of allied species, but in certain cases some of the individuals which compose a generally migratory species never migrate at all. The common Bluebird affords an example of this peculiarity. All through the southern states the Bluebird is a resident, its numbers in the winter being increased by migrants from the north. At the approach of spring they gradually spread out from their base, working northward as the season favors them until they reach the limit of their range; which, by the way, has been considerably extended as the land has been brought under cultivation. All over the area from the Gulf of Mexico to Northern Ontario and Southern Manitoba the Bluebird finds suitable breeding conditions and so do other species. Why then do birds incur the perils involved in migration? As winter comes on in the north we know that they must leave that region, or the intense cold and failure of food would destroy them, but that does not explain the spring movement at all, for we see that many individuals of migratory species find the climate conditions and food supply of the south perfectly suited to their requirements. I can only infer that, as I have said, the impulse to migrate is an express provision for the dispersal of birds over the earth during the period when their services are most required for the maintenance of the balance of nature. This impulse is undoubtedly hereditary in regularly migrant species, for young birds brought up from the nest in captivity always become possessed of a spirit of restlessnesss during each flight season, particularly at night.

While it is undoubted that the impulse to migrate is inherited, many ornithologists are of opinion that the ability to do so is not hereditary, but has to be acquired, and is, in fact, the result of the education of the young by old and experienced birds. This theory might be accepted as an explanation of the wonderful faculty which enables them to find their way over the thousands of miles which sometimes intervene between their summer and winter homes if all birds were gregarious at the time of migration, and if the old and young united and made the journey together. Some species do this, but in other cases the adults migrate before the young, and there are still other species the individuals of which strike out singly and perform the whole journey alone. Birds of this latter class must have inherited the ability to migrate as well as the impulse.

A striking example of individual migration is afforded by the Ruby-throated Humming Bird. These little creatures migrate by day, so their movements can be observed. In the spring they reach Southern Ontario early in May, the males preceding the females by a week or more. Through June they are occupied in nesting, and early in July the adult males abandon their mates and young and go south. In September the females and young gradually take their departure. Just at this season dozens of them in a day may be seen flying swiftly from east to west along the shore of Lake Ontario, following the route taken by all our migrants here, though this course is not so invariably followed by them as by all other day-flying species, for I have, on several occasions, seen a little Humming Bird strike out over the lake flying directly from north to south, the distance here from shore to shore being about thirty-five miles. Humming Birds when migrating always fly low, so that it is impossible for them to gain any knowledge of their course by the exercise of their vision. It seems evident, then, that as they have no opportunity to be educated as to the route they should follow, and that even their acute sight cannot be of very great service in guiding them over a course which may in some individuals extend from Hudson's Bay to Brazil, they must be possessed of a peculiar faculty which enables them to act upon their inherited impulse to migrate when the season for flight arrives.

Of this wonderful instinct which plays so important a part in migration there is, I think, but one explanation to be given, viz.: That, as nature provided the periodical migrations of certain forms of life for the purpose of maintaining an equable distribution of those forms over all parts of the earth during the seasons best fitted for their maintenance, the necessary faculties to enable them to carry out this provision were developed with the impulse which induces the movement of dispersal.

HAWKS AND OWLS.

Among the most injurious pests of the farmer and fruit grower are the small animals commonly known as rats and mice; individually they are insignificant; but where permitted to increase, their productiveness soon renders them formidable.

It is very difficult to make anything like a correct estimate of the average damage inflicted upon the country by these creatures, but every farmer knows by sad experience that he continually suffers from their work.

The enormous amount of grain they destroy and the young trees girdled and killed by them are visible to every one, but the perpetrators of the mischief, owing to their nocturnal habits and secretive lives, are comparatively seldom seen. Their enormous increase of late years, and consequent capacity for serious mischief, is, of course, owing to the fact that man has seriously interfered with the balance of nature and has thoughtlessly, perhaps, destroyed the principal natural enemies of these creatures.

Man himself is almost powerless to stop their ravages to any great extent. The constant exercise of his ingenuity in trapping and so forth results in very little and occupies his time to no purpose. The natural enemies of these animals are gifted with special faculties for their destruction and so are able to cope with them. Chief among the enemies of this class of farm pests are the Hawks, Owls, Shrikes and Crows. These birds are wonderfully provided by nature with the means to fulfill their part in maintaining the correct balance between the small rodents and plant life, and if not destroyed by man would so keep down the numbers of these four-footed thieves that their plundering would be scarcely noticeable.

Unfortunately all the birds of prey are considered by uninformed people to be chiefly poultry killers and therefore enemies, while the truth is that, with but few exceptions, as is shown further on, our common species are beneficial; and should be protected.

The incessant destruction of these birds if permitted to continue will sooner or later result in such an increase of mice that they will become a devastating plague, as they have several times in Great Britain and notably in Scotland in the years 1888 to 1892, when parts of Roxburghshire, Selkirk, Peebles, Lanark and Dumfries were over-run by field mice and every growing thing practically destroyed. In order to ascertain the cause of this outbreak, and if possible find a remedy, a committee was appointed by the British Board of Agriculture of which the Earl of Minto, our late Governor-General, was, I think, chairman.

Evidence was given before this Committee by about eighty farmers and shepherds and by several gamekeepers; their testimony proving conclusively (1) That the effect of the outbreak was to practically destroy all crops. (2) That the cause of the increase in number of the mice was the destruction of hawks, owls, weasels, and other natural enemies of the mice. (3) That remedies are expensive and difficult of application. Poison on small enclosed areas was efficacious, but its application over farms, even if practicable, would be attended with much risk to other forms of life. Traps, while successful in destroying many, are troublesome to make and expensive.

Cats, though tried on a large scale, were of no service whatever. Large numbers of mice were killed by men and terrier dogs; systematic work by man and several dogs giving better results than any other method employed, one man with his dogs having destroyed fifteen thousand in a month.

The result of this investigation was that the persecution of Hawks and Owls ceased and these birds soon gathered in the district affected in sufficient numbers to clear off the mice.

No phenomenon in connection with the plague of field mice in Scotland was more marked than the arrival and continued residence in the affected districts of large numbers of the Short-eared Owl. This bird, which is distributed over every part of the world and used to be quite abundant in Canada, is a regular winter migrant to the British Islands, arriving there in autumn and departing in the spring. Under ordinary circumstances it very rarely nested in Great Britain, but in consequence of the vast multiplication of their chief food, the meadow mice, these Owls not only flocked to the spot in great numbers, but as they were undisturbed, and in fact protected, they remained and bred freely in the infested district, laying too a larger number of eggs for each brood than is usual with them and they also raised more than one brood in the season. The Owls destroyed so many of the mice in feeding their young, that on some of the farms the shepherds stated that the ground was covered with the "castings" of the Owls, composed entirely of the fur and bones of the mice.

The committee finally reported: "It would be difficult to condemn too severely the foolish action of those who allow or encourage the destruction of Hawks and Owls. It is with much satisfaction that your committee record that many farmers and land owners seem to have become convinced in late years that Hawks and Owls are not only harmless but most beneficial to agriculturists and have issued orders for the preservation of these birds."

Our position in Ontario may at any time, if we are not careful, resemble that of the Scotch farmers in 1892. It would be well therefore for our people to exert their best influence for the protection of our beneficial Hawks and Owls at once, in order to avert what may develop into a serious calamity.

The birds of prey may be roughly divided into two classes—the Hawks and the Owls. Of the Eagles little need be said; they are now so rarely found in the cultivated districts that their influence for good or ill is practically nothing.

HAWKS.

Of the hawks there are eleven species, occurring regularly in this Province in greater or less abundance every season. These are the Marsh Hawk, Sharp-shinned Hawk, Cooper's Hawk, Goshawk, Red-tailed Hawk, Red-shouldered Hawk, Broad-winged Hawk, Rough-legged Hawk, Duck Hawk, Pigeon Hawk and Sparrow Hawk; there are two or three others, but they are only occasional visitors. Of these eleven, the Sharp-shinned Hawk, Cooper's Hawk, Goshawk, Duck Hawk and Pigeon Hawk are the species which occasionally make raids upon the poultry yards, and which at all times seem to prefer feathered game to either fur or insects; they should, therefore, be shot whenever the opportunity is given. The Sharp-shinned Hawk and Cooper's Hawk are the two species which most frequently attack poultry. They are both small hawks, but make up for their lack of size by boldness and dexterity. It is but seldom they attack a full-grown fowl, but if they once find an accessible lot of chickens they will continue to visit the flock until they have taken them all, or are killed in the attempt to do so. The mischief done by these two species has been the principal cause of the prejudice existing among farmers against all the hawk tribe, and is usually given as an excuse for the slaughter of the valuable species whose constant work inures to man's benefit. The food of the Duck Hawk and Pigeon Hawk consists chiefly of wild birds. They rarely visit the farms, their usual resort being the marshes and shores of lakes frequented by water fowl. The Pigeon Hawk is not so named because it has any preference for pigeons, either wild or domestic, but because it slightly resembles a pigeon in shape both when on the wing and when at rest.

The Goshawk fortunately does not visit the cultivated portion of Ontario in any numbers regularly: it is a winter visitor usually; and rather an expensive one to entertain when it does come. The winter of 1896-7 was one of the seasons in which it was particularly abundant through southern Ontario, and poultry owners suffered greatly from its destructive powers in consequence. This Hawk is a large powerful bird, quite capable of killing and carry off a full grown hen. Owing to its boldness and strength it is capable of doing a great deal of damage, and should consequently be killed whenever seen. As previously stated, this hawk generally occurs in winter, and therefore it is not likely to be mistaken for any of the hawks whose food habits are beneficial. As a general rule, if a hawk is seen about the farm-yard during the winter it is safe to assume that it is there for no good

Goshawk.

Rough-legged Hawk.

purpose, and the gun should be brought into requisition at once, as all our beneficial hawks migrate southward when cold weather sets in.

From the above species, all of which are undoubtedly injurious to the interests of the agriculturist by reason of the destruction they work in the poultry yard, and amongst our insectivorous wild birds, we turn to the remaining six species of hawks frequenting this Province, every one of which spends the greater part of its time and devotes its energies to the destruction of animals and insects which are known to be amongst the greatest pests the farmer has to contend with; these are the Marsh Hawk, Red-tailed Hawk, Red-shouldered Hawk, Broad-winged Hawk, Rough-legged Hawk and Sparrow Hawk.

Nearly every one knows the Marsh Hawk and has seen it gracefully skimming over the low meadows, occasionally hanging poised over one spot for a second or two, and then dropping down into the long grass: this drop generally means the death of a meadow mouse; sometimes, but more rarely, a frog: of these two creatures its food principally consists, and the number of meadow mice destroyed by each of these birds in a season must be something enormous. As many as eight have been found in the stomach of one of these hawks, and four or five quite frequently. The hawk's digestion is very rapid and their hunting and feeding is continued with but few intermissions from daylight until dark.

How many mice each bird would take on the average each day would be difficult to state exactly, but it is safe to assume that at least six would be required. Now multiply that by the vast army of hawks that resort to this Province and the total number of mice destroyed would be amazing: and then against this good work constantly going on there is no damage to be set off. Not one instance, in forty years observation of this bird's habits, has ever come to the writer's knowledge of their having attacked a single domestic fowl. It does sometimes make a meal off a dead duck or other bird it may find in the marshes, but it is doubtful if it ever kills for itself a bird of any kind, at any rate in this Province. Every farmer and every sportsman in the land should do his utmost for the protection of this hawk. Unfortunately they are constantly destroyed by persons who are ignorant of the good they do, and thousands are killed every autumn by mischievous people who must shoot at everything they see that has life in it. If people who wantonly shoot hawks would sometimes look at the stomach contents of the birds they kill they would soon be convinced of the wrong they were doing and would perhaps exercise sufficient commonsense to refrain from continuing the evil practice.

For the sake of brevity the Red-tailed Hawk, Red-shouldered Hawk, and Broad-winged Hawk may be considered together. These three common species are usually known as "Hen Hawks." Why, however, it would be difficult to say. They are all fairly large, slow, heavy flying birds, whose food consists principally of mice, squirrels, toads, frogs and snakes: very rarely do they ever take a bird of any kind. In fact it would be extremely difficult for them to do so, unless the bird was very young, or injured seriously. They will, when pressed by hunger, feed on carrion, but the staple article of diet with them is meadow mice and squirrels, varied, as before stated, by toads, frogs and snakes, besides grasshoppers and other insects.

I have especially omitted from this group, to which it really belongs, the Rough-legged Hawk. This is done purposely, because the great value of the species to the farmer should be particularly pointed out, the bird having been most unjustly persecuted. It is the largest of the Canadian hawks, and one that deserves the greatest consideration and protection from every man having an interest in agriculture. It can be safely said that this so-called "Hen-Hawk" has never killed a head of poultry at any time, nor do they ever kill birds of any sort. During the fall of 1895 these hawks were very abundant in southern Ontario and large numbers were killed. I obtained all the bodies I could for the purpose of investigating the contents of their stomachs, and I spent much time in watching their habits whilst feeding. All day long, every day from the first of October of that year to November 28th, the birds were constantly passing slowly through southern Ontario, feeding as they went, and not one fowl was taken or attacked by them anywhere, so far as I could learn, and I made enquiries from poultry keepers wherever I could. In all, 32 specimens were examined by me, and the result corroborated my previous experience. In one stomach I found a frog, in another the flesh of a muskrat—taken from a pile of bodies of these creatures which had been thrown together in Ashbridge's Marsh. Another stomach was filled with large grass-hoppers, and the rest contained mice, and nothing but mice, or traces of them, ranging in quantity from a little fur and a few bones to seven whole ones. From this it can be judged whether or not the Rough-legged Hawk is the friend of the farmer.

The attention of the Department of Agriculture at Washington was some time ago called to the fact that mice and other destructive rodents were largely increasing throughout the United States, and it was suggested that the constant destruction of the hawks and owls was the reason for it. In consequence of this the Department placed the matter in the hands of Dr. Merriam and Dr. Fisher, two of the leading ornithologists of America, with instructions to prepare a report on the subject. This they have done, and the result of their investigations, which I shall give at the end of this chapter, shows conclusively that all the hawks which I have referred to as being beneficial to agriculture are of the greatest possible value in ridding us of enormous numbers of destructive animals, and they are practically innocent of the commonly urged charge against them of poultry-killing.

There is only one more species of hawk to be considered, and that is the beautiful little Sparrow Hawk, probably the commonest of all our hawks, and which may be distinguished from any of the others by its smaller size and red back. It may be constantly seen hovering over fields in Ontario, all through the summer, for it breeds with us, raising its young in a convenient hole in a tree, frequently choosing one that has been deserted by one of the large woodpeckers. The very small size of this bird precludes the idea that it can take a full grown fowl, or even a pigeon, and I have never known in my own experience that it has even taken a young chicken. Its principal food consists of mice and grasshoppers, of both of which it consumes immense quantities, but it does occasionally take wild birds, more particularly those which frequent the open fields and skulk in the grass or run about the stubble. The birds taken by this species are, however, so few compared to the number of mice which it destroys, and so much good is done in reducing the swarms of grasshoppers which infest our fields, that we may well forgive its slight trespasses, the balance of good over evil being so great that this bird deserves our protection. The following shows the result of the investigation made by Dr. Fisher at the request of the Department of Agriculture of the United States:

Red-tailed Hawk. 562 stomachs examined: 54 contained poultry or game birds; 51, other birds; 409, mice and other animals; 37, reptiles, etc.; 47, insects; 9, crawfish, etc.; 13, offal; and 89 were empty.

Sparrow Hawk.

Red-shouldered Hawk. 220 stomachs were examined: 3 contained poultry; 12, other birds; 142, mice and other mammals; 59, reptiles, etc.; 109, insects; 7, crawfish; 2, offal; 3, fish; and 14 were empty.

Broad-winged Hawk. 65 stomachs were examined: 2 contained small birds; 28, mice and other mammals; 24, reptiles, etc.; 32, insects, etc.; 4, crawfish; and 7 were empty.

Rough-legged Hawk. 49 stomachs examined: 45 contained mice and other mammals; 1, lizards; 1, insects; and 4 were empty.

Sparrow Hawk. 320 stomachs examined: 1 contained a quail; 53, other birds; 101, mice and other mammals; 11, reptiles, etc.; 244, insects, etc.; and two were empty.

Marsh Hawk. 124 stomachs were examined: 7 contained poultry or game birds; 34, other birds; 79, mice and other mammals; 9, reptiles, etc.; 14, insects; and 8 were empty.

Thus it can be seen that of the 49 stomachs of the Rough-legged Hawk examined by Dr. Fisher, and the 32 examined by me, in 1895, not one contained a trace of any domestic fowl and nearly every one contained mice. Yet many people persist in calling this bird the "Big Hen Hawk" and in treating it as an enemy, when both by law and public opinion it should be protected by every possible means. The statement as to all the other species that I have referred to as beneficial is equally corroborated by my own experience, and shows how well entitled these birds are to consideration at our hands instead of the persecution they usually meet.

INJURIOUS HAWKS.

Description.

DUCK HAWK.

Adult. Upper parts dark bluish slate color; primaries barred with ochraceous; tail and upper coverts barred with blackish and ashy grey and tipped with white; under parts creamy buff barred and spotted with black except on throat and breast. A black patch on each cheek, wings stiff, long, thin and pointed. Bill bluish, notched: the cere yellow. Talons long and black.

Immature. Upper parts fuscous, more or less margined with pale rufous; region below the eye black; ear coverts buffy; under parts cream-buff streaked and spotted with black. Male L 16.00; W 12.25; T 6.50 Female L 19.00 W 14.00 T 7.50.

Nest, on rocky cliffs. Eggs, three or four varying from creamy white heavily marked with cinnamon brown to pale reddish brown more or less marked with shades of same color.

PIGEON HAWK.

Adult. Upper parts slaty blue, a broken rusty or buff collar on the neck, primaries barred with white; under parts buffy or almost fawn with long blackish marks except on the throat, which is almost white. Tail with three or four greyish white bars and white tip.

Immature. Upper parts brownish fuscous, a broken buffy collar on nape, primaries barred with ochraceous; tail with three or four incomplete buffy bars and a whitish tip. Under parts similar to adult.

L 10.00—13.00; W., 8.00; T., 5.50.

Birds in adult plumage are rarely seen in Ontario.

Nest, in trees or on cliffs. Eggs, four or five varying from creamy white more or less heavily marked with reddish brown or chocolate.

GOSHAWK.

Adult. Upper parts bluish slate color: head almost black, a white line over and behind the eye. Tail like back and slightly marked with blackish: tip whitish: entire under parts evenly marked with irregular wavy bars of grey and white, the feathers of the throat and breast with dark shafts.

Immature. Upper parts dark brownish, margined with rufous, primaries barred with black; under parts white or creamy streaked with black.

Male L., 22.00; W., 13.00; T., 10.00. Female L., 24.00; W., 13.40., T., 11.50.

Nest, in trees. Eggs, three to five, pale bluish white.

SHARP-SHINNED HAWK.

Feet extremely slender; bare portion of tarsus longer than middle toe: scutellæ frequently fused; tail square. Above dark brown (deepest on the head, the occipital feathers showing white when disturbed) with an ashy or plumbeous shade, which increases with age until the general color is quite bluish ash: below, white variously streaked with dark brown and rusty, finally changing to brownish red, with the white then only showing in narrow cross-bars, chin, throat and crissum mostly white with blackish penciling; wings and tail barred with ashy and blackish: quills white, barred basally. Tail whitish tipped; bill dark; claws black; cere and feet, yellow.

Male L., 10.12; W., 6.7; T., 5.6. Female L., 12.14; W., 7.8; T., 7.

Nest, in trees. Eggs, four or five varying from bluish white to pale cream buff, distinctly spotted, blotched or even washed with reddish brown or chocolate.

COOPER'S HAWK.

Feet moderately stout, bare portion of tarsus shorter than middle toe: scutellæ distinct, colors and their changes as in the Sharp-shinned Hawk, but the bird is larger and tail rounded.

Male L., 16.18; W., 9.10; T., 7.8. Female L., 18.20; W., 10.11; T., 8.9.

Nest, generally in an evergreen tree. The abandoned nest of some other large bird is often used. Eggs four or five, greenish white, sometimes faintly spotted with brown.

Sharp-shinned Hawk.

Marsh Hawk.

BENEFICIAL HAWKS.

MARSH HAWK.

Adult Male. Upper parts grey or ashy. Upper tail coverts white; tail irregularly marked or barred with blackish; upper breast pearl-gray; lower breast and belly white spotted and barred with rufous.

Adult Female. Upper parts dark brownish, head and neck streaked and the wing coverts spotted or margined with rufous; upper tail coverts white; middle tail feathers barred with ashy and black, others barred with buff and black; under parts reddish buff streaked with dark brown.

Immature. Similar to the female. but somewhat darker all over.

Male L., 19.00; W., 13.75; T., 9.00. Female L., 22.00; W., 15; T., 10.00.

Nest. on the ground in marshes. Eggs, four to six pale bluish white.

RED-TAILED HAWK.

Adult. Dark brown above, many feathers edged with tawny; four outer primaries emarginate. Wing coverts not edged with rufous; below creamy white streaked with various shades of brown, generally forming a broken band across the abdomen. Tail, rich chestnut-red with black band near the end and a narrow white tip.

Immature. Similar, but tail of same color as the back with distinct blackish bars.

Male L., 20.00; W., 15.50; T., 9.25. Female L., 23.00; W., 16.50; T., 9.75.

Nest in high trees. Eggs, two to four dull white. generally scantily marked with rich brown of various shades.

RED-SHOULDERED HAWK.

Adult. Upper parts dark greyish brown. the feathers more or less edged with rufous. Bend of the wing, orange brown, forming a conspicuous "shoulder patch"; four outer primaries emarginate; tail blackish with four or five white cross-bars and white tip, throat streaked with blackish. rest of the under parts rufous, everywhere barred with whitish.

Immature. Upper parts similar to adult; lesser wing-coverts margined with rufous, basal part of primaries mostly ochraceous buff, fading to whitish on the inner web with broken bars of dusky brown; tail greyish brown indistinctly barred, the inner webs of the feathers with white bars; under parts white with dark streaks.

Male, L., 18.30; W., 12.50; T., 8.00. Female, L., 20.35; W., 13.50; T., 9.00.

Nest, in trees. Eggs, four or five; dull white. generally blotched with reddish brown.

BROAD-WINGED HAWK.

Adult. Upper parts dark greyish brown the feathers more or less margined with buffy, those of the hind head and nape white at base; three outer primaries emarginate; tail with two or three dark bands alternating with narrow white ones. Below white variously streaked and spotted with rusty, the latter color predominating in some specimens.

Immature. Upper parts much as in adult; tail greyish brown, crossed with bands of dusky. Below dull white with longitudinal brown or dusky streaks on breast and sides.

Male, L., 15.89; W., 10.68; T., 6.75. Female, L., 16.76; W., 11.41; T., 7.09.

Nest, in trees. Eggs, three or four, dull white blotched or washed with various shades of brown.

AMERICAN ROUGH-LEGGED HAWK.

Adult. Head and neck whitish streaked with dusky, upper parts brown, irregularly varied with white, grayish dusky or rufous; base of tail and upper tail coverts, white; rest of tail lighter brown, barred near the end with blackish. Under parts varying from white to buffy streaked and spotted with black, these marks uniting to form a black abdominal zone. Legs densely feathered in front and on sides down to base of toes.

Immature. Similar to adult, but tail without bars except for the white tip. Under parts more heavily marked with black.

Black phase. Plumage more or less entirely black; primaries and tail barred with whitish and grayish.

L., 22.00; W., 16.00; T., 9.50.

The plumage of this species is very variable but it may always be distinguished by its large size and feathered legs.

Nest, on large trees or shelves of rocks. Eggs, two or three dirty white, blotched with reddish brown.

AMERICAN SPARROW HAWK.

Adult Male. Head slaty blue with generally a rufous spot on crown; a black mark before and behind the white ear coverts; back, chestnut red, with or without black spots or bars; tail chestnut red, a black band near its end; tip, white. Under parts creamy white to buff, with a few black spots or none.

Adult Female. Back, tail and wing coverts chestnut red barred with black; head as in the male; under parts more or less streaked with brown.

Immature. Resembles the adult.

L., 10.00; W., 7.30; T., 4.80.

Nest, in a hole in a tree. Eggs, four or five, very variable, usually pale reddish buff, marked all over with reddish brown.

OWLS.

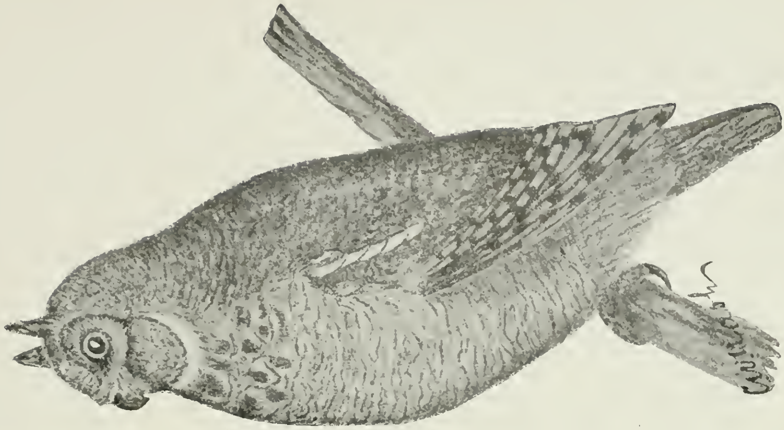
For some reason owls have always been treated with a certain amount of ridicule and contempt. In the minds of the ignorant and superstitious they were associated with cats and witches, and were supposed to possess a certain amount of influence with the latter, whose orgies they entered into with a great deal of spirit. In mythology, however, this bird was treated respectfully. Minerva, the goddess of wisdom, selected it as her attendant, and "as wise as an owl" has passed into a proverb by reason thereof.

Most of the owls seen in the day-time seem to be stupid, clumsy and inert creatures, as they sit winking and blinking in the unaccustomed light, striving as much as possible to shade their wonderful eyes from the too-powerful rays; but see these birds at dusk and after—what a transformation takes place! They are then as alert as any hawk; their soft plumage enables them to skim noiselessly around our farm buildings and over the fields in search of food. Unlucky then is the mouse or rat that ventures to show itself, or even utter a squeak from its hiding place in the grass, (for owl's ears are as wonderfully constructed as their eyes, and their hearing is as acute as their sight). The fate of that mouse will be sealed, and it will vex the farmer no more.

Some of the owls however are day feeders—the Snowy Owl and the Hawk Owl I think entirely so—while the Great Horned Owl seems to be almost as active on dull days as at night; and whether the day be bright or dull these birds can always see well enough to take care of themselves and keep out of the range of a gun. In the cultivated portions of the Province of Ontario we have five species of owls that may be treated here as residents. They are not strictly so, as there is a certain migratory movement amongst them, caused probably by the failure or abundance of their food supply, which may cause them to either leave certain districts for a time or gather there in larger numbers than usual. Many instances are on record of plagues of mice having been stayed and the trouble removed by the arrival on the infested spot of large numbers of owls; these birds rapidly killed off the mice and then scattered again. Our resident species are the Great-Horned Owl, Long-eared Owl, Short-eared Owl, Barred Owl and Screech Owl.

The Great Horned Owl, or "Cat Owl," as it is often called, is the only one I have ever known to attack poultry, and it can work havoc amongst them if they are left out to roost in unprotected places. The destruction of this owl is certainly justifiable and necessary where it has taken up its quarters in a locality in which poultry is kept. It also captures great quantities of our favorite game birds, more particularly Ruffed Grouse, many a brood of which goes to satisfy the hunger of the Horned Owl's family, and are so lost to the sportsman. But as against the charge of poultry and game killing which has been proven against it, this owl has some redeeming qualities. It kills great numbers of rats, mice, squirrels and other rodents that are injurious to farmers, and strange to say it seems to be a determined enemy to the skunk. Numbers of cases have been cited in which the flesh and hair of this animal have been found in the stomachs of these owls, more particularly in the spring, and I know that fully one-half of the bodies of these birds that I have handled were well perfumed with the odor of skunk—in many cases so much so, that I have had to throw away fine specimens, the smell being quite unbearable. Possibly these birds are fond of strong odor, for those whose feathers are not scented with skunk perfumery have generally a strong odor of muskrat, the flesh of which they also appreciate. I have frequently known them to hunt and kill these rats in the spring, during the day time when they were about the banks of the creeks, driven there by the high water of our usual spring freshet. These owls are very powerful birds, usually killing for themselves all the food they eat, and only resorting to carrion in the direst extremity of hunger. Turkeys and Guinea fowls, from their habit of roosting in trees, frequently fall victims to the strength and rapacity of these creatures. In such cases only the head and neck of the slain will be eaten, the bodies being left for animals of less power or meaner ambition to finish.

The Long-eared Owl is a much smaller bird than the last (being about fifteen inches in length), and contents itself with much humbler fare than its big cousin. It is fairly common through the cultivated districts, particularly in the autumn.



Great Horned Owl.

Screech Owl.

when it may often be found in clumps of willows and alders that have been left in low places about the fields and pastures. Quite frequently a pair will be found together. These are not, however, always male and female. I have never seen any evidence to show that this owl attacks poultry, and I do not believe that it could kill any domestic fowl larger or stronger than a pigeon. Its chief food consists of mice, varied occasionally by small birds and insects, more particularly the wood-boring beetles; of these one or more will generally be found in the stomach of every specimen examined. It is nocturnal in its habits, rarely moving about during the day unless disturbed, and even then it seems loath to move. Only once have I seen it attempting to hunt in daylight, and that occurred in western Ontario on a very dull, still day in November, when about four o'clock in the afternoon I saw a pair of them hovering over a field of long grass into which we had driven a bevy of quail. I suspected the owls of quail-hunting on their own account so followed them and shot both, but their stomachs contained no trace of feathers—nothing but mice. The only harm these owls can ever justly be accused of doing is the occasional killing of a small bird, and that is so far overbalanced by the great amount of good they do, that they are entitled to all the protection possible.

The Short-eared Owl is about the same size as the last named species, but may be distinguished from it by the absence of the long ear-tufts, which are a conspicuous feature of the latter. This is probably the most abundant of all our owls, but it seldom frequents cultivated land, usually resorting to low-lying meadows and marsh hay lands. It is most commonly seen in the autumn, and appears to be somewhat gregarious, large numbers sometimes arriving at one of their feeding grounds together, and remaining there for a few days, then all move off again as they came, to be replaced after a short interval by another lot. The great bulk of them leave this Province by midwinter, or before if the snow should become deep, their movement towards the south being regulated entirely by the depth of snowfall. Whilst the ground is uncovered they are able to obtain a full supply of mice, which form the staple article of their diet; when the snow is deep the mice work underneath it. The supply being cut off, they are driven southward, whither the small birds have already gone, so they cannot fall back upon them. Unfortunately this is a bad failing with the Short-eared Owl—in fact my experience shows that it feeds upon mice and small birds indiscriminately, and what is worse I am satisfied that it kills far more birds than it can eat. Near my home there is a large marsh partially surrounded by low meadows, which support a rank growth of grass, rushes and weeds of various kinds. This place is much frequented in the autumn by sparrows and warblers, migrating southward; in fact at times the place fairly swarms with them. Suddenly a number of Short-eared Owls will appear on the scene, and then numbers of small birds will be found lying about dead, some partly eaten and others with only the skull crushed and a few feathers plucked off. At these times I have shot many of the owls, and found the crops and stomachs to contain mice and small birds mixed. This will go on for a few days, or until the owls leave, and each morning the number of dead birds lying about will have increased. After the owls have gone the destruction ceases, only to begin again when the next lot of owls arrive. The small birds thus destroyed are of the greatest value to an agricultural community, and their loss is much to be deplored; but on the other hand the owls destroy an immense number of mice, so that the good they do probably balances the evil, and in such a case the best way is to let nature take its course without our intervention.

Long-eared Owl.

Short-eared Owl.

The Barred Owl is so rare with us that its influence on agriculture, for either good or ill, is practically nothing. The few I have found in this Province have always contained mice, but to the south of us, where the poultry are allowed to roost in trees, it is charged with occasionally killing half-grown chickens.

The noisy little *Screech Owl,* which may in some winters be found in half the barns in the country, is well known to every one, and should be protected by every farmer. It watches the granary, the barnyard and the garden, and is the most indefatigable mouser we have. It seems not only to kill mice for its immediate wants, but also for the pleasure of hunting them. If the roosting place of one of these birds is examined after the bird has used it for a short time, numbers of dead mice will be found, most of them untouched after being killed and deposited there; probably they lay up this store in order to provide against nights of scarcity, but in nearly all cases it will be found that they are well ahead of any danger of famine. Not only does this little owl rid the country of numberless mice, but in towns and cities it does useful work in keeping the common House Sparrow within proper limits. During the winter particularly, it may often be seen hunting about verandahs, under eaves, and among the Virginia creeper growing around dwelling houses, for the sparrows that roost there, and it will go regularly over the same beat night after night, until the accessible sparrows are thinned down, so that it finds it more profitable to change its hunting ground. Besides its great value as a destroyer of mice and House Sparrows, the Screech Owl eats a great many large beetles, particularly the wood-borers and May beetles, both of which classes of insects are capable of doing much injury if suffered to become too numerous. Grasshoppers also form a considerable article of this bird's diet. The good qualities of this little owl cannot be over-estimated. Its food consists entirely of such creatures as are most injurious to the crops, and it has not a single evil habit. It should, therefore, be carefully protected, and encouraged to take up its abode in and about the farm buildings. This I believe it would readily do if it was left unmolested. All it asks in return for its valuable services is peace and quiet, and a dark corner to roost in during the day.

The Great Gray Owl, the Snowy Owl, the Hawk Owl, Richardson's Owl and the Saw-whet Owl are only irregular visitors, usually occuring in the winter. The two first named are large birds whose food consists chiefly of game birds when in their northern home; here they feed upon the small rodents.

The island and sandbar to the south of Toronto is usually visited by a few Snowy Owls every winter. Here the birds feed upon the common house rats, which are altogether too abundant at this spot. As every owl of any kind that visits the place is at once shot, the rats, having it all their own way, are increasing rapidly.

The Hawk Owl hunts by day, on the prairies of the North-West, and where it occurs in sufficient numbers it must do much good by the destruction of meadow mice. Its visits to us are so rare, however, that it need not be considered here.

Richardson's Owl and the Saw-whet Owl are two little Owls that destroy many mice and noxious insects, but are too rare to need further mention.

Of the ten species of owls before mentioned, nine of them are among the best of the farmer's friends, watching and working when he is sleeping. In following out the natural law which governs their lives they greatly help to keep in check that vast army of little animals which, if allowed to increase unrestrained by their natural enemies, would in a few seasons destroy all vegetation on the face of the earth. The chief and most effective check upon the undue increase of this army of rats, mice, etc., are the birds of prey. These birds are endowed with natural faculties specially adapted for the work they do, and they do it well: the only trouble is that we have too few of them. If, however, public opinion can be brought to bear on this important matter before it is too late, and the wanton and useless destruction of our beneficial hawks and owls be stopped at once, the balance of nature may be restored, to the great advantage of mankind.

The following shows the result of Dr. Fisher's investigation of the food habits of the owls as reported to the Department of Agriculture at Washington.

Great Horned Owl. 127 stomachs examined: 31 contained poultry or game birds; 8, other birds; 13, mice; 65, other mammals; 1, insects, etc.; 1, fish, and 17 were empty.

This shows that, although the bird does some injury by its raids upon game and poultry, yet its evil propensities are somewhat counterbalanced by its destruction of mice, rats, rabbits and other small mammals. It is the only one of the owls about whose record for good there can be any doubt. All the others should be protected, while this one should certainly be killed off if it begins visiting the barnyard.

Long-eared Owl. 107 stomachs examined; 1 contained a game bird; 15, other birds; 84, contained mice; 5 other mammals; 1, insects, and 15 were empty.

Short-eared Owl. 101 stomachs examined: 11 contained small birds: 77 contained mice; 7, other mammals; 7, insects, and 14 were empty. My own experience shows a larger proportion of small birds than the above.

Barred Owl. 109 stomachs examined: 5 contained poultry or game birds; 13 other birds; 46, mice; 18, other mammals; 16, frogs, lizards, etc.; 16, insects, etc., and 20 were empty.

Screech Owl. 254 stomachs examined: 1 contained the remains of a pigeon; 38, other birds; 91, mice; 11, other small mammals; 25, frogs, lizards, etc.; 107, insects, etc., and 43 were empty.

The above examinations of the stomachs of our resident species show most positively that, with the exception of the Great Horned Owl, the whole family are of the greatest value to the farmer. My own experience, both in Manitoba and Ontario, corroborates this, and is perhaps a little more favorable to the owls, for (always excepting the Great Horned Owl) I have never found a trace of a game bird or domestic fowl in any of them.

GREAT HORNED OWL.

Description.

Ear-Tufts conspicuous, nearly two inches in length. Plumage varies greatly: in general the upper parts are mottled with varying shades of buff and brown; facial disc buff; a white collar on the throat, rest of the under parts greyish white or buff; barred with black. Legs and feet feathered. Eyes yellow.

L., 22.00; W., 15.00; T., 8.50.

Nest, sometimes in a hollow tree, a cleft in rocks or among the branches of a high tree, very often an old hawk's, or crow's, nest is occupied. Eggs, three or four, round, white.

SCREECH OWL.

Adult. Rufous phase—Ear-tufts conspicuous; about an inch in length; upper parts bright rufous sharply streaked with black; under parts white, the feathers centrally streaked with black and irregularly barred with rufous.

Gray phase—Upper parts generally brownish gray, streaked with black and finely mottled with buff; under parts white, finely streaked and more finely and irregularly barred with black.

Immature. Entire plumage regularly barred with grayish or rufous and white.

This owl may always be identified by its small size and ear-tufts. Its color phases are not dependent upon age, sex or season and both phases are sometimes represented in the same brood. Between the two there is a complete intergradation. In any phase there is a more or less conspicious light stripe along each side of the back and a black line down the shafts of the feathers, sometimes throwing out short transverse bars.

L., 9.50; W., 6.50; T., 3.09.

Nest, generally in a hollow tree. Eggs, four to six white, nearly round.

HAWK OWL.

No ear tufts; upper parts dark greyish brown more or less spotted with white, tail (long and rounded) barred with whitish; a patch of uniform black or dark brown on each side of hind neck. Under parts barred black and white.

L., 16; W., 9; T., 7.

Nest, in trees. Eggs, five or six; white, rounded, oval.

RICHARDSON'S OWL.

Adult. No ear-tufts, upper parts grayish brown, the head and back spotted with white; tail with four or five imperfect white bars; under parts white, heavily streaked with grayish brown; legs and feet heavily feathered, whitish, barred with grayish brown; eyes yellow.

Immature. Upper parts dark cinnamon brown with a few more or less concealed white spots; tail as in the adult; breast like back; belly, buffy.

L., 10; W., 6.75; T., 4.40.

Nest, in trees. Eggs two to four, white, nearly round.

SAW-WHET OWL.

Adult. No ear-tufts, upper parts dark cinnamon brown, the head finely streaked, and back spotted with white; tail with three or four imperfect white bars; under parts white, heavily streaked with cinnamon brown; legs and feet heavily feathered, buffy white, unbarred; eyes yellow.

Immature. Upper parts as in the adult, but head and back with little or no white.

Nest, in hollow trees or old crow's nests usually, but sometimes among the branches of large trees. Eggs, two to four, nearly round, white.

GREAT GRAY OWL.

The largest Owl of this country. No ear-tufts; upper parts ashy brown, everywhere mottled with white; facial disc gray marked with dark concentric rings; under parts white, the breast barred and the belly broadly streaked with greyish brown; legs and feet heavily feathered; bill and eyes, yellow.

L., 25. to 30; W., 17.50; T., 12.50.

Nest, in evergreen trees. Eggs, two to four, white, nearly round.

SNOWY OWL.

No ear-tufts. White, more or less barred, with blackish markings. In some few males the dark marks are absent.

L., 25.00; W., 17.00; T., 9.50.

Nest, on the ground in Arctic regions. Eggs, four to seven, white, oblong oval.

LONG-EARED OWL.

Ear-tufts conspicuous, an inch or more in length, black bordered by white and buffy; upper parts brown mottled with white in small pattern, the bases of the feathers buff; tail mottled and barred with dark brown; facial disc buff bordered by black. Under parts whitish and buff, the breast streaked with brown; sides and belly irregularly barred with blackish; eyes, yellow.

L., 14.50; W., 11.90; T., 6.00.

Nest, sometimes in a thick evergreen, more frequently an old crow's or hawk's nest is occupied. Eggs, four to six, oval, white.

SHORT-EARED OWL.

Ear-tufts short, inconspicuous; upper parts buffy, broadly streaked with dark brown; tail and quills, buff with dark bars; under parts buffy, the breast broadly streaked with brown, belly more finely streaked, but not barred; facial disc pale buff, eye patch, blackish.

L., 15.50; W., 12.75; T., 6.05.

Nest on the ground in marshy meadows. Eggs, four to seven, white, nearly round.

BARRED OWL.

No ear-tufts; upper parts grayish brown, barred with white; tail and quill feathers barred ashy brown and white; facial disc gray, finely mottled; under parts white, somewhat tinged with buffy, the breast barred and the sides and belly streaked with brown. Bill yellow; eyes, brownish black.

L., 20.00; W., 13.50; T., 9.50.

INSECT DESTROYERS.

During the last twenty years the decrease in the number of small birds about our farms and gardens and the consequent increase of insect pests has become a cause of serious complaint.

Insects now affect every form of vegetable life. Borers work their way beneath the bark of the trees and cut long tunnels through the wood. Leaf eaters, by individual or combined attacks, often completely defoliate the trees. Curculios and grubs of various sorts enter the fruit, disfiguring it and rendering it useless, and weevils, with many other insects, attack our grain crops and despoil the farmer of the reward of his skill and labor.

While these species are at work upon the exposed portions of our plants, others, and by far the most injurious kinds, are beneath the soil boring into their roots, or eating away the fibres which provide them with nourishment, whilst the cut-worms, by severing the stalk at the surface of the ground, entirely destroy every plant they attack.

How to keep in check these insect pests is a question of the greatest possible importance to the whole community. It can be partly done, but at considerable expense, by our own labor, or it can be done at little or no cost, by intelligently encouraging and protecting our birds until they have increased sufficiently to restore the balance of nature.

Every class of our birds has its particular work to do, and the destruction or serious reduction in the number of individuals comprised in any class means a corresponding increase in the number of insects which it is the special mission of the birds to keep in check.

The Woodpeckers are wonderfully specialized to enable them to feed upon the borers that live in the trunks of trees. The Thrushes, Meadow Larks and Blackbirds feed principally upon such insects as hide just beneath the surface of the ground. Warblers, Orioles, Cuckoos, and many others, gather their food from among the branches, their prey consisting chiefly of leaf-eating caterpillars and beetles. The Flycatchers, from some post of observation, dart out and capture every winged insect that passes within their range; whilst the Swallows and Night Hawks are constantly engaged in clearing the air of the myriads of flies and midges which if not kept in check would render life almost unendurable.

SHRIKES.

Of this family we have two representatives in Ontario, the Northern Shrike which is a winter visitor, arriving in October and remaining here until the early part of April, and the Loggerhead Shrike, a summer resident, arriving in the early part of April, breeding here, and departing about the end of August. Both these birds, and, in fact, the whole family of them, are generally known as "Butcher Birds," all the species having the same peculiar habit of killing more victims than they actually require for their daily food, and spitting them on a thorn or twig near their resort. In their other habits these shrikes are much the same. When seeking food they generally perch on the top of some small tree, or a fence post, from which they can get a clear view all around them. Here they will sit in an erect, hawk-like attitude, silent and watchful until some large insect, a mouse or small bird comes within the range of their vision, when it is at once pounced upon and killed. If the shrike is hungry at the time, its prey is devoured at once, but if not the victim will be impaled upon some thorn, twig, or splinter in the vicinity. I have seen the barbs of a wire fence used for this purpose on the prairie, and in places where bushes were scarce. Whether the shrikes ever eat these bodies or not I do not know. Probably they would do so in times of scarcity, but at any rate if a shrike's haunt is examined a good many specimens of its butchering will be seen perfectly dried up and past the stage when they were likely to afford any kind of nourishment. The shrikes are very handsome, bold birds, very fair singers and mimics. I have often heard the Northern Shrike imitate the screams of a small bird in distress, apparently for the purpose of attracting others to the spot to see what the row was about, and no doubt the ruse would be successful, for it is the habit of all the smaller birds to flock to the place from which such cries proceed.

As the Northern Shrike is with us only in the winter it cannot be expected to feed largely upon insects, yet I have rarely examined the stomach contents of one of these birds, without finding at least the remains of a few beetles. When they first arrive in the autumn, however, their principal food consists of moths, grasshoppers, and such other insects as retain their vitality until frost comes. After that they feed upon mice and such small birds as remain here in winter; the House Sparrow forming a considerable portion of their fare.

I have never seen the Loggerhead Shrike kill a bird, nor have I ever noticed one hung up in its shambles, but it does destroy a great number of the larger insects and a good many mice. This is one of the very few birds that will eat the hairy caterpillars, commonly known as "woolly bears"; of these the Loggerhead seems to be rather fond. I have often found them among its stomach contents, and on the 12th of April, 1899, I took a specimen, the stomach of which was perfectly filled with them.

SHRIKES.

Description.

NORTHERN SHRIKE.

Adult. Upper parts clear bluish ash, becoming white on upper tail coverts and scapulars. A black bar alongside of the head not meeting on forehead; forehead whitish. Wings and tail black; primaries white at the base, secondaries tipped with white; tail feathers tipped with white, the outer feathers mostly white; under parts white, barred with fine wavy blackish lines: bill hooked and hawk-like.

Immature. Similar, but entire plumage more or less heavily suffused with grayish brown.

L., 10.32; W., 4.50; T., 4.00.

Nest, in low trees or bushes. Eggs, four to six dull greenish gray, marked and spotted with obscure purple, light brown, or olive.

LOGGERHEAD SHRIKE.

Upper parts slaty gray, whitish on scapulars and upper tail coverts; wings and tail black, primaries white at base, secondaries tipped with white; tail feathers tipped with white, the outer one mostly white; a black bar on each side of the head, connected by a narrow black line across the forehead at base of the bill. Under parts always white.

L., 8.50; W., 3.80; T., 3.85.

Nest, in low trees or thorny bushes. Eggs, five or six, similar to those of last species, but smaller.

SANDPIPERS AND PLOVER.

These two groups contain a large number of species, most of which are of interest to sportsmen; but only four of them, two Sandpipers and two Plover, resort to the cultivated fields of Ontario. The others are chiefly birds of the sandy beaches and muddy margins of the marshes, on which during the migrations they used to gather in vast flocks. Constant persecution has now so reduced their numbers, that the larger and more desirable varieties have become very scarce.

Bartramian Sandpiper. Though this bird is a true Sandpiper it seldom or never visits either the marsh or the beach. Its usual haunts are high dry grassy meadows and old pastures; or in the West the open prairie.

In Ontario it only occurs in a few localities and in small numbers. I have found it breeding in the Counties of Brant and Norfolk and on Amherst Island, and Dr. Clark reports it as breeding regularly near Kingston. In Manitoba, where it is generally known as the Upland Plover, it is sufficiently abundant to be of interest to sportsmen.

About the middle of May these birds return to their breeding grounds from the south, and then may be heard the remarkable note of the male, which differs so widely from any other sound in nature that even the most unobservant is attracted by it.

Early in August the Upland Plovers leave us, drifting away towards their winter quarters in South America just when the insects which form their food are in the greatest abundance. Why they should do this is one of the mysteries of migration yet unsolved.

Spotted Sandpiper—Teeter. These birds arrive here about the beginning of May and at first confine themselves to the shores of our lakes and rivers where their graceful movements may easily be watched as they run rapidly along at the edge of the water, stopping abruptly now and then to pick up an insect or go through the tail-wagging performance; after a week or so of this method of life, during which they no doubt arrange their courtship and matrimonial affairs, they spread out over the country for the purpose of nesting: some few however remain in their lake or riverside haunts through the season.

I have found their nests in pasture fields, on summer fallows, in grassy orchards, fields of standing grain and on sandy beaches. One day as I was crossing a field of mangels I came upon a pair of Spotted Sandpipers with their brood of four chicks. Quicker than the eye could follow the little ones squatted down on the ground and were lost to sight, while the mother bird feigned lameness and all sorts of injuries, fluttering along just in front of me in order to decoy me from the vicinity of her downy treasures, taking care, however, to keep just far enough away to be safe. It is a strange instinct which impels certain birds to resort to this device in order to induce their enemies to follow them and abandon the search for their helpless young.

I do not suppose any person is ever deceived by the trick, but four-footed animals invariably are, even the wisest sporting dogs never seem to learn by experience, but will dash headlong in hot pursuit after the apparently disabled old bird, which flutters enticingly before them, but always out of danger, until tired and panting the dog gives up the chase in disgust.

When on the ground this Sandpiper is as graceful and active as any of its tribe, but when on the wing its flight seems somewhat stiff and constrained, its wings do not seem to move with the same freedom exhibited by the other shore birds, but for all that it is a remarkably swift and strong flier.

Its note (by which it may always be recognized) is a loud "tweet tweet," not very musical perhaps, but on the shore it seems to harmonize with its surroundings.

From an economic point of view these birds are decidedly valuable; they feed upon nothing but insects, amongst which small beetles furnish the greater part. I once shot one in a pea field the stomach of which was filled with pea weevils.

Loggerhead Shrike.

Killdeer.

SANDPIPERS.

Description.

BARTRAMIAN SANDPIPER.

Head and neck streaked with black and tawny; back and wing coverts, buff, barred with black. primaries dark grayish brown, the outer one barred with white; throat, breast and sides pale buffy, the throat streaked, breast and sides with dark arrowhead markings and bars; axillars and lining of wings white, barred with blackish; under tail feathers brownish gray, outer ones varying from buff to white, all more or less barred with black.

L., 11.50; W., 6.50; T., 1.90.

Nest, on the ground, often in a pasture field. Eggs four, pale clay color, spotted with reddish brown chiefly at the larger end.

SPOTTED SANDPIPER.

Adult. Upper parts of grayish olive with a greenish lustre, finely barred with black; white line over the eye; inner tail feathers like back, outer ones with blackish bars. Under parts white, everywhere spotted with black.

Immature. Upper parts much as in adult but colors and marks less distinct. Under parts pure white unspotted.

L., 7.50; W., 4.20; T., 2.

Nest, on the ground. Eggs, four, clay color, blackish with brownish-black markings.

PLOVER.

Golden Plover. Formerly vast flocks of this Plover visited Ontario every autumn, resorting to ploughed lands, pasture fields and sandy beaches for food. As they are, while here, purely insectivorous they form an important factor in the reduction of ground insects which abound in such places.

Unfortunately the birds are in great demand for the table and have been so relentlessly pursued by gunners that their numbers are seriously reduced.

In the spring Golden Plover pass Northward by way of the Mississippi Valley to their breeding grounds on the "barrens" of the Arctic Circle and so we do not see them, but during the fall flight they still appear on the farms, in some localities, in sufficient numbers to be of material service in ridding the fields of wireworms, cutworms and other insects exposed by the plough.

On the prairies of Manitoba they are abundant and are particularly partial to the burnt over lands. I have seen them in flocks of thousands following the fires; they will alight on the ground a few hours after the fire has passed and no doubt fare sumptuously upon the scorched and disabled insects they find among the charred grass roots.

Killdeer Plover. As soon as the ice is out the killdeer announces its return from the South by vociferously calling its own name as it circles about the water soaked fields, which are its favorite haunts from April to August.

It is an exceedingly active and graceful species, more apt to run than to fly, if not too closely approached; but if followed, it rises up and dashes off rapidly on its powerful wings, uttering at the same time an alarm call which puts every wild thing in the neighbourhood on its guard.

The food of the killdeer consists of earthworms and insects of which small beetles form the greater part. A brood of these birds containing four young and the two parents will relieve a farm of an enormous number of insect pests every day. I have frequently found the stomachs of these birds to be completely filled with weevils which they had obtained from orchards where clean cultivation had been practised. Towards autumn the broods leave the high, dry fields and gather into small scattered parties on river-side meadows and sandy shores, where they remain until the first frost.

PLOVER.

Description.

GOLDEN PLOVER.

Adult in summer. Upper parts mottled black, greenish, golden yellow and a little white, the yellow in excess: tail brownish gray indistinctly barred with whitish; sides of breast white; sides of head and under parts black; under wing coverts ashy gray. Bill and feet black. Toes three.

Adult in winter and immature. Upper parts and tail dusky, spotted and barred with yellow or whitish, the colours duller than in summer; under parts grayish white, throat and sides of head streaked, breast and sides of body mottled with dusky grayish brown; legs dusky.

L., 10.50; W., 7.00: T., 2.75.

Nest, on the ground, in Arctic regions. Eggs, four buffy drab spotted and splashed with very dark brown, chiefly at the larger end.

KILLDEER.

Above grayish brown, with a greenish tinge, most of the feathers tipped with tawny; upper tail coverts bright rufous; inner tail feathers grayish brown, outer ones rufous and white, all tipped with black and white; secondaries mostly white; primaries with a white space: a black bar across the crown: forehead white: two black bands on neck and breast, otherwise entire under parts white. Tail rounded at end; eyelids scarlet.

L., 10; W., 6.50; T., 3.50.

Nest on the ground. Eggs, four, clay colour, heavily marked with blackish brown.

CROWS, BLACKBIRDS, ORIOLES, ETC.

Some of the species comprised in these two families of birds are charged with being amongst the worst of the feathered enemies of the farmer. The mischief they do is plainly visible: the good not always seen. When the Crow visits the corn field in the spring, and is seen digging into the hills, abstracting the half sprouted grain, and when the Blackbirds in clouds alight on the ripe wheat and oats, eating much and threshing out more, so that it is lost to its lawful owner, it is not to be wondered at that the farmer loses his temper and says in his wrath that all birds are a nuisance: but these birds also do some good, though, as they have not acquired the knack of advertising it, their benefits are quite overlooked. If their case is tried impartially it may be found that even the Crow, like another celebrated personage, is not quite "so black as he is painted." I do not think the merits of the Crows, or any of the so-called blackbird family, will be found sufficiently great to entitle them to protection, but their faults scarcely warrant their extermination, except in the case of the cow-bird, to be spoken of hereafter.

Raven. This species occurs only in the more northerly portions of the Province, having retired before the encroachments of civilization. To the pioneer it is sometimes a nuisance, poultry and young lambs falling easy victims to this bird's strength and rapacity. They also destroy a large quantity of game, but fortunately their number is so small, and the birds themselves so conspicuous, that it is not difficult to get rid of them.

Crow. Twenty-five years ago the Crows of the Province of Ontario were as regularly migratory as the Robins. A few occasionally stayed through the winter with us, and their doing so was considered a sign that we would have a mild season. As the land has been brought under cultivation, and more particularly in neighborhoods where market gardening is carried on extensively, the number remaining through the winter has steadily increased, so that the species may now be considered a resident one. In the vicinity of Toronto vast flocks gather at the close of the autumn, feeding on the refuse vegetables left in the market gardens outside the city, and resorting at night to some of the pine woods still left standing. In these they roost all through the winter. They may sometimes be pinched by hunger, but, unless the snow becomes too deep, they can generally get at the piles of manure drawn out on the market gardens, and other refuse left about the land. At this time they do no harm, and probably a little good, as they pick up many mice and insects in their foraging, but when spring opens they again scatter over the country and seek their nesting places. Seeding operations are now going on, and the first of the Crow's mischievous propensities asserts itself. As soon as the grain has absorbed sufficient moisture from the ground to become soft and has slightly sprouted, then it becomes a favorite morsel for the Crows. Corn is preferred to any other grain. I have rarely found any quantity of any other grain in the stomach of a Crow, but even when the birds have been seen feeding among the hills of sprouting corn, and have been shot right on the spot, I have always found the stomach contained quite as large an amount of insect remains as of corn, the cut-worm forming one of the Crow's choicest articles of diet, and the question arises as to whether it is not better to let the Crow have a little corn and get rid of the cut-worm, than to let the cut-worm take off a lot of corn if we get rid of the Crow. Later on I will say something about the history of this same cut-worm. It is always wisest "of two evils to choose the least," and it must be conceded that the corn-eating propensity of the Crow is an evil; but it is certainly less than the evil done by the cut-worm. So perhaps, so far as the Crow's case goes here, it would be as well to call the balance even and give the Crow the benefit of it.

The next scene in the Crow's proceedings shows him with a lively and decidedly hungry family of four or five little ones, whose cravings demand constant attention from their parents. The variety of food supplied to these insatiable youngsters will vary somewhat according to the locality in which they are placed. In any case, no more grain will be taken by the parent birds; their food will now consist entirely of insects, mice and the young of other birds. Nor will they stop at the young if they can catch an adult small bird. Sometimes they will try to elude the vigilance of an old hen, and will snatch up her chickens more adroitly than any hawk; ducklings fall easy victims to their cunning. It is at this season they do the greatest amount of mischief, by destroying the nests and young of more valuable birds, particularly of such as nest upon the ground. For this reason chiefly Crows should be kept within proper limits as to numbers. Of late years they have increased altogether too fast, and our small birds have suffered in consequence.

After the young birds leave the nest they move about with their parents and feed on the most varied diet. They will make a raid on the fruit grower, and demolish his cherries or raspberries if the idea strikes them, or they will prowl along the lake shore and enjoy themselves for a few days on fish fare, after which they will visit a pasture field and clear out all the wire worms, grubs and mice they may find there: in fact, very few things come amiss to them, as they roam about the country, until the cold nights warn them to get together in some place where they can get at least a bare subsistence to carry them over the winter.

As I have said before, Crows have increased too fast of late years, and we have now too many of them in the country: their numbers can easily be reduced if a little attention be paid to the matter in the spring. Just at nesting time they are less shy and wary than at any other season, and can be approached in the trees within shooting distance. If one of each pair were shot off their numbers would soon be reduced to such an extent that the damage they could do would not be noticeable. These birds are so well able to take care of themselves that even more stringent measures might be adopted against them without any danger of extermination, their natural enemies being very few, and those of that class against which man has carried on a most successful war. Of these the Great Horned Owl was the most noteworthy, but the Great Horned Owl will kill the poultry of a farmer who allows his fowls to roost out on winter nights, and so the Owl must go and the Crow has one enemy the less.

CROWS.

Description.

RAVEN.

Entire plumage black, with glossy steel blue reflections: feathers on the throat narrow, long and pointed.

L., 22.00; W., 17.00; T., 10.

Nest, on high trees or cliffs. Eggs, four to six, pale bluish or olive green, spotted, blotched, or washed with purple or greenish brown; very variable.

AMERICAN CROW.

Entire plumage black, with blue, green and purplish reflections; the under parts duller; feathers on the neck short and rounded. Nasal bristles about half as long as bill.

L., 19.30; W., 12.20; T., 7.70.

Nest, in trees. Eggs, four or five, generally bluish green thickly marked with shades of brown, but very variable.

BLUE JAY.

Blue Jay. It is a pity that so beautiful and interesting a bird as this should be possessed of such mischievous propensities as it has, but I am afraid that neither its good looks nor its good acts can be said to balance its evil deeds. This bird like the common Crow, seems to forget its usual shyness when spring arrives, and will leave its wooded haunts and build its nest in gardens, orchards and shrubberies, close to houses, and quite within reach of every person passing, nor does it affect any sort of concealment as a rule. I have seen many nests so placed that they were visible from public roads where people and vehicles were continually passing.

The female could quite readily be seen sitting, yet the birds carried on their duties regardless of prying eyes. It seems a pity that their confidence should be abused, but I am compelled to say that in all cases that came under my observation the Blue Jays badly repaid the persons in whose gardens they were protected and allowed to raise their young. In the first place, they steal a large amount of small fruit, and further, they rob and destroy the nests and young of other birds to such an extent that they are positively injurious to agriculture, the birds they destroy being all of that class whose food consists principally of insects, and without whose assistance I doubt if we could succeed in raising any crop to maturity.

The Blue Jays themselves, however, destroy no inconsiderable number of insects, and they do no damage to grain; they may occasionally pick off a little corn from the cob, but that is about the extent of the injury they do in that direction. Their unfortunate fondness for the young of other birds more valuable than themselves makes it necessary that they should be destroyed when they take up their residence about our gardens, for it is there, and in our cultivated fields, that our insectivorous birds do the most good; and to get them there we must give them as much protection as possible from their natural enemies, and teach them that they are in greater safety near our dwellings than they would be in the woods. Birds of all kinds soon lose their fear of man if unmolested by him, and particularly if they find that in his immediate neighborhood they can raise their young safely. I know of several farms and large gardens where the birds have been encouraged and protected from their enemies; to these places they return in increased numbers year after year, until nearly all available breeding places are taken up. On these premises the owners rarely suffer from the depredations of cut-worms or other insects, and so find themselves well repaid for the little care they require to exercise on behalf of their feathered friends.

Canada Jay, Whisky Jack. In Northern Ontario, one of the commonest and certainly the most familiar bird of the region is the Whisky Jack. This fluffy. loose feathered creature—except at nesting time—seems to have no fear of humankind whatever; in fact, seeks and enjoys their society. As soon as the settler puts up his shack and starts to cut a hole in the forest, the birds will be his constant visitors; everything he does has an interest for them, from the felling of a tree, which will expose some borers, to the cooking of a dinner; everything brings grist to the Whisky Jack's mill and nothing comes amiss.

Like the Blue Jay, this species is practically omniverous, and in its native haunts is serviceable as a destroyer of insects and mice.

JAYS.

Description.

BLUE JAY.

Upper parts purplish blue; below pale gray: white on throat, belly and crissum; forehead, a band passing across the back of the head down the sides of the neck and across the breast black; head crested. Exposed part of wings and tail rich blue, with black bars, the greater coverts. secondaries and tail feathers, except the central broadly tipped with pure white.

L., 11.50; W., 5.15; T., 5.50.

Nest, in small trees or bushes. Eggs, four or five pale, greenish olive or sometimes clay colored, thickly spotted with olive brown. Very variable.

Blue Jay.

CANADA JAY—WHISKY JACK.

Back wings and tail dull leaden gray, most of the feathers of wings and tail narrowly tipped with white; fore part of head white, back of head and nape sooty black; throat and sides of the neck white, rest of the under parts ashy gray.

L., 12.00; W., 5.80; T., 5.80.

Nest in coniferous trees. Eggs, four or five, light gray, finely marked at the larger end with dots and blotches of slate color and brown, very variable.

BLACKBIRDS, ETC.

Bronze Grackle, better known throughout the country as the "Crow Blackbird," is, when in full plumage, a very handsome bird, and may be distinguished from the other so-called blackbirds by its large size and the brilliant metallic lustre of its feathers. Like the Rook of Europe, it breeds in colonies, and is gregarious at all times of the year. To the farmer, the fruit grower, and the lover of birds generally, this bird is a nuisance. All that can be said in its favor is that it is very beautiful, and that it does, at times, eat a large number of cut-worms, for which it may often be seen working industriously on the lawns and grass fields near its nesting place; but, as against that, it has a heavy record of crimes to answer for. They are early migrants, arriving here about the end of March, and resorting at once to their nesting places. From this time until the oats are sown, they probably feed entirely on insects, but as soon as the grain is in the ground, they visit the newly sown fields and help themselves liberally, varying their diet by taking as many small bird's eggs and young as they can conveniently get at. I have on several occasions seen them attack and carry off young robins, in spite of the vigorous defence set up by the victim's parents and all the friends they could summon to their assistance. The row made by the despoiled nest owners on these occasions, together with the frantic dashes they made at the robber, would be sufficient to shake the nerves of one of the hawk family, but the Crow Blackbird disregards it all and goes off with its prey.

As soon as the strawberries, cherries, etc., are ripe, these birds display a fondness for fruit and a persistency in gratifying it that is maddening to the fruit grower, whose profits dwindle day by day by reason of the visits of these thieves, who will continue to carry it off until the young leave the nest. When the young Grackles can fly, they gather in large flocks and roam about the country all day; roosting together in vast numbers in some marsh every night. The Dundas marsh, near Hamilton, used to be much favored by them for this purpose; it is at this season they do the worst of their mischief to the fields of wheat and oats. Not only do they eat an immense quantity, but as they flutter and struggle in their efforts to balance themselves upon the straw of the standing grain, they thresh out and cause the loss of much more. Nor does the cutting and shocking stop their ravages; they still continue to feed upon it until the last sheaf is in the barn. In the Province of Manitoba, where these birds are abundant, I have seen all the grain threshed out from the ears for a space of ten yards in width around fields which have been selected by them for their feeding ground. In this Province, they are rarely to be found in sufficient numbers to do as much damage as that, nor are they likely to become so, for, although their chief natural enemies, the hawks and owls, have been too much reduced to be able to keep them entirely in check, yet their number is still manageable, and may be kept so by the judicious use of the gun. I advise any one who shoots them, particularly in the early autumn, to try blackbird pie. Whoever does so will, I think, want to repeat the experiment.

Bronze Grackle.

Rusty Grackle. This is a much smaller species than the last, and is not of any importance to us from an agricultural point of view. I merely mention it as it occurs here in considerable numbers for a short time in the autumn, but as it does not arrive until the early part of September, the crops are safe from its ravages. In Manitoba, where it is very abundant, it unites with the other blackbirds and destroys a large amount of grain. A few pass through this Province in the spring on their way to the north to breed, but they make no delay and are not noticeable.

Red-winged Blackbird. From an agricultural standpoint this bird has little to recommend it, but to the lover of nature its beautiful coloring and cheery note in early spring render it an object of interest. They are among our earliest migrants, arriving about the middle of March, and resorting at once to the marshes, in which they remain until the young are able to fly. While in the swamps their food consists almost entirely of aquatic insects, of which the larvæ of the dragon flies form the principal part. As these larvæ form an important item in the food of some of our most valuable fish, and the mature dragon flies feed largely on mosquitos and other small winged insects, the blackbirds are not doing mankind a particularly friendly service by destroying them. This would perhaps not be worth sufficient consideration to warrant our interference with the birds were it not for their other and more serious failing. As soon as the young are able to fly strongly, which is about the middle of July, they leave the marshes in which they were bred, and in great flocks resort to the grain fields, where, like the Grackle, with which they frequently associate, they do much damage, particularly to oats, which they seem to prefer to any other grain. As these birds are very abundant, the loss caused by their plundering, must be very great, but they can fortunately easily be managed if a little attention is paid to them in the spring, when they may be shot off on their breeding grounds.

After the grain is carried, they again return to the marshes, and gorge themselves on the wild rice, until not a grain of it is left, thereby depriving the wild ducks, etc., of a most attractive food As soon as the first frost comes they retire to the south, where they cause much worry to the rice-grower. Little can be said in extenuation of these serious faults. They never interfere with other birds or their nests, and they probably destroy some noxious insects, such as cut worms, etc., in meadows. lying near the swamps they frequent in the early part of the season, but this is all that can be urged in their favor.

Cowbird. This bird should be known to every one, and should be destroyed whenever the opportunity occurs. It is the only feathered creature against which I would advocate a war of extermination, and this I do, because it is not only of no value in itself, but the rearing of each one of its young means a loss to the country of an entire brood of one of our valuable insectivorous birds. It is true that during the early part of the season it frequents the pasture fields where cattle are grazing, and feeds principally on the insects affecting such places, but this is easily counterbalanced by the grain it destroys later on. These birds do not mate, nor do they build a nest for themselves, but the female deposits each of her eggs in the nest of some other small bird. The egg is whitish, thickly covered with greyish brown dots. I have found the eggs of this bird in the nests of nearly all the sparrows, finches and warblers that breed in the Province. After the egg of the Cowbird is deposited, the female takes no further interest in the matter, but leaves it to be hatched by the real owner of the nest in which it has been placed; in due time the young will appear and then the trouble arises. In a few days the young Cowbird has far outgrown its

Cowbird.

fellow nestlings, in size, strength and voracity, so that it requires and manages to get all the food the parent birds bring to the nest, the result being that the proper occupants of the nest are either starved to death or crowded out by the interloper, which from that time until it is full grown taxes to the utmost all the energies of its foster parents to supply its voracious appetite. Nothing can be more pitiable than the plight of a pair of small birds upon whom one of these parasites has been foisted. They are forced to raise an ugly foundling instead of their own young, and then by reason of the long continued helplessness of their foster child they are prevented from raising a second brood; for although it quickly grows large and strong enough to crowd out its fellow nestlings and its body develops rapidly, so that it can leave the nest and follow its foster parents through the trees, yet its energy does not develop proportionately with its body, and it requires to be fed for a longer period than the young of any other small bird. The destruction of the natural enemies of this bird, and the constantly enlarging area of cultivated land, both operate favorably for the increase of this pest, so that it has become altogether too abundant. Of late years in the southern part of Ontario it has swarmed everywhere, and I notice an egg of this bird's in quite half the nests of other small species that I chance to find; of course in every case I take it out and promptly smash it, thereby saving the proper brood. It is to the increase of these creatures that I attribute almost wholly the decrease which has become so noticeable in our more useful species. Some idea may be obtained of the terrible destruction worked among the valuable species by Cowbirds, by just noticing the immense flocks of them that occur here in the autumn, and remembering that for every one of those Cowbirds, a brood of some other species has perished. Most of our insectivorous birds produce an average of about four young to the brood, and some of them would raise two broods in a season; the deposit of an egg by the Cowbird in a nest prevents the raising of any young at all of its own by the bird victimized. Just how many eggs each Cowbird lays each season is rather uncertain; in all probability four or five are deposited. If that is so, every female Cowbird that arrives here in the spring, and is allowed to follow her own method of reproduction, causes the loss of from fifteen to twenty-five of the young of our most valuable birds. In view of the great increase that has taken place in the numbers of this bird of late years, it is not to be wondered at that our other native species are decreasing, and we should take steps at once to regulate matters. Every person on finding a nest of any of our small birds should look over the eggs contained in it, and if one is found therein different from the others and corresponding to the description of the egg of the Cowbird, which I have already given, that egg should be taken out and destroyed. School teachers throughout the country would do well to impress this upon their pupils.

Shooting the females in early spring is perhaps the most satisfactory way of keeping down the number of this most undesirable bird, and I strongly urge every one who has access to a gun to use it for this purpose, about his own premises: for, as I have already pointed out, every Cowbird killed at this season means the salvation of much valuable bird life and a corresponding lessening of our insect pests.

Bobolink. One of the most familiar sounds of summer in the country is the merry rollicking song of the Bobolink, to be heard at all times in the fields of scent-laden clover; its bubbling notes, poured out in the exuberance of its spirits, seem to express the feeling of joy that pervades all nature in June. The birds arrive here about the middle of May, the males coming a few days before the females. They resort at once to the hay meadows, and remain there through the nesting season, which is concluded by the time the hay is ready to cut. Whilst on the farms their

Bobolink.

food consists entirely of insects, of which the caterpillars that feed on clover form the greater part. These caterpillars are very abundant, and, where they are not kept in check by the birds, sometimes do serious injury, so that apart from its appearance, and its good qualities as a musician, the Bobolink has a claim upon us which entitles it to our best care and protection. After the hay is cut the males lose their black and white plumage, and become like the females and young in appearance, of a yellowish brown color. They then associate in small flocks and frequent the marshes, feeding on wild rice and the seeds of some rush-like plants, until the first frosts come, when they retire to the south for the winter.

In the rice growing States these birds are sometimes accused of doing considerable mischief to the planters' crops, but I am inclined to think that the various species of blackbirds which also resort to these States are the principal depredators, and by reason of their greater abundance do the most of the damage.

Meadowlark. The Meadowlark is a common though, unfortunately, not now an abundant bird on the farm. Some years ago it could be found wherever the land was cultivated, all through the Province, but owing to its size and slow straight flight, which makes it an easy mark for the gunner, its numbers are decreasing very fast. This is a great pity, for it is an exceedingly valuable bird to the farmer. From the time of its arrival here in March until its departure in November it resorts to the cultivated land and grass meadows, feeding entirely on insects, and never indulging in grain or fruit of any kind. All its work being done amongst the crops upon which man expends his labor, and to which he is compelled to look for his subsistence, the benefit conferred is direct, and should be appreciated. We cannot make any return for the good it does, but we can at least refrain from destroying its life, and exert ourselves a little to prevent others from doing so. The class of insects upon which this bird feeds during the early part of the season is perhaps the most injurious to vegetable life of all our insect enemies. Its food consists chiefly of those known as cut worms, wire worms, etc., all of which work underground for the most part during the day, and emerge from their hiding places at night only. By some highly developed faculty the Meadowlark is enabled to locate these creatures in their hiding places, and being provided with a sharp beak of sufficient length for the purpose, is able to drag them out and devour them. Of all the stomachs I have examined prior to July, the principal contents were wire worms, cut worms, and some few other caterpillars and beetles; later in the season the food consisted principally of grasshoppers. On two or three occasions I have found a few of these birds wintering with us, in the vicinity of market gardens, and being curious to know if at that season they had been compelled to fall back on a seed or vegetable diet, I shot one out of each lot, and I found the birds were in remarkably good condition. Their stomach contained, however, nothing but insects, chiefly bugs and beetles, which they had probably obtained from manure heaps and the refuse cabbages left in the gardens. These birds build a domed nest on the ground, in grass fields; their eggs and young are therefore liable to be destroyed by Crows, skunks and other vermin, and those that escape their natural enemies are subject to such continued persecution from gunners who ought to know better, that our beautiful Meadowlark is in danger of extermination, unless some effort is made for its protection.

ORIOLES.

Baltimore Oriole. The Golden Robin, Fire Bird, or Hangnest, as the bird is sometimes called, is of more importance to the fruit grower than the grain farmer, as it gleans its food entirely among the branches, only visiting the ground for

Meadowlark.

material with which to construct its purse-like nest. Its food consists largely of leaf-eating caterpillars and beetles. It is also particularly fond of the moths which frequent the trees for the purpose of laying their eggs; of these moths it devours large numbers, and in this way materially assists in keeping down the army of leaf eaters which so frequently strip our trees of their foliage. Very few of our birds will eat a hairy caterpillar, but when they eat a female moth before she has laid her eggs they destroy at one stroke a whole brood of these pernicious creatures, and to this work the Oriole devotes itself with great industry. I have on several occasions obtained a brood of young Orioles and hung them out in a cage near my house for the purpose of discovering the nature of the food brought to them, and found that fully one-half consisted of moths; unfortunately I did not keep a record of the number of these brought in any one day, but it was very large, and the usefulness of this bird in keeping down the swarms of destructive caterpillars, by cutting off the source of supply, was clearly exemplified.

During the summer of 1900 I received a number of reports as to the valuable work done by Orioles in clearing off Tent caterpillars. In several cases my informants stated that they watched the birds at work in their orchards day after day destroying these pests and that in the end they completely cleared the trees of them.

A most interesting account of the operations of a pair of these birds was sent me by Mr. Yarwood, of Picton. He says: "A pair of Baltimore Orioles delighted me this summer by building in a silver maple in our door yard. As I was going in to breakfast one morning, when the caterpillars were but lately hatched and had small nests, I saw an Oriole cleaning one of the little nests out. When I came out after breakfast he had finished that nest and was engaged on another. His appetite seemed to be immense. They must have eaten an enormous number of insects, for they raised four or five of a brood. * * * * I did not have to spray any gooseberries and currant bushes this year. I would notice branches that worms had started on, but some enemy had devoured them."

When the cherries ripen the Oriole displays a certain partiality for fruit, but the small quantity they take may well be spared them, more particularly as it is only in this direction that they levy any toll for their services. The brilliant coloring of the male, his flute-like note, and the ingenuity displayed in the construction of the nest, all commend these birds to the lover of nature, and we could well spare a few cherries for the sake of having them about our gardens, even if their usefulness was less pronounced than it is. In the southwestern portions of our Province the Orchard Oriole occurs. It differs from the Baltimore in being smaller, and in color being chestnut and black, instead of the orange and black which marks the present species. Its habits are much the same as those of the familiar Baltimore, but it is too rare to have any economic value.

BLACKBIRDS, ORIOLES, ETC.

Description.

BRONZE GRACKLE—CROW BLACKBIRD.

Adult male. Head, neck, throat and upper part of breast, varying from brilliant metallic purple to bluish green or steel blue; back metallic bronze; wings and tail metallic purplish or bluish black, lower breast and belly similar to the back but duller.

Adult female. Much duller, the back and belly brownish, sometimes without metallic reflections.

L., 13.00; W., 6.00; T., 6.09.

Nest, generally in trees. The birds often nesting in colonies. Eggs four or five, lightish green or smoky blue, with irregular lines, dots, blotches and scrawls of purplish brown all over the surface; very variable.

RUSTY GRACKLE.

Adult male in summer. Entire plumage uniform glossy bluish black, tail feathers of nearly equal length.

Adult male in winter. Similar, but the feathers of the upper parts widely tipped with rufous, the under parts similarly tipped with cream-buffy; a buffy line over eye.

Adult female in summer. Dark slate colour, glossy above, duller below; wings and tail darker and more glossy.

Adult female in winter. Similar but somewhat lighter, the upper parts tipped with rusty and under parts tipped with cream buffy.

L., 9.50; W., 4.60; T., 3.50.

Nest, on the ground or in trees or bushes. Eggs, four grayish or light green, very thickly covered with blotches and dots of purplish and reddish brown, very variable.

RED-WINGED BLACKKBIRD.

Adult male. Uniform black; lesser wing coverts bright scarlet; middle wing coverts varying from buff to buffy white. In fall specimens the black is more or less tipped with rusty.

Female. Smaller under 8.00. Above blackish brown with pale streaks inclining on the head to form median and superciliary stripes; below, whitish with many sharp dusky streaks; sides of the head, throat and bend of wing tinged with yellowish red.

Male. L., 9.50; W., 4.70; T., 3.75.

Nest, usually fastened to the rushes in a marsh. Eggs, four or five, pale blue, curiously marked and scrawled with dark purplish brown.

COWBIRD.

Adult male. Head and neck, dark chestnut brown. the rest of the plumage glossy black with metallic reflections.

Adult female. Dull brownish gray, rather paler below, especially on the throat.

Immature in first plumage. Similar to the female, but whiter below, all the features edged with buffy.

Male. L., 7.90; W., 4.25; T., 3.05.

Nest, none. The eggs, which are deposited in the nests of other birds, are dull white, thickly dotted or sometimes blotched with brown.

BOBOLINK.

Adult male in summer. Top, sides of head and under parts black, the feathers more or less tipped with a narrow whitish or cream buff fringe which wears off as the season advances; back of the neck with a large creamy buff patch; middle of back generally streaked with creamy; scapulars, lower back, and upper tail coverts, soiled grayish white; wings and tail black; tail feathers with pointed tips; bill blue black.

Adult female. Upper parts yellowish brown streaked with black; crown blackish, with a central stripe of buff; wings and tail blackish, pale edged; under parts yellowish.

Male in the autumn. Similar to female.

MEADOWLARK.

Each feather of the back blackish margined with brownish yellow, neck the same but pattern smaller, crown streaked with black and brown, a buffy line through the centre and over eye, a yellow spot over eye and a blackish line behind it; outer tail feathers mostly white, middle ones with imperfect bars or scallops of black brown and gray, sides of throat and ear coverts whitish; edge of wing and under parts generally bright yellow; a black crescent on the breast; sides and crissum pale brownish, streaked with black.

Female. Similar smaller L., about 9.50.

Male. L., 10.75; W., 4.75; T., 3.75.

Nest, on the ground, generally arched over. Eggs, four to six, white, spotted with reddish brown.

BALTIMORE ORIOLE.

Adult male. Head, neck, throat and back black; breast, belly, lower back and lesser wing coverts, rich reddish orange; wings black, the outer margin of the greater coverts and quills edged with white; end half of middle tail feathers black, base orange; all the others orange, crossed by a black band in the middle.

Adult female. Upper parts grayish orange, brighter on the rump; head and back mottled with black, wings grayish brown; greater and middle coverts tipped with white, tail like the rump, the middle feathers stained with black, under parts dull orange.

L., 7.50; W., 3.50; T., 2.85.

Nest, pensile, on trees. Eggs, four to six, white scrawled and dotted with fine black or reddish brown markings, chiefly toward the larger end.

ORCHARD ORIOLE.

Adult male. Head, neck, throat, upper back black; breast, belly, lower back and lesser wing coverts chestnut; wings and tail dark grayish brown more or less edged or tipped with whitish.

Adult female. Upper parts grayish olive green, brighter on the head and rump; wings dark grayish brown, middle and greater coverts tipped with whitish, tail olive green; under parts dull yellow.

Baltimore Oriole.

Immature male in first year. Similar to the female, but back browner.

Immature male in second year. Similar to the female, but with the throat black and occasionally patches of chestnut on the under parts.

L., 7.35; W., 3.20; T., 2.95.

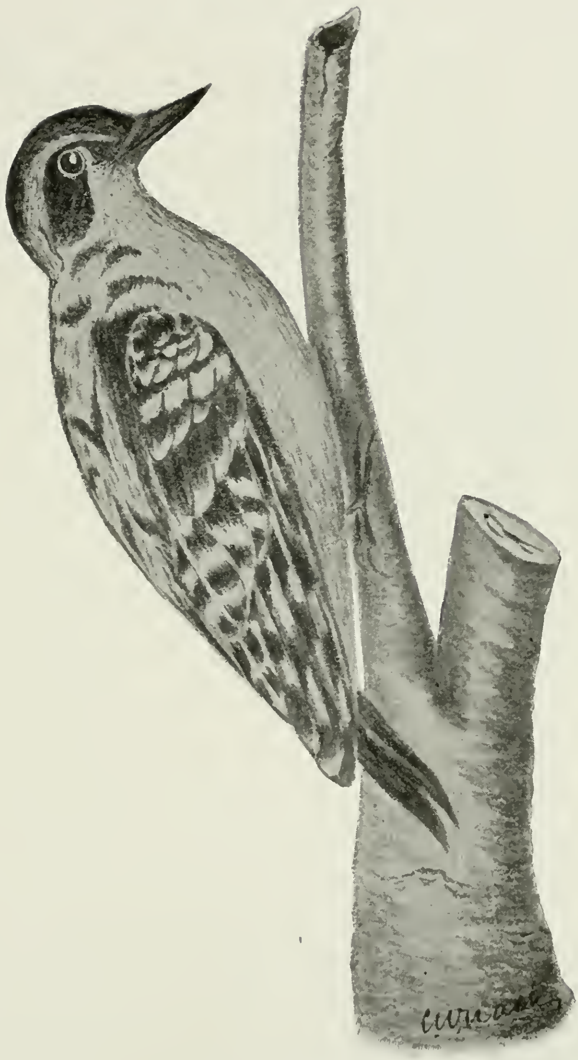
Nest, pensile, on trees. Eggs, four or five, bluish white spotted and scrawled with purplish brown and black.

WOODPECKERS, NUTHATCHES, TITMICE, ETC.

The various species which constitute these families have been grouped together, because of certain similarities in their habits, although structurally they differ widely. They are all tree climbers, and obtain the greatest part of their food from the trunks of trees, some of them by laboriously digging out the grubs which bore into the solid wood, others by prying into every crack and crevice of the bark, where they find insects in various stages of development.

Of the Woodpeckers we have in Ontario nine species, namely, the Pileated Woodpecker (better known as the "Cock of the Woods"), the Arctic Three-toed Woodpecker, the American Three-toed Woodpecker, Hairy Woodpecker, Downy Woodpecker, Yellow-bellied Woodpecker, Golden-winged Woodpecker, Red-headed Woodpecker and Red-bellied Woodpecker. The first three are true birds of the forest, very seldom showing themselves in the neighborhood of cultivation, so that, although their services are of great value to the country, by reason of the constant war they carry on against the borers, which are so injurious to our timber, we need not consider them in this paper. The Hairy Woodpecker and the Downy Woodpecker are two species that almost exactly resemble each other, both in habits and appearance, the only material difference being in their size, the Hairy Woodpecker measuring about nine inches in length, the Downy about six inches. Their food, which consists almost entirely of insects, is obtained either by digging the grubs out of the wood, or picking them out of the crevices of the bark in which they hide during the day. Sometimes during the winter I have found the stomachs of these birds filled with the seeds of the hemlock. These seeds seem to form a favorite food with many of our birds at this season; the berries of the sumach are also occasionally eaten by the little Downy, perhaps for the sake of the small beetles that are always to be found amongst them. These are the only two vegetable substances that I have ever known either of these species to feed upon.

Both these Woodpeckers are accused of injuring trees by boring holes in them to obtain a flow of sap, which they are said to drink. This is a mistake. The bird having the sap-sucking habit is the Yellow-bellied Woodpecker, an entirely different species, of which I shall speak presently. Nature has most perfectly fitted these birds for their task of ridding the trees of the grubs which bore into them. Their beaks are hard, sharp and chisel-like, so that they are enabled to enlarge the holes inhabited by these insects sufficiently to enable them to insert their long, barbed tongue, with which they extract the larvæ from their hiding places. In the winter these birds frequently visit the orchard, garden and shrubbery, and there they do most valuable work, by destroying the chrysalids of the moths that produce the leaf-eating caterpillars. The toughest cocoon ever spun by caterpillar is no protection against the sharp beaks of these birds, even the strong case which encloses the chrysalis of the large Cecropia moth is soon torn open when found by a Downy Woodpecker, and the contents devoured. Ants and borers in the trees are also greedily eaten by both species; in fact, nothing in the shape of insect life comes amiss to them, that can be found within their reach. The valuable work done by these birds



Downy Woodpecker.

Red-headed Woodpecker.

for the protection of our trees should commend them to every lumberman, fruit grower and nurseryman, and though we cannot do very much to protect them from their natural enemies, we can cease destroying them ourselves and discountenance it in others.

The Downy Woodpecker may be readily attracted to an orchard in the winter season by baiting the trees with pieces of fat, in the same manner as is recommended for Nuthatches and Chickadees further on. The work done by this bird in extracting borers from the trees, and destroying the larvæ of the Codling moth, will amply repay a fruit grower for the small amount of attention necessary.

Red-headed Woodpecker. This is the most beautiful bird of the whole Woodpecker family, the strong contrast of the glossy black and the white of its body, and the brilliant crimson of the head of the adult birds, render them very conspicuous objects of the country; their value from an economic point of view, however, is debatable. From the time of their arrival here in May until the first strawberry ripens, these birds feed on insects entirely, and in pursuit of their food they often adopt the tactics of the fly-catchers, by mounting to the top of a telegraph pole or bare limb of a tree, thence darting out at any passing insect large enough to attract their attention. If the location selected is a favorable one and food abundant, they will remain at the same spot for some time; but after the small fruits ripen their tastes change, and they then visit the strawberry patches, both wild and cultivated, and cherries and raspberries are also eaten by them and carried to their young. When the season for small fruit is over, they again resort to their insect eating habit, and, so far as I have been able to observe, are not in this Province ever addicted to pilfering grain. I have occasionally seen an odd one make a raid on a vineyard and take a few grapes, and once or twice have seen them pick holes in apples, but the habit does not seem general.

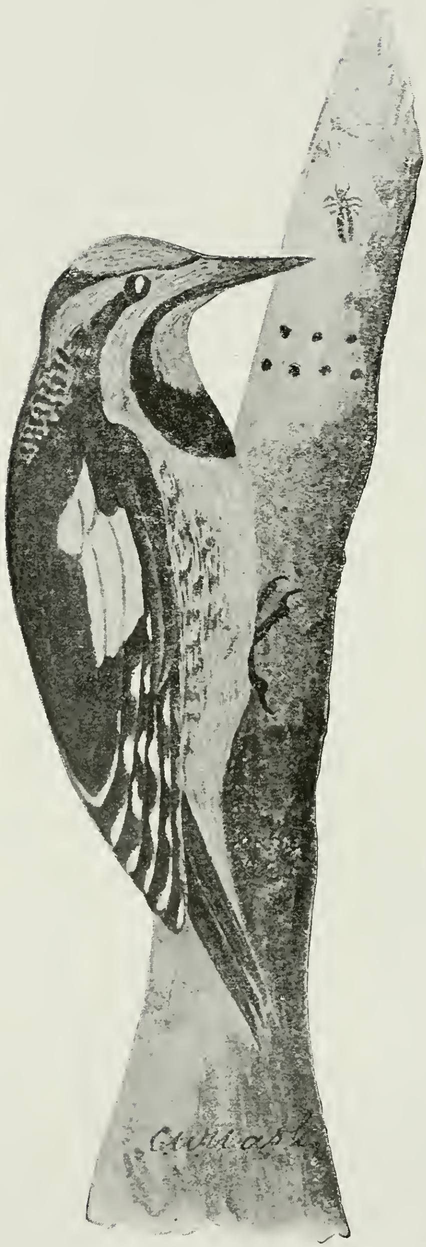
There is no doubt that in the spring they do much good by destroying numbers of mature insects, which, if allowed, would deposit eggs to produce vast numbers of injurious caterpillars. It is true also that in districts where small fruit is cultivated for profit they do much harm, if they become sufficiently numerous. As the case now stands, they are too scarce to do much injury, and, except when they are too persistent in their visits to a garden or orchard, they may well be left alone. Although these birds are regular migrants, arriving here about the middle of May and leaving in September, I have once or twice met with them in sheltered woods in south-western Ontario in the winter, where their bright plumage showed to great advantage against the evergreens.

The habits of the Red-bellied Woodpecker are very similar to those of the above species, and its economic value about the same, but as it only occurs in the south-western counties of the Province, and then in very small numbers, it need not be further considered.

Golden-winged Woodpecker. Flicker, High Holder, Yellow Hammer, Pigeon Woodpecker, and half a dozen other aliases, testify that this is a well-known, if not always a popular, character. Like the last species, the value of this bird from the fruit-growers' standpoint is debatable, but it is not quite so much given to fruit eating as the Redhead, though, when it has seven or eight hungry young ones to feed, and it finds a cherry orchard handy, it will help itself to a good many cherries, for which it has a decided predilection. Apart from this unlucky habit, the bird has many good qualities. In some of its ways, it much resembles the Meadowlarks; like them, it may often be seen on the ground searching for ants, of which it destroys vast quantities. I have often found their stomachs filled with them, and have rarely examined one without finding it contained some of these insects; it also devours great numbers of grasshoppers, beetles, moths, and other ground insects. This bird is really a ground feeder, for, though classed among the Woodpeckers by reason of certain similarities of structure, it does less wood-pecking than any other of its class, the beak not being as well fitted for that operation as the beaks of the others. It has also the peculiarity of being able to perch crosswise on a branch, a method rarely adopted by its relations. There is one other evil trait that I have seen this bird exhibit, on two occasions only, that is the destruction by it of nests of the Bluebird; both the nests destroyed were built by the Bluebirds in holes in trees much higher than usual, probably from forty to fifty feet from the ground. I am not certain what the nests contained at the time, but I saw the Woodpeckers pull out the nests and throw them piecemeal to the ground, in spite of the resistance of the Bluebirds, but I found no trace of eggs or young; If there were any, they must have been eaten. It is probable that the Woodpeckers wanted the nesting site for themselves, and so dispossessed the owners. If so, they were disappointed, for I settled the question by killing them, but I am sorry to say I omitted to examine the stomachs to see whether or not they had devoured the young Bluebirds, if there were any. I am inclined to think these were exceptional cases; they occurred over thirty years ago, and I have never seen a repetition of the trick. If these birds become a nuisance in a garden or orchard, they can easily be killed off while they are committing their offence; but I think that through the country generally the good they do far overbalances the little damage they may do locally.

Yellow-bellied Woodpecker or Sapsucker. Adult male, crown and chin crimson, back and wing coverts black and white, wings black with large white bar, tail black, inner web of the two central feathers white with black spots, breast black edged with yellowish, the rest of the under parts dull yellowish, the sides white with black streaks. In the female the crimson of the crown and chin is wanting, the crown is black, with sometimes a few traces of crimson on the forehead, the chin is white. I give a description of this species in order that it may be distinguished from the other small Woodpeckers, because it is principally owing to the propensity for drinking sap, which the bird has, that a certain prejudice exists in some localities against all the Woodpeckers, or Sapsuckers as they are called. It is quite true that this Woodpecker does in the spring, when the sap is rising, bore small holes in the bark of various trees for the purpose of obtaining the sap as it flows from them, and perhaps to attract the insects upon which they feed to the same spot, so that they can satisfy their hunger and thirst without having to over-exert themselves in so doing. If life was not so short, I might be tempted here to go into the question as to whether this bird had to acquire this habit, because its tongue was peculiarly fitted for it, or whether the tongue became modified so as to just suit the habit after the bird had acquired it; for the bird's tongue certainly differs from that of other Canadian Woodpeckers and is admirably fitted for the use to which it is put. A discussion of the question would exceed the scope of this article, and probably not lead to anything after all. We know the bird has this habit, and the question is. what is the effect of it upon the trees which are bored? I have made what observations I could, and as many enquiries from others as possible, and I have come to the conclusion that the only real damage done is that a young tree may be rendered unsightly for a time, or it may even be permanently disfigured by some peculiarity in the healing of the bark, but usually no harm ensues. That a tree ever was, or could be, killed by it I do not believe, for

Flicker.



Yellow-bellied Woodpecker—Sapsucker.

I have never yet seen or heard any evidence in proof of it. Further we know that Maple and Birch trees are tapped year after year for commercial purposes but the general health of the tree seems never to be adversely affected by doing so.

With regard to this habit of the Sapsucker, Mr. E. H. Forbush says that in thirty years experience in Massachusetts no instance has come to his knowledge of its doing any appreciable harm there.

Apart from its sap drinking proclivity the bird's record is excellent; it is not a fruit or grain eater, though in the autumn it will feed on mountain ash and a few other wild berries. In general it devotes itself to the destruction of insects that live on the trees or hide in the loose bark. Ants form a large proportion of its food. These it obtains from the rotten wood in which they burrow, as it does not descend to the ground in search of them. Beetles and moths are also sought out and devoured, but as this bird's tongue is not as well barbed as that of some of the other Woodpeckers, fewer grubs of the wood-boring class are eaten by it. I suppose if any man believes that these birds are doing an injury to his trees he should be allowed to protect himself in the only way possible, viz., by getting rid of the birds on his own premises; but for his own sake he should be sure he gets rid of the right one, and that neither the Downy nor the Hairy is destroyed by mistake. Both the Downy and the Hairy Woodpecker remain with us all through the year, whilst the Sapsucker is a summer resident only; so that whenever a Woodpecker is seen in the winter it should be spared, for it is most certainly a beneficial one.

WOODPECKERS.

Description.

PILEATED WOODPECKER—COCK OF THE WOODS.

Adult male. Upper parts dull black; top of the head brilliant scarlet, the feathers lengthened to form a crest, a white stripe borders this crest and separates it from the dusky ear coverts; a stripe beginning at the nostril and passing down the sides of the neck to the shoulders is tinged with yellow before the eye and is white behind the eye; a scarlet stripe at base of the lower mandible, basal half of the wing feathers white; under parts dusky black, the feathers sometimes slightly margined with white.

Adult female. Similar but with less scarlet on crown and none at base of lower mandible.

L., 17.00; W., 8.90; T., 6.25.

Nest, a hole in the trunk of a tall tree. Eggs, four or five, white, oval.

ARCTIC THREE-TOED WOODPECKER.

Adult Male. Toes three, two in front. Middle of crown with a bright yellow patch; rest of upper parts shining blue black; wing feathers spotted with white; middle tail feathers black, outer ones white, except at the base; a white line from the nostrils passes below the eye; sides barred with black and white; rest of the under parts white.

Adult female. Similar, but without yellow patch on crown.

L., 9.50; W., 5.10; T., 3.40.

Nest, in a hole in a stub or tree. Eggs, four or five, white.

AMERICAN THREE-TOED WOODPECKER.

Adult male. Three toes, two in front; head spotted with white and a yellow patch on crown; back barred with black and white; wing feathers spotted with black and white; middle tail feathers black, outer ones black and white, region below the eye mixed black and white, sides more or less barred with black and white; rest of the under parts white.

Adult Female. Similar, but crown spotted with black and white and without yellow patch.

L., 8.75; W., 4.55; T., 3.10.

Nest, in a hole in a stub or tree. Eggs, four or five, white.

HAIRY WOODPECKER.

Adult male. Black with a long white stripe; wing feathers and coverts spotted with white; four middle tail feathers black, next pair black and white, outer feathers white. A scarlet band on nape; crown and sides of head black with a white stripe over and another below the eye; under parts white.

Adult female. Similar but without scarlet on back of the neck.

L., 9.50; W., 4.80; T., 3.50.

Nest, in a hole in a tree. Eggs, four or five, white.

DOWNY WOODPECKER.

Adult male. Upper parts black, a long white stripe on back; wing feathers and their coverts spotted with white; middle tail feathers black, outer ones white, barred with black; a scarlet band on back of neck; wing feathers and their coverts spotted with white; a white stripe above and another below eye; under parts white.

Adult female. Similar but without scarlet band on nape.

L., 6.75; W., 3.70; T., 2.50.

Nest, in a hole in a stub or tree. Eggs, four or five, white.

YELLOW-BELLIED WOODPECKER—SAPSUCKER.

Adult male. Crown scarlet; back irregularly barred with black and yellowish white; wing feathers spotted with white, their coverts mostly white; tail black, the middle feathers with broken black bars, the outer ones with white margins; a white line from the bill passes below the eye; throat scarlet; breast black; sides streaked with black; belly pale yellow.

Adult female. Similar but throat white; crown sometimes black; outer tail feathers with broken white bars.

Immature. Similar to adults, but with the crown dull blackish, and breast brownish gray, barred with black, the throat whitish.

L., 8.50; W., 4.80; T., 3.15.

Nest, in a hole in a tree. Eggs, four or five, white.

Pileated Woodpecker.

GOLDEN-WINGED WOODPECKER—FLICKER HIGH-HOLER.

Adult male. Top of head ashy gray, a bright scarlet band across back of the neck; back, wing coverts and innermost quills brownish gray, thickly barred with black; tail coverts white, barred with black; primaries black externally, inner surface of wing and shafts of the feathers bright yellow; tail black above, below yellow, tipped with black; sides of the head throat and upper breast vinaceous; a broad black stripe on either side of the throat from the base of the bill and a broad black crescent across the breast; rest of the under parts white, more or less tinged with vinaceous and thickly spotted with black.

Adult female. Similar, but without the black streaks on the side of the throat.

L., 11.00; W., 6.00; T., 4.00.

Nest, in a hole in a stub or tree. Eggs, five to nine white.

RED-HEADED WOODPECKER.

Adult male and female. Head, neck and upper breast deep crimson; back, primaries, bases of the secondaries and wing coverts glossy blue black; end of secondaries, rump and upper tail coverts white; tail black, the feathers more or less margined with white; lower breast and belly white, generally tinged with reddish.

Immature. Head, neck and upper breast grayish brown; upper back bluish black barred with ashy; primaries and wing coverts black; end half of secondaries irregularly barred with black; tail black generally tipped with white; lower breast and belly white, more or less streaked or spotted with gray.

L., 9.25; W., 5.50; T., 3.25.

Nest, in a hole in a tree. Eggs, four to six, white.

RED-BELLIED WOODPECKER.

Adult male. Whole top of the head and back of the neck bright scarlet; back regularly barred with black and white; primaries black at the end, white irregularly barred with black at the base; secondaries black, regularly spotted and barred with white; upper tail coverts white, with streaks or arrowheads of black; outer tail feathers and inner vanes of the middle ones irregularly marked with broken black and white bars; cheeks and under parts dull ashy white, the region about the base of the bill, the middle of the belly and sometimes the breast more or less tinged with red.

Adult female. Similar but with the crown grayish ashy, the scarlet confined to the nape and nostrils.

Immature. Similar, but with the belly sometimes tinged with buffy instead of red.

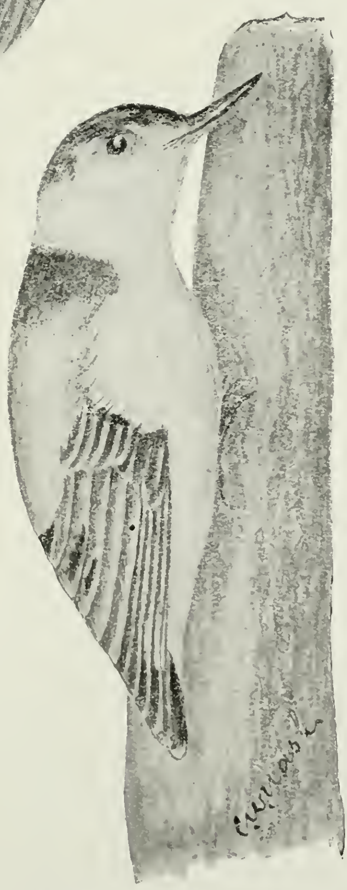
L., 9.50; W., 5.00; T., 3.50.

Nest, in a hole in a tree. Eggs, four to six, white

NUTHATCHES, CHICKADEES, AND TREE CREEPER.

Of these we have two species of Nuthatches—the White-breasted and Red-breasted,—two Chickadees and one Creeper. They are all resident species, though more frequently seen around cultivated lands in the winter

Wood Thrush.



White-breasted Nuthatch.

than in any other season. They are among the most active insect destroyers we have, gleaning their food from the bark, branches and leaves of trees, and seldom descending to the ground, though when wood-chopping is going on in the bush the logs, sticks, and chips will all be carefully searched for grubs which have been exposed by the axe. The familiarity displayed by these little creatures at this time is very pleasing. As soon as work begins, and the first few strokes of the axe sound through the bush, they gather round and investigate every piece of bark and decayed wood thrown open, and from each one gather some prizes. It is very amusing to watch the little Chickadee when he finds a large grub of one of the borers partly exposed. He pulls and tugs at it until it comes out, and then securely holding it down with his feet he tears it in pieces and devours it. Without the assistance of the chopper it is but seldom that they can get at the larger grubs that bore deeply into the solid wood, as they have neither the strength nor proper tools for digging them out; but they have found that when the farmer cuts his cordwood their opportunity for a feast arrives, and so they take advantage of it. As a general rule, however, they scour the bush, orchard, and shrubbery in merry little parties searching for food, from time to time uttering their musical notes, which always have a peculiar "woodsy" quality about them. The seeds of the hemlock are occasionally eaten by the Chickadee and the Red-breasted Nuthatch, and the White-breasted Nuthatch is said to sometimes eat beechnuts and acorns, but I have never found any trace of them. The Tree Creeper eats no vegetable substance whatever.

This little group of birds is of the greatest value to fruit-growers, as they feed principally on the minute insects and their eggs, which are individually so small that they escape our observation until, having seen the damage done by them, our attention is called to their existence, and then it is too late to enable us to remedy the matter for the season.

In the winter fruit-growers should endeavour to encourage birds of this class to resort to their orchards, for they are among the most effective checks upon injurious insects that we have.

They destroy immense quantities of eggs from which the tent caterpillar, the canker-worm and aphides are produced. The larvæ and pupæ of the codling moth are also eagerly sought for and devoured.

When you see these little birds scrambling about the trunks and branches of your trees, peering sharply into every crevice of the bark, it is these insects they are looking for, insects and their eggs that at this season are generally so well hidden that only the birds' sharp eyes can detect them. They do, however, find enough of them to supply their wants, and thereby save the trees from much damage the following season.

The best way to induce the birds to remain in and about an orchard is to hang up among the trees a few bones with some fat on them, or a few lumps of fat tied to the branches here and there will have the desired effect. The birds will soon find them out, and if the supply is kept up will remain in the neighborhood all the season. Feeding on this will not prevent their insect hunting, but will obviate the necessity for their wandering over too much ground, and they will concentrate all their efforts upon the trees where they are sure of finding food.

A remarkable example of the benefit that may be derived from the presence of a flock of Chickadees has been recorded by Mr. E. H. Forbush in a bulletin of the Massachusetts State Board of Agriculture.

In a certain orchard in Massachusetts the canker-worm moth had deposited great numbers of eggs upon the trees. Pieces of bone and fat were fastened to the trees early in winter to attract the Chickadees. The birds came and remained about the orchard nearly all the winter. They were carefully watched and it was found that they were feeding on the eggs of the canker-worm moths. A few birds were killed to determine the number of eggs eaten. Between two and three hundred canker-worm eggs were found in the stomach of each of these birds. In the spring the female moths of the spring canker-worm were also devoured. The result was that the Chickadees, assisted in spring and early summer by some other birds, saved the orchard from any serious injury by the canker-worm.

NUTHATCHES—TITS—TREE CREEPER.

Description.

WHITE-BREASTED NUTHATCH.

Adult male. Crown and nape glossy black; back rump and middle tail feathers ashy blue; outer tail feathers black, with white patches near the tips, inner secondaries bluish gray, marked with black: wing coverts and quills tipped with whitish; sides of head and under parts white, lower belly and under tail coverts mixed with rufous.

Adult female. Similar, but the black of head and neck duller.

L., 6.00; W., 2.70; T., 1.95.

Nest, in a hole in a stub. Eggs, five or six, white, streaked with reddish brown.

RED-BREASTED NUTHATCH.

Adult male. Crown shining black, bordered by a white line over the eye, a black line from the bill through the eye to nape, widening behind the eye; upper parts bluish gray; outer tail feathers black, with white patches near their tips, middle ones bluish gray; throat white, rest of the under parts rusty red, sometimes reddish buff.

Adult female. Similar but top of head and line through eye, dark bluish gray.

L., 4.65; W., 2.65; T., 1.65.

Nest, in a hole in a tree or stump. Eggs, five or six, white, speckled with reddish brown.

CHICKADEE.

Crown, nape and throat, black; sides of head and neck, white; back ashy gray; wing and tail feathers margined with whitish; breast white; belly and sides washed with pale buff.

L., 5.25; W., 2.50; T., 2.50.

Nest, in a hole in a stump or tree. Eggs, six to eight; white, spotted and speckled, chiefly at the larger end, with reddish brown.

TREE CREEPER—BROWN CREEPER.

Upper parts curiously marked with brown, buff and white; rump pale chestnut; wings dusky, marked with tawny and white and with a band of creamy buff; tail dusky, the feathers sharply pointed; under parts white; bill slightly curved.

L., 5.50; W., 2.60; T., 2.65.

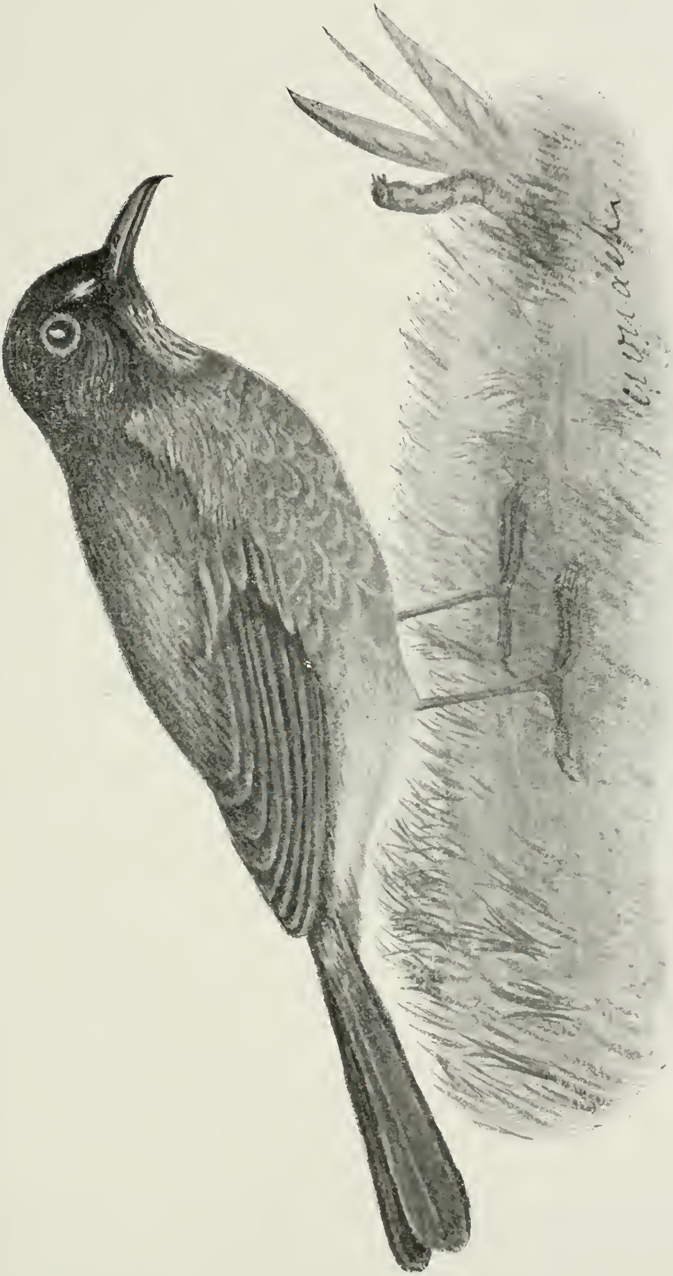
Nest, generally in a crevice behind the loose bark of a tree. Eggs, five to eight, white, speckled and spotted with reddish brown, chiefly in a wreath at the larger end.

THRUSHES.

We have in Ontario seven species belonging to this family, all of them migratory, arriving here from the south in early spring and leaving us in the autumn, as cold weather sets in. They are the Wood Thrush, Wilson's Thrush, Grey-cheeked Thrush, Olive-backed Thrush, Hermit Thrush, Robin and Bluebird. The Olive-backed Thrush, Grey-cheeked Thrush, and most of the Hermit Thrushes pass on and raise their young to the north of us; the others remain throughout the summer and breed here.

The Wood Thrush and Wilson's Thrush, or Veery, as it is sometimes called, are strictly birds of the woodlands, and seldom venture far from the edge of the bush, though both species will at times select a garden where there are shrubs for their summer residence, if they find themselves unmolested, particularly if there are no domestic cats about the premises. The cats at all times prefer young birds to mice or rats, and are as much to blame for the decrease of our native birds as bird-nesting boys or anything else, perhaps, except the Cowbird. Wilson's Thrush is one of our most abundant species, but it has the faculty of concealing itself to such perfection that it is often overlooked, though there may be many within a few yards of where a person is standing. The Wood Thrush is very rare with us, which is to be regretted, as it is a beautiful songster.

All these thrushes are very valuable birds to the agriculturist, their food consisting for the most part of grubs that live under the surface of the ground and caterpillars. In the autumn they eat many wild berries, those of the Elder and Viburnum being especial favorites, but (except the Robin) they never help themselves to the produce of the farm or garden. The best known and most familiar of the thrush family is the Robin, and opinion is very strongly divided as to its utility. Many fruit-growers condemn this bird with great emphasis, stating that it is the worst enemy they have; others weigh its merits and demerits more carefully, and are inclined to think that it at least pays for the fruit it eats by the destruction of insects. No doubt it does take a large number of cherries, strawberries and raspberries, and some grapes, but it is open to question if it were not for the birds whether there would be any cherries, strawberries, grapes, or, indeed, whether any crop could be brought to maturity. The great merit of the Robin is, that in the early part of the season it feeds itself and its young almost entirely on cut worms, and on the large white grub, the larvæ of the May beetle. Of all our insect enemies the underground cutworm is about the most destructive, for in feeding it just comes above the surface and cuts off the entire plant; or if the plants are very young and the stems small, it cuts off half a dozen or more at one time, only eating a small section out of the stem of each, and leaving the plants dead on the surface of the ground. Whole rows of peas, corn, beets, cabbage, and cauliflower are often so treated; tomatoes, too, fare badly with them. In 1908 one farmer near Jordan lost over six thousand tomato plants by the ravages of the cut worm, and many others in the fruit-growing districts suffered almost as severely. The only remedy that seems effectual against their attacks is to wrap paper around the stems of the plants from the surface of the soil to the height of about three inches above it. This is obviously impossible in the case of field crops, and it is equally impossible to go over the fields and take the worms out by hand, so that we must rely, for-



Robin.

the most part, upon the ground feeders among the birds; these are fitted by nature for digging out the insects and devouring them.

Robin. Among the most conspicuous of these birds is the Robin, and one need only watch one of them at work in the garden, from April to about the middle of June (which is the season of the cut worm's activity) to be satisfied as to the Robin's good work. I will give the result of an experiment carried on by myself which shows the number of these insects a pair of Robins will destroy when they are feeding a brood of young. In May, 1889, I noticed a pair of robins digging out cutworms in my garden, which was infested with them, and saw they were carrying them to their nest in a tree close by. On the 21st of that month I found one of the young on the ground, it having fallen out of the nest, and in order to see how much insect food it required daily I took it to my house and raised it by hand. Up to the 6th of June it had eaten from fifty to seventy cut worms and earth worms every day. On the 9th of June I weighed the bird; its weight was exactly three ounces, and then I tried how much it would eat, it being now quite able to feed itself. With the assistance of my children I gathered a large number of cut worms and gave them to the Robin after weighing them. In the course of that day it ate just five and one-half ounces of cut worms. These grubs averaged thirty to the ounce, so the young Robin ate one hundred and sixty-five cut worms in one day. Had it been at liberty it would probably have eaten some insects of other species and fewer cut worms, but this shows near about what each young Robin requires for its maintenance when growing; the adult birds require much less, of course. The average number of young raised by a Robin is four, and there are usually two broods in the season. A very simple calculation will give a good idea of the number of insects destroyed when the young are in the nest. After the young have flown they are apt to visit the small fruit and it is no doubt very provoking to find a flock of them helping themselves to strawberries, etc. If possible, they should be kept off without destroying them, a resort to the gun being avoided as long as possible.

Bluebird. Twenty years ago the Bluebird was one of the most abundant of the summer residents in the cultivated districts of the Province; there was scarcely a farm throughout southern Ontario upon which two or more pairs of these birds did not breed. The same birds seemed to return regularly to occupy their holes in the old apple trees and fence posts, year after year, and so familiar were they that they actually seemed to know the members of the family whose premises they occupied. In one case, near Niagara, a pair of Bluebirds, for several years in succession, built their nest in a letter box which was placed at the gate of the farm, opening on the main road. The mail carrier deposited letters and newspapers in the box every day, which were duly taken out by the members of the family. To all this the birds paid no attention whatever, but would confidently sit upon their eggs or visit their young while the box was opened and the people stood close to them: and I have seen many similar instances of confidence on the part of these birds.

Of late years the Bluebirds have not remained with us, and they have been much missed. Enquiries are constantly being made as to where the Bluebirds have gone. That is not easy to answer, but that they still exist in undiminished numbers I am able to state positively, for so late as last March I saw many thousands passing over Toronto from west to east. The flight lasted from daylight to nine or ten o'clock every fine morning for about a week. I have seen this same movement every spring for years. My opinion is that the birds have gone back to the new settlements, where they can still find snake fences, and pastures in which the old stumps are standing—our modern wire fencing which has taken the place of the old stake and rider fence having deprived them of a favorite nesting-place. The up-to-date fruit grower, too, no longer allows his apple trees to go untrimmed and full of holes, but cuts out the old trees and replaces them with young ones. This has removed many of the old nesting sites, and the birds have spread over the large area of new country now being brought under cultivation. They introduced themselves to the Province of Manitoba about 1884, and have since become quite common there, having evidently followed the settlers, as they were quite unknown in that country before it was brought under general cultivation. The utility of this bird as an insect destroyer is beyond question. It eats neither grain nor fruit; occasionally in stormy weather, in early spring, when insect food is hard to obtain, it will eat the berries of the sumach, but that is the only vegetable substance I have ever known it to take. The beauty of its plumage, its sprightly spring song, and even the rather melancholy farewell notes in which it bade us good-bye, as it drifted southward in the last days of October, made it a great favorite everywhere, and every lover of nature would be glad to see it return and take its old place about the farm once more.

Nest boxes placed in the orchards too low down to tempt the House Sparrows to occupy them, would probably induce the Bluebirds to remain with us.

THRUSHES.

Description.

WOOD THRUSH.

Upper parts bright rufous brown, brightest on the head, and changing gradually to pale olive brown on the upper tail coverts and tail; under parts white, thickly marked with large round black spots except on the throat and middle of the belly.

L., 8.25; W., 4.40; T., 3.00.

Nest, generally in low tree or sapling. Eggs, four or five, greenish blue.

WILSON'S THRUSH—VEERY.

Upper parts, wing and tail nearly uniform tawny, not so bright as in the Wood, Thrush; centre of the throat white, sides of the throat and breast with a tinge of buff, spotted with small wedge shaped dusky spots, the breast with half round marks of the same colour.

L., 7.55; W., 4.06; T., 3.00.

Nest, generally in low bushes. Eggs, four or five, greenish blue.

GRAY-CHEEKED THRUSH.

Upper parts uniform olive (no buffy tint about the head) eye-ring whitish, lores grayish; middle of the throat and middle of belly white; sides of the throat and breast, with a very faint tinge of cream buff; sides of the throat spotted with wedged shaped marks, the breast with half round black marks.

L., 7.58; W., 4.09; T., 3.00.

Nest, in low trees or bushes. Eggs, four or five, greenish blue spotted with rusty brown.

OLIVE-BACKED THRUSH.

Upper parts uniform olive, sides of head. throat, neck and breast strongly tinged with buff; eye-ring deep buff; sides of throat marked with wedge shaped spots, the breast with rounded black spots.

L., 7.20; W., 3.95; T., 3.00.

Nest, in bushes or small trees. Eggs, three or four, greenish blue, speckled with reddish brown.

HERMIT THRUSH.

Upper parts, cinnamon brown, tail rufous of a decidedly different colour from the back; throat and breast with a slight buffy tinge; feathers of the sides of the throat and breast with wedge shaped black spots, those of the breast with large rounded spots; middle of belly whitish.

L., 7.25; W., 3.25; T., 3.00

Nest, on or near the ground. Eggs, greenish blue.

AMERICAN ROBIN.

Adult male. Top and sides of head black; a white spot above the eye, rest of upper parts slaty gray; tail black, the outer pair of feathers, white tipped; throat white, with black spots; breast and sides rufous, the feathers sometimes slightly margined with white; middle of belly white.

Adult female. Similar but much duller and paler.

Immature. Darker brown and spotted above and below.

L., 9.75; W., 5.00; T., 4.00.

Nest, in any convenient place, most frequently in trees. Eggs, four or five, greenish blue.

BLUEBIRD.

Adult male. Upper parts uniform bright blue, the feathers sometimes irregularly margined with rusty; throat breast and sides dull rufous; belly white.

Adult female. Similar but much duller.

Immature. Back spotted with whitish; the feathers of the breast margined with grayish brown.

THRASHERS AND MOCKERS.

Catbird. Neither this nor the succeeding species belong to the Thrush family, but there is a sufficient similarity in their food habits to warrant our considering them here. They are closely allied to the famous Mocking Bird of the south, and their musical powers are not very much inferior to that splendid songster. They do not, however, so frequently exercise their power of mimicry. The peculiar mewing note uttered by the Catbird has caused a certain amount of prejudice to exist against it, and has made it subject to persecution at the hands of most boys; but apart from the unpleasant note the Catbird is one of the most accomplished musicians we have, and it is more to be admired because it does not retire into soli-

Catbird.

tude to pour out its joyous song, but rather seeks the society of mankind, and in the morning and evening will sing its clear notes from the top of some tree in close proximity to the dwelling house. Its food in the early part of the season consists almost entirely of caterpillars and beetles, which it obtains generally from the branches and leaves of trees, though sometimes after rain it seeks for cut worms and other grubs from the ground. Later in the year it feeds largely upon elderberries and other small wild fruits, and does occasionally levy some slight toll from the garden; but for all the cultivated fruit it takes it has amply repaid the gardener by its efforts in the destruction of the insect tribe.

Brown Thrush or Thrasher. All that I have said of the Catbird applies to this species, but it is not quite so familiar and confiding in its habits. It displays a decided preference for thick shrubbery at some little distance from the house. Here it remains in seclusion for the greater part of the day, but in the early morning and evening the male bird mounts to the top of some tall tree near its haunt, and for an hour or so will sing his beautiful song, which is much louder, though less varied, than that of the Catbird.

THRASHERS AND MOCKERS.

Description.

CATBIRD.

Crown and tail black; rest of the plumage dark slaty gray; under tail coverts rich chestnut.

L., 8.95; W., 3.75; T., 4.00.

Nest, in thick bushes; sometimes in a brush pile. Eggs, four or five, dark greenish blue.

BROWN THRUSH—THRASHER.

Upper parts rich rufous brown; wing coverts tipped with whitish; under parts white, heavily streaked with black except on throat and belly.

L., 11.25; W., 4.00; T., 5.25.

Nest, usually on or near the ground in a low bush. Eggs, four or five, greenish white, thickly speckled with minute dots of reddish brown.

WRENS.

This is a most interesting and useful family of very small birds. Four species of them are found in this Province in the summer. Two of them, the Long-billed Marsh Wren, and the Short-billed Marsh Wren, as their name implies, frequent our marshes and low swampy meadows, where they assist in keeping down hordes of mosquitos that are bred in such places. The Winter Wren is a more transitory visitor, the great bulk of them only passing through here in the spring and fall migrations. A few, however, remain through the summer, and nest in some secluded ravine in the woods.

The pert little House Wren takes up its abode right in and around the farm buildings, and even in our cities it will find a resting place, if it can get access to sufficient garden room to give it a hunting ground, and as it is quite satisfied to place its nest in a crevice or hole at no great height from the ground, it is not so likely to be dispossessed of its home by the House Sparrow as are birds that prefer

House Wren.

Cedar Waxwing.

a higher location. They are most indefatigable insect hunters, and should be encouraged to build in every garden. All that is necessary is to furnish them with a small box having a hole about one and one-half inches in diameter. Nail this up to a fence, about eight or ten feet from the ground, so that cats cannot get at it; and if any Wrens come that way in the spring they are almost sure to take possession of it, and having once occupied it, they will in all probability return every year. The domestic cat is their worst enemy, and they seem to know it, for as soon as they catch a sight of one of these detested creatures they start such a scolding that they arouse the whole feathered tribe in their neighbourhood. In the autumn they eat a few elderberries, but this is the only vegetable food I have known them to take.

The number of times House Wrens feed their young in the course of a day has several times been carefully noted. In one case it was found that the young were fed from thirty to forty times every hour, and it must be remembered that the old birds usually carry to their young on each visit not one insect only, but a beak full.

WRENS.

Description.

LONG-BILLED MARSH WREN.

Crown, brown; a white line over eye; back black, streaked with white; rump cinnamon brown; wings and tail barred with blackish; under parts white.

L., 4.75; W., 1.85; T., 1.75.

Nest, globular, attached to flags or rushes in a marsh. Eggs, five or six, pale brownish grey, so thickly speckled with minute chocolate dots as to appear almost entirely of that colour.

SHORT-BILLED MARSH WREN.

Dark brown above, everywhere streaked with black, white, and buffy; wings and tail barred; under parts white, washed on the breast, sides and under tail coverts with buffy.

L., 4.25; W., 1.75; T., 1.50.

Nest, globular, in tall grass in low meadows. Eggs, five or six, white.

WINTER WREN.

Above dark brown; wings and tail barred; a whitish superciliary line; under parts pale brown, the lower breast, sides and belly, more or less heavily barred with blackish.

L., 4.00; W., 2.00.; T., 1.25.

Nest, usually globular, among the roots of a fallen tree, or in a brush heap. Eggs, five or six, creamy white, spotted with reddish brown.

HOUSE WREN.

Upper parts brown, brighter on rump and tail; back with fine indistinct bars; wings and tail finely barred; sides and flanks with many dark bars, other under parts whitish.

Nest, in a hole or crevice, commonly in a bird box. Eggs, six to eight, white, thickly speckled with reddish brown.

CUCKOOS.

Cuckoos. These birds do not seem to be very well known in our Province, though we have two species, one of which is not common. They are known as the Black-billed Cuckoo and the Yellow-billed Cuckoo. Both of them are slim birds, about twelve inches in length, of an olive-brown color above, and white beneath. The Yellow-billed may be distinguished from its relative by the light chestnut color of the inner webs or part of the wing feathers. This is quite noticeable when the bird is flying. It also has the under mandible of the beak clear yellow. In the Black-billed species, the beak is all black, sometimes showing slight dull yellow marks below. Although the birds themselves are not known, most residents of the country must have noticed the loud harsh notes of "kow, kow" uttered by them, most frequently heard before and during rain, by reason of which the birds are in some localities called "rain crows."

The well-known Cuckoo of Europe has the bad habit of laying its eggs in the nests of other birds. but although I have heard our birds charged with the same thing, I have never yet come across an instance of it, but have always found their nesting habits to be quite orthodox, though the nest they build can hardly be considered a model of bird architecture.

These two species of birds are the only ones that to my knowledge habitually eat hairy caterpillars, and of these noxious insects they must destroy a large quantity, an examination of their stomachs generally showing a considerable number of them. On one occasion I found the stomach of a Black-billed Cuckoo packed with the spiny caterpillar of *Vanessa antiopa,* an insect that feeds in colonies and does much damage to the elm and willow trees. And as many as two hundred and fifty tent caterpillars have been found in the stomach of a Cuckoo.

The habits of the two Cuckoos are much alike; the only difference I have noticed is that the Yellow-billed species seems to prefer the upper branches of tall trees in which to obtain its food, while the Black-billed resorts more to the orchard trees and shrubbery. I have not found any evidence of habitual fruit-eating against either of them, so that from an economic standpoint they must be considered as purely beneficial, even if they do occasionally deposit an egg in the nest of another bird.

As an illustration of the number of caterpillars devoured by these Cuckoos, Chapman says that a Yellow-billed Cuckoo shot by him at six o'clock one morning had the partially digested remains of forty-three tent caterpillars in its stomach.

An examination of the stomachs of sixteen Black-billed Cuckoos by the Biological survey of the Department of Agriculture at Washington showed the remains of three hundred and twenty-eight caterpillars, eleven beetles, fifteen grasshoppers, sixty-three saw-flies, three stink bugs, and four spiders. In all probability more individuals than these were represented, but their remains were too badly broken for recognition. Most of the caterpillars were hairy and many of them belonged to a genus that lives in colonies and feeds on the leaves of trees, including the apple. One stomach was filled with larvæ of a caterpillar belonging to the same genus as the tent caterpillar and possibly to that species. Other larvæ were those of large moths for which this bird seems to have a special fondness. The beetles were for the most part Click beetles (the larvæ of which are wireworms) and weevils with a few June beetles and some others.

Of the Yellow-billed Cuckoo twenty-one stomachs were examined. The contents consisted of three hundred and fifty-five caterpillars, eighteen beetles, twenty-three grasshoppers, thirty one saw-flies, fourteen bugs, six flies, and twelve spiders. As in the case of the Black-billed Cuckoo most of the caterpillars belonged to hairy species and many of them were of large size. One stomach contained twelve American tent caterpillars; another, two hundred and seventeen fall web-worms. The beetles were distributed among several families, but all more or less harmful to agriculture. In the same stomach which contained the tent caterpillars were two Colorado potato beetles. The saw-flies were in the larval stage in which they resemble caterpillars very closely. Many species of saw-fly larvæ are exceedingly injurious, among them being the well-known currant worm.

At Midsummer the Yellow-billed Cuckoo seems to be much more active at night than during the day. In the trees around my house I commonly hear them as they forage for food at all hours from sunset to dawn.

CUCKOOS.

Description.

BLACK-BILLED CUCKOO.

Upper parts clear olive brown, with a greenish gloss, wings and tail the same, the latter tipped with white. Under parts dull white; in the adult the eyelids scarlet; yellow in birds of the first season; no rufous on the wings; bill blackish except an occasional trace of yellow on lower mandible.

L., 11.75; W., 5.50; T., 6.50.

Nest, in bushes or low trees. Eggs, two to five, pale greenish blue.

YELLOW-BILLED CUCKOO.

Upper parts clear olive brown, with a greenish gloss; wings mostly reddish chestnut on inner webs of the quills; central tail feathers like the back, the rest black with large white blotches at tips, the outer feathers margined with white; lower mandible chiefly yellow.

L., 12.00; W., 5.50; T., 6.50.

Nest, in bushes or low trees. Eggs, four or five, pale greenish blue.

VIREOS.

Vireos. Among the most voracious, and therefore the most useful, of our insect-eating birds are the Vireos, or Greenlets, as they are sometimes called. The family contains six species, of which the Red-eyed Vireo, Philadelphia Vireo, and Warbling Vireo are fairly common summer residents, breeding in our orchards and shubberies throughout their range in the Province. The Yellow-throated Vireo is uncommon, but probably breeds where it occurs. The White-eyed Vireo is a southern form which has been recorded only once in Ontario, and the Blue-headed Vireo is a regular and not uncommon migrant in spring and autumn, probably breeding in the interior. All these Vireos glean their insect food from the trees and shrubs, never descending to the ground in search of it, and their appetite seems to be insatiable; even in the hottest weather, when most birds retire to the shade and rest for a time in the middle of the day, these birds are active and constantly feeding.

All insect-eating birds require about their own weight of insect food every day, but if I may judge from my experience in trying to feed some of them in

Black-billed Cuckoo.

captivity, the Vireos require much more than that. Probably the wear and tear caused by their constant activity compels them to consume more than most other birds of their size. These birds and the Flycatchers, like the Hawks and Owls, and some others, have the habit of disgorging pellets composed of the indigestible portions of their food.

VIREOS.

Description,

RED-EYED VIREO.

Crown slaty gray, edged with blackish line, a conspicuous white line over eye; below this a dusky stripe through eye; rest of the upper parts light olive green; no wing bars. Under parts white, faintly shaded along sides and on lower tail coverts with olive; eyes red. No spurious quill.

L., 6.20; W., 3.20; T., 2.20.

Nest, pensile, suspended from a forked branch of a tree or bush. Eggs, four, or five, white, with a few brown or blackish spots about the larger end.

PHILADELPHIA VIREO.

Upper parts olive green, brightest behind; crown sometimes grayish; a dull white line over the eye; wings and tail edged with olive green; under parts pale yellowish; nearly white on throat and belly. No obvious wing bars; no spurious quill.

L., 4.75; W., 2.60; T., 2.00.

Nest, pensile, suspended from a forked branch of a tree or bush. Eggs, four, similar to those of the Red-eyed Vireos.

WARBLING VIREO.

Upper parts, ashy olive green, wings and tail brownish edged with olive green; first primary very short, not more than 1.00; under parts white, more or less washed with yellowish. No wing bars.

L., 5.75; W. 2.85; T., 2.20.

Nest, pensile, suspended from the forked branch of a tree. Eggs, three or four, white, with a few spots of brown or blackish at the larger end.

YELLOW-THROATED VIREO.

Upper parts bright olive green, changing to gray on the rump and upper tail coverts; greater and middle wing coverts tipped with white, forming two distinct wing bars; outer web of inner secondaries white; below bright yellow; belly and under tail coverts white; superciliary line and ring round eye yellow; tail dusky, nearly all the feathers with white edging; no spurious quills.

L., 6.00; W., 3.00; T., 2.25.

Nest, pensile, suspended from a fork in a bush or low tree. Eggs, four or five, white, with a few spots of dark brown or blackish chiefly at the larger end.

WHITE-EYED VIREO.

Upper parts bright olive green, more or less washed with grayish; greater and middle wing coverts tipped with yellowish white, forming two distinct wing bars; outer web of inner secondaries whitish; lores and eye ring yellow; throat white or whitish; belly white; breast and sides washed with greenish yellow; iris white in adult; hazel in the young.

L., 5.27; W., 2.37; T., 2.00.

Nest, pensile, suspended from a forked branch in a bush or low tree. Eggs three or four, white, with a few specks of black or dark brown at the larger end.

BLUE-HEADED VIREO.

Crown and sides of head, bluish gray; back olive green; wings and tail dusky, most of the feathers edged with whitish; greater and middle wing coverts tipped with white, forming two distinct wing bars; a broad white line from nostrils around the eye and a dusky loral line. Below, white, sides washed with greenish yellow.

L., 5.50; W., 2.75; T., 2.25.

Nest, pensile, suspended from a fork of a bush or low tree. Eggs, four or five, white, with a few spots of blackish or dark brown chiefly at the larger end.

WAXWINGS.

We have two species of this family in Canada. The Bohemian Waxwing is a winter visitor only, and a somewhat rare one. As it is of no economic importance whatever it need not be considered.

The Cedar Waxwing or cherry bird is very common and, though very beautiful and an insect destroyer to a certain extent, its value to the fruit-grower is somewhat questionable. It undoubtedly consumes a large number of cherries and currants, and some few raspberries, but so far as I have observed the mischief it does is confined to these varieties of fruit alone.

The quantity of fruit consumed by each individual Waxwing does not amount to much, but the trouble is that these birds are gregarious at all times, and visit the cherry orchards in such large flocks, and remain where they find food to their liking so long, that they really do seriously reduce the value of a crop. Where a man makes a specialty of growing these small fruits and finds himself visited by an excessive number of Cherry birds he is undoubtedly justified in protecting his property from destruction, which does not necessarily mean killing the birds. As against this cherry-eating habit of the Waxwing, it may be urged that the birds destroy a large number of injurious insects, leaf-eating beetles especially forming a large proportion of their food. They are also very expert fly-catchers, often hawking about after winged insects in the manner of the Swallows, though their flight is never long sustained. At other times they dart out after passing insects in the manner of the flycatchers, and so on the whole may be said to do more good than harm, for it is only when too many have gathered together in some particular cherry orchard that the damage they do is noticeable at all.

The Cedar Waxwing is rather erratic in its movements, generally being with us a summer resident only, but I have occasionally seen large numbers here in the winter. They then feed on the berries of the Mountain Ash, haws and such other wild fruits as remain hanging on the bushes during the cold season.

WAXWINGS.

Description.

BOHEMIAN WAXWING.

Forehead, chin and line through eye velvety black; a conspicuous crest; front of crown chestnut brown; upper parts rich grayish brown; upper tail coverts, wings and tail grayish; primary coverts and secondaries tipped with white, the latter with narrow red, sealing-wax like tips (sometimes wanting); all but the outer primaries tipped with yellow or white on the outer web; tail broadly tipped with yellow; breast grayish brown; under tail coverts, rich chestnut.

L., 8.00; W., 4.60; T., 2.60.

Nest, in trees. Eggs, pale blue, spotted and marked with purplish brown or black.

CEDAR WAXWING.

Forehead, chin and line through the eye velvety black, bordered on the forehead with white; a conspicuous crest; upper parts rich grayish brown; upper tail coverts, wings and tail gray; secondaries and sometimes tail with small narrow, red sealing wax like, tips (these may be entirely absent); tail tipped with yellow; breast grayish brown, yellowish below; under tail coverts white.

L., 7.25; W., 2.50; T., 2.40.

Nest, in a low tree. Eggs, four or five, pale blue, spotted and marked with purplish brown or black.

FLYCATCHERS.

These birds, as their name implies, subsist largely upon winged insects, which they capture by darting upon them from some elevated post overlooking an open space frequented by their prey. We have eight species, of which the Crested Flycatcher, the Kingbird, the Phœbe bird, the Wood Peewee, and the Least Flycatcher are summer residents, and the Olive-sided, Yellow-bellied, and Traill's Flycatcher are transient visitors, passing through southern Ontario in their spring and fall migrations, and breeding in the interior.

The Kingbird is probably the most obtrusive creature of the whole feathered tribe in Canada. As soon as a pair take possession of a tree in an orchard they immediately proclaim the fact to the neighborhood, and then trouble befalls everything wearing feathers that ventures to trespass on what they are pleased to consider their domain. Crows, Hawks, Jays, and Blackbirds are their especial detestation, and should one of these birds appear near their tree, an attack by the Kingbirds immediately follows, the assault being kept up until the intruder is ignominiously driven off, having lost a few feathers in the encounter, the loss serving to remind him that others have rights which he is bound to respect. The Kingbird captures a vast number of mature insects, both in the air and on the ground, and as at least half these insects would produce eggs to become caterpillars the service rendered is very great. In the early spring, when driven by hunger, the Kingbird will eat the berries of the sumach, but as the clusters of these berries form a favorite hibernating place for many beetles, it is quite possible that the insects form the attraction and not the fruit. They will also take a few June berries when ripe, but so far I have never known them to touch cultivated fruit of any kind.

Kingbird

I have heard complaints from bee-keepers that these birds will destroy bees. It is just possible that they will occasionally take them, but I have seen no evidence that they have acquired the habit. In case the Kingbirds should be seen frequenting the vicinity of hives it would be well to watch closely before shooting the birds, as they are too valuable to be wantonly destroyed, and in all cases an examination of the stomach contents should be made, and the information gained should be reported.

Since writing the above I have received a number of reports from gentlemen in various parts of the Province, who are engaged in bee-keeping, and who have therefore had occasion to observe somewhat closely the habits of such birds as might be suspected of injuring their bees. In no case has the Kingbird been found to be injurious to the inhabitants of the hives, and in all cases the writers speak highly of the services rendered by the Kingbirds in destroying injurious insects and in driving away Crows and Hawks.

Mr. Thaddeus Smith, of Pelee Island, says, "I am a cultivator of the grape and other fruits and also a bee-keeper. . . . I was raised in one of the Southern States, and never knew the Kingbird there by any other name than 'Bee Martin,' and of course it was considered a great enemy of the bees. I have been here over thirty years, and at one time made the science of apiculture a special study, raising choice Italian queens, etc. Kingbirds are here every season, and are to be seen around my bee hives. Years ago I killed some and examined their stomachs, and found them full of bees, but nearly every bee in them was *a drone;* I found *only one worker bee.* You know the drones have no sting and as their name implies they are of no use in the hive. They are the male bee, and their only use is to fertilize the queen bee. The only damage the Kingbird can do is that they might sometimes catch the young queen while on her wedding flight as her size and slow flight make her quite conspicuous. But the possibility of this happening is so slight that I never now shoot the Kingbirds."

The United States Biological Survey has made an examination of 281 stomachs of King birds collected in various parts of the country, but found only fourteen containing remains of honey bees. In these fourteen stomachs there were in all fifty honey bees, of which forty were drones. Four were certainly workers and the remaining six were too badly broken to be identified as to sex.

One bee raiser in Iowa, suspecting the Kingbirds of feeding upon his bees, shot a number near his hives, but when the birds' stomachs were examined by an expert entomologist not a trace of honey bees could be found. (F.E.L., Beal B.S.)

This coincides with my own experience during the last thirty years, during which time I have examined a great many Kingbirds, but have never yet found honey bees among the insects eaten by them.

Phœbe. There is scarcely a farm in the country that has not one or more pairs of Phœbe birds nesting in or about the buildings, and I fancy there are not many bridges of any size under which a nest may not be found; and so I hope it may continue, for the Phœbe is a most useful and friendly little bird. It has all the good traits of the family without being too aggressive, and no suspicion of any act which is in the least injurious attaches to it. If the birds and their nests are left unmolested, they will return year after year to their old home, and as none of our feathered friends are more valuable than they, we should give them every encouragement to do so.

I have particularly mentioned the Kingbird and the Phœbe because they may be regarded as typical of the whole family to which they belong, and being familiar in their habits, they are likely to be well known to every one. All the other species are more or less birds of the woods and orchards, but each one of them in its own chosen locality is rendering us good service the whole summer through.

FLYCATHERS.

Description.

KINGBIRD.

Upper parts grayish slate colour darker on the head and upper tail coverts; crown with a concealed orange patch; tail black tipped with white; under parts white, washed with grayish on the breast; wings dusky, with much whitish edging,

L., 8.50; W., 4.60; T., 3.50.

Nest, usually on the horizontal branch of a low tree Eggs, four or five, white, spotted with reddish brown and lilac.

CRESTED FLYCATCHER.

Upper parts grayish brown, tinged with olive; outer vane of primaries margined with pale chestnut; inner vane of all but the middle tail feathers pale chestnut; throat and breast pearly gray; belly sulphur yellow.

L., 9.00; W., 4.15; T., 3.75.

Nest, in a hole in a tree. Eggs, four or five, white, streaked lengthwise with purplish brown and chocolate.

PHŒBE.

Upper parts dark grayish brown; crown much darker; wings and tail dusky, outer tail feathers, inner secondaries and usually the wing coverts, edged with whitish; under parts white tinged with brownish gray across the breast and elsewhere, washed with yellowish. In the autumn the lower parts are often decidedly yellow.

L., 7.00; W., 3.33; T., 3.25.

Nest, on a beam or rafter of a building. Eggs, four or five, usually pure white.

OLIVE-SIDED FLYCATCHER.

Upper parts dusky brown, with an olive tinge; darker on the crown; wings and tail dusky; chin, throat, under tail coverts and centre line of the breast, white, slightly tinged with yellowish; rest of under parts grayish brown. A tuft of fluffy yellowish white feathers on either flank.

L., 7.40; W., 4.05; T., 2.70.

Nest, on a horizontal branch of a tree. Eggs, four or five, creamy white, spotted with reddish brown.

WOOD PEWEE.

Upper parts olivaceous brown, rather darker on the head, wings and tail dusky; wing coverts tipped with whitish, forming two, more or less, distinct wing bars; under parts white, washed with olive gray on sides of throat and breast.

L., 6.50; W., 3.33; T., 2.60.

Nest, on a low tree. Eggs, four or five, white, dotted and marked at larger end with various shades of brown.

YELLOW-BELLIED FLYCATCHER.

Upper parts olive green; wings and tail dusky; greater and lesser wing coverts tipped with white; under parts sulphur yellow, the throat, breast and sides more or less washed with olive green.

L., 5.65; W., 2.65; T., 2.16.

Nest, on the ground. Eggs, four or five, creamy white, spotted and blotched with brown or various shades.

TRAILL'S FLYCATCHER.

Upper parts olive green, with a brownish tinge; wings and tail dusky; greater and lesser wing coverts tipped with tawny white; under parts whitish, washed with dusky gray on the breast and sides; a slight tinge of yellowish below.

L., 6.09; W., 2.87; T., 2.33.

Nest, low down in a bush. Eggs, four or five, creamy white, with reddish brown markings chiefly towards the larger end.

LEAST FLYCATCHER.

Upper parts grayish olive; wings and tail dusky; greater and lesser wing coverts tipped with ashy brown; under parts whitish, washed with dusky grayish on the breast and sides; pale yellowish below.

L., 5.40; W., 2.50; T., 2.20.

Nest, in a crotch of a tree. Eggs, four or five, usually pure white.

SWALLOWS.

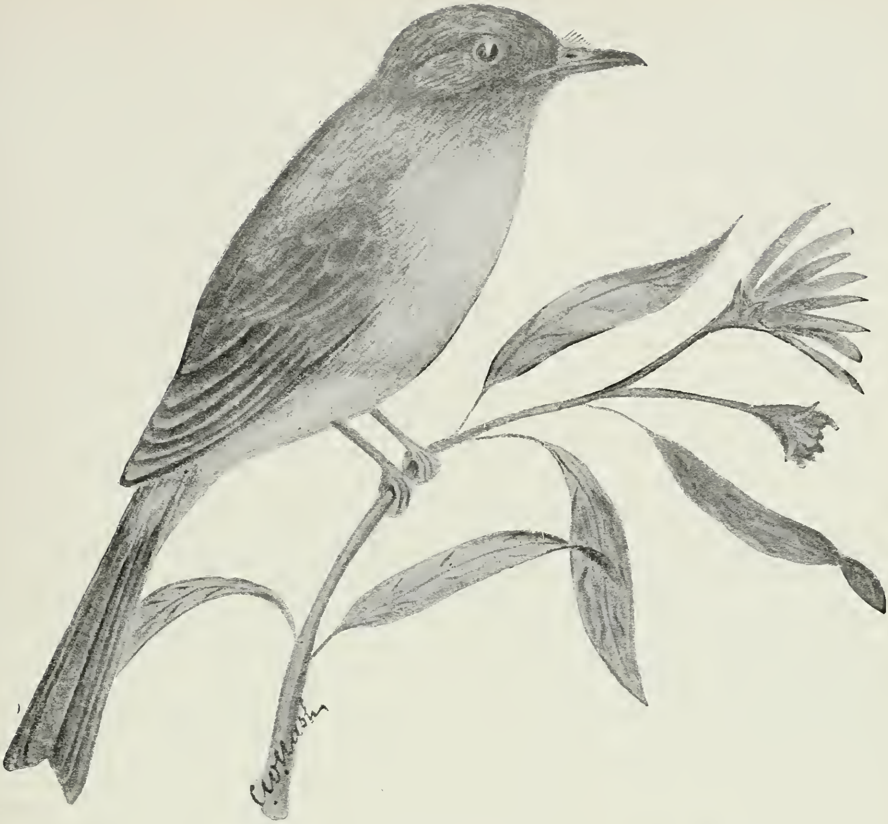
Of this family we have five species, viz.: the Purple Martin, the Barn Swallow. Cliff Swallow, White-breasted Swallow, and Sand Martin, all regular summer residents. Another one, the Rough-winged Swallow, occasionally occurs here, but as it closely resembles the Sand Martin its appearance is not readily noticed.

The economic importance of these birds is very great; without them the smaller winged insects would multiply to such an extent as to become an unbearable nuisance to men and animals; for it is, I believe, to these birds chiefly that we are indebted for our freedom in the cleared and cultivated parts of the country from the swarms of midges, black flies, and gnats of various kinds that so abound in the woods.

These birds seem to have a great predilection for the society of men, partly because the clearing he makes in a forest country opens up to them the necessary space for feeding grounds, and partly because the buildings he erects afford them convenient nesting places, of which the House Sparrow, unfortunately, is dispossessing them.

Except in very stormy weather Swallows usually capture their food whilst they are on the wing, but in the cold windy days that frequently occur in early spring the insects on which they depend are too chilled to fly, and then the Swallows seek them in open places on the ground. The sandy shores of our lakes are particularly resorted to at such times.

In the latter part of July and the beginning of August the large female ants swarm from their nests, each one prepared to found a colony for herself were she permitted; the Swallows, fortunately for us, however, interfere and gorge themselves upon these creatures, the Purple Martins particularly destroying vast numbers of them, even after the ants have divested themselves of their wings: when



Phoebe.

Barn Swallow.

this has taken place the Martins alight on the ground, pursuing them there with the greatest activity.

None of the Swallows, Swifts, or Night Hawks ever under any circumstances take any vegetable food while in this Province, nor have they any habits that are open to objection of any kind, so that our utmost efforts should be put forth to preserve them and encourage them to build about our premises.

I have heard one or two people state that they did not like Swallows about their houses because they brought bed bugs; how such an idea got into any person's head is difficult to understand, and let me say most emphatically that there is no foundation for the belief whatever. Swallows, like all other living creatures, have their insect parasites, but no parasite affecting the Swallows will ever trouble human beings.

SWALLOWS.

Description.

PURPLE MARTIN.

Adult male. Glossy blue black; wings and tail duller.

Adult female and immature. Upper parts glossy bluish black, duller than in the male; wings and tail dusky black; throat, breast and sides brownish gray, more or less tipped with white; belly white.

L., 8.00; W., 5.80; T., 3.00.

Nest, in holes in buildings or in bird houses. Eggs, four or five, white.

CLIFF SWALLOW.

Forehead creamy white, crown steel blue; throat and sides of the head chestnut; a brownish gray ring round the neck; breast brownish gray, tinged with rufous and with a steel blue patch in its centre; belly white; back steel blue; upper tail coverts, pale rufous; tail dusky.

L., 6.00; W., 4.35; T., 2.00.

Nest, of mud generally flask shaped, beneath the eaves of buildings, or under cliffs. Eggs, four or five white, spotted with reddish brown.

BARN SWALLOW.

Upper parts, glossy steel blue; tail deeply forked, all but the middle feathers with white spots on their inner webs. Forehead throat and upper breast rich chestnut; lower parts same colour but paler.

L., 7.00; W., 4.70; T., 3.30.

Nest, generally on or against a rafter in a building. Eggs, four or five, white, spotted with reddish brown.

WHITE-BREASTED SWALLOW.

Upper parts glossy greenish blue; under parts pure white.

Immature. Upper parts brownish gray; below white.

L., 6.00; W., 4.75; T., 2.50.

Nest, in a hole in a tree or building. Eggs, five or six, white.

SAND MARTIN—BANK SWALLOW.

Upper parts brownish gray; throat white; a brownish gray band on the breast. A small tuft of feathers above hind toe.

L., 5.20; W., 4.00; T., 2.00

Nest, in a hole in a sand bank; these birds usually nest in colonies. Eggs, four to six, white.

ROUGH-WINGED SWALLOW.

Upper parts brownish gray; throat and breast pale brownish gray; belly white; outer web of first primary with a series of recurved hooklets; no tuft of feathers above the hind toe.

L., 5.75; W., 4.35; T., 2.10.

Nest, usually in holes under bridges, or in sand banks. Eggs, four to six, white.

NIGHTHAWKS.

All the Swallow tribe gather their food during the day, and the hotter and brighter it is the more active they seem to be; the Chimney Swift's period of greatest activity is the early morning and late evening. The Nighthawk and Whip-poor-will commence their work at dusk and keep it up till sunrise. Their food consists, for the most part, of the large night-flying moths and beetles. On one occasion, however, I found the stomach of a Whip-poor-will filled with the large female wingless ants, which could only have been obtained from the ground, and in all probability in the day time. The common June bug is a favorite article of food with both these birds, and as this is a very destructive insect, both in its larval and mature stages, the birds are entitled to our best consideration for the good work they do in lessening its numbers.

Since writing the above I have found that the large black ant referred to, is active at night as well as through the day and therefore the Whip-poor-will probably captured them during its ordinary feeding time. Where these insects occur abundantly they become an intolerable nuisance, working their way into houses, they swarm over provisions of all kinds and render them distasteful. They also have a habit of forming their nests under the shingles of a roof, and when they do so, leakages quickly follow and repairs are constantly required. When established in a roof it is almost impossible to dislodge them without tearing out the whole fabric. Any bird that assists in keeping these ants in check will always be considered a benefactor by those who have suffered from their ravages.

NIGHTHAWKS.

Description.

WHIP-POOR-WILL

Adult male. Upper parts dark brownish gray, streaked and mottled with brownish-black and buffy; primaries dusky black, with broken rufous bars: four middle tail feathers, like those of the back, the three lateral ones white in their terminal half; throat and breast, similar to the back, with a transverse band of white on the foreneck; rest of the lower parts paler than above and mottled, or barred with blackish.

Whip-poor-will.

Nighthawk.

Adult female. Similar, but three outer feathers narrowly tipped with pale buff and band on the throat creamy buff, instead of white.

L., 9.75; W., 6.08; T., 4.65.

Nest, none. Eggs, two, creamy white, much blotched and marbled with various shades of brown and lilac. The eggs are deposited on the ground, among ferns and dead leaves, in woods or thickets.

NIGHTHAWK.

Adult male. Upper parts mottled with black, brown gray and tawny; below from the breast barred with dusky black and white; throat with a broad white band; primaries dusky, crossed in the middle by a conspicuous white bar; tail dusky black, with broken bars of buff and a large white spot on all the feathers near the end, except the middle ones.

Female. Similar, but no white band on tail, and throat patch buff instead of white.

L., 10.00; W., 7.85; T., 4.60.

Eggs, two, deposited on the bare ground, in open fields or pastures, sometimes in cities on a flat gravelled roof, grayish white marbled and speckled with various shades of gray and brown.

SWIFTS AND HUMMING-BIRDS.

Chimney Swift.

In its manner of feeding the Chimney Swift somewhat resembles the Swallows, for which reason it is commonly called the Chimney Swallow, though it belongs to an entirely different family and is nearly related to the Nighthawks.

These Swifts never alight upon the ground nor upon any horizontal surface. When disposed to rest they do so upon their nest or else cling to the perpendicular side of some hollow tree or building. The materials for the nest are merely dead twigs which are broken off trees as the birds fly.

In cool weather these birds hunt for insects during the day, flying until late in the evening, but when the bright hot days of midsummer come they work chiefly at night, filling up their capacious mouths with great numbers of insects with which to feed their ever hungry young.

Description.

Entire plumage dusky black; grayish on the throat; a sooty black spot before the eye; shafts of the tail feathers, extending beyond the vanes.

L., 5.40; W., 5.00; T., 1.90.

Nest, a basket of twigs, glued to the inside of a chimney or wall of a building with saliva of the bird. Eggs, four or five, pure white.

HUMMING-BIRD.

As this gay little creature flits from plant to plant or hovers before the flowers, thrusting its long beak deep into the corolla, the idea that it is rendering any particular service does not often occur to the casual observer; yet the bird has its own part to play in the economy of nature, and no bird is more highly specialized for the functions it is required to perform than this.

Ruby-throated Humming-bird.

An an agent in the fertilization of many deep tubular flowers its services are very valuable. When the Hummers are working among plants bearing blossoms of this kind their foreheads frequently become so covered with white or yellow pollen, as the case may be, that the real colour of the crown feathers is lost. The pollen so gathered is carried from flower to flower and thus fertilization is effected.

The commonly accepted idea that these birds feed only on the nectar of flowers is erroneous; that they sip some from the blossoms they visit is probably true, for in captivity they are fond of sweetened liquids, but that insects constitute their real food, is proven by examination of the contents of many stomachs. The insects taken are of course very minute, but perhaps none the less harmful on that account.

Humming-birds appear to be partial to small spiders. Of these I have always found a good many among the stomach contents. In taking these spiders from the base of tubular flowers the Hummers were doing good service to the plants, for should the fertilizing organs in the blossom be covered with spiders web, no pollen could be carried in or out, and so fertilization would be impossible.

Description.

Adult male. Upper parts brilliant glossy green; wings and tail dusky with purplish reflections; throat beautiful metallic ruby red bordered on the breast by whitish; rest of the under parts dusky.

Adult female. Similar but duller and no red upon the throat.

L.,. 3.75; W., 1.55; T., 115.

Nest, on the horizontal branch of a tree. Eggs, two, pure white.

WARBLERS.

Warblers. This family contains a large number of species, among them being some of our brightest colored and most interesting birds, though none of them are remarkable as songsters. They are all entirely insectivorous, and consequently of great value from an economic point of view. Thirty-three species are known to occur in this Province; of these seven are so rare as to be considered accidental visitors. They are the Prothonotary, the Golden-winged and Hooded Warblers, the Louisiana Water Thrush, the Prairie Warbler, Kirtland's Warbler, and the Yellow-breasted Chat. Probably when they do occur, they remain and breed here. The Cape May, Orange-Crowned, Tennessee, Cerulean, and Connecticut are regular but uncommon visitors. Of these the Cerulean is known to breed in some localities in southern Ontario, but it is not generally distributed.

The Parula, Black-throated blue, Myrtle, Magnolia, Blackburnian, Bay-breasted, Black poll, Palm and Wilson's Warblers all pass on to the north before nesting. Just how far they go is difficult to say, but in all probability the majority of them at any rate will be found breeding in the unsettled districts of Muskoka, Algoma, etc., and some even south of that.

The Black and white, Nashville, Yellow, Chestnut-sided, Pine, Redstart, Black-throated green, Oven bird, Water Thrush, Mourning, Maryland and Canadian Warblers are generally distributed and breed with us in suitable localities and in varying numbers each season, the most familiar of them all being the Yellow Warbler, which habitually raises its young in and about our orchards and shrubberies. All through the summer they are actively engaged in exterminating the hosts of our smaller insect enemies, and many thousands of broods of caterpillars are destroyed by them before they have become large enough to do mischief.

Although but few species of this group spend the summer with us, the service rendered by the Warblers in the aggregate is beyond compute. In the spring vast waves of them sweep across the Province from south to north feeding as they go upon small insects and newly hatched caterpillars, destroying countless thousands of them before they have time to do mischief and thus no doubt preventing many an outbreak which would be disastrous in its results. Again on their return in the autumn, their numbers increased by their young, they drift slowly southward feeding incessantly, and working so thoroughly over every bush and tree that it would seem impossible for an insect to escape.

Mr. E. H. Forbush says, " In this family we find birds that assume the care of the trees from the ground to the topmost twig. Some walk daintily over the earth searching among the shrubbery and fallen leaves; others cling close to the bark, and search into every crevice for those insignificant insects which collectively form the greatest pests of forest and orchard; others mount into the tree, skip from branch to branch and peer about among the leaves or search the opening buds: others habitually ascend to the tree tops; while still others are in almost constant pursuit of the winged insects that dart about among the branches.

WARBLERS.

Description.

BLACK AND WHITE WARBLER.

Adult male. No yellow anywhere; upper parts streaked with black and white: ear coverts black; inner webs of outer tail feathers with white patches; wing coverts black tipped with white: throat and upper breast black; sides streaked with black and white; middle of belly white.

Adult female. Similar, with fewer black streaks; sides washed with brownish.

Immature. Similar to female but more streaked below.

L., 5.30; W., 2.75; T., 2.00.

Nest, on the ground at base of a stump. Eggs, four or five, white, spotted with reddish or dark brown, chiefly in a wreath at larger end.

PROTHONOTARY WARBLER.

Adult male. Whole head, neck and under parts rich orange, lighter on the belly: back greenish yellow, changing to bluish gray on the rump; wings and tail ashy; inner webs of all but the middle feathers white, except at the tip. No wing bars.

Adult female. Similar, but the yellow is paler, the belly with more white.

L., 5.50; W., 2.90; T., 1.85.

Nest, in a hole in a stump. Eggs, four or five, white, thickly and rather heavily marked and washed with various shades of brown.

GOLDEN-WINGED WARBLER.

Adult male. Crown bright yellow; rest of the upper parts bluish gray, sometimes washed with greenish; a large black patch about the eye; separated from another on the throat by a white stripe; a white line over the eye, wings and tail bluish gray; tips of middle wing coverts and outer webs of greater ones, bright yellow, forming a large yellow patch on the wing; outer three tail feathers with large white patches on their inner webs at the tip; fourth feather with a smaller patch; lower breast and belly white; sides grayish.

Adult female. Similar, but the crown duller, the patch on the sides of the head and throat grayish instead of black.

L., 5.10; W., 2.45; T., 1.95.

Nest, on or near the ground, generally in bushy fields. Eggs, four or five, white, speckled and spotted with various shades of brown, chiefly about the larger end.

NASHVILLE WARBLER.

Adult. Top and sides of the head bluish gray, a partially concealed chestnut patch in the centre of the crown; back and rump bright olive green, wings and tail edged with the same; under parts bright yellow, whiter on the belly.

L., 4.75; W., 2.30; T., 1.80.

Nest, on the ground among bushes. Eggs, four or five, white, thickly speckled with reddish brown, chiefly at the larger end.

ORANGE-CROWNED WARBLER.

Adult. Upper parts ashy olive green; feathers of the crown orange at the base; wings and tail edged with olive green; eye ring yellow; under parts greenish yellow, obscurely streaked with dusky on the breast.

Immature. Similar, but duller and without orange on the crown.

L., 5.00; W., 2.50; T., 2.00.

Nest, on or near the ground. Eggs, four or five, white, speckled with various shades of brown, chiefly at the larger end.

TENNESSEE WARBLER.

Adult male. Top and sides of the head bluish gray, in strong contrast with the bright olive green back and rump; wings and tail edged with olive green; inner margin of inner vane of outer tail feathers generally white at tip; under parts white.

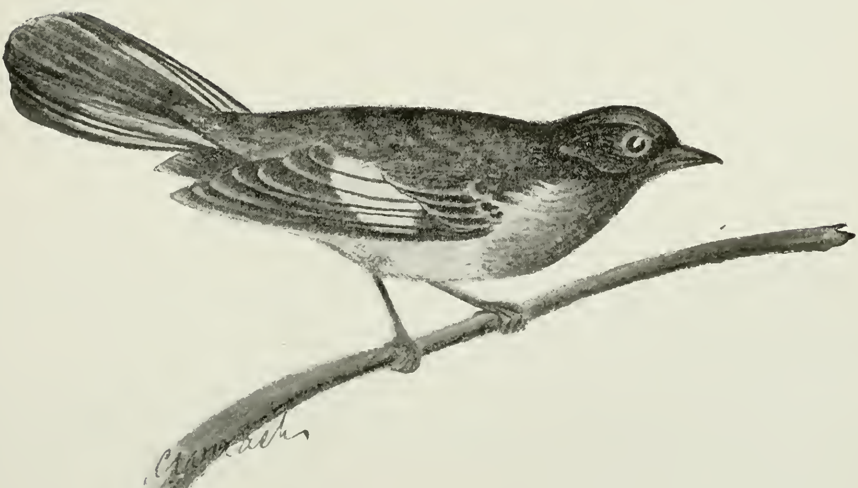
Adult female. Similar, but crown tinged with greenish and under parts washed with yellowish.

Immature. Upper parts uniform olive green, under parts washed with yellowish; under tail coverts white.

L., 5.00; W., 2.65; T., 1.70.

Nest, in a low bush near the ground. Eggs, pearly white, with a wreath of brown and purplish spots around the larger end.

Myrtle Warbler.



American Redstart.

PARULA WARBLER.

Adult male. Upper parts blue; a brownish yellow patch in the middle of the back; greater and lesser wing coverts tipped with white; outer tail feathers with a white patch near the end; throat and breast yellow, more or less marked with rufous, a rich brown or blackish band across the breast; belly white.

Adult female. Similar, but duller, and the throat and back patches indistinct or wanting.

L., 4.75; W., 2.40; T., 1.75.

Nest, generally among hanging mosses. Eggs, four or five, white, with reddish brown spots, chiefly around the larger end.

CAPE MAY WARBLER.

Adult male. Crown black, slightly tipped with greenish; ear coverts chestnut, bounded behind by a large yellow patch on the side of the neck; back olive green, broadly streaked with black; rump yellow; a large white patch on the wing coverts; outer tail feathers with a large white patch on their inner webs, near the tip; under parts yellow, heavily streaked with black, lower belly and under tail coverts whitish.

Adult female. Upper parts grayish olive green; rump yellowish; a yellow line over the eye; middle wing coverts with narrow white tips; outer tail feathers with a white patch on their inner webs near the tip; under parts yellow, streaked with black.

L., 5.00; W., 2.60; T., 1.85.

Nest, partially pensile, on a branch of a small tree in open woodland. Eggs, three or four, dull white, slightly speckled and wreathed round the larger end with spots of brown and lilac.

YELLOW WARBLER.

Adult male. Upper parts greenish yellow; bright yellow on crown; wings edged with yellow; tail dusky, the inner vanes of the feathers yellow; under parts bright yellow streaked with reddish.

Adult female. Upper parts uniform yellowish olive green, tail and wings as in the male, under parts yellow, but slightly streaked.

L., 5.25; W., 2.50; T., 2.00.

Nest, in shrubs or low trees. Eggs, four or five, bluish white, spotted and blotched with reddish brown.

BLACK-THROATED BLUE WARBLER.

Adult male. Upper parts slaty blue; wings and tail edged with blue; base of the primaries white, forming a white spot on the wing at the end of the primary coverts; inner vanes of outer tail feathers with a white patch near their tips; sides of the head and throat black; breast and belly white.

Adult female. Upper parts dull olive greenish, sometimes with faint bluish shade, the white patch on outer feathers of tail sometimes scarcely distinguishable; white at base of the primaries very much reduced; ear coverts dusky gray; under parts soiled yellowish.

L., 5.25; W., 2.50; T., 2.25.

Nest, in a bush near the ground. Eggs, four or five, white, dotted with various shades of brown, chiefly at the larger end.

MYRTLE WARBLER.

Adult male. A yellow patch on the crown, rump, and either side of the breast; upper parts bluish gray, streaked with black; two white wing bars; outer tail feathers with white spots on their inner vanes near the tip; throat white; breast heavily marked with black; belly white.

Adult female. Similar but duller, the blue with a brownish tinge and less black below.

L., 5.65; W., 2.85; T., 2.25.

Nest, in low trees. Eggs, four or five, grayish white, spotted and speckled with various shades of brown

MAGNOLIA WARBLER.

Adult male. Crown bluish gray; cheeks and forehead black, a white line behind the eye; back black, bordered with olive green; a large white patch on the wing coverts; rump yellow, tail black, inner vanes of all but the central feathers with white patches on their middle, the end third of the feather being entirely black; throat yellow, breast and sides heavily streaked with black.

Adult female. Similar but with the back greener and the colours duller.

L., 5.12; W., 2.30; T., 2.00.

Nest, in low trees. Eggs, white, marked with dots of varying shades of brown, chiefly wreathed at larger end.

CERULEAN WARBLER.

Adult male. Upper parts bright blue; sides of head and back streaked with black; wings and tail edged with blue; two white wing bars; inner vanes of all but the central tail feathers with white patches at their tips; under parts white, sides and breast streaked with bluish black.

Adult female. Upper parts bluish olive green, wings and tail as in the male; under parts white, more or less tinged with yellowish.

L., 4.50; W., 2.65.

Nest, in a tree. Eggs, four, creamy white, thickly blotched with reddish brown.

CHESTNUT-SIDED WARBLER.

Adult male. Crown bright yellow; a black line behind the eye; front part of the cheeks black; ear coverts white; back streaked with black and margined with olive green; wing bars yellowish white; tail black, the outer feathers with white patches on their inner vanes at the tip; under parts white, the sides chestnut.

Adult female. Similar but duller in colour.

Immature. Upper parts, bright yellowish olive green, back sometimes streaked with black; wing bars yellowish white; under parts pure white, the sides sometimes with spots of chestnut.

L., 5.14; W., 2.45; T., 2.00.

Nest, generally low down in a bush. Eggs, four or five, white, wreathed at the larger end with various shades of brown.

BAY-BREASTED WARBLER.

Adult male. Forehead and cheeks black; a creamy buff patch on the sides of the neck; crown chestnut; throat, upper breast and sides reddish chestnut; back brownish ashy, streaked with black; two white wing bars; inner vanes of outer tail feathers with white patches at their tips, lower breast and belly buffy white.

Adult female. More olivaceous than male and colours duller, but always more or less chestnut.

Immature. Upper parts bright olive green, indistinctly streaked with black; wings and tail much as in the adults; under parts white, tinged with buff on sides and flanks.

L., 5.63; W., 2.95; T., 2.12.

Nest, in low trees. Eggs, four or five, white, finely dotted, chiefly at the larger end, with various shades of brown.

BLACK-POLL WARBLER.

Adult male. Crown black; ear coverts white, nape streaked, black and white; back and rump ashy, streaked with black; two white wing bars; inner vanes of outer tail feathers with white patches at their tips; under parts white, streaked with black, the streaks most numerous on the sides and wanting on the middle of the breast and belly.

Adult female. Upper parts olive green, distinctly streaked with black; wings and tail as in the male; under parts white tinged with yellow; the breast and sides streaked with black.

Immature. Similar to female, but the upper parts brighter and not distinctly streaked; under parts yellower and not distinctly streaked.

L., 5.75; W., 3.00; T., 2.25.

Nest, generally in spruce trees. Eggs, four or five, white, more or less speckled and blotched at the larger end with various shades of brown.

BLACKBURNIAN WARBLER.

Adult male. Back, black more or less interrupted with yellowish; crown, with a central orange spot; a broad black stripe through the eye enclosing the orange under eye lid; rest of head with whole throat, most brilliant orange; other under parts, whitish, more or less tinged with yellow; sides streaked with black; wing bars fused into a large white patch; tail blotches, white, occupying nearly all the outer feathers.

Adult female. Upper parts, olive and black streaked; superciliary line and throat clear yellow, fading insensibly on the breast; lower eyelid yellow; wing patch, resolved into two bars; tail blotches nearly as extensive as in the male.

L., 5.25; W., 2.75; T., 2.25.

Nest, usually in coniferous trees. Eggs, four greenish white, speckled toward the larger end with various shades of brown and lilac.

BLACK-THROATED GREEN WARBLER.

Adult male. Upper parts bright olive green, back sometimes spotted with black; line over the eye and cheeks bright yellow, ear coverts dusky; two white wing bars; inner vanes of outer tail feathers entirely white, outer web white at the base; throat and breast black; belly white, sometimes tinged with yellow; sides streaked with black.

L., 5.10; W., 2.45; T., 2.00.

Adult female. Similar, but the black of throat and breast more or less mixed with yellowish.

Nest, generally in coniferous trees. Eggs, four, white, spotted with various shades of brown chiefly at the larger end.

KIRTLAND'S WARBLER.

Head bluish gray, sometimes spotted with black; lores and sides of the throat black; back brownish ashy, spotted with black; no white wing bars; outer tail feathers with white patches on their inner webs at the tips; under parts pale yellow; sides streaked and spotted with black.

L., 5.75; W., 2.75; T., 2.25.

PINE WARBLER.

Adult male. Upper parts bright olive green sometimes washed with ashy; two whitish wing bars; outer tail feathers with white patches on their inner vanes near the tip; under parts bright yellow, more or less washed with ashy, turning to white below, sides sometimes with a few black streaks.

Adult female. Similar, but much duller; under parts mostly whitish tinged with yellow.

L., 5.50; W., 2.75; T., 2.25.

Nest, usually in a pine tree. Eggs, four or five, grayish white, much speckled with various shades of brown, chiefly at the larger end.

PALM WARBLER.

Crown chestnut; back brownish olive; rump olive green; no white wing bars; secondaries sometimes tinged with chestnut; tail edged with olive green, the outer feathers, with white spots on their inner vanes near the tips; line over the eye and eye ring yellow; under parts entirely bright yellow; sides of the throat, breast and sides, streaked with chestnut.

L., 5.45; W., 2.60; T., 2.25.

Nest, on or near the ground. Eggs, four or five, white, spotted with various shades of brown chiefly near the larger end.

PRAIRIE WARBLER.

Adult male. Upper parts bright olive green; back spotted with chestnut; wing bars yellowish; outer tail feathers with large white patches at their tips, the outer vane of the outer feather white at the base; a yellow line over the eye; lores and a crescent below the eye black; under parts bright yellow; sides heavily streaked with black.

Adult female. Similar, duller, and sometimes with no chestnut on back.

Nest, in briary bushes. Eggs, four or five, white, spotted with various shades of brown, chiefly in a wreath at the larger end.

GOLDEN-CROWNED THRUSH—OVEN-BIRD.

Centre of crown, orange brown, bordered with two black stripes; rest of the upper parts, wings and tail olive green; no wing bars or tail patches; under parts white, thickly spotted with dusky on breast and sides; a narrow blackish maxillary line; eye ring white.

L., 6.15; W., 3.00; T., 2.25.

Nest, on the ground, covered in, the entrance at one side. Eggs, four or five, white, speckled finely with reddish brown and lilac.

WATER THRUSH.

Upper parts and tail deep olivaceous brown; no wing bars or tail patches; a buffy line over the eye, under parts white tinged with pale sulphur yellow and thickly streaked with blackish.

L., 6.00; W., 2.25; T., 2.15.

Nest, on a bank or among the roots of a fallen tree. Eggs, four or five, white, marked with reddish brown and lilac.

LOUISIANA WATER THRUSH.

A conspicuous white line over the eye; upper parts wings and tail deep olivaceous brown; no wing bars or tail patches; under parts white tinged with creamy and streaked with black except on the throat and middle of belly.

L., 6.28; W., 3.25; T., 2.15.

Nest, on a bank or among the roots of a fallen tree. Eggs, four or five, white, spotted with various shades of brown and lilac.

CONNECTICUT WARBLER.

Adult male. Head, neck and breast ashy gray, lighter on the throat; eye ring white; rest of upper parts, wings and tail olive green; no wing bars or tail patches; below from the breast yellow; sides tinged with olive green.

Adult female. Upper parts uniform olive green; throat and breast grayish brown; below pale yellow.

L., 5.50; W., 2.75; T., 2.00.

Nest, on the ground. Eggs, four, creamy white, a few spots of purplish brown and black about the larger end.

MOURNING WARBLER.

Adult male. Head and neck bluish ash, the feathers of the throat and breast black margined with ash; no white eye ring; rest of upper parts, wings and tail olive green; no wing bars or tail patches; below yellow.

L., 5.50; W., 2.25; T., 2.25.

Adult female. Similar but duller, olive green above slightly grayer on head; breast grayish; throat whiter.

Nest, on or near the ground. Eggs, four, white, speckled with reddish brown.

Yellow Warbler.

American Goldfinch.

MARYLAND WARBLER.

Adult male. A broad band across the forehead, on the cheeks and ear coverts, black, bordered behind by grayish; rest of the upper parts, wings and tail olive green; no wing bars or tail patches, throat and breast bright yellow, whitish below; under tail coverts yellow.

Adult female. No black mask; upper parts, wings and tail olive green; throat and breast yellowish.

L., 5.33; W., 2.20; T., 2.00.

Nest, on or near the ground. Eggs, four or five, white, rather thinly speckled with reddish brown, chiefly near the larger end.

YELLOW-BREASTED CHAT.

Upper parts, wings and tail olive green; line from the eye to the bill, one on the side of the throat and eye ring white; throat and breast bright yellow; below white; sides grayish.

L., 7.45; W., 3.00; T., 3.05.

Nest, in a bush near the ground. Eggs, four or five, white, evenly speckled with reddish brown.

HOODED WARBLER.

Adult male. Forehead and cheeks bright yellow; crown black, connected behind with the black throat; upper parts, wings and tail olive green; outer tail feathers, with inner vane mostly white; below yellow.

Adult female. Similar but with the black on head and breast somewhat restricted and less clearly defined.

L., 5.50; W., 2.50; T., 2.25.

Nest, in bush or low tree. Eggs, four or five, white, rather thinly speckled with reddish brown chiefly about the larger end.

WILSON'S WARBLER.

Adult male. Forehead yellow, crown black; rest of the upper parts, wings and tail bright olive green; no wing bars or tail patches; under parts bright yellow.

Adult female. Similar but black cap small or wanting.

Immature. Like female.

L., 5.00; W., 2.20; T., 2.00.

Nest, on the ground. Eggs, four or five, white, speckled with reddish brown and pale lilac.

CANADIAN WARBLER.

Adult male. Upper parts, wings and tail gray, no wing bars or tail patches; crown spotted with black; line from the bill to the eye and under parts yellow; sides of the neck black; a necklace of black spots across the breast; under tail coverts white.

L., 5.60; W., 2.50; T., 2.25.

Nest, in a bank or among roots. Eggs, four or five, white, speckled chiefly at the larger end with reddish brown.

REDSTART.

Adult male. Upper parts, throat and breast shining black, basal half of the wing feathers orange, end half and wing coverts black; basal two-thirds of all but the middle tail feathers orange, end third and middle feathers black; sides of the breast and flanks deep orange; belly white.

Adult female and Immature. Orange of the male replaced by dull yellow; head grayish; back ashy brown.

L., 5.40; W., 2.55; T., 2.25.

Nest, in the crotch of a small tree. Eggs, four or five, grayish white, spotted and blotched chiefly at the larger end with various shades of brown.

KINGLETS AND GNATCATCHERS.

Kinglets. These are, next to the Humming bird, the smallest birds we have, their want of size, however, being amply compensated for by their constant activity in pursuit of their insect food, and the number of them that pass through the Province during their migrations. There are two species of them, the Ruby Crowned Kinglet and the Golden Crowned Kinglet, the latter being much more abundant. The names given them are sufficiently descriptive of the color of their crests to enable them to be easily identified when examined; in other respects they are almost indistinguishable. The Ruby Crown has a wonderfully loud voice for such a minute creature, and is a good singer. The Golden Crown has no song at all. Early in April myriads of these little birds pass over the country working their way northward, and may be seen in our orchards and shrubberies carefully searching every part of the trees and bushes for the insects and their eggs that are hidden from all eyes less keen than theirs, and cutting short the career of a vast number of insects before they have developed sufficiently to do mischief. Neither of them has as yet been positively ascertained to breed in the southern part of Ontario, but no doubt they do so in the evergreen woods to the north of us. About the end of September they return, their numbers increased by the broods of the year; they are not now in any hurry, but just loiter along toward the south, until the middle of November, when the last of the migrating host disappears. All the Ruby Crowns leave us, but there are always a goodly number of Golden Crowns which remain in our sheltered evergreen woods all through the winter. How such tiny creatures can resist the extreme cold of that season is a mystery; but they do it, and can even then find enough insects and their eggs (for they eat nothing else) to keep them in good condition.

They are expert in capturing small moths on the wing and no doubt destroy a great many of them, but the greatest service they render us is in destroying the eggs of the aphides, scale insects and other insects which are too small to attract the attention of larger birds.

Blue-gray Gnatcatcher. In Southwestern Ontario this little bird is a regular though never a common summer resident. While it does not occur in sufficient numbers to be an important economic factor, yet it assists the warblers in keeping in check the foliage devouring insects which swarm the trees in summer.

KINGLETS AND GNATCATCHERS.

Description.

RUBY-CROWNED KINGLET.

Adult. Crown with a partly concealed crest of rich scarlet; upper parts, greenish olive; below whitish; wings and tail dusky, edged with yellowish; wing coverts whitish tipped.

Immature. Similar, but crown patch wanting during first year.

L., 4.50; W., 2.25; T., 1.70.

Nest, usually in a coniferous tree. Eggs, five to nine, whitish, faintly speckled with reddish brown at the larger end.

GOLDEN-CROWNED KINGLET.

Adult male. Centre of crown bright reddish orange, bordered by yellow and black; a whitish line over the eye; rest of upper parts olive green; wings and tail dusky, margined with greenish yellow; under parts soiled whitish.

Adult female. Similar, but crown without orange, its centre yellow and bordered by black.

L., 4.50; W., 2.25; T., 1.70.

Nest, in coniferous trees. Eggs five to nine, creamy white, spotted with brown and lilac.

BLUE-GRAY GNATCATCHER.

Adult male. Upper parts bluish gray; forehead narrowly bordered by black; wings edged by grayish, the secondaries bordered with whitish; outer tail feathers white; changing gradually until the middle ones are black; under parts dull grayish white.

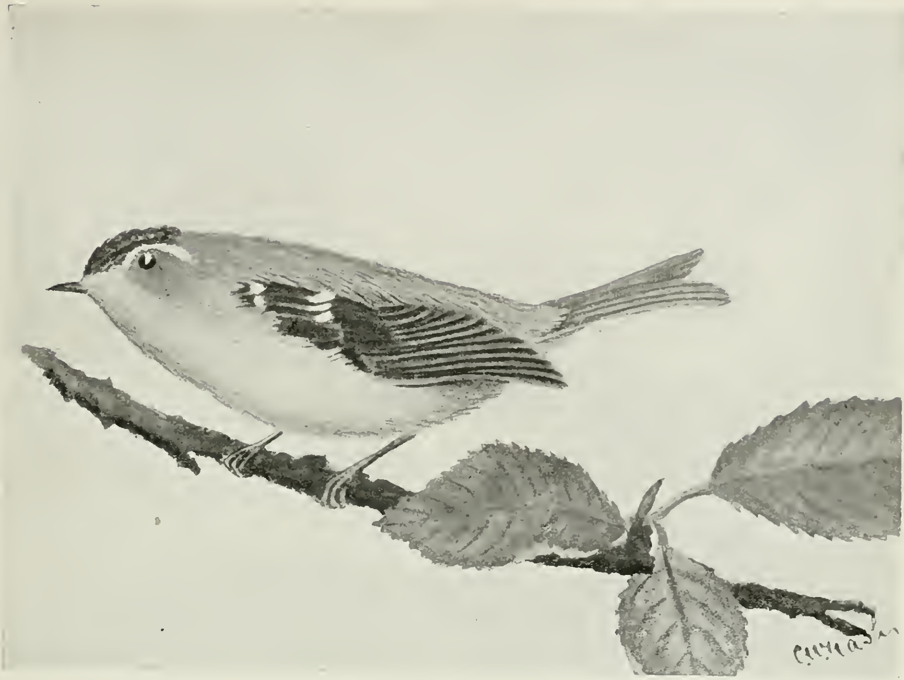
L., 4.50; W., 2.05; T., 2.00.

Nest, in a tree. Eggs, four or five, bluish white, thickly speckled with varying shades of brown.

WEED DESTROYERS.

It used to be the custom to divide birds into three classes with reference to the food they are supposed to eat, viz., birds of prey, insect eaters, and seed eaters. No such distinction can properly be made; all birds, even the Hawks and Owls, feed more or less upon insects, and nearly all the so-called seed-eating birds raise their young entirely upon insects. After the young reach maturity and the approach of cold weather reduces the insect supply, birds of this class display their usefulness by helping to clear the fields of the seeds of weeds as they ripen, and all through the winter they continue the work of harvesting this most objectionable crop.

Year after year farmers and gardeners expend large sums for labor applied for the destruction of noxious weeds, and would no doubt be willing to pay much more to fully protect their crops from injury by these pests if it could be done. Perfect immunity from insects and weeds can never be expected. We may, however, reduce the loss caused by them much below what it is at present without the expenditure of any great amount of time or money by availing ourselves of the assistance of the natural enemies of both of them.



Golden-crowned Kinglet.

Rose-breasted Grosbeak.

In 1881 Mr. F. E. L. Beal made an estimate of the amount of weed seed eaten by the common Tree Sparrow during the winter months in the State of Iowa. As the conditions in that state so far as the Tree Sparrow is concerned are similar to our own, I give the estimate to show the value of birds of this class as weed destroyers Mr. Beal says: "Upon the basis of one-fourth of an ounce of seed eaten daily by each bird and supposing that the birds averaged ten to each square mile and that they remain in their winter range two hundred days, we shall have a total of 1,750,000 pounds or 875 tons of weed seed consumed by this one species in a single season."

Personal experience has shown me that Mr. Beal's estimate of the amount of weed seed eaten each day by birds such as the Tree Sparrow, Song Sparrow and Snow Bird is correct; for I have had many of our finches and sparrows in captivity for long periods and have carefully measured the quantity of seed they consumed, in all cases it was about a quarter of an ounce daily, and I feel assured that birds at liberty in cold weather would certainly require more than that. Most farmers can make a guess at the number of the seeds of the common weeds that would be required to weigh a quarter of an ounce and that will give an idea of the good service a flock of gray birds or snow birds are rendering him while they are frequenting his fields.

SPARROWS, FINCHES, ETC.

This is a very large family, represented in Ontario by thirty-four species. Want of space prohibits my calling attention to the food habits of each of these in detail. It will, however, be sufficient for the purpose of this paper to refer particularly to those only which in some manner are specially beneficial or injurious to the crops usually cultivated for profit. All these birds are insect eaters in the summer months, and their young while in the nest are fed entirely on insects; but in the autumn, winter and early spring the mature birds subsist principally on the seeds of wild plants and forest trees.

Native Sparrows. Among the most familiar birds that spend the summer on and about the farm are the native Sparrows, commonly known as Grey Birds. The most abundant of these are the Chipping Sparrow, Song Sparrow, Vesper Sparrow, and Field Sparrow. The first three are to be found everywhere; the Field Sparrow is more locally distributed, but is sufficiently abundant to be of economic value where it occurs. These are all of the so-called seed eating class, but the seeds eaten by them are the seeds of plants that can well be dispensed with. I have but rarely found any cultivated grains among their stomach contents, the only ones being a few oats in the fall. All through the summer a large part of the food of the adults consists of insects, and the young are fed entirely upon them until they leave the nest. As these birds raise two and sometimes three broods each season this means a vast number of insects taken from the crops. Small insects of all kinds are eaten, but the birds seem to show a preference for beetles, and a great partiality for the pea weevil or peabug. These appear about the peas when they are in blossom, and I have often watched the Chipping Sparrow, Vesper Sparrow and Song Sparrow, together with the much abused House Sparrow, busily engaged in capturing these beetles about the pea vines, and specimens taken by me at this time had their crops and stomachs filled with them.

When the breeding season is over these Sparrows gather into flocks and may be found in large numbers in the weed patches too often left about the farm. Here they are doing service not less valuable than that rendered by their destruction of insect pests in the summer, and which has only to be observed to be appreciated.

In the spring we are visited by an innumerable army of Sparrows larger than those I have mentioned. These are the White-Throated Sparrow, White-Crowned Sparrow, and Fox Sparrow. They are on their way to their breeding grounds to the north of us. The Fox Sparrows pass through early in April, and rarely stay more than three or four days. The other two come later, and remain much longer, their migration lasting about three weeks. During all this time they frequent weedy places, where they may be observed industriously foraging for the seed of injurious plants About the middle of September they return, having their number largely increased by the young raised during the summer, and they remain for about a month. During that time they visit nearly every weed patch and brush heap in the Province and feed luxuriously, not only on the seeds of the weeds we are most anxious to get rid of, but they also find in such places large numbers of mature insects which would lie there dormant during the winter ready to emerge in the spring to work mischief in the crops. Each female insect killed at this time means cutting off the source of supply of several hundreds of larvæ for the next year. In this way the birds are doing most excellent work for the farmer, the value of which can hardly be calculated in dollars and cents, and it is work that, with all our industry and ingenuity, we are not yet able to do for ourselves.

As winter comes on and our summer residents and spring and autumn visitors leave for the south, vast flocks of weed gleaners come from the north to take their place. The best known of these are the Snow Bird, Tree Sparrow and Slate-Colored Junco. Large numbers of these birds remain with us all through the cold season, frequenting patches of weeds that carry their seed above the snow, and by their work materially lessening the number to spread over the country and germinate in the spring.

SPARROWS.

Description.

CHIPPING SPARROW.

Adult. Forehead black, a short grayish line in its middle; top of the head chestnut; a grayish line over eye and a black line behind it; back of neck grayish; back streaked with black, chestnut, and buffy, rump slaty gray; wing bars not conspicuous; under parts grayish white, whiter on throat; bill entirely black.

Immature. Breast streaked, no chestnut on crown; bill brownish.

L., 5.37; W., 2.75; T., 2.30.

Nest, in trees or bushes. Eggs, four or five, pale blue, with brown or blackish marking at larger end.

SONG SPARROW.

Crown reddish brown, with a grayish medium line; a grayish line over eye; a reddish brown line from behind eye to the nape; feathers of the back streaked with black and margined with brown and gray; greater wing coverts with black spot at their tips; tail reddish brown, the middle feathers darker along their shafts; sides of the throat with blackish streaks; breast with wedge shaped streaks of black and dark brown which tend to form a large blotch on the centre; sides washed with brownish and streaked with dark brown.

L., 6.30; W., 2.50; T, 2.60.

Nest, on the ground, or low down in bushes or brush heaps. Eggs, four or five, grayish or bluish white, speckled with brown of various shades; very variable.

VESPER SPARROW.

Upper parts brownish gray streaked with black and a little buff; wings dusky, greater and middle coverts tipped with white; lesser coverts bright chestnut; tail dusky, the outer feathers mostly white, the next one with less; under parts white; the breast and sides streaked with black and buff.

L., 6.15; W., 3.00; T., 2.30.

Nest, on the ground. Eggs, four or five, pinkish white, spotted with reddish brown.

FIELD SPARROW.

Top of head dull chestnut; a gray line over eye; back finely streaked with black, the feathers margined narrowly with ashy brown; middle and greater wing coverts tipped with white; under parts white tinged with buff on breast and sides.

Immature. Breast streaked with blackish.

L., 5.65; W., 2.50; T., 2.55.

Nest, on the ground or low down in a bush. Eggs, four or five, bluish white, variously marked with reddish brown.

WHITE-THROATED SPARROW.

Adult male. Centre of crown with a clear white stripe, bounded on either side by wider black stripes; a white stripe from the eye passes backward along the side of head, in front of which is a short yellow stripe; back chestnut brown streaked with black, the feathers in part margined with grayish; rump grayish brown; bend of wing yellow; greater and median wing coverts tipped with white, forming wing bars; tail grayish brown; under parts grayish and darker on the breast; throat with a clear white patch.

Female and immature. The clear white of crown and throat replaced by buff.

L., 6.75; W., 2.90; T., 2.85.

Nest, in bushes. Eggs, four or five, bluish white, clouded and blotched rather heavily with reddish brown.

WHITE-CROWNED SPARROW.

Adult. Centre of crown with a clear white stripe bordered on either side by black stripes all of about equal width, a clear white line over the eye passes back along the side of the head; nape gray; general color above ashy gray, the middle of the back streaked with brown and whitish, greater and middle coverts tipped with white; tail dusky; under parts grayish white.

Immature. Similar, but sides of the crown rufous brown and centre of crown pale grayish brown.

L., 6.85; W., 3.00; T., 2.85.

Nest, on or near the ground in bushes. Eggs, four or five, pale greenish blue, speckled at the larger end with reddish brown.

FOX SPARROW.

Upper parts rusty red; upper tail coverts and tail bright rufous; wings margined with rufous; below white, heavily streaked with rusty brown and blackish; tips of middle and greater coverts forming two whitish wing bars.

L., 7.25; W., 3.35; T., 2.85.

Nest, on the ground or in low trees or bushes. Eggs, four or five, pale bluish, heavily spotted with rusty brown.

Chipping Sparrow.

Song Sparrow.

SNOWFLAKE—SNOW BUNTING.

Adult in winter. Upper parts rusty brown, darker on the centre of the crown; back showing irregular streaks of black caused by the black bases of the feathers showing through their rusty tips; wings white, the end half of the primaries and inner secondaries black; outer tail feathers white, inner ones black, all these more or less edged with rusty; under parts white, the breast and sides washed with rusty.

Adult in summer. Whole head, neck, upper tail coverts and under parts white; back, black; outer tail feathers white, inner ones black.

L., 7.00; W., 4.00; T., 2.75.

Nest, on the ground, in arctic regions. Eggs, four or five, white, scrawled and dotted with brown and lilac.

TREE SPARROW.

Top of head chestnut brown, in winter edged with ashy, a grayish line over eye and a chestnut brown line behind it, back streaked with chestnut brown, black and buff; upper tail coverts pale grayish brown; greater and middle wing coverts tipped with white, forming whitish wing bars; primaries and tail feathers dusky with pale edges; below whitish tinged with ashy, an obscure dusky blotch on the middle of the breast.

L., 6.36; W., 3.00; T., 2.85.

Nest, on or near the ground. Eggs, four or five, pale, greenish blue, speckled with reddish brown.

JUNCO.

Adult male. Upper parts dark grayish slate color; below abruptly pure white from the breast; two outer feathers of the tail and part of third white; bill, flesh color.

Adult female. Similar, but duller; upper parts browner.

L., 6.25; W., 3.00; T., 2.75.

Nest, on the ground. Eggs, four or five, bluish white, speckled and blotched with reddish brown.

HOUSE SPARROW.

A member of this family about which there has been much controversy is the imported European House Sparrow. This bird was introduced into Ontario about the year 1873 by some gentlemen who no doubt were under the impression that the sparrows would devote themselves exclusively to killing and eating the caterpillars that infest the shade trees in our towns. They either forgot or did not know that the Sparrow belongs to a class of birds whose diet consists of vegetable substance and insects in about equal proportion, and that the Sparrow having attached itself to the haunts of man usually obtains its vegetable food from the plants and seeds cultivated by men for their own use. I have read many reports of so-called observers, who have stated that the House Sparrow never eats insects of any kind, that it drives away our native birds, and that it is altogether an unmitigated nuisance. Sweeping assertions of this kind are only conclusive evidence that the so-called observer cannot observe. No one with ordinary perceptive faculties can walk through our public parks, or along one of our streets where there are trees and grass in the summer time,

White-throated Sparrow.

Fox Sparrow.

without seeing some Sparrows industriously hunting for insects with which to feed their young, and should anyone have a Sparrow's nest under his verandah or about his house in such a position that some of the food brought by the parent birds to their young will fall where it can be seen, the proof that they do eat insects, and in large quantities too, will be very clear. The old birds also eat insects at this season, varying their diet with such undigested grain as they may find in horse droppings, and with bread crumbs and such like refuse from houses.

Sparrows, like the majority of birds, will not often eat hairy caterpillars, but I have seen them eat the spiny larvæ of *Vanessa antiopa,* which is one of our shade tree pests that few birds will touch. Besides this I have seen them take moths of almost any kind, including the large Cecropia and Luna moths and the Tussock moth (both the winged male and the wingless female), beetles of many kinds, even such large species as the aquatic *Dytiscus,* which they find on the sidewalks beneath the electric lights to which the beetles are attracted at night, the green cabbage worm (the larvæ of the cabbage butterfly)—of these they eat great numbers. They also hunt about fences, and take the pupæ of this same butterfly. Currant worms and the mature insects are also taken in large numbers, as are also grasshoppers, and both the black and green aphides that occur on apple trees, and rose bushes, are eaten greedily. On one occasion a flock of Sparrows completely cleaned off the green aphis from some rose bushes near my windows. It took them several days to finish their work, but they did it effectually in the end.

About harvest time the Sparrows show their grain-eating proclivities. They then gather into large flocks, and, leaving the town where they were bred, visit the surrounding country and make serious raids upon the wheat and oats, and do more damage while the grain is standing by beating it out than eating it. It is in early spring, however, that the worst trait in the sparrow's character becomes apparent. Vegetation awakens after the long winter's sleep; the trees put forth their buds, and seedlings break through the soil. The Sparrow, probably needing an alterative after the hard fare of the winter, attacks all these; nothing green comes amiss to him, and then the gardener, wrathful at the loss of prospective fruit, vegetables and flowers, forgets the good qualities the bird has, and would have the whole tribe exterminated. Whether or not he would be the gainer by this is somewhat difficult to decide. My own opinion at present is, that the number we now have do as much good as they do harm, but that they should not be allowed to increase to any great extent.

The Sparrow is also charged with driving away our native birds. The charge is well founded, only in the case of such birds as were formerly in the habit of building in holes and crevices about our houses, such as the Swallows and the Wrens. In the case of the Wrens the difficulty can easily be got over by placing their nest boxes low down, say about eight feet from the ground; the Sparrows will not then occupy them. But the Swallow problem is not so easy to solve. The trouble arises from the fact that the Sparrows remain here all through the winter and use the Swallows' nests in that season as roosting places. As spring comes they build in them, and so have possession when the Swallows return from the south. As they then, naturally enough, decline to turn out, the Swallows have to seek elsewhere for a home; the result being that we lose a valuable, purely insectivorous bird and get in the place of it one whose value is questionable. Continually shooting off the Sparrows as they appear seems to be the only remedy, and I think eternal vigilance would be required to make it successful in any place where the Sparrows are well established.

That Sparrows are rather quarrelsome amongst themselves in the season of love-making is evident to everyone, but so far I have not seen them interfere with any other species whose nesting interests do not conflict with theirs. In my own neighborhood, House Wrens, Orioles, Vireos, Catbirds, Wilson's Thrushes, Robins, Chipping Sparrows, Song Sparrows, the American Goldfinch and the Yellow Warblers have all bred in close proximity to many pairs of Sparrows, and have not been interfered with by them; but if I had not kept a pretty close watch over the nests, and taken out the eggs of the Cowbirds which were deposited therein, but few broods would have been successfully raised.

The House Sparrow has one particularly good trait which should not be overlooked, and that is its fondness for the seeds of the Knot grass or Knot weed and of the Dandelion. These pernicious plants frequently appear on our boulevards and lawns and sometimes destroy the grass completely. As soon as the seeds of these weeds form the Sparrows find it out, constantly visit them and greedily devour the seed, so that they are kept down to a very great extent and in some cases quite cleared out.

HOUSE SPARROW.

Description.

Adult male. Crown gray, bordered from the eye backward and on the nape by chestnut; lesser wing coverts chestnut, middle coverts tipped with white; back streaked with black and chestnut; upper tail coverts ashy; middle of the throat and breast black: sides of the throat white: belly whitish.

Adult female. Upper parts grayish brown, the back streaked with black and dull buffy, under parts grayish white.

L., 6.33; W., 3.00; T., 2.30.

Nest, about buildings or in trees. Eggs, four or five, very variable, ground color, generally grayish or greenish white, speckled and blotched with varying shades of brown.

FINCHES AND TANAGERS.

PURPLE FINCH.

The Purple Finch (the adult male of this species is crimson, not purple) in the spring is sometimes injurious in orchards and gardens, where it destroys the buds of fruit trees. They will also devour great quantities of sunflower and other seeds. They are not, however, sufficiently numerous to cause much loss.

WILD CANARY.

Certainly a very useful weed destroyer is the American Goldfinch or Wild Canary as it is commonly called: the majority of these little birds remain with us in Southern Ontario all through the year. In winter they gather into flocks and resort to the evergreen woods, where, in their dull brownish yellow plumage of that season they are not often recognized. At this time their food consists of the seeds of the hemlock and birch, and of such plants as stick up through the snow. On mild days flocks of them may sometimes be seen visiting the weed patches about the clearings. In the summer they scatter all over the country, frequently nesting in the small trees about the farms and orchards. They are not insect destroyers to any appreciable extent, their favorite food being the seeds of some of our most noxious plant enemies, such as the Dandelion, Canada Thistle, and others bearing plumed seed. The first appearance of these birds in the cultivated parts of the country is generally co-incident with the seeding of the Dandelion. As soon as the seed is formed numbers of these birds, assisted by some of the sparrows I have mentioned, the Purple Finch and Indigo Finches, may be seen flitting from head to head eagerly feeding upon it, and so preventing a greater spread than we have of this troublesome plant. By the end of July and on through August the Canada and other thistles are forming and ripening their seeds. The little Goldfinches fairly revel in these. Their sharp beaks are adapted for probing the involucre of the plants and extracting the seed, from which they first cut off the plume, and then devour the seed.

This class of weeds is one of the worst pests we have to contend with, and is very difficult to get out of the land where it has established itself. As it is we are overburdened with it, and without its natural enemies to assist us in keeping it down we should find the contest much more difficult to carry on.

FINCHES.

Description.

PURPLE FINCH.

Adult male. Entire body crimson, brightest on the head, upper tail coverts and breast; streaked and washed with brown on the back; white on the belly; wings and tail dusky; the outer webs of the feathers finely edged with red.

Adult female. Upper parts grayish brown, finely streaked with black; wings and tail dark grayish brown; under parts white heavily streaked with brown; a whitish line over the eye.

L., 6.00; W., 3.25; T., 2.30.

Nest, in low coniferous trees. Eggs, four or five, blue, spotted and scrawled at the larger end with purplish brown.

INDIGO FINCH.

Adult male. Rich blue, darkest on the head and throat; lores, blackish; wings and tail black, the quills margined with blue.

Adult female. Upper parts uniform cinnamon brown without streaks, wings and tail dusky, the quills usually slightly margined with blue; under parts whitish brown, indistinctly streaked, belly whiter.

L., 5.50; W., 2.55; T., 2.10.

Nest, in a low bush. Eggs, three or four, pale bluish white.

SCARLET TANAGER.

Adult male. Bright scarlet, wings and tail black.

Adult female. Upper parts clear olive green; below clear greenish yellow.

L., 7.25; W., 3.75; T., 2.10.

Nest, on the horizontal limb of a tree. Eggs, three or four, pale bluish white, speckled with reddish brown and lilac.

REDPOLL.

Adutl male. Crown very deep crimson; back grayish brown, the feathers margined with buff; upper tail coverts white or rose pink; wings and tail dusky, the feathers more or less edged with whitish; middle of the throat black; breast in birds of high plumage suffused with rose pink; sides streaked with blackish.

Adult female. Similar, but without pink on breast or tail; coverts and sides more heavily streaked.

L., 5.50; W., 2.75; T., 2.33.

Nest, in a low tree. Eggs, four or five, pale bluish, spotted with reddish brown.

PINE FINCH—SISKIN.

Above, dull olivacious streaked with dusky and brown, the feathers margined with pale grayish; wings dusky, most of the feathers margined with yellow and yellow at the base; tail dusky all but the middle feathers, yellow at the base; under parts whitish and heavily streaked with dusky.

L., 5.00; W., 2.75; T., 1.85.

Nest, in coniferous trees. Eggs, four or five, pale bluish white, thinly spotted with reddish brown.

GROSBEAKS.

The Rose-breasted Grosbeak is one of the largest and most beautiful of the family, and is of more than usual interest because it is one of the very few birds that will eat the Colorado potato beetle and its larvæ, and also the larvæ of the Tussock moth, this last being a hairy caterpillar very destructive to almost all shade and orchard trees.

I have had two of these birds in my possession for a long time, one of them for sixteen years. They are both extremely fond of potato beetles and will at any time readily eat from ten to a dozen of them from my fingers and then, like Oliver Twist, ask for more.

Unfortunately these Grosbeaks are of a retiring disposition and usually resort to the seclusion of the woods, probably because, owing to its bright plumage, it has been persecuted. Of late, however, it seems to be increasing in Ontario, and if unmolested it may possibly become more familiar in its habits. If so its services in lessening the number of Tussock Moths and potato beetles would be of great value.

None of the members of this family are addicted to eating the ordinary grain or fruit crops.

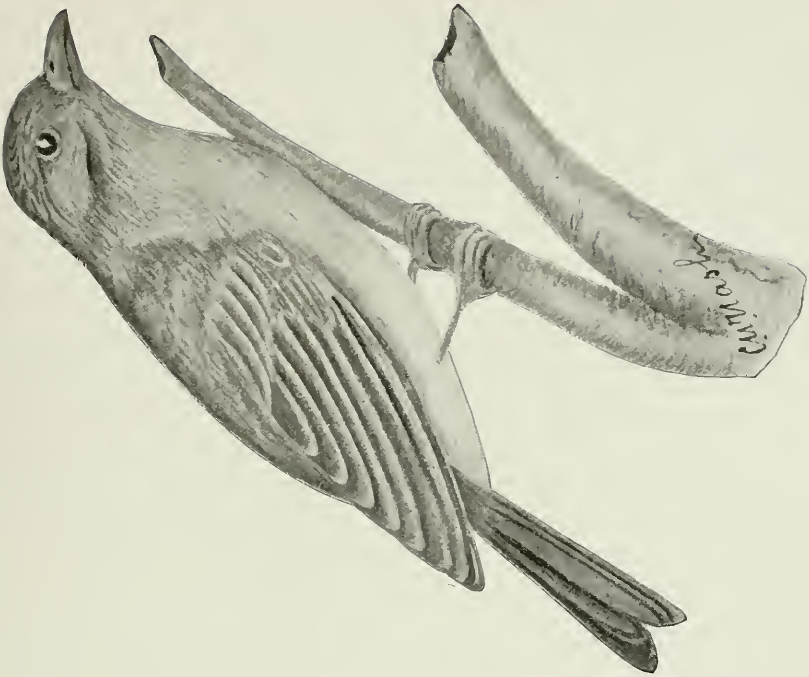
GROSBEAKS.

Description.

ROSE-BREASTED GROSBEAK.

Adult male. Head, throat and back black; upper tail coverts white barred with black; wings black; primaries, white at the base and wing coverts tipped with white; tail black, the outer feathers tipped with white on the inner web; breast bright carmine; under wing coverts rose red; rest of under parts white.

Adult female. Upper parts grayish brown, the feathers margined with buffy gray; a buff line down the centre of the crown and a white line over the eye; wings and tail dusky brown, wing coverts tipped with white; under wings, coverts yellow; the rest of the under parts creamy, streaked with brown.



Purple Finch.

Horned Lark.

L., 8.12; W., 4.00; T., 3.00.

Nest, in a low tree. Eggs, four or five, pale blue, much spotted with reddish brown.

PINE GROSBEAK.

Adult male. Chiefly carmine, darkest and streaked with dusky on the back, fading to rose red on the upper tail coverts and breast; wings dusky with two white bars; tail dusky.

Female. Ashy gray; crown, upper tail coverts and breast more or less olive yellow.

L., 9.00; W., 4.35; T., 3.65.

Nest, in the far north, on low coniferous trees. Eggs, four or five, pale greenish blue, spotted and blotched with brown and lilac.

EVENING GROSBEAK.

Adult male. Forehead and line over the eye yellow, crown black, sides of head olive; upper tail coverts yellow; tail, black; wings, black, end half of the secondaries and their coverts, white; scapulars and belly, yellow; bill, greenish yellow.

Adult female. Brownish gray; lighter and more or less tinged with yellow on the under parts.

L., 8.00; W., 4.50; T., 3.50.

Nest, in North-West, on a low tree. Eggs, three or four, greenish, spotted with brown.

LARKS.

PRAIRIE HORNED LARK.

Prairie Horned Lark. These birds have become summer residents with us only within the last forty years, prior to that a Horned Lark rather larger and darker than the one we now have used to visit us in small numbers with the snow birds in winter; of late this winter form has rarely been seen. The Prairie Horned Lark is the first of our migrants to distribute itself through the country, usually becoming abundant in the southern frontier counties early in February, when those that have remained in this part of the country are joined by those that have spent the winter further south, and they spread all over the cultivated parts of the Province before the snow disappears. It is the first of our small birds to breed. I have several times found their nests containing eggs in the first week in April, and have seen young able to fly a little as early as the 15th of that month. Two or sometimes three broods are raised in the season.

These birds frequent open fields and tracts of fallow or sandy land, and feed on the insects they find in such places, and on the seeds of many of our most troublesome weeds. Sometimes in the autumn I have noticed a few grains of oats among their stomach contents, but never at any other season. As these larks, during their stay with us, obtain nearly all their food from the cultivated lands, and that food consists of just the things we are most anxious to keep in check, the services they render are very valuable.

In November the bulk of the Horned Larks leave us and go south. A good many, however, remain in Southern Ontario, if the winter is not too severe, and now that the custom of hauling out manure onto the fields through the winter is becoming general the number of birds that stay seems to be increasing.

PRAIRIE HORNED LARK.

Description.

Adult male. Forehead line over the eye, ear region and throat white, more or less tinged with yellow; fore part of the crown, a tuft of elongated feathers on either side of the head, a mark from the bill below the eye and then downward to the side of the throat, and a patch on the breast black; back of the head and neck and upper tail coverts vinaceous, more or less washed with grayish brown; back grayish brown, edged with brownish ash and tinged with vinaceous; wing coverts deep vinaceous; tail black, the outer vanes of the outer feathers margined with white, the middle feathers broadly margined with brownish and vinaceous; below white.

Adult female. Similar, but duller and the black much less sharply defined.

L., 7.75; W., 4.25; T., 2.84.

Nest, on the ground in open fields. Eggs, four or five, grayish white, speckled with dusky and brown.

DOVES—MOURNING DOVE.

Besides the species I have referred to there are many others assisting us as weed destroyers, amongst them the Mourning Dove. This is the only bird I know that feeds exclusively on seeds, and while it may possibly at times consume a little grain, yet its services in keeping down some of our most noxious weeds will amply pay for what it takes, unless perhaps it should become too abundant in the country, a condition not likely to happen in these days of breech-loaders, etc. I have on several occasions shot these doves in the autumn, and on picking them up found their crops so full of weed seeds that they burst on striking the ground. In several cases I noticed that the bulk of the food contained in the crop consisted of seeds of the bindweed, a plant that becomes very injurious when established on cultivated land.

Description.

Adult male. Upper parts grayish olive; forehead vinaceous; crown bluish slate color; sides of the neck with brilliant metallic reflections of purple, green and bluish; a small black mark below the ear and several others on the wing coverts and scapulars; middle tail feathers like back: the others slaty blue for the basal half, then crossed with a black bar, then white; breast vinaceous; below creamy buff.

Adult female. Similar but duller, less iridescence; breast and forehead grayish brown.

L., 11.80; W., 5.75; T., 5.50.

Nest, on a low tree, or overgrown fence. Eggs, two, pure white.

GAME BIRDS.

Of our game birds the only two that are of economic importance as insect or weed destroyers are the Ruffed Grouse, commonly called "Partridge," and the Quail or "Bob White."

The Ruffed Grouse sometimes visits the edges of cultivated fields lying next to woodlands, and there feeds upon weed seeds to a limited extent, but as a grasshopper destroyer this bird is of considerable value.

In the latter part of August and through September "Partridges" are fond of getting out on grassy places at the edge of bush pastures where they gorge themselves upon these insects. If examined at this season their crops will often be found to be packed full of them.

In the cool mornings and evenings of September grasshoppers are lethargic and may be found on the weed stems in great numbers. At such times the "Partridges" can get them easily without exposing themselves too far from cover, and they generally avail themselves of their opportunity, thereby doing themselves and the farmers much good.

THE QUAIL.

This beautiful game bird, besides furnishing considerable sport and delicious food, is an insect eater and a notable weed destroyer, and therefore of the greatest possible economic importance to the farmer and fruit grower. Unfortunately for the rest of the Province this bird is confined to our southern and southwestern counties, and even there it is not now nearly as abundant as it used to be, or as it should be.

The Quail is one of the birds that is directly beneficial to the agriculturist; all its life is spent among the crops upon which he expends his labor and from which he derives his profit, and it is constantly engaged in destroying the insects that are most destructive to the plants raised by his care under cultivation.

For the first two or three months of their lives young quail feed almost entirely on insects, and each one will, while it is growing, consume nearly its own weight of them every day. To obtain this quantity the number eaten must be very large. As the birds approach maturity they vary their diet by adding the seeds of various weeds, grasses, etc., to their fare, but still take large numbers of insects so long as they are obtainable, grasshoppers in the autumn forming one of the principal articles of their food. After these fail they are compelled to find their sustenance in the stubble fields and weed patches, where they glean sufficient food to keep themselves in good condition until the supply is cut off by deep snow; then it is that our quail suffer from lack of food and die in large numbers from starvation and cold.

If well fed, quail can withstand the severity of our winters quite readily, but if starved they, like all animals, gradually succumb to cold, and it is by reason of their inability to obtain food when deep snow covers the ground that so many are lost every winter. This could be prevented if the farmers and fruit growers in the quail counties would afford the birds a little food and protection to carry them over the latter part of the winter season in which the greatest mortality occurs.

A simple method of affording the requisite protection and food is to arrange three or four forked poles so that they support each other in tent form, and throw over them a little pea straw, buckwheat stalks, or any such waste stuff, so as to have a hollow underneath, into which the birds can go and be safe from storms. Into these places throw a few measures of tailings or waste grain occasionally, and the quail will be able to maintain themselves in safety.

For the slight trouble necessary to provide a few of these shelters around a farm and orchard the farmer and fruit grower will be amply repaid the following season by a good stock of quail to keep down the insects and weeds that destroy his crops during the summer, and to provide sport for himself and his friends in the autumn.

Quail—Bobwhite.

QUAIL—BOB WHITE.

Description.

Adult male. Upper parts variegated with chestnut, black, gray and tawny; interscapulars with broken black bars: inner vane of tertials widely margined with creamy buff; tail ashy gray, the inner feathers finely mottled with buffy; front of the crown, a band from the bill to beneath the eye and a band on the upper breast black; throat and a broad line from the bill over the eye white; sides chestnut, margined with black and white; lower breast and below white barred with black.

Adult female. Similar but duller and the throat, line over the eye, forehead and lores buff; little or no black on the upper breast.

Nest, on the ground, arched over by grass or weeds. Eggs, ten to fifteen, pure white.

RUFFED GROUSE—PARTRIDGE.

A very variable species; general color of the upper parts much variegated with black, chestnut buffy and gray, sometimes chestnut and sometimes gray prevailing; sides of the neck with large tufts of broad glossy black or coppery colored feathers; tail varying from pearly gray to rich chestnut, irregularly barred and mottled with black; a broad black or coppery band near the end; tip gray; throat and breast creamy, barred with blackish or brown.

Nest, on the ground in woods. Eggs, eight or ten, buff, sometimes faintly speckled with brown.

CONCLUSION.

There are other families of birds more or less directly beneficial or injurious to our interests, but space will not permit an extended notice of each. Even the little Humming-bird, which is generally supposed to feed only on the nectar of flowers, is a destroyer of insects, and also helps to pollenize many blossoms. Enough, I trust, has been said to impress upon my readers the great value of the majority of our birds to the agriculturist.

I have seen estimates of the amount of damage done to the crops by insects in various countries, including our own Province, and although they usually stand at some millions of dollars annually, I believe they are much below the mark. It is difficult to form an estimate of the yearly loss from this cause to ordinary field crops, because the plants are crowded so thickly together that a large proportion may be destroyed in the earlier growing stages without being noticed, and it is only when the matured crop fails to reach the expected quantity that we realize the fact that something has gone wrong, but unfortunately it is then too late to remedy the matter. In our gardens we can more readily see the amount of injury done by insects, and can take measures to reduce it; but in spite of our efforts the loss is still enormous. What would it be if we had not the birds to assist in keeping down the swarm of insect life? The great trouble now is that we have not sufficient number of birds to keep the balance between vegetable and insect life in our favour.

We know that the common cut-worm causes much loss every year in spite of the fact that almost all our ground-feeding birds eat great numbers of them, and that the birds that feed among the trees and on the wing destroy very many of the moths which produce them, so we can easily imagine what the result would be to the crops if these creatures were allowed to increase unmolested by their natural enemies; so prolific are they, that I believe the increase of one season would provide a sufficient number to clear off all the crops we cultivate.

A constant war is being carried on between the insect world and the vegetable kingdom. The laws of nature would keep the balance about evenly adjusted. But man requires that it should be inclined in favour of the plants he cultivates for his own use. To obtain this end it is necessary that we should carefully protect and encourage all the forces that will work on our side against our insect enemies, and while they are not the only ones, yet the birds are the most important allies we can have in the struggle. We cannot very well increase their number or efficiency by any artificial means, but we can protect them from such of their natural enemies as occur in our own neighborhood, and we can encourage them to remain and breed about our farms and gardens. If this was done over the country generally we should find ourselves amply repaid for the small amount of trouble expended, by the protection they would give our plant life against its destructive enemies.

Experience has shown that laws are of but little use in accomplishing reforms, unless sustained by an intelligent, sympathetic public opinion, and this is what we require to cultivate on behalf of our birds. We have a protective law, which is amply sufficient if it was only properly enforced. Every person can protect the birds upon his own lands, and if he would only do so, the benefits to be derived from his efforts would soon be apparent.

Not only should we defend and encourage our birds for the good they do in protecting our crops, but also from higher motives. There is nothing in nature more beautiful than the living bird—nothing that shows more clearly the wonderful adaptation of the created thing to the purpose it is intended to serve, and no form of life that can better gratify the more refined senses of mankind than our feathered friends; their graceful forms and beautiful colouring excel the flowers, while they alone are gifted with the power of producing that exquisite music which above all things charms the lover of nature.

ACT FOR THE PROTECTION OF INSECTIVOROUS AND OTHER BIRDS.

Chapter 289, R.S.O. 1897.

HER MAJESTY, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows:

1. Nothing in this Act contained shall be held to affect *The Ontario Game Protection Act*, or to apply to any imported cage birds or other domesticated bird or birds generally known as cage birds, or to any bird or birds generally known as poultry.

2.—(1) Except as in section 6 of this Act provided, it shall not be lawful to shoot, destroy, wound, catch, net, snare, poison, drug or otherwise kill or injure, or to attempt to shoot, destroy, wound, catch, net, snare, poison, drug or otherwise kill or injure, any wild native birds other than hawks, crows, blackbirds and English sparrows, and the birds especially mentioned in *The Ontario Game Protection Act*.

(2) Any person may, during the fruit season, for the purpose of protecting his fruit from the attacks of such birds, shoot or destroy, on his own premises, the bird known as the robin without being liable to any penalty under this Act.

3. Except as in section 6 of this Act provided, it shall not be lawful to take, capture, expose for sale or have in possession any bird whatsoever, save the kinds hereinbefore or hereinafter excepted, or to set wholly or in part any net, trap, springe, snare, cage or other machine or engine, by which any bird whatsoever, save and except hawks, crows, blackbirds and English sparrows, might be killed and captured; and any net, trap, springe, snare, cage or other machine or engine, set either wholly or in part for the purpose of either capturing or killing any bird or birds save and except hawks, crows, blackbirds and English sparrows, may be destroyed by any person without such person incurring any liability therefor.

4. Save as in section 6 of this Act provided, it shall not be lawful to take, injure, destroy or have in possession any nest, young or egg of any kind whatsoever, except of hawks, crows, blackbirds and English sparrows.

5. Any person may seize, on view, any bird unlawfully possessed, and carry the same before any justice of the peace, to be by him confiscated, and if alive to be liberated; and it shall be the duty of all market clerks and policemen or constables on the spot to seize and confiscate, and if alive to liberate, such birds.

6. The chief game warden for the time being, under *The Ontario Game Protection Act*, may on receiving from any ornithologist or student of ornithology, or biologist, or student of biology, an application and recommendation according to the forms A and B in the schedule hereto, grant to such an applicant a permit in the form C in said schedule, empowering the holder to collect, and to purchase or exchange all birds or eggs otherwise protected by this Act, at any time or season he may require the same for the purposes of study, without the liability to penalties imposed by this Act.

7. The permits granted under the last preceding section shall continue in force until the end of the calendar year in which they are issued, and may be renewed at the option of the chief game warden for the time being under *The Ontario Game Protection Act*.

8.—(1) The violation of any provision of this Act shall subject the offender to the payment of not less than one dollar and not more than twenty dollars, with costs, on summary conviction, on information or complaint before one or more justices of the peace.

(2) The whole of the fine shall be paid to the prosecutor unless the convicting justice has reason to believe that the prosecution is in collusion with and for the purpose of benefiting the accused, in which case the said justice may order the disposal of the fine as in ordinary cases.

(3) In default of payment of the fine and costs, the offender shall be imprisoned in the nearest common gaol for a period of not less than two and not more than twenty days, at the discretion of the justice.

9. No conviction under this Act shall be quashed for any defect in the form thereof, or for any omission or informality in any summons or other proceedings under this Act so long as no substantial injustice results therefrom.

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Ontario Department of Agriculture

ONTARIO AGRICULTURAL COLLEGE

BULLETIN 219

The San Jose
AND
Oyster-Shell Scales

By

L. CAESAR, B.A., B.S.A.

Provincial Entomologist and Lecturer on
Economic Entomology, O.A.C.

TORONTO, ONTARIO, JANUARY, 1914

BULLETIN 219] [JANUARY, 191

Ontario Department of Agriculture

ONTARIO AGRICULTURAL COLLEGE

San Jose Scale

By L. Caesar.

SUMMARY OF CONTENTS

The original home of the San José Scale is China. It was unwittingly introduced into San José, California, about 1870. By 1893 or 1894 it had spread all over most of the United States and had even been brought into Ontario. Shipments of infested nursery stock were the chief means of its distribution. In Ontario there is believed to be no scale at present north of a line drawn from about Sarnia to Toronto, and more than half of the territory south of this is still free. The scale will probably live and thrive wherever peaches will live and bear some fruit, even though not in a commercial way. It is likely to spread into all such districts, and possibly farther.

All orchard trees, except sour cherries and usually Kieffer pears, are attacked. Currants and rose bushes, mountain ash and hawthorn, and a few other trees and shrubs are also severely affected.

The easiest way to identify the scale is to become familiar with the adult female and the immature black stage, and to know that the insect usually causes small, circular, reddish spots on the fruit and a purplish discoloration of the tissues beneath the bark where it feeds. The adult female is almost circular, nearly flat, about 1-16 of an inch in diameter, grayish to ashy brown in color, with usually a small yellowish central area. The immature black stage is found at all seasons of the year and is very small, a mere dot, black, circular, with a nipple in the centre, around which is a depressed ring or groove.

The first brood of young scales begins to appear about June 20th. There are probably three, or nearly three, full broods a year in Ontario, and young active larvæ may be seen up to the severe frosts about the end of October. So prolific is the insect that we may have at least 1,000,000 offspring from a single over-wintering female. It is this enormous power of reproduction that causes San José scale to be so destructive.

All parts of a tree above ground are subject to attack. Young trees may be killed in two years, older trees take longer. Orchards not sprayed will, if infested, be destroyed by the insect.

There are a number of native foes that attack it, but up to the present they are of little importance in Ontario.

The insect can be readily controlled by a single thorough spraying once a year before the buds have burst in spring. Badly infested trees should always be sprayed twice the first year. Old apple trees must be well pruned and the rough bark removed to secure satisfactory results.

The spraying must be very thoroughly done, so that every part of the tree from the ground up is covered. It should not be done when the bark is wet or the temperature is below freezing point.

This spraying would pay even if there were no scale, and our best apple growers regularly apply it along with two or more later applications to keep their orchards healthy and the fruit clean.

Lime-sulphur is the best and cheapest well-tested remedy.

It is usually possible to control the scale in one's own orchard independently of neighbors.

All nurseries to-day are inspected, and infested trees broken down and burned. No nurseryman is permitted to sell nursery stock without its being first fumigated with hydrocyanic acid gas.

Fig. 1. An old neglected apple orchard nearly killed by San José Scale. Observe the numerous leafless dead branches. (Original.)

SAN JOSÉ SCALE.

(Aspidiotus perniciosus, Comstock.)

INTRODUCTORY.—With the renewed interest of the last few years in fruit growing, and especially in apple growing and in the renovation of old apple orchards, has come a new interest in the different insect pests and diseases of the orchard. Of these foes the most destructive, wherever it occurs and is able to thrive, is the San José (pronounced Săn Hō zay, or Săn Hō say) Scale. This insect infests only a small part of the Province, but a part that is admirably adapted for fruit growing, hence the importance to the orchardists in these districts of being well informed on the means of identification, habits and best methods of controlling this pest. Interest, however, in the San José Scale is by no means limited to the infested areas, because progressive fruit growers in other parts of the Province, having heard or read reports of its destructiveness elsewhere, are anxious lest it get established in their locality. Consequently the demand for information is already large and increasing. To satisfy this demand so far as possible is the purpose of this bulletin. In preparing it the writer has not depended solely on his own investigations and the experience and observations of others in this Province, but has freely consulted the publications of various investigators elsewhere, who have made a careful study of the life history and control of the insect. The chief works thus consulted are the various publications of the Bureau of Entomology at Washington, D.C., and of the Experimental Stations of New York, Illinois, Ohio, New Jersey, Georgia and Tennessee.

Brief History.—The native home of the scale has been discovered by Dr. Marlatt to be in China. In 1873 it was first discovered in North America at San José in California. From here it was unwittingly shipped on nursery stock to nurseries in the Eastern States, and infested shipments from these in turn spread it widely. By 1894 it had become established in most of the Eastern States and in many of the Middle and Pacific ones as well. In 1897 it was found in Ontario, in Kent and Essex Counties, and also near St. Catharines and Niagara-on-the-Lake, but the large number of infested trees showed that it must have been introduced about 1893 or 1894, and so has been approximately twenty years in this Province. It was doubtless brought in on nursery stock. So far as I can discover, Ontario is the only Province in Canada where it has become established. It has twice been found in moderate numbers in British Columbia, but I am told by the Provincial Horticulturist and one of his assistants, and also by Mr. Treherne, the local Dominion Entomologist, that it has been exterminated, or at any rate has not been seen for several years. It has also been introduced into Nova Scotia, but infested trees have been destroyed, and there is good reason for believing that it has not obtained a foothold.

PRESENT DISTRIBUTION IN ONTARIO.

The map gives a fairly accurate outline of the districts where the scale is found. A good deal of time has been devoted to getting the data on which the map is based. Not only were all records of places from which the scale was sent in in the past considered, but the co-operation of the district representative in each county was gained. As these men know their respective counties well, and are greatly interested in all that in any way affects the farmers, their assistance was invaluable. In addition to this Mr. Jas. Neilson, a student of the Agricultural College, Guelph, devoted five months this summer under my direction to the sole task of determining the northern limits to which the scale had spread.

It will be seen that a line drawn from about Sarnia to Toronto marks the present northernmost limit of the scale. A study of the counties south of this line shows that Kent, Essex, Elgin, Welland and Lincoln are the worst infested counties. In Lambton the lower third has considerable scale, and there are a few isolated places farther north, as high or a little higher than Sarnia, where it is found. The southwest corner of Middlesex contains badly infested orchards, and there are also two or three affected orchards about five miles from London. In Oxford there was one badly infested orchard about four miles north-west of Woodstock. (The orchard has been sprayed this year and nearly all the scale destroyed). This seems to have been the only infested locality in this county. In Norfolk there are five localities where the scale has been found. In Brant there is an outbreak near St. George, but apparently only a very limited area is affected. In Haldimand there is considerable scale in the district along the lake, and though we have no reports of

Map showing the present distribution of San José Scale in Ontario. Areas darkened by close oblique lines are worst infested; those with lines farther apart are lightly affected, not every orchard being attacked. The small dark squares or rectangles indicate isolated infested localities in otherwise scale-free counties.

its being found elsewhere in the county it is probable that more careful search would reveal its presence to a slight extent in several other localities. In Wentworth all the section between the so-called "Mountain" and the lake is more or less infested, but we have no proof that it has yet spread beyond this district up into the higher land. In Halton there is a small area of about two miles square close to Burlington lightly infested. In Peel a few trees in one orchard at Dixie are somewhat badly attacked.

In the great fruit districts north of Lake Ontario and around Georgian Bay no trace of living scale could be found. It can easily be seen therefore that only a small portion of the Province is affected at present.

Readers of course should not make the mistake of supposing that every orchard in the darkened area is badly infested. The fact is that this area includes nearly all of the tender fruit belt, and it is only in the neglected or semi-cared for orchards that the scale is found doing any injury. The well-cared for orchards are clean, and it is with difficulty that any scale can be found in them. In Kent and Essex, however, and in parts of Elgin, Welland and Lincoln there are hundreds of apple orchards that have been killed by it and hundreds more that will soon be killed. The owners of these orchards are not trying to save them, largely because they have not yet learned how valuable an asset an old apple orchard may be made.

The Effect of Climate in Limiting Spread.—Since the San José scale is to-day, as shown in the map, confined to the south-western part of the Province, which is also the warmest part, it is very natural that the question should arise whether it can thrive in the other parts or is ever likely to do much damage to the fruit industry there. There is not sufficient data to give a definite answer to this question, but in my opinion there is very little doubt that the insect can live and thrive at least wherever peach trees can be grown. We may therefore expect that it will gradually spread through all the peach districts, including the district around Forest and the southern part of Lake Huron. At Collingwood at the base of the mountain, a well sheltered locality, I have seen peach trees that were about twenty years of age. I feel satisfied that if the scale got established there it would be able to do considerable damage. Furthermore in many parts of the Province we find here and there in back yards in towns a peach tree flourishing and bearing fruit. In such sheltered places I should expect the scale could become destructive. But apart from these cases in the great fruit districts where peaches cannot grow in the open we have considerable reason to hope that time will prove that the scale will not flourish or do much harm, though once introduced it may be able to maintain a struggling existence for years. While such is my hope, my advice to everybody is: *Take no chances, and on the least suspicion of its presence do your best to eradicate it.*

A brief review of the reasons for hoping that this pest may not be able to flourish much farther north than its present limits will be of interest:—

(1) The insect has now been in Ontario for about twenty years. In the course of this time it can scarcely be doubted that live scale has many times been shipped on nursery stock into such districts as the flourishing commercial apple-growing counties north of Lake Ontario; in fact I myself know of three cases where it has been found during the last five years on young trees in these districts, and yet has never got established. I am not sure whether the owners destroyed all these trees, but in any case there must have been similar occurrences where the trees were not destroyed.

(2) From correspondence with entomologists in the northern parts of the United States, where climatic conditions may be found approximating to those of our own uninfested fruit districts, I have received the following information:—

In New Hampshire the insect's present northern limits are Wolfeboro' and Plymouth, latitude about 43° 40′. In this State Prof. O'Kane says: "In general, in New Hampshire it is so far troublesome largely in the neighborhood of cities, although we are getting occasional reports of it from orchards, and in some cases severe damage is recorded." It seems evident from this statement that it is not regarded as doing a great deal of damage in New Hampshire, and does not occur at all in the northern part of the state.

In Vermont, Mr. Harold L. Bailey, Assistant Entomologist in charge of insect suppression, states that the northernmost infestation consists of two orchards in the Champlain Valley which supposedly became infested from nursery stock in 1901. These orchards have not been sprayed except spasmodically until this year. Mr. Bailey says: "The fact that the insect has not apparently spread to any trees outside the orchards into which it was originally brought seems to show that no rapid spread is to be looked for in this district." He states that in the lower and thus warmer part of the state it is spreading much more rapidly.

In New York some of the fruit-growing districts are badly infested with scale, but Dr. Felt, the state entomologist, says that in some of the colder parts the scale seems unable to make any headway. One colony at Lebanon Springs that was apparently thriving ten years ago has practically disappeared to-day.

In Minnesota, Prof. Washburn states: "It evidently cannot survive our severe winters." He has tried rearing it out of doors, but after a few years it perished.

In Michigan, Prof. Pettit tells me that conditions are approximately the same as in Ontario. The scale is abundant in the warmer districts corresponding to our badly infested counties, but outside of these is rarely found. He says: "My belief is that the scale will grow almost anywhere, where peaches will fruit, but that it will not stand a colder climate than that required for peaches. This does not mean that peaches will grow successfully in a commercial way, but where they will grow some kind of fruit that can be called a peach."

In Idaho, Prof. Aldrich has given a good deal of attention to the effect of climate upon the scale, and has described to me a very interesting case. He says there is a valley situated about 700 feet above sea level. The land to the north of this rises up rapidly, and at a distance of three miles the average elevation of the country is about 2,600 feet. This height is maintained for at least 30 miles back. In the valley tender fruits flourish; on the heights the hardier fruits. In the valley the San José scale has thriven for 25 years; on the high land it has never been able in all that time to become established.

Dr. Aldrich is inclined to think that it is not the occasional dropping of the thermometer in winter to a very low point that is the important factor in determining the natural control of the scale in a locality, but rather the total number of hours during the summer when the temperature is above 80° or perhaps even 90°F. In the valley referred to, in which the town of Lewiston is situated, he says he feels sure that there are five times as many hours of optimum temperature from 80° to 90°F or upwards, as at Moscow on the higher land thirty miles away. By "optimum" temperature is meant the temperature at which the scale thrives best and reproduces most rapidly.

(3) By reading Dr. Marlatt's account of the distribution of the scale in 1906 as given in bulletin 62 of the Bureau of Entomology, Washington, D.C., and comparing this with the present distribution in the northern states and Ontario, one sees that since that date the pest has spread northwards only to a very limited extent.

(4) In the northern districts there is a gradual lengthening of the winter, and also a longer period of humid, wet, alternately freezing and thawing weather in spring and fall, both of which have an unfavorable effect upon the scale. Now we know that ordinarily less than 50 per cent. of the scales come through the winter alive even in the Niagara district; we should look therefore for a much smaller percentage in a climate like Guelph, and a still smaller in colder and more moist

climates. Again between Guelph and the Niagara district the difference in climate is sufficient to lessen the length of the breeding season by about a month, so that this factor along with the greatly lessened number of days of optimum temperature and the other facts mentioned above all lead to the hope that most of the parts not infested to-day in Ontario will remain free. Time alone, however, will tell whether this hope will be verified, and until we are certain the best course is as I have said above, to "Take no chances."

PLANTS ATTACKED BY SAN JOSÉ SCALE.

We have found the scale attacking the following orchard trees and shrubs severely: *Apple, crab, pear, plum (both European and Japanese), peach, sweet cherry, red currant* and *black currant.* It very seldom attacks sour cherry; in fact we have never found it on any of the sour cherry varieties. Kieffer pears, though occasionally attacked, are seldom much infested even when near other trees badly attacked. Quince, apricot and gooseberry in our experience are not commonly or severely attacked, though it is very probable that we may find exceptions in the future, as some writers include these among the severely or commonly infested plants. Of apple trees, the Spy, though by no means immune, seems usually to be less severely attacked than most other varieties.

In addition to the above plants we have found the scale on the following ornamentals or forest trees and shrubs: *Mountain ash, hawthorn, Japanese quince, Japanese flowering crab, rose, wild red cherry or pin cherry, American elm, European elm, dogwood (Cornus alternifolia and C. siberica), willow (Salix vitellina), poplar (species not certain, but probably Carolina poplar (Populus deltoides), juneberry, lilac, sumach (Rhus typhina), Japanese walnut* and *honey locust (Gleditsia triacanthos).* The first four of these plants are often very severely attacked, and sometimes killed. The elms, when small, may be destroyed; but once they have become fifteen feet or more in height the scale does not seem to be able to kill them, though it may cause some of the smaller branches to die.

Dr. W. E. Britton* in his carefully compiled list of plants commonly attacked by the scale includes the following additional Ontario trees and shrubs: Chokecherry, Lombardy poplar, flowering currant (*Ribes aureum*), osage orange and several species of willow.

San José Scale may also be found in very limited numbers on almost any tree that is close beside or beneath badly infested trees; for instance I have found it on the following young trees: maples of several kinds, catalpa, birch, oak, tulip, basswood and horse chestnut, situated alongside very badly infested pears and plums, but it is doubtful whether it winters on such trees.

The above lists of ornamental and forest trees and shrubs might give the impression that our forests are likely to harbor the scale in great numbers and so become a dangerous source of infestation, but this does not seem to be the case. We find that scale-infested trees are usually situated in the orchard or else along the roadside, in fence corners or on lawns, and, while susceptible species of the outer trees of a forest bordering on an infested orchard may be attacked, there is usually little danger from the forest trees as a whole.

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*Report of the Connecticut Agricultural Experimental Station, 1903, Part II., second report of the Entomologist, pp. 132-138.

HOW TO IDENTIFY THE SAN JOSÉ SCALE.

Appearance of the San José Scale.—If we take a San José Scale infested piece of bark or an infested apple or pear in the summer or early autumn and examine it carefully we shall find the surface studded with small dot-like bodies. If we crush these, juice or fat will run out from beneath, and if we use a pin or a knife we can easily remove them from the bark or the skin of the fruit. These little dot-like bodies or specks are scales. Now if we examine them more closely with a hand lens we shall see that there are a few circular scales several times larger than any of the others. These are the adult female scales, and they are usually grayish or grayish-brown in color. Further study will reveal a good many elongate or oblong scales about twice as long as broad, and usually grayish or blackish in color. These are the adult males. Examining those that are left we shall find large numbers of little black scales about half the size of the males but quite circular. These are a very important stage of the immature females and males, because it is in this stage that all, or practically all, the San José scale winters, and by them we usually identify the insect. In addition to these three forms we shall find, especially on warm days, numerous little orange yellow scales running about. These are the larvae, both

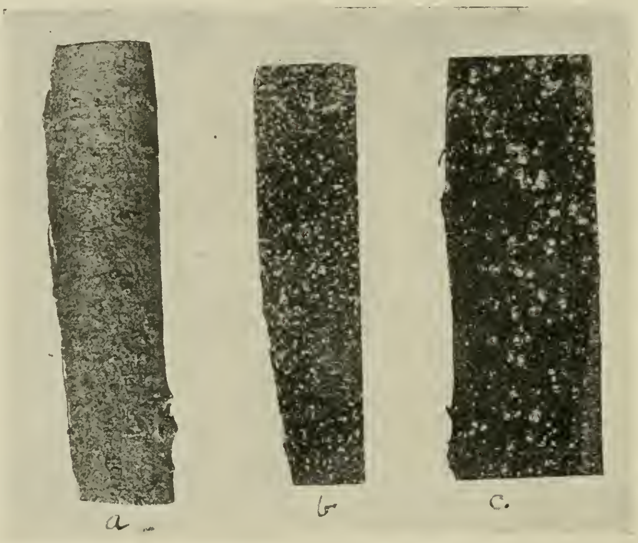

Fig. 2. (*a*) A healthy piece of apple bark showing the natural smooth surface.
(*b*) A badly infested piece with the bark completely covered by the scale. This piece has an ashy appearance.
(*c*) A similar piece of bark to *b*, but showing the small circular areas from which dead adult female scales have dropped off. Natural size. (Original.)

males and females. It is only while in this stage that females can move about. Intermediate between these active little yellow larvae and the small black circular stage will be seen little white dots, which are the young larvae that have just settled down and covered themselves over with their first waxy coat. As this covering thickens and hardens it gradually becomes darker, until the black stage mentioned above is produced, so that we shall find many very small scales varying in color between white and black. Of course, what we see with the naked eye, with the exception of the little active yellow larvae, is not the insects themselves, but merely the covering or scale that protects them. To see the insect itself, take a pin or the point of a knife and gently lift the scale, and underneath will be found a pear-shaped, fat, yellow, helpless body, the real insect, with no legs or eyes in the case of the females, but only a long sucking tube beneath its body projecting into the bark or tissues of the fruit beneath. (See Fig. 4.)

DESCRIPTION OF THE SCALE IN MORE DETAIL.—Now that we have given a general description of the various stages of the scale found in summer, let us consider more carefully the three most important stages for identification, namely, the adult female, adult male and the black or winter stage.

(*a*) *Adult female Scale.* (See Fig. 3A) :—Shape circular or almost circular, nearly flat, being slightly raised towards the centre; size 1.2 to 2.0 mm. in diameter, average about 1.5 mm. (about 1-16 of an inch); general color grayish or ashy brown, with a lighter colored central area from 1-4 to 1-5 of the total diameter in

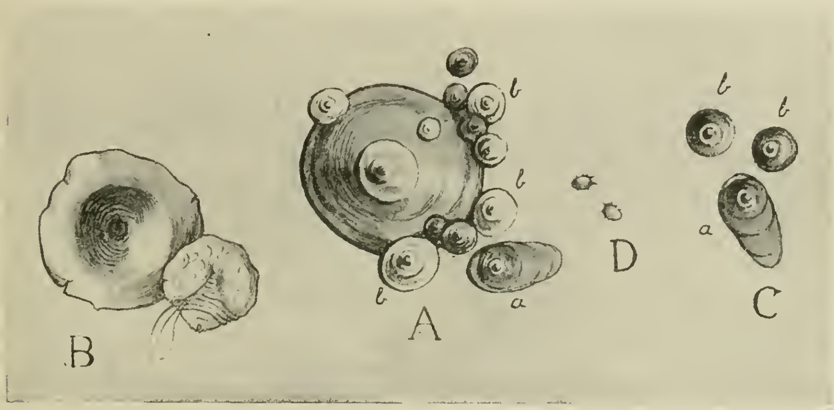

Fig. 3. Various stages of San José Scale, all enlarged about fifteen times: A. Adult female scale with immature young of various stages settled down around or upon it; *a*, an adult male scale; *b*, *b*, *b*, three small black scales, winter stage. B. An adult female scale turned over, revealing the insect herself beneath with bristle-like mouth parts exposed. C. *a*, an adult male scale; *b*, *b*, two immature black winter stage scales. D. Young active larvae soon after birth. Note the nipples and little grooves around them in A *b*, *b*, *b*, and in C *b*, *b*. (B redrawn from Alwood, the remainder original drawings by Miss A. Hearle.)

width. This lighter area varies in color from a dirty white to yellowish-brown or yellow, and if very carefully examined with a good hand lens will usually be seen to consist of two portions: First an outer belt occupying a little more than half the space and an inner area usually a little more elevated than the outer, and with a tiny knob or nipple in the centre. Sometimes, but by no means always, a little depressed ring or groove can be seen around this nipple. Occasionally a black fungus growth conceals this central area, or a thin waxy film may entirely or partly cover it, but if these are gently rubbed off the normal color will be found beneath.

(*b*) *Adult male.* (See Fig. 3C a) :—Shape irregularly oval or elliptical, about twice as long as broad; length, about half the total diameter of the adult female; width, as implied, about half the length. Adult male scales are therefore very much smaller than the adult females, not being more than 1-5 the size. The general color varies from a light gray or grayish-brown to black. Near one end is a circular area, in the centre of which is to be seen a little knob or nipple which often, but not always, has a tiny depressed ring or groove around it. This circular area is easily seen with a hand lens, and is commonly yellowish in color, though sometimes black.

(*c*) *The Black or Winter Stage.* (See Fig. 3A bb):—At this stage the scale is very small, looking to the naked eye like a tiny black speck. A hand lens is absolutely necessary to make out any of the details. An examination of fig. 3A b shows that it is circular, flattened, not more than 1-10 the size of an adult female, and about half the size of the male. It has a little nipple in the centre surrounded by a depressed ring or groove. The nipple and depressed ring around it, along with the black color, are the most important characteristics to remember. Sometimes the color varies a little and the nipple may be whitish, frequently the outer margin of the ring is whitish, but usually in Ontario every part of this stage is black. As said above, this is practically the only stage in which the insects pass the winter. Of course adult females and very young scales are to be found in early winter, but they apparently all die.

Other Scale Insects Allied to and so Closely Resembling San José that they are Often Mistaken for it.—Such scales as the Oyster Shell, Scurfy and European Fruit Lecanium, or, as it used to be called, New York Plum Scale, are so much larger, especially the last named, and so different in shape that no one who has read the above account and examined the figures could for a moment mistake any of them for San José. There are, however, in Ontario probably a dozen scales belonging to the same genus (*Aspidiotus*) as the San José, but only four of these are at all commonly found. These are: 1st, the European Fruit Scale, or, as many of us are accustomed to call it, the Curtis Scale (*Aspidiotus ostreaeformis*); 2nd, the English Walnut Scale (*Aspidiotus juglans-regiae*); 3rd, the Putnam Scale (*Aspidiotus ancylus*), and 4th, the Cherry Scale (*Aspidiotus forbesi*). None of these scales are very destructive in Ontario orchards. The first of these, the European Fruit Scale or Curtis Scale, is common on apple trees, especially on the very large branches where it may often be found under the loose bark, though it by no means always feeds under shelter. It is the only one of these four that I know of that is ever found on the fruit. During the last two years I have seen several apples with these scales on them, and resembling so closely the San José scale that they would usually be mistaken for it. The resemblance is increased by this scale having the same power as the San José to cause a reddish discoloration of the fruit. The English Walnut Scale has not, I think, been found on fruit trees in Ontario, though in other places it does attack them. In St. Catharines it is very abundant on soft or white maple (*Acer saccharinum*). I have also had it sent in on poplar, and Prof. Jarvis has found it on willow. I find both it and the previous scale heavily parasitized. The Putnam and Cherry Scales are not very common, though they are occasionally sent in. They attack the bark of orchard trees and of a few other trees. I have never seen one on the fruit itself.

I had planned to add a key for the identification of these four species, but they vary so much with the different kinds of bark on which they are found, and at different times in the season, that no matter how carefully and accurately the key might be made there would always be the danger of mistakes; hence when in doubt the best way will be to send specimens for identification to the Department of Entomology, O.A.C., Guelph, or to the Dominion Entomologist, Central Experimental Farm, Ottawa. Many of the best students of scales find it necessary at times to clear the insect itself beneath the scale in certain solutions and then examine what is known as its anal plate under a compound microscope. A study of this part is the final test of its identity.

HOW SAN JOSÉ MAY BE DISTINGUISHED FROM THE ABOVE SCALES.

If it is not advisable to try to show how the above four scales may be distinguished from one another, it is very important to give simple methods by which any person can tell if he finds one of these whether it is the San José Scale or not. The following points will enable him to do so:

(1) All five scales, if the surface is rubbed, will show a small nearly circular area quite different in color from the rest of the scale. This area we shall call the exuviae, because it is due to the moulted skins (*exuviae*) of the insect having become worked into the covering scale and showing through it. In the San José scale the exuviae is situated in, or almost in, the centre of the scale, and is yellowish. In most of the other four scales it is situated a little to one side of the centre, and is either some shade of red or orange, being very rarely yellowish. Frequently it is covered over by a film which conceals it unless first rubbed gently. The color and position of the exuviae are therefore very helpful distinguishing characteristics.

(2) Among the adult males and females of the San José Scale are always to be found a very large percentage of small black scales, each with a little nipple in the centre and groove around it. This has been already described, and mentioned as being also the wintering stage of this scale. If none of these small black scales are to be found the insects are not San José, or if some are present that, roughly speaking, answer to this description but are not black they are not San José.

(3) Look for the adult female scales, and if these though circular are more than 2 mm. about 1-12 of an inch) in diameter the scale is not San José, because the adult female of this is never more than 2 mm., and is usually about 1.5 mm. or 1-16 of an inch in diameter, whereas the adult female of the English Walnut Scale (*Aspidiotus juglans-regiae*) is 3 mm., or nearly ⅛ of an inch in diameter. The other three species are smaller than it, and nearer the size of San José.

(4) If the scale occurs in abundance on the fruit and causes red spots on it, or if it often produces a reddish discoloration on young shoots, or if, when the bark of a badly infested branch is cut through obliquely, the tissues beneath are seen to be stained purple or reddish, the insect is almost certain to be San José Scale. It is true that the Curtis Scale and also the Scurfy Scale will produce red spots on the fruit, but they are very seldom found on it. Moreover the Scurfy Scale is not circular and does not resemble the San José closely.

These points, along with a careful study of the description given above and of the accompanying illustrations, should make the identification of San José Scale comparatively easy.

A Red Spotting of Fruit not Caused by San José Scale.—Frequently one sees various kinds of apples in autumn with tiny red spots on the surface. Bellflowers are very subject to this. At first glance these spots are very suggestive of San José Scale, but on a close examination with a magnifying glass it is easy to discover that they are due to some other cause, probably some species of fungus. If they had been caused by any scale insect either this would be present and could be lifted up with the point of a knife blade or with a pin or it would leave a light-colored central area showing that it had been removed by something. The spots referred to above, however, are darkest in the centre, and in this darkest part the epidermis is usually ruptured as if by a fungus growth.

LIFE HISTORY.

The insects, as already mentioned above, pass the winter in the small black circular immature stage. In this stage both males and females are alike. After the warm weather comes in the spring the male scales begin to elongate until they become oblong, and as described on page 9. (See Fig. 3Ca.) Towards the latter part of May (this year May 20th or 21st), the living insects beneath the scale covers have become winged, and back out from beneath the cover. Fig. 5 shows the appearance of one of these male adults, but is of course much enlarged, since the insect itself is so small that it can only with difficulty be seen without the aid of a hand lens. The general color of the body is orange. There are only two wings each with two veins in it. The antennae are long and conspicuous, and, projecting from the end of the body, is a long style, which makes it very easy to distinguish the male from tiny parasites or other small insects. (Any winged parasites that might be found would have four wings instead of two.) Soon after emerg-

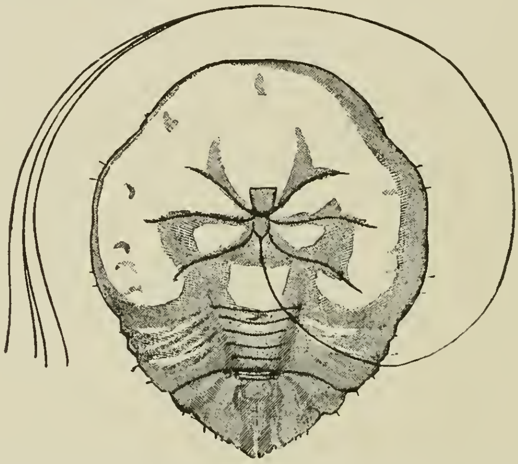

Fig. 4. Full-grown female from beneath scale, showing the very long sucking tube, composed of several tiny bristles; greatly enlarged. (After Howard and Marlatt.)

ence the males move around in search of the females. The latter then begin to increase in size, and towards the middle of June have reached the size and appearance described on page 9. (See also fig. 3A.) They now begin to give birth to living young, no eggs being laid by this species, contrary to what we find in the case of most other scales, even very closely allied species. Each female produces several young a day, and may continue to do this for 40 or 50 days, so that the total number of young from each may be over 400. (At St. Catharines young larvae began to appear this year on June 25th, and last year, 1912, on July 1st. June 20th is probably about the average date). For a few hours after birth the young larvae remain by the mother insect under the protection of her covering scale, and can easily be seen by lifting this up. They then come out and run around actively for an average of about 24 hours. During this time they may have travelled several feet from the mother insect, but more frequently the distance is only a few inches, and not uncommonly if they have moved away at all they return to her again. At the end of about twenty-four hours they insert their little sucking beaks through the bark or the surface of the leaf or fruit on which they may happen to be. Very often they settle on the margin of the mother scale and force their beaks right through her waxy covering. (See fig. 3A.)

The young larvae are very small, mere dots, of an orange-yellow color, oval in shape, with six legs, one pair of antennae, and two eyes. The most striking thing about them is the character and position of the mouth parts. These consist of a long thread or bristle-like sucking apparatus really composed of four very fine sharp little bristles fitting closely together, and arising from underneath the body. They can be seen in Fig. 6 as a little coiled thread. This beak is about three times as long as the body, and in the case of the full-grown scale reaches deep into the bark. It seems wonderful that such a delicate little structure can be forced through the hard bark of an apple or plum tree.

After settling down and inserting its sucking tube, the little insect begins to assume a circular form, and at the end of about a day becomes covered all over with delicate white wax, which is secreted through pores on its own body. Soon this becomes thicker, more compact and larger as the insect grows, and gradually

Fig. 5. Winged male, much enlarged. (Redrawn from Alwood.)

Fig. 6. Young active larva, ventral view, much enlarged; natural size is a mere speck. Redrawn from Alwood.)

the color changes until the black winter stage described on page 9 (see also Fig. 3Cbb) is reached.

Up to this time the external appearance of both males and females has been the same, but now they begin to differentiate, and in about two weeks more another brood of adult winged males appear which fertilize any females that are sexually mature. All the males do not of course emerge at the same time, nor are all the females sexually mature at once, because, as said above, a single adult female continues ordinarily to give birth to living young for forty days or longer; hence there will be a great overlapping and confusing of broods. From the time of birth to its emergence as a winged adult the male, according to Marlatt,* requires from 24 to 26 days. Our observations would lead us to believe that this year in Ontario 30 days would be nearer the time. The hotter the climate the shorter the time would naturally be, and Marlatt's figures are for Washington, D.C. He also states that from the time of birth to the production of young by the female requires in

***See Bulletin 62, page 47, U. S. Bureau of Entomology.**

summer from 33 to 40 days. Here again with us the period seemed to be about ten days or more longer.

At Washington it was found that there were four full broods and a possible partial fifth, but as the males emerged early in April, and in Ontario not until about May 20th, a month or more later, we should not expect so many broods. It was not part of my original plan to attempt to work out the life history or number of broods. However, my assistant, Mr. G. J. Spencer, and I by placing a definite number of the earliest larvae on each of several uninfested nursery trees secured for the purpose were able to make some valuable observations. As a result of these I am of the opinion that we have not more than three broods, and probably the third is not quite a full one. To be absolutely certain on this point would require a good deal more work with great care to see that natural outside conditions were observed. Our rearing was done outside, but under cheesecloth, and in the city of St. Catharines.

Whatever the number of broods, running larvae may be seen in warm days as late as November. I found a few this year on November 4th in the Niagara district.

Estimate of the Number of Offspring in a Year from a Single Over-wintering Female.—It is estimated that each female may on an average produce 400 or more offspring; approximately half of these may be males. Now if we suppose, as I think is correct, that we have not more than three generations, the total number of offspring at this rate from a single adult, if all lived, would be 16,000,000, and if we estimate the number of generations at two and one-half it would be 8,000,000. If we allow for a total mortality of 50 per cent. in each generation we shall still have at least 2,000,000 if there are three full broods, and 1,000,000 if there are only two and a half. It is because of this marvellous power of reproduction that the San José Scale, though such a tiny creature, is so destructive. None of our other species of native scales can increase at anything like this rate, the highest probably being not faster than an average of 1,000 from a single female in a season.

MEANS OF DISTRIBUTION.

By far the most important of all the various means of distribution of the San José Scale from one district to another has been infested nursery stock. In this way it has been carried from California to the Eastern States, Canada, and to several other portions of the world. Once in a locality, it spreads from tree to tree and orchard to orchard by the little active larvae crawling upon various kinds of insects or birds that alight upon or frequent infested trees and then go to some other tree either near by or at considerable distance. As active larvae abound on infested trees from the end of June to the severe frosts, it is quite evident that they are also carried on the hands, clothes, baskets or ladders of the pickers, or even on the horses or vehicles used in the orchard gathering the fruit or for any other purpose. Where trees are close together the larvae travel from branch to branch, or may be carried by the wind a short distance from a higher branch of one tree to a lower one of the neighboring tree. Many of the inspectors of nursery stock believe that the wind plays an important part in infesting stock situated near large, badly attacked trees. Just how far the scale may be carried in this way I cannot say definitely. In a moderate breeze I have caught them on tanglefoot placed near the ground six feet away from a branch about 15 feet high. I should not be at all astonished if strong gales would carry them occasionally as far as 30 or 40 feet from the top of tall trees. They do not cling very tenaciously to the part they are on, and many drop off. Rains doubtless wash them from higher to lower branches. To spread through an orchard of, say, ten acres until every tree is clearly infested will sometimes require two or three years, and apparently depends largely upon what part of the orchard became first infested and how well the scale thrives in the district.

Many fears have been expressed that the scale will get established in new centres through marketing infested apples, which may be shipped to various parts of the Province. There is apparently very little danger from this in the case of winter fruit, which is packed late, and from which active young getting on trees would scarcely have time to become sufficiently advanced to stand the winter. In the case, however, of fruit marketed earlier in the season, it is more reasonable to fear that the insects might get a foothold. Ever since the San José Scale was discovered to be a very serious pest entomologists have thought of this possibility, but it is very encouraging to learn that in no case up to the present is there any

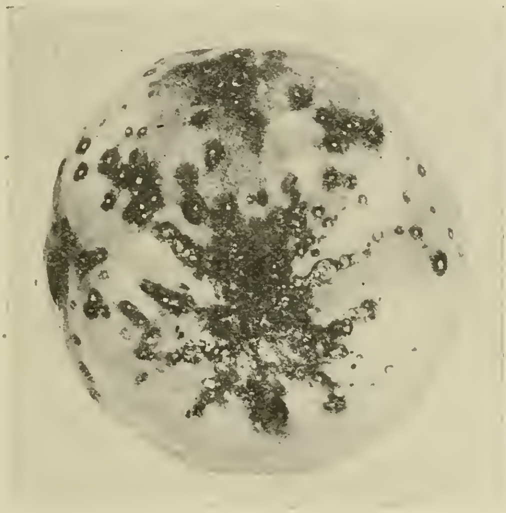

Fig. 7. San José Scale on apple, showing both the scales themselves and discoloration caused by them, natural size. (Original.)

known recorded proof that the marketing of infested fruit has resulted in the establishment of new colonies. Nevertheless, as a wise precaution, the sale of such fruit is forbidden by law, and any person found selling or offering it for sale is liable to a penalty of not less than $10 nor more than $100.

INJURY TO PLANT LIFE.

Parts of the Plants Attacked and Nature of the Injury.—The scale will attack any part of the tree or plant above ground—trunk, branches, twigs, leaves, leaf-stems, fruit and fruit-stems. Small trees are usually attacked nearly uniformily all over, except that the leaves are not so badly infested. Large apple trees are worst attacked on the outer branches and twigs, the coarse, thick bark of the trunk and large branches having fewer scales on it probably because more difficult to pierce with their delicate little beaks. A badly infested tree or branch will become so thickly encrusted with the insects that the bark is completely concealed. (See Fig. 2.) Such branches look as if they were covered with ashes. If we cut through the bark obliquely we shall see that the tissue beneath even as far as the outer sapwood is conspicuously colored purple. On young branches and nursery stock there is frequently, but not always, a reddish area around where the scale feeds. This helps the inspector to find the insect more easily. The skin of the fruit, especially of apples and pears, is also conspicuously marked with these red discolorations, which often make it easy to detect the presence of the scale even without looking at the bark. On apples the insects are regularly most numerous in the calyx and stem ends, probably because these are more sheltered parts. Leaves, though not so commonly attacked as fruit and bark, are often badly infested,

Fig. 8. San José Scale on pear leaves and discolorations caused thereby, natural size (after Lowe and Parrot).

especially on the upper surface. The insect causes these also to become discolored. (See Fig. 8.)

The injury done by San José Scale is caused by the millions, or more correctly billions, of the little creatures sucking the juice out of the plant through their long, delicate beaks, and thus starving the tree by depriving it of its food. It is claimed that they also secrete a poison which increases the injury. Small trees may be killed in a couple of years; larger trees usually take longer, and an old apple tree may survive for six years or more, but ultimately will perish if not treated. The same fate will befall any orchard once attacked and left unsprayed. In old trees it is the outer branches that die first, and in putting a tree into shape to spray one often finds it necessary to cut such branches back six feet or more to reach the living parts. Infested fruit is usually dwarfed, and frequently there are small depressions where the scale feeds, especially in the case of pears. Such fruit is often almost worthless except to feed to stock, as it is illegal to sell it.

It is clear, therefore, that if not kept under control there is no more destructive enemy to fruit trees than the San José Scale.

Natural Enemies.—Many of our scale insects are to a very considerable extent kept in check by predaceous enemies and parasites, but this is not true of the San José Scale. Its chief enemies are as follows:—(1) A very tiny, glossy-black ladybird beetle, *Microweisea* (Pentilia), *misella* and its brown larvae. (See Fig. 9.) A considerable number of these were found on most of the trees examined, but they were never numerous enough anywhere to control the scale even on a single branch. (2) A much larger black ladybird beetle with two red spots on its back, *Chilocorus bivulnerus*. This is a common insect in Ontario, but was very rarely found feeding on San José Scale. (3) Four-winged hymenopterous parasites (see Fig. 10.) Two species of these *Aphelinus mytilaspidis* and *Aphelinus fuscipennis* were reared a few years ago by Mr. Alfred Eastham, a graduate of the Agricultural College, but a careful examination of several orchards showed very few scales with little circular holes in them indicating that a parasite of this nature had emerged. (4) A large red mite that I have not yet had a chance to get identified. (5) A

Fig. 9. The Pitiful Ladybird Beetle and its larva (*Microweisea misella*), both much enlarged. The small lines show the natural size (redrawn from Marlatt).

fungus disease. This seems to be very rare. I have not myself seen it, but the late Dr. Fletcher reported it from the Niagara district.

From my own observations I think that all these enemies combined do not kill more than one scale out of one thousand. This, however, is not true of all parts of North America, for in some places disease or parasites or both are very helpful. In October Prof. Surface, of Pennsylvania, replying to a letter of mine said that the four-winged parasites there were becoming very abundant and doing a great deal to control the scale. He reported that there were many different species at work. It is my intention next year to bring in a good supply of parasitized material from Pennsylvania and try to establish these friends in our worst infested districts. Whether they will increase rapidly in our climate and become of much assistance is impossible to tell.

MEANS OF CONTROL.

In controlling San José Scale it is absolutely necessary to depend upon thorough spraying of infested orchards, but spraying is simplified and made less costly by certain preliminary steps. It should be borne in mind in treating neglected orchards that the first year's work is far more difficult than that of any succeeding year. Once the scale is brought under control it is not very difficult to keep it there; in fact I consider it easier to combat successfully than the Codling Moth in the warmer parts of the Province.

Treatment of Orchards, Especially of Old, Neglected Apple Orchards, Before Spraying.—Every orchard before it is sprayed should be carefully pruned to thin out any unnecessary branches and to remove dead or dying ones. This lets in the sunlight, allows the spray to reach every part more easily, and causes less waste. The trees are also healthier and bear better fruit.

Old, neglected apple orchards, however, require much more work to put them into shape for satisfactory spraying. They are often so tall and thick with branches that it is impossible to spray them thoroughly just as they are. Moreover the trunk and larger branches are covered with loose bark, under which the scale may be concealed and be untouched by the spray. Such trees should always have the branches well thinned out, and if tall, headed back to a reasonable height for convenient spraying It is usually desirable to lower the tops considerably, sometimes

Fig. 10. *Prospalta aurantii*, a common parasite of the scale in some parts of North America, greatly enlarged (after Howard).

as much as eight feet or more. In doing this one should use judgment, and should try to make a well-balanced head. It is especially important in cutting back the upright branches to cut close to a cross branch, especially to one running in such a direction as to keep the centre of the tree from being too open. Open centres tend to favor sunscald on large branches and are also undesirable, because this part should, like the rest of the head, be bearing fruit; in fact it is the part best adapted, because receiving most sunlight, to bear the choicest fruit. Cutting close to cross branches is necessary, because if this is not done the stubs that are left will rot and cause the tree to become hollow and thus weakened. Large cuts should be painted with white-lead or coal tar.

Where the orchard is large and help scarce the pruning may be done in scale infested districts at any time after the leaves are off, and the work in this way be distributed over several months. I find long-handled pruners, about eight or ten feet long, very helpful in thinning out branches one inch or under in diameter. They cost from 80 cents to $1. Good ladders also soon pay for themselves. All prunings should be burned before the end of May.

After the trees are pruned the rough bark should be scraped off the larger branches and trunk with a hoe. This will expose all the scale to the spray. It may be done at any time of the year before spraying, and does not need to be done again for several years.

SPRAYING.

When and How Often to Spray.—Unless a tree is badly infested, one thorough annual application of the right mixture at the proper strength applied

Fig. 11. An old neglected apple tree. Heavy pruning, lowering the top and scraping off the bark is necessary before this tree can be thoroughly and economically sprayed (original).

in spring just before the buds burst will satisfactorily control the scale, but badly infested trees should receive two applications the first year to make a thorough job. Even on these it is quite possible, especially if the weather is dry at the time of spraying and for a few days later, to control the scale completely with a single application; but only the most thorough sprayers succeed in doing so, especially in old apple orchards. One of these two applications may be given in autumn soon after the leaves have nearly all fallen or at any time in the spring when the weather permits; the other should be done preferably just before or as the buds are bursting, because the mixture will thereby remain on much longer into the summer and have more value in destroying any young scale there may be; for these seem unable to settle down and thrive on bark coated with lime-sulphur.

Peach trees are an exception to this late spraying, because we want the one application to control the San José Scale and the Peach Leaf-curl at the same time, and to do this it is necessary to spray before the buds have begun to swell. If the spraying is delayed until these are ready to burst, and if the weather has been wet and cold, the Leaf-curl will not have been controlled.

Fall spraying instead of spring where only one application is to be given is advocated by some. Good results are usually obtained, but on the whole it is found

Fig. 12. How an old orchard very badly attacked by San José Scale had to be pruned to get rid of dead branches and put it into shape to save it (original).

better to spray in spring. Some writers have been advocating summer applications about July 1st or a little later for the scale. In my opinion, based on some tests made, the results do not justify the trouble and expense.

The Best Mixture to Use.—The lime--sulphur wash is to-day recognized all over North America as much the safest, best and cheapest spray mixture to use against San José Scale. Oil washes of various kinds have often given good results, but they have also under certain weather conditions, which may occur any season, caused much injury to the trees. They are much dearer than the lime-sulphur, usually costing more than double as much. Moreover they have but little fungicidal value, whereas lime-sulphur is well known to be a very valuable fungicide. In badly infested old apple orchards the use of an oil wash, such as Scalecide or Target Brand or even Kerosene Emulsion containing about 25 per cent. kerosene, to supplement lime-sulphur for scale on the outer branches and twigs would be quite valuable, because the oily nature of these sprays enables them to spread better over the bark and get more easily into contact with any scales situated among the pubescence on the smaller branches where they are hard to reach with lime-sulphur. However, if orchardists remember the need of spraying these outer twigs very carefully on account of the pubescence they can get quite satisfactory results with the lime-sulphur alone.

A new spray mixture manufactured by the Niagara Brand Spray Company, and known as Soluble Sulphur, promises to be a valuable wash for the scale. I used it this year, at the strength recommended on the containers, on nine large very badly infested old apple trees and one pear tree, and got good results from the one application—just as good as from the regular lime-sulphur. Soluble Sulphur is a yellowish-green powder, and is made by combining sulphur and certain compounds of soda at a very high temperature and then apparently grinding the dry compound into a powder after it is cold. It dissolves readily in water, and is therefore very convenient to ship, store and use. Its price at present is about the same as that of commercial lime-sulphur. It may be that if a rain followed soon after spraying it would not give so good results as lime-sulphur. This remains to be tested. The directions for use are given on the cans. The manufacturers claim that their mixture can be safely used as a subsitute for lime-sulphur in all the

Fig. 13. The same trees photographed from a little farther to the right two months later, about July 20th (original).

regular orchard applications. Without further tests under different weather conditions I am not prepared to recommend it for summer use.

The Proper Strength of Lime-sulphur to Use.—As it is very important to use sufficiently strong mixtures, and as the most common forms of lime-sulphur are the commercial and the home-made concentrated, and as the different barrels of these vary in strength, it is very important to test them with an hydrometer before using, and then reason out by rule how much to dilute each gallon to get the proper strength. Specific gravity hydrometers are the most convenient, and cost about 80 cents. From my own experience and that of others I think the most desirable strength is about 1.035 specific gravity. A full account of how to use the hydrometer is given in the Lime-Sulphur Bulletin, No. 198, pages 10 to 13, and also a less full one in the Spray Calendar. Briefly stated, the rule is:—Gently drop the hydrometer into the clear concentrated liquid of the barrel after all sediment has settled and the temperature is that of the surrounding air. Note the figure to which it sinks. Suppose this is 1.300 in one barrel and 1.280 in another. Then to determine how much to dilute each of these to get a strength of 1.035 divide the last three figures of the 1.300 and 1.280, respectively, by 35, and this will give the total number of gallons which each gallon, respectively, will make. Thus 300÷35=8 20-35, or approximately 8⅔, and 280÷35=8. This means that each gallon of the strength of 1.300 must be diluted with water to 8⅔ gals. to make a strength of 1.035, and each gal. of the strength of 1.280 to 8 gals. to give the same strength.

Those who wish to use the old home-boiled lime-sulphur, an excellent but troublesome spray to make and apply, should consult Bulletin 198, page 14.

Formula for Kerosene Emulsion for Use on Scale.—A number of fruit-growers in the districts where there are oil wells have asked for a formula by which they could make use of crude petroleum against San José Scale. The following formula is taken from Circular No. 124, Bureau of Entomology, Washington, D.C.:

"*Kerosene Emulsion* (*stock solution* 66 *per cent. oil*). Kerosene emulsion is made after the following formula:—

Kerosene (coal oil, lamp oil)	gallons 2
Whale-oil soap or laundry soap (or 1 quart of soft soap)....	pound ½
Water	gallon 1

Dissolve the soap in boiling water, then remove vessel from the fire. Immediately add the kerosene, and thoroughly agitate the mixture until a creamy solution results. The stock emulsion may be more conveniently made by pouring the mixture into the tank of a spray pump and pumping the liquid through the nozzle back into the tank for some minutes. The stock solution, if well made, will keep for some months, and is to be diluted before using. In order to make a 10 per cent. spray (the strength for trees in foliage), add to each one gallon of the stock solution about 5⅔ gals. of water. For 20 and 25 per cent. emulsions (for use on dormant trees and plants), use, respectively, about 2⅓ gallons and 1⅔ gallons of water for each one gallon of stock emulsion. Agitate the mixture in all cases after adding the water. The preparation of the emulsion will be simplified by the use of naptha soap. No heat will be required, as the kerosene will combine readily with the soap in water when thoroughly agitated. Of naphtha soap, however, double the quantity given in the above formula will be required, and soft or rain water should be used in making the emulsion. In regions where the water is "hard" this should first be broken with a little caustic potash or soda, such as common lye, before use for dilution, to prevent the soap from combining with the lime or magnesia present, thus liberating some of the kerosene; or rain water may be employed.

Crude Petroleum Emulsion. Crude petroleum emulsion may be prepared in identically the same way as described for kerosene emulsion, substituting crude petroleum for kerosene. The same dilutions for winter and summer spraying should be made as prescribed for kerosene emulsion, but it should be noted that for summer treatments of trees in foliage the kerosene emulsion is preferable, as it is less likely to cause injury.

I have not myself tested these emulsions, but would advise that they should be used only to supplement lime-sulphur in spring, especially on the outer branches and twigs of large apple trees. It is not safe to drench trees with any oil wash, particularly the trunks and large branches. Spraying should be stopped as soon as it is seen that the part is well covered, and before it begins to run. It is also safer to spray on a bright or windy day than in dark gloomy weather, because the former permits the oils to evaporate more quickly. Crude petroleum alone is seldom safe to use. Many trees have been killed by it.

Some Points to Remember About Spraying for San José Scale.—(1) Do not spray when the trees are wet; this weakens the wash.

(2) Do not spray just before a rain, because the rain will rapidly wash the mixture off unless it has first become thoroughly dry.

(3) Do not spray when the thermometer is at or below freezing point. The mixture does not seem to get into contact with the insects so well as in warm weather.

(4) If possible start soon enough to finish by the time the buds are bursting. If not through then and the scale is abundant spray ahead at the regular strength until all the trees are done. Often no damage to leaves will follow, in any case the spray will do less injury than the scale.

(5) Test the strength of the lime-sulphur with a hydrometer; it is the only business-like way where concentrated lime-sulphur is used.

(6) Take advantage of the wind. A strong wind is often helpful, especially for large trees.

(7) Do not be stingy with the material. Cover every inch from the base of the trunk to the topmost twig. Remember a single female missed may mean 1,000,000 by the end of the season. It may take eight gallons or more for a large tree, but only thoroughness will pay.

(8) A good gasoline outfit is very much quicker and more satisfactory than a hand pump for large, old orchards, but good work can be done with a hand pump, too.

(9) Keep the spray machine in good repair, pump clean water through it every night and take off the nozzles to prevent their getting set. It will save much loss of time. A circular piece of leather three inches in diameter placed at the base of the nozzles will largely prevent the mixture running down the rod and wetting the hands.

(10) Use gloves to save the hands.

(11) Try to supervise all the spraying yourself, or put it in charge of your best man.

Is it Possible for a Man to Control the Scale in His Own Orchard Independently of His Neighbors?—Wherever an orchard is some distance, say ten rods or more away from an infested orchard, it can be kept almost free from scale whether the infested orchard remains neglected or not. In the Niagara district most good growers would not care much whether their neighbor sprayed or not. They are aware, too, that if he does not spray the scale will soon kill his trees and so remove the menace. However, there are often cases where orchards are almost touching, and if the one on the west, the side of the prevailing wind (from other directions the danger is usually not quite so great) is composed of tall trees badly infested there is no doubt that the nearest row or two of the neighboring orchard, however well sprayed and cared for, will be more or less affected by this. Under these circumstances if a man cannot persuade his neighbor to control the scale he should appeal to the scale inspector, if there is one, or else ask permission to treat his neighbor's outer row at his own expense, if he thinks it worth while to do so.

INSPECTION.

Scale Inspectors.—During the past season there have been several inquiries as to the appointment of inspectors, especially in townships where our survey of the orchards showed there was scale, though the owners of the orchards either did not previously know of it or were not aware that it was so serious a pest. Sec. 7, Clause 1, of *The Fruit Pest Act* reads: "The Council of any local municipality may, and upon the petition of twenty-five or more fruit-growers who are ratepayers shall, by by-law, appoint at least one inspector to enforce the provisions of this Act in the municipality, and fix the amount of remuneration, fees or charges he shall receive for the performance of his duties." The Department of Agriculture pays half the salary of these men and the municipality the other half. For further particulars write to the Department for a copy of the Act. It is clear therefore under what circumstances an inspector may be appointed. In many districts inspectors are very desirable and helpful, but not in all. To be a success the inspector must have public opinion behind him, and must be looked upon not as an intruder, but as a friend who is trying to improve the fruit industry. Men who will only spray because they are compelled will seldom have any success against the scale, because they will not spray thoroughly, and poor spraying is very little better than none. These men, as a rule, try to work up opposition to the inspector, and often succeed so well that next year the Council thinks it expedient to get a new man. Now a competent new man with plenty of backbone will not be easily secured, because he can readily see that if he tries to do his duty he, too, need not expect to be re-engaged the following year. It is difficult in the face of strong opposition for a local man to do his duty as inspector and enforce the law impartially. When he sees the task ahead of him he will usually resign. Under circumstances like these I should urge the men who are anxious to have the scale controlled in their district to try to show their neighbors by their own thorough and successful work not only that the scale can be controlled, but also that it will pay well to look after their orchards. To convince a man that a thing pays is the surest way to get him to do that thing and to do it well. In most counties there are district representatives, and these men, if their attention is called to it, are always willing and able to help in arousing an interest in any great question, such as the control of the San José Scale. They are sometimes able to take charge of an orchard in an infested district and show by actual demonstration how to bring it back to health and the bearing of large crops of good clean fruit.

Inspection of Nurseries and Fumigation of Nursery Stock.—Since the chief means of spreading San José Scale has been on nursery stock, and since there is always a possibility of some of the stock escaping fumigation where the nurseryman is careless and the inspector unable to guard against it, it has been found advisable to supplement the fumigation by a careful inspection of the growing stock itself in the nursery grounds. This year all saleable stock, over 4,000,000 trees, was examined tree by tree. Wherever possible, badly infested areas were examined twice, and sometimes three times. Every tree on which even a single scale, whether dead or alive, was found was broken down and the nurseryman required to dig it out the same day and burn it. In order to insure better results all trees and shrubs in fence corners, roadsides, and orchards in and for half a mile at least on every side of the nurseries were examined early in the spring, and if infested either required to be destroyed or well sprayed. The nurserymen have heartily co-operated in this work. Inspection, however, though of great value, is not meant to take the place of, but to supplement, fumigation with hydrocyanic acid gas. Each fumigation house is carefully inspected and tested by the Provincial inspector and the local inspector before the fumigation begins, and in order to be sure that the chemicals used are not adulterated, nurserymen are required to purchase them only from certain reliable firms who guarantee the purity and strength.

Conclusion.

We have seen that the San José Scale is a very destructive insect. The method of combating it successfully has also been described. Some may think that the amount of labor involved is great. It sometimes is, especially in neglected old orchards the first year, but it should be remembered that an old orchard may often be made the most valuable part of the whole farm. Many of the best paying orchards of to-day were neglected until a few years ago. *The steps outlined for putting them into shape for spraying for San José Scale are those that would have to be followed in renovating the orchard even were there no scale.* Of course these have to be supplemented by two later sprayings to control the various insect pests and keep off disease so that the fruit may be clean and the foliage healthy. The orchards also require either to be cultivated or fertilized, or often both, to supply plenty of food for growth. Any man who will take the trouble to combat the scale in earnest will naturally go farther and do the extra spraying and fertilizing to insure a good return for his labor. Often the first year his crop will be poor, because the trees if badly infested have been too starved and weak to produce fruit buds, but the second year he may ordinarily expect a crop. San José scale is being satisfactorily controlled all over North America to-day, and no man really interested is losing any trees by it. Many growers claims that the insect in their particular district has been more of a blessing than a curse to them, because it has shown them the value of spraying and of thoroughness.

The Oyster-Shell Scale

(*Lepidosaphes ulmi, L.*)

Introduction.—The Oyster-shell Scale is well known to nearly all the fruit-growers of Ontario, as it occurs not only in every fruit district but also in most orchards in these. Like the San José Scale, it is believed to be an imported insect. When it was introduced is unknown. It has, however, been in North America for more than 120 years. It is so widely distributed over the world to-day that the original home is uncertain. A few years ago this insect was much feared by fruit-growers, who believed it was increasing and likely to seriously injure their orchards. The methods of control then advocated were thought to be unsatisfactory, and the need of a simpler effective remedy was keenly felt. Fortunately this has been found, and has gained the confidence of the growers.

Plants Attacked.—Apples, pears, plums, cherries, currants and gooseberries are attacked, but of these apples are much worse infested than the others. Prof. Jarvis and I have found it also on rose bushes, spireas, lilacs, hawthorn, mountain ash, red-osier dogwood, black ash, white ash, prickly ask, poplar (Populus tremuloides), basswood, horse chestnut and mulberry. Of these, hawthorns and red-osier dogwood were the favorites, and were sometimes badly infested. There is no doubt that further search would show that the insect feeds also on many other plants in this Province. Prof. Quaintance, of the Bureau of Entomology, Washington, D.C., in Circular 121, gives a long list of plants on which the scale has been found in North America.

Nature and Extent of the Injury.—Unlike the San José Scale, the Oyster-shell does not attack every part of the tree, but confines itself almost entirely to the trunk and branches, though occasionally it is found on the fruit of apple trees. Probably the reason this is not worse attacked is that nearly all the young active larvae have settled down and inserted their sucking beaks into the bark before the fruit has begun to form. The new growth on the branches, except towards its base, is also exempt for the same reason. The injury, as in the case of the San José Scale, is caused by the numerous insects with their long, hair-like beaks sucking the food out of the tender tissues beneath the bark and slowly starving the trees. An oblique cut beneath the affected bark shows little brown areas where the scales have fed. In my experience the insect exhibits a decided preference for neglected and weakened trees, such as those we see along the roadside or in fence corners here and there over the farm, or in orchards that have been starved or weakened by winter injury. It is not at all uncommon to find the above classes of trees so badly attacked that the bark is almost concealed by the scales. Young trees as a rule seem to be worst infested. Occasionally a tree badly attacked dies, but usually they continue to live for many years in a weakened condition. The bark on these trees becomes after a few years very rough and scurvy, and even if the scale is killed does not recover its smoothness for several years. In thrifty orchards the insect is seldom very abundant, though it is usually present in moderate numbers in most of the trees unless they have been treated to destroy it. Occasional branches in these orchards may be so badly attacked as to die, but this is not very common.

I have on several occasions seen trees that were once badly infested throw off the scale in some inexplicable manner and take, as it were, a new lease of life. This, however, does not seem to happen very frequently.

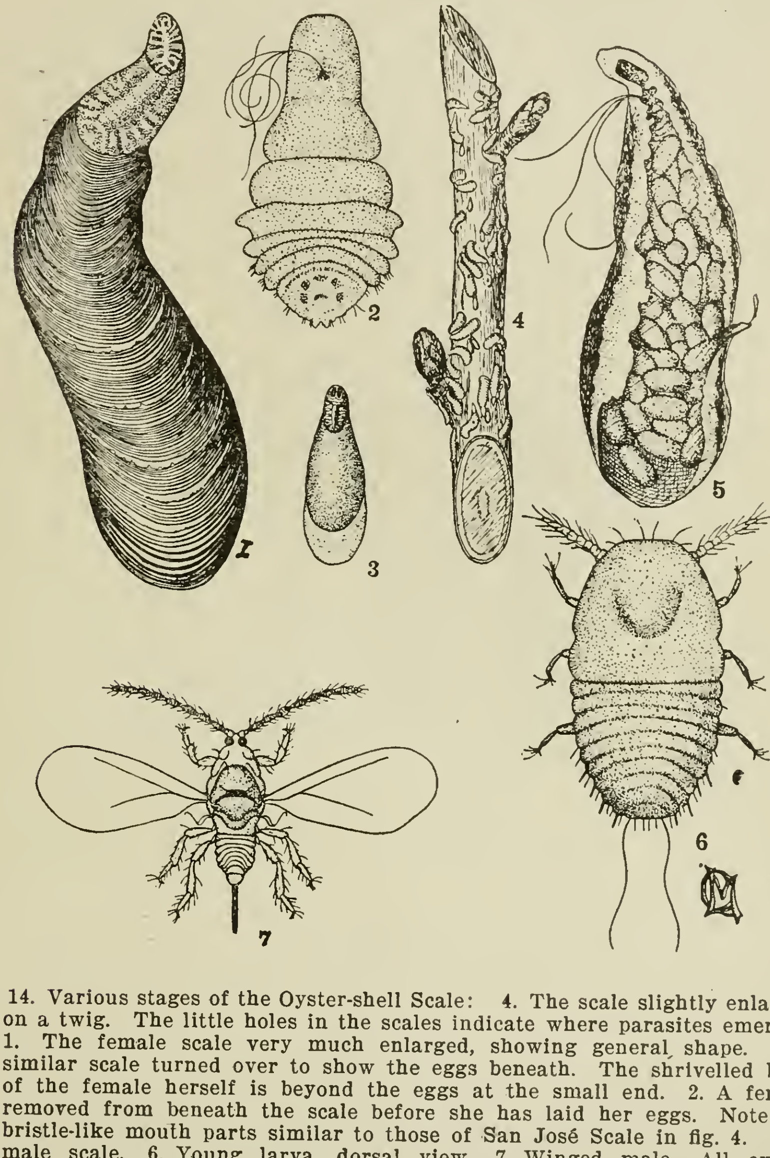

Fig. 14. Various stages of the Oyster-shell Scale: 4. The scale slightly enlarged on a twig. The little holes in the scales indicate where parasites emerged. 1. The female scale very much enlarged, showing general shape. 5. A similar scale turned over to show the eggs beneath. The shrivelled body of the female herself is beyond the eggs at the small end. 2. A female removed from beneath the scale before she has laid her eggs. Note the bristle-like mouth parts similar to those of San José Scale in fig. 4. 3. A male scale. 6. Young larva, dorsal view. 7. Winged male. All except No. 4 much enlarged (after Sherman and Metcalfe).

HOW TO IDENTIFY THE OYSTER-SHELL SCALE.

Appearance.—Fig. 14 with the description beneath it makes the appearance of the adult female scale (the only stage of the insect noticed by fruit-growers) so clear that very little further description is necessary. The insect is about $\frac{1}{8}$ of an inch long and scarcely 1-3 of this in width, is frequently curved more than shown in the figure, especially when they are crowded together; tapers towards one end, and is brownish in color, though it usually resembles very closely the color of the bark on which it is found, so that on light-colored bark like hawthorn it is decidedly lighter in color than on the reddish-brown bark of an apple tree.

The male scales (see No. 3, Fig. 14) as shown here, and as found in nature, are like diminutive females. They are colored much the same, but are very much smaller. Usually when the bark is examined they escape notice among the other scales. They seem to be rare.

It is interesting to compare Figs. 3 and 14 and see how very different in form the San José and Oyster-shell scales are. Clearly no one need ever mistake one for the other.

Life History.—The Oyster-shell Scale, unlike the San José, passes the winter in the egg stage beneath the scale covering. (See No. 5, Fig. 14.) The eggs are glossy white, and may easily be seen if fresh-looking scales on a piece of bark are

Fig. 15. The little white dots are the young white or cream-colored larvae of the Oyster-shell scale just after settling down on the bark.

removed with a pin or knife over any black surface, on which they will show up clearly, as some will usually fall out during the operation. With the aid of a hand lens those left inside the scale can also be seen. There are from about 20 to 100 eggs in each scale, and about an average of 40 or 50. In Ontario the eggs hatch usually around the first of June or about the time the blossoms have fallen; sometimes it is a few days later before they are all hatched, as this continues for five days or more, depending apparently on the amount of heat; in hot weather they hatch more quickly. The little larvae that hatch from the eggs are white or cream-colored (see Fig. 15), and for a few hours after emerging they run around on the bark and then settle down and insert their long, hair-like sucking tube, which is just like that of the San José Scale (see Fig. 6), through the bark. Soon they cover themselves over with a pale, brownish, waxy covering, and later, as they continue to grow, the large, familiar brown scale is gradually formed. The female insects never move after they have once settled down, but remain under the brown covering. The males, on the contrary, when full grown, back out from under their covering as tiny two-winged little creatures (see No. 7, Fig. 14), and fertilize the females before these are full size. This probably takes place early in July, the exact date unfortunately was not determined. In August the female has reached its full development, and its body is so distended with eggs that it occupies the whole of the cavity beneath the covering. It then begins to lay its eggs, and as it does so its body gradually gets smaller and smaller, until by the time they are all laid it is so small that it can only with difficulty be seen beneath the small end of the scale close to the eggs. The female dies very soon after laying all her eggs. There is only one brood a year in Ontario, though in counties farther south there are two broods.

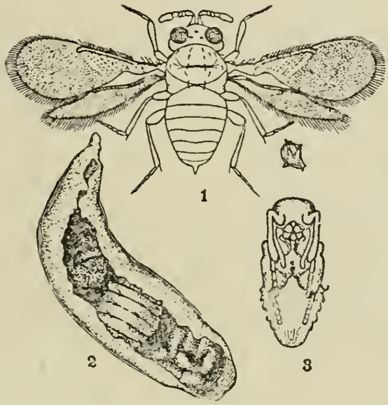

Fig. 16. 1. Adult parasite (*Aphelinus mytilaspidis*) of Oyster-shell Scale. 2. Larva of parasite in scale with scale insect on one side and eggs on the other. 3. Pupa of parasite. All much enlarged, (after Sherman and Metcalfe).

Rate of Annual Increase.—As stated above, the average number of eggs per female is between 40 and 50. If, as in the case of the San José Scale, we allow for a mortality of about 50 per cent.—which I think is not too high for the Oyster-shell Scale, though probably much too high for the San José—there will not be more than 25 offspring from a single female in a year. The rate of increase therefore is small. Comparing this increase of 25 from one with 1,000,000 from one on the part of the San José Scale, we can easily see why the latter scale is so much more destructive and to be feared.

Means of Distribution.

The chief means of distribution for the Oyster-shell Scále, just as for the San José, is the shipment of infested nursery stock. It is also spread by the little cream-colored larvae crawling on birds, insects of various kinds, or almost any kind of moving thing that comes in contact with them, and being carried by these to other trees. As the time when larvae are active is only a few days around the first of June, compared with a long period of over three months for the San José Scale, it is clear that this latter method of distribution would not be so rapid in the case of the Oyster-shell.

Natural Enemies.—The natural enemies of the scale in Ontario are more important than those of the San José Scale. Certain Ladybird beetle adults and larvae feed to a small extent upon them, as do also a few mites; a reddish fungus disease also occasionally does some good, but the only foes of real importance are the tiny four-winged parasites like the one shown in figure 16. These little creatures in their larval stages feed both upon the insect itself under the scale and upon the eggs, and when full grown come out from tiny round holes which they make near the centre of the scale, and which can easily be seen with a hand lens. There are several species of these parasites, but the only one I know of at present in Ontario is shown in figure 16. In some localities as high as 50 per cent. or more of the scales have these small holes, and though they do not destroy all the eggs beneath a scale they must be of considerable aid in keeping down the rate of increase.

MEANS OF CONTROL.

The lime-sulphur wash, properly applied, will readily control this scale. Two sprayings should be given for the best results, the first at the strength of 1.030 specific gravity hydrometer reading, or about one gallon of the commercial lime-sulphur diluted to ten gallons with water and applied shortly before or as the buds are bursting; the second at the strength 1.009 specific gravity, or the commercial diluted one gallon to thirty or thirty-five with water and applied just after the blossoms have fallen. Two pounds of arsenate of lead should be added to every forty gallons of the mixture for this application, as this is the proper time to spray for the Codling Moth, Plum Curculio and Lesser Apple-worm. Of these two applications the first is far the more important, but does not always give uniformly good results. Sometimes it will destroy almost all the eggs or prevent the larvae if they hatch from escaping from the covering scale, at other times a large number hatch, though most of these soon die, killed apparently by the spray mixture that remained on the tree. There is no doubt that this one application repeated each year will itself soon free the trees from the pest, but the results are accomplished more quickly by the aid of the second application at the time stated above. This will kill most of the larvae that are already hatched, and will leave the bark covered and so repulsive to any that may hatch a few days later. The great point, however, in favor of using lime-sulphur in preference to any other known remedy is that this wash not only destroys the Oyster-shell Scale, but many other things as well; for instance, the first application before or as the buds are bursting will also control San José Scale, Blister Mite, Tent Caterpillars—these must be hit soon after hatching—but also helps to ward off such diseases as Scab and Black Rot Canker. The second application, combined with the arsenate of lead, is always required to control Codling Moth, Plum Curculio, Lesser Apple Worm, Scab and Leaf Spot. For this spray lime-sulphur has proven itself even more satisfactory than Bordeaux mixture as a fungicide, because it keeps off the Scab on the fruit without causing the serious russeting and even cracking of apples commonly resulting from Bordeaux mixture. It is clear, therefore, that these two applications with these mixtures should be given even if there were no Oyster-shell or San José Scale to combat. In addition to these, our best growers give an intermediate application just before the blossoms burst, and most of them use the weak lime-sulphur here, too, along with two or three pounds of arsenate of lead. Bordeaux, however, may be used in place of the lime-sulphur, and is possibly even more effective at this stage as a fungicide. This application is important for the destruction of early-feeding caterpillars and for the control of scab.

As in the case of the San José Scale, old trees should be pruned before spraying and the rough bark scraped off. If the trees are not vigorous, a liberal dressing of barnyard manure or cultivation in May and early June will help them to recover more quickly from the effects of the scale.

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Ontario Department of Agriculture

ONTARIO AGRICULTURAL COLLEGE

BULLETIN 220

Lightning Rods

Their Efficiency, Principles and Installation on Farm Buildings.

By

W. H. DAY, B.A., Professor of Physics.

TORONTO, ONTARIO, MARCH, 1914

"Immediately you say, 'I never saw the flash spread out like that, either on the earth or in the cloud.'"—Page 23.

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Ontario Department of Agriculture

ONTARIO AGRICULTURAL COLLEGE

Lightning Rods

W. H. Day

"Lightning Rods! Are They any Good?"

Hundreds of times during the past thirteen years this question has been put to the instructors of the Department of Physics. Hundreds of times we have answered "Certainly," only to be immediately confronted with the logical sequent "How do you know?" Until a year ago our chief reason was "Because science says so," but to the farmer that reason has seldom carried conviction, not because he doubted our word particularly, but because he is accustomed to dealing with individual concrete examples, and he has sometime or other known or heard of a "rodded" building having been burned, and with him this one example carried more weight than the teachings of science, no matter how imperfectly the rodding may have been done.

To-day, however, we are no longer dependent upon science alone for our answer, to-day we know from experience that lightning rods, properly installed, are almost absolute protection. Out of every thousand dollars worth of damage done to unrodded buildings by lightning nine hundred and ninety-nine dollars worth would be saved if those buildings were properly rodded! A pretty strong statement, you say. We realize that it is strong. It has taken thirteen years of investigation to compile the data upon which that statement is founded.

Away back in 1901, when Prof. J. B. Reynolds was head of the Department of English and Physics, he began to investigate the efficiency of lightning rods. Five years later, when two departments were formed of one and he chose the Department of English, leaving the writer the Department of Physics, the writer thought he could not do better than continue the work so ably begun. To-day after eight years' further study added to the five we have the problem solved.

Lightning Rods Save Buildings if Struck.

The first question we asked ourselves was this: "If a rodded building is struck, is it as likely to be burned as an unrodded one which is struck?" Reports were received from a number of selected observers in the various counties, also from insurance companies, but a still greater number were clipped from the daily and weekly papers, and in all cases where the owner's address was learned he was written to for a personal report. In the ten years from 1901 to 1910 reports were received covering 599 buildings that were struck by lightning. Of these

317 were burned, or 53.6 per cent. This percentage is higher than obtains generally, because most of our reports originated in the newspapers, and naturally it is chiefly the severe strokes that are thus reported. Amongst that 599 there were only 18 rodded buildings, and of these only three were burned, which is one in six or 16.6 per cent., as against 53.6. Hence we concluded that an unrodded building if struck is more than three times as likely to be burned as a rodded one. This is the sum total of the results of our first ten years' study of this subject. As there seemed to be no object in pursuing this phase further, the original line of investigation was discontinued.

On the three rodded buildings that were burned the rods were reported in good repair, but whether the rodding was correctly done we had no means of determining.

Do Lightning Rods Prevent Strokes?

But as early as 1906 we had begun to enquire whether lightning rods hadn't a greater function to perform than save buildings that are struck. We had begun to ask ourselves whether lightning rods do not actually prevent many buildings from being struck! At first thought this looks preposterous, but seemingly preposterous things sometimes turn out real and contain great truths.

But how could we determine whether rods prevent buildings from being struck? If 1,000 rodded buildings escaped damage during a storm, how could we ascertain whether some of them would have been damaged if not rodded? We knew that amongst 599 buildings that were struck there were only 18 rodded ones, which is just 3 per cent. If we knew what percentage of farm buildings in Ontario were rodded that would settle the question. If rods neither prevent nor induce strokes then the percentage of rodded buildings amongst those struck should be just the same as the percentage of rodded buildings in Ontario. If the rods cause strokes then proportionally more rodded ones would be struck than unrodded, but if they prevent strokes, then proportionally less.

Clues That Failed.

To determine what percentage of Ontario buildings are rodded we first endeavored to have the township assessors make a record regarding the buildings on each farm and to have them give a return showing the result. In this we failed. We approached the inspector of insurance with a view to having him make a regulation requiring fire insurance companies to report in every application whether the buildings insured were rodded or not. Again we were disappointed. We thought of endeavouring to have the census enumerators ascertain the number of rodded and unrodded buildings, but this seemed impracticable. We wrote every insurance company doing business in Ontario, about one hundred and forty in all, but they were unable to tell us whether the buildings in their risks were rodded or not.

However, writing the insurance companies was the beginning of the solution. It drew their attention to our work. Early in 1912 the writer accepted an invitation to address the Mutual Fire Underwriters' Association on the subject of Lightning Rods. After dealing with the subject from a scientific standpoint and giving the result already noted of our ten years' investigations along the practical side, the writer laid before the members of the Association the important question as to whether rods actually prevent strokes from occurring, and asked their co-operation in answering it.

A few weeks later we wrote to all the Mutual Companies doing business in Ontario. enclosing a card for reply asking whether they would co-operate with us, and suggesting that if they were prepared to do so they should put a question on their application form asking whether the buildings were rodded. We received favorable replies from thirty-eight companies. In the beginning of December we sent out report forms to be filled by them. Eighteen of them kept a special record of all business from July 1st, 1912, and reported results to us.

In Ontario Efficiency of Rods in 1912 Was 94½ Per Cent.

From the reports of these eighteen companies, covering more than one-quarter of the Province, it was found that in every 200 farm buildings insured, 42 were rodded. which is 21 per cent., but out of every 200 farm buildings struck by lightning only 3 were rodded—we should have expected 42 if the rods were no good.*

Or stating it in another way, in every 7,000 *unrodded* farm buildings insured by these companies, 37 were struck by lightning, of which several were burned; but out of every 7,000 *rodded* ones insured, only 2 were struck (and damaged only)—we should have expected 37 if the rods were no good, hence, in Ontario as rods are installed, an unrodded building is 18½ times as likely to be struck as a rodded one is. These results cover all kinds of rods used in Ontario and doubtless include some improper rodding. To prevent damage in 35 cases out of an expectancy of 37 means an efficiency of 94½ per cent.

This result was almost astounding. From scientific considerations we were led to believe that rods must prevent strokes, but we were not prepared for such a sweeping result as this. But you say, "This is only one year's reports, and another year might give the very opposite result."

Efficiency of Rods in Ontario in 1913 was 92 per cent.

During 1913 the insurance companies continued their most valuable co-operation. Forty of them kept special records for us, sixteen being able to give us reports complete in every particular. They represented twelve different counties, and of the buildings insured by them 26.2 per cent. were reported as rodded, showing an increase since last year of 5.2 per cent. The total number of claims paid for lightning damage to buildings was 193, of which 36 were burned, amounting in all to $40,904.53. If the rods had no effect—good or bad—we would have expected 26.2 per cent. of the strokes and damage would have been on rodded buildings, which would mean 50 strokes and $10,715.98, while as a matter of fact the number of strokes to rodded buildings was only 8, and the damage only $57.64, a saving of $10,658.34. To save this amount out of an expectancy of $10,715.98 shows an efficiency of 99.5 per cent.

Of the other twenty-four companies, fifteen were located in the counties above referred to and nine in other counties, in some of which the percentage of rodded buildings is exceptionally high, a fact which we know by personal inspection, so we may safely say that in the whole forty companies the rodded buildings total 26.2 per cent. or more.

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* Note: If the efficiency be calculated from these figures it will not agree exactly with that in the succeeding paragraph. This is because the actual percentage was not exactly 21, but that was the nearest whole number—we could not have a fraction of a building struck.

In the reports of the twenty-four companies we find records of two rodded buildings which were burned, one owned by Mr. Harold Currie, of Strathroy, the other by Mr. Murdock Kerr, Embro. Neither of these buildings was rodded according to standard specifications, the former being particularly defective. It is dealt with in detail on page 34. This building would undoubtedly have been saved if properly rodded. Mr. Kerr's rodding was defective in two regards: first, the systems on the main barn and straw barn were not connected, and, secondly, the ground-rods were down only about 3½ to 4 feet, but they were moist when pulled out for examination. Whether the defects were responsible for the fire we have not been able to determine. The bolt was of the ball type, a ball of fire about as large as a man's head coming straight down and hitting the straw barn.

Taking the whole forty companies together, there were 621 lightning damages totalling $113,459.89. 110 of these buildings were burned. We should have expected 26.2 per cent. of the strokes and damage to be on rodded buildings. This would have given 163 strokes and a loss of $29,726.49. As a matter of fact, only 16 rodded buildings were struck and the loss was $3,917.09, so the rods saved $25,809.40, out of an expected loss of $29,726.49, showing an efficiency of 86.8 per cent. Since Mr. Currie's fire was directly due to the absence of ground-rods at a vital point, it seems only fair to consider this barn as not rodded. If this is done the efficiency of the rods in 1913 would be 92.0 per cent.

Perhaps some may reply: "But maybe those rodded buildings expected to be struck were actually struck, and the rods carried off the strokes harmlessly and so the insurance companies, having no claim to pay, have no record of those strokes." If any take this ground, well and good, because it is an admission that the rods in one way or another brought about the desired result, viz., to save the buildings from damage by lightning.

It may be well, however, to remark that in all probability there is some ground for the objection. Probably more than two of the 37 rodded buildings expected to be struck in 1912 were actually struck, and of those expected to be struck in 1913, probably more than 16 were actually struck, and the rods carried off the current without damage, indeed without any trace of the strokes remaining to show that they ever occurred. The exact comparative value of the *saving* and *preventive* functions of rods we are not able to determine, but scientific considerations now lead us to conclude that the preventive function is by far the more important. As the teachings of science regarding the general value of rods have been so strongly confirmed by practical experience, we may with confidence accept the dictum of science when it says that the *chief* function of rods is to prevent strokes from occurring.

For those who want reports over a longer period of years we have them. During these Ontario investigations our attention had been drawn to Iowa and Michigan, where it was reported some advanced work in rodding had been done. Consequently in September, 1913, by the kindness of the Hon. Mr. Duff, the writer was enabled to visit these States and examine conditions at first hand.

In Iowa Lightning Rods Show an Efficiency of 98.7 Per Cent.

In Iowa some valuable data were available. For the eight years 1905-1912 inclusive, a large number of insurance companies doing farm business only have reported the percentage of rodded buildings covered by their risks, and also the claims paid on rodded and unrodded buildings. The highest number of companies reporting in any one year was 68 and the lowest 46, the average being 55. These companies report that about 50 per cent. of all their risks are rodded. From the reports the following facts are gleaned:

The total lightning claims paid by all these companies for the whole eight years on *rodded* buildings was only $4,464.30, which is an average of $10.15 per company per year. On *unrodded* buildings, however, they paid lightning claims amounting to the large sum of $341,065.32, which is an average of $775.15 per company per year—and the number of unrodded buildings insured was the same as the number of rodded ones. Comparing $775.15 with $10.15 we see that for every $1 paid on rodded buildings $76 was paid on unrodded ones, or the rods save $75 out of an expected loss of $76, if the buildings had not been rodded. This shows an efficiency of 98.7 per cent. It is probable that some improper rodding is included, as the rods were not subject to inspection.

The case is not yet complete, however—in both Ontario and Iowa the reports cover some defective rodding. The true efficiency of lightning rods can only be determined when we consider a large number of properly rodded buildings.

Inspected Rods in Michigan Show an Efficiency of 99.9 Per Cent.

In Michigan the writer was fortunate enough to procure such a report. The Farmers' Mutual Lightning Protected Insurance Company of Michigan, as its name implies, insures only rodded buildings, and that only after the Company's inspectors have carefully examined the rodding and approved of it. During 1909-1912, inclusive, in a business which for the four years totalled $55,172,075 risk, this company paid only $32 for damage to buildings by lightning, in three small claims all traceable to defects in rodding which were overlooked by the Company's inspector.

The Patrons' Mutual Fire Insurance Co. which also does business all over the State of Michigan insures both rodded and unrodded buildings. In the same four years, on a total risk of $59,567,272 this company paid lightning damage on buildings to the extent of $32,268.78, which is 1,008 times as much as the protected company paid. In conversation the Secretary of the Patrons' Company said that in eleven years they had only had three small claims for lightning damage on rodded buildings, all the rest of their lightning damage being on unrodded ones. They report 20 per cent. of their risks rodded. Deducting these rodded risks we see that the $32,269 damage occurred on unrodded risks amounting to $47,753,818. At this rate the loss on $55,172,075 of unrodded risks, the same risk as the Protected Company had, would be $37,282, which is 1,168 times as great as the loss on the same amount of properly rodded risks. Thus we see that when the damage to properly rodded buildings amounts to $1, the damage to unrodded ones amounts to $1,168, or in other words, rods save $1,167 out of an expected loss of $1,168, indicating an efficiency of 99.91 per cent., or a saving of $999.10 out of an expected loss of $1,000, thus substantiating the claim made on page 1.

Insurance Assessments Favor Rodded Buildings.

The Protected Mutual began business in October, 1908. Its risks now total $35,000,000, while the Patrons' Mutual in the same time has only increased from $12,000,000 to $19,000,000. So phenomenal has been the success of the Protected Company that it began to draw members rapidly from the other companies. To them this meant ultimate death, so some of them began to carry their rodded and unrodded buildings in separate classes, *each class being assessed for its own losses,* and now nearly every mutual insurance company in the State of Michigan is carrying rodded and unrodded classes, or preparing to do so. The Patrons' Mutual referred to above has been doing so for five years, and its assessments per $1,000 of risk have been as follows:

Year	Assessment per $1,000 of Risk	
	Unrodded	Rodded
1909	$2 50	$1 50
1910	3 33	2 50
1911	2 50	1 87½
1912	3 33	2 00
1913	3 33	2 00

During the same five years the assessments of the Protected Company have been:

Year	Assessment per $1,000 of Risk
1909 } 1910 } Together	$2 00
1911	1 30
1912	1 20
1913	2 00

Iowa Protected Mutual.

In Iowa there is also a Protected Company, insuring only rodded buildings. The president, Mr. C. N. Doane, Newton, Iowa, is also president of the Mutual Fire and Tornado Association, insuring in the same vicinity as the Protected Company, and taking both rodded and unrodded risks. In six years this Iowa Protected Mutual has not had a claim due to lightning damage to a rodded building or stock in building. Its total assessment per $1,000 for the last five years has been $8.00, while in the Fire and Tornado the total assessment for the same period has been $14.50, a difference of 44.8 per cent. in favour of the Protected Company.

Michigan Insurance Rates Average 36½ Per Cent. Cheaper on Rodded Buildings.

While in Michigan the writer spent two days at Lansing in the Department of Insurance examining the original reports of ten different companies including the two above mentioned and compiling data therefrom. Previous to 1913 five of them were carrying both rodded and unrodded classes. I find the average assessment by these five companies on unrodded buildings is $2.96 per $1,000 of risk, while the average on their rodded buildings is $1.89, showing a difference of $1.07 per $1,000 in favour of the rodded buildings. If we calculate that difference in percentage we find that the assessment on rodded buildings is 36½ per cent. less than on unrodded ones. Or taking the rodded assessment as the standard, then the assessment on the unrodded ones is 56.6 per cent. greater than on the rodded ones. Now this is not theory or science—it is the practical experience of cool-headed insurance men and cautious farmers in mutual insurance companies, where the assessment is in direct proportion to the losses incurred. This is the protective value of lightning rods reduced to dollars and cents in insurance rates. Insurance men the world over cannot ignore the experience of the Michigan Companies. Farmers the world over should profit from the lessons taught by the Michigan farmers.

Being now assured that lightning rods are of high protective value, our next logical enquiry would be: "When is a building properly rodded?" Before one can appreciate some of the directions to be given for rodding a building he must have at least a limited knowledge of electricity and its laws, and this we shall now proceed to acquire, leaving directions for rodding to come later on page 24.

Discovery of Electricity.

If a small piece of cheap scribbling paper, after being warmed to dry it, be rubbed briskly upon the coat sleeve for a few moments and then placed against

Fig. 1.—Paper rubbed briskly on coat sleeve adheres to hand. Paper is electrified by friction.

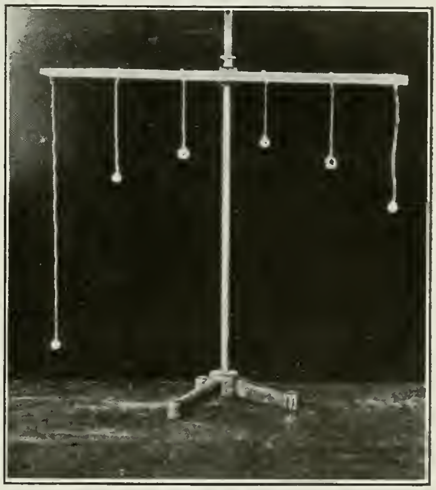


Fig. 2.—Pith balls suspended by *silk* thread to be used in experiments.

the window pane, it adheres to the glass, or it will adhere to the hand. (Fig. 1.) Another piece not rubbed, does not adhere to glass or hand. Hence the rubbing has produced some new property in the paper. The first experiment of this kind was performed by Thales, an ancient Greek, in the year 640 B.C. While walking along the seashore he picked up a piece of amber. In order to burnish it he rubbed it briskly upon his garments, and in some way or other discovered that after the rubbing the amber had the property of attracting light substances, such as dry leaves, twigs and chaff to itself. The Greek word for *amber* is *electron,* and hence this new property first discovered in the amber has come to be known as *electricity.* The paper in being rubbed upon the coat sleeve is said to have become *electrified.* In the year 70 A.D. electricity is again mentioned in history, but no real progress was made until the year 1600 A.D. Then Dr. Gilbert, a famous English scientist, discovered that all substances when properly manipulated could be electrified by friction just as the amber was.

Here is another experiment. Several light pith balls, cut from the pith of an elder bush, are suspended from a little beam by silk threads. (Fig. 2.) They are free to swing about like the pendulum of a clock. Here also is a piece of cat's fur, while in this clamp is an ebonite or hard rubber rod. (Fig. 3.) A hard rubber comb would do just as well as the rod. To begin with, each one of these pith balls must be touched with the hand. The rod also must be touched from end to end with the hand. (Fig. 4.) If the rod be now placed near the pith balls we see that it neither

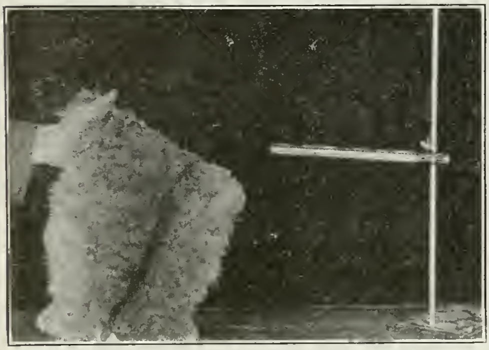


Fig. 3.—Cat's fur (in hand) and ebonite rod (in clamp), to be used in experiments.

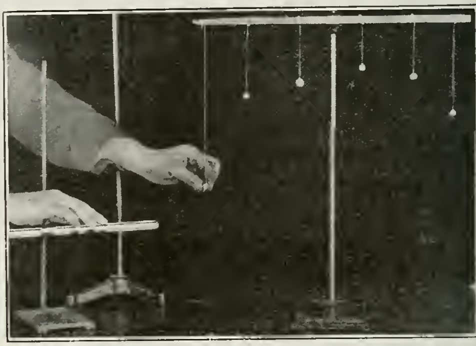


Fig. 4.—Before the experiments are begun the pith-balls and ebonite rod are both touched by the hand to make them "neutral."

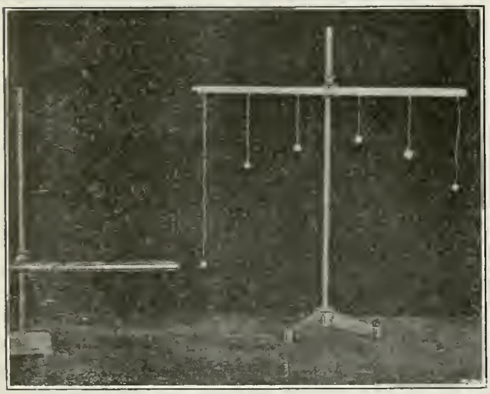


Fig. 5.—Pith-balls and ebonite neutral, no attraction between them.

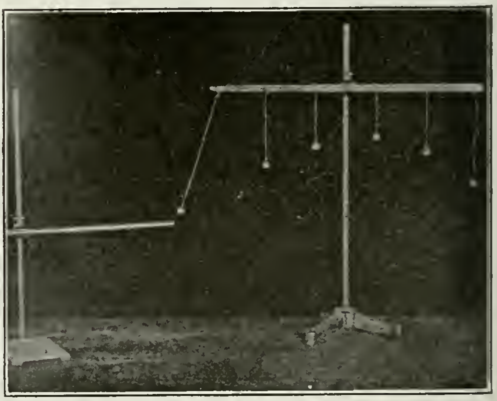


Fig. 6.—Ebonite rubbed with cat's fur attracts pith-balls. Ebonite said to be electrified.

attracts nor repels them. Both may be said to be "neutral." (Fig. 5.) But on rubbing the ebonite with the cat's fur and then holding it near a pith ball we see it is violently attracted to the rod. (Fig. 6.) It has been electrified by friction against the cat's fur.

Placing the rod close enough that one of the pith balls can touch it, we see that immediately after contact, the ball, instead of being attracted, is strongly repelled. The ball has been electrified with part of the charge that was on the ebonite. Thus "like charges repel." (Fig. 7.)

Other substances will produce electricity. For instance, a silk cloth and a glass rod. If the glass be rubbed briskly with the silk and then placed near one of the neutral pith balls the ball is attracted. The glass rod has also been electrified by friction. If the glass is placed close enough that the pith ball touches it, then it immediately repels the ball. The ball on touching the glass becomes electrified by contact with part of the charge that is on the glass. Thus again, " like charges repel."

Two Kinds of Electricity—Like Charges Repel; Unlike Charges Attract.

But if the electrified glass be applied to the pith ball that was charged from the ebonite, the ball is attracted! Also charging the ebonite from the catskin, as before, and applying it to the ball charged from the glass this ball is likewise attracted. Thus, we see that the charge on the glass and ebonite are different. The glass will repel a ball charged from itself, but attract one charged from the ebonite; the ebonite, likewise, repels the ball charged from itself and attracts the one charged from the glass. (Fig. 8.)

Consequently, we see that there are two kinds of electricity, one of which is produced on ebonite by rubbing it with cat's fur and the other on glass by rubbing it with silk; and, furthermore, we are able to say that "like charges repel and unlike charges attract." This is a fundamental law in electricity. The charge found on the glass is called *positive* and that on the ebonite *negative*. It can also be shown that whenever a positive charge is generated in one body by friction an equal negative is generated in the other body which produced the friction.. Scientifically there is no inherent reason why these terms should not have been reversed when the distinction was first made.

Conductors and Non-conductors.

One of these pith balls is suspended by a *cotton* thread. If the electrified ebonite or the electrified glass be applied to this ball we see that it is very strongly attracted, and, further, that when it is allowed to touch the rod it clings instead of being repelled as were the others after contact. (Fig. 9.) In this position it remains until by and by it lets go and hangs straight down. (See figure 5.) Testing this ball now we see that it is not charged as the ones suspended by the silk threads were after contact and no charge is left on the ebonite! Both ball and ebonite are neutral! Consequently, we conclude that cotton and silk behave differently with regard to electricity. The cotton thread has allowed the charge to flow along it to the beam and away to the floor and thence to the earth. The cotton is called a " conductor," while the silk is called a " non-conductor." Copper, or indeed any metal, would conduct a charge away much faster than even the cotton. The words " conductor " and "non-conductor " are not absolute, but rather relative. There is probably no substance which is an absolute non-conductor of electricity. The term simply means that the substance referred to is a poor conductor.

Three Ways to Charge a Body, viz., Friction, Contact, Induction.

We have seen two ways of charging a body with electricity. One is by " friction " and the other by " contact " with a charged body. There is a third, namely, by " induction." A brass body is supported on a glass base. Glass is a non-conductor, or insulator. The brass body is touched by the hand to make it neutral. If applied to a neutral pith ball there is no attraction. If neutral ebonite be placed

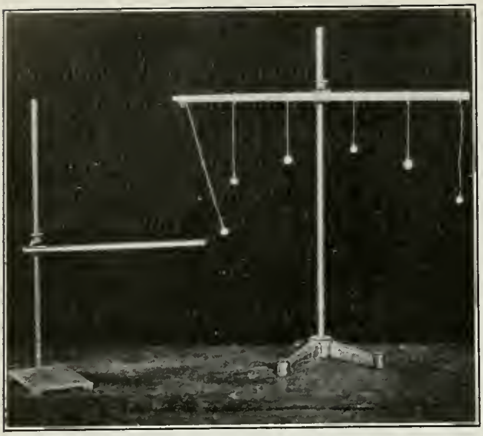


FIG. 7—A pith-ball suspended by *silk*, after touching the electrified ebonite is repelled. Part of the electric charge on the rod has passed to the ball, hence "like charges repel."

FIG. 8.—Negative ebonite rod between two balls, left charged negatively from ebonite rubbed with cat's fur, the other charged positively from glass rubbed with silk. Like charges repel, unlike charges attract.

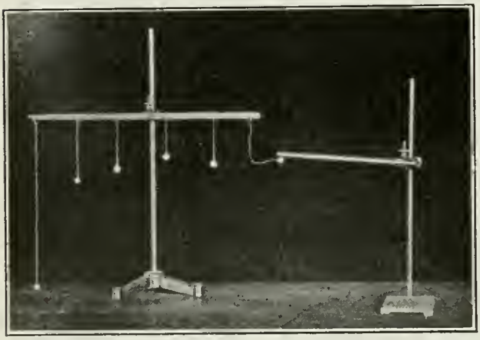


FIG. 9.—A pith-ball suspended by *cotton* thread clings to the charged ebonite for a time. When the pith-ball lets go both are neutral, as in figure 5.

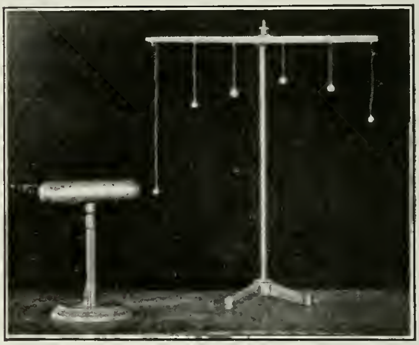


FIG. 10.—Brass conductor on glass stand, also pith-balls. Both neutral. No attraction.

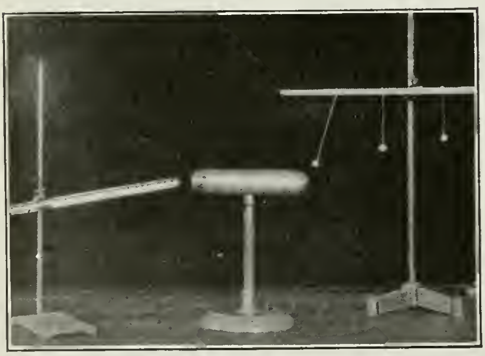


FIG. 11.—Charged ebonite rod held *near* end of brass conductor. Pith-ball is attracted, hence conductor has been charged by the influence of a charge at a distance, i.e., by "induction."

FIG. 12.—Two brass plates on glass stands. Plates separated. One plate charged, as shown by the repulsion of the pith-ball.

near the brass there is likewise no attraction (Fig. 10), but when the ebonite rod is charged and held near, but not touching the brass body, we find that the pith ball is attracted! (Fig. 11.)

Thus we see the brass body has been charged not by either friction or contact, but by the influence of the charge on the ebonite rod a little distance away. The brass is said to have been charged by "induction."

A Condenser Increases the Charge.

Two brass plates on glass stands are so arranged that they can be placed face to face. Each plate has a small pith ball attached by a cotton thread, which will show when the plate is charged. From the ebonite one of these plates is now charged by touching it a number of times with the rod which is each time rubbed with the catskin. The pith ball is strongly repelled, and stands out from the plate almost in a horizontal position. (Fig. 12.)

Fig. 13.—The same plate as in figure 12 (with the same charge) after plates were placed close together, but not touching. Note that the pith-ball has dropped showing less repulsion. More electricity can now be given to the charged plate. That is why the plates when close together are called a "condenser."

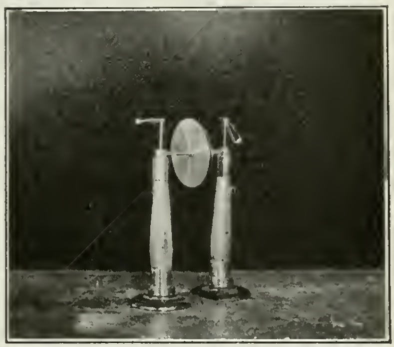


Fig. 14.—The same condenser as in Figure 13. Note pith-ball horizontal again as in Figure 12. As much extra charge was added to the left-hand plate as the plate originally held. The right hand plate has become charged by "induction," as shown by repulsion of pith-ball.

Now when the other plate is brought close to the charged one we note that the pith ball drops considerably (Fig. 13), and more electricity can be put on the charged plate, in the same manner as before, until the ball again stands in a horizontal position. (Fig. 14.)

Two insulated plates, side by side, are, consequently, called a "condenser." A condenser enables us to store up a much larger charge of electricity than either plate alone will hold.

Charges Reside on the Surface.

One other law should be mentioned, viz.: When a conductor is electrified the charge resides entirely on the surface. This can be readily proven, but the experiment does not lend itself to illustration by photograph.

Electrical Machine Produces Heavy Charges.

Thus far we have produced only very small charges, and at the expenditure of considerable labour in producing the friction. However, forty years after Dr. Gilbert's discovery, an electrical machine was invented by which large charges could be generated. At first condensers were not used on the electrical machines, but shortly afterwards they were applied in the form of Leyden jars. A Leyden jar is an ordinary glass vessel like a fruit jar, covered with tinfoil on the outside, about half way up, and on the inside about half way up. These two tin foils form the two plates of the condenser, and by means of Leyden jars very strong charges can be stored up.

Figure 15 shows an electrical machine consisting of two glass plates, one of which is rotating and the other stationary. Without the Leyden jars it produces a very fine spark which will jump about two inches of space. When the two Leyden

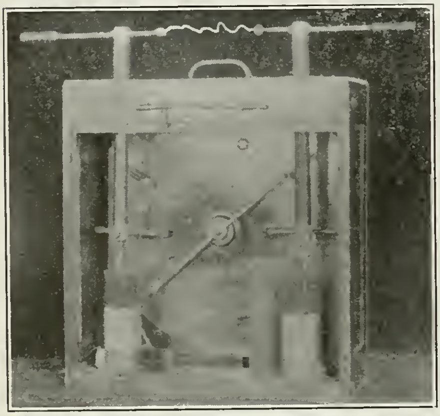


Fig. 15.—An electrical machine. It is being turned by crank in rear. Note spark between knobs.

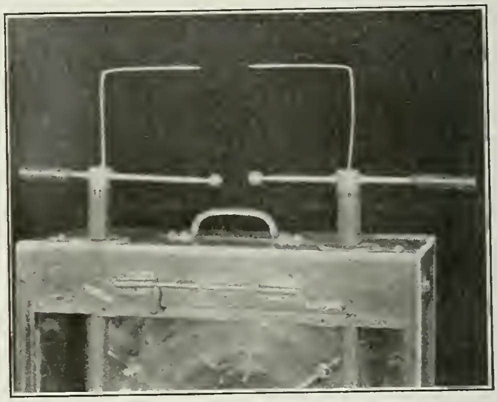


Fig. 16.—Electrical machine with points attached to positive and negative poles. No flash can be produced.

jars are connected up the spark is very much stronger, and sufficient to give one a severe shock. It will jump five or six inches of space, and the spark looks exactly like a flash of lightning.

Electricity Leaks Off Points.

With this machine one can demonstrate another fundamental principle. If two sharp wires are attached, one to the positive side of the machine and the other to the negative, and the points turned towards each other we find that the machine does not produce a spark and cannot be made to produce one, if the electrification takes place gradually. (Fig. 16.) If a lighted candle is held to one of the points it is extinguished when the machine is turned. There is sufficient wind at this point to blow out the candle. (Figs. 17 and 18.)

There is only one conclusion possible, viz., that the electricity formed by the machine leaks off these sharp points, preventing sparks from occurring.

Franklin Proves That Lightning is Electricity.

The electrical machine was discovered in 1640, but it took one hundred years to perfect it and produce the large sparks, and to learn the fundamental principles of electricity. In 1751 Benjamin Franklin, observing the similarity between the lightning flash and the sparks that could be produced by an electrical machine, came to the conclusion that lightning was nothing else than a discharge of electricity, or rather the light produced by such discharge. To prove this, he sent a kite up into the clouds as a thunderstorm was approaching. The string which held the kite was connected with an electric key in the laboratory. As soon as the string became wet electric sparks occurred at the key, which were in every respect like those produced with the electrical machine. Franklin's reasoning then ran something as follows: If lightning is produced by a discharge of electricity, then it must obey the laws of electricity. Hence, it should be possible to prevent lightning in many cases, just as an electric spark can be prevented in this machine by having a pointed

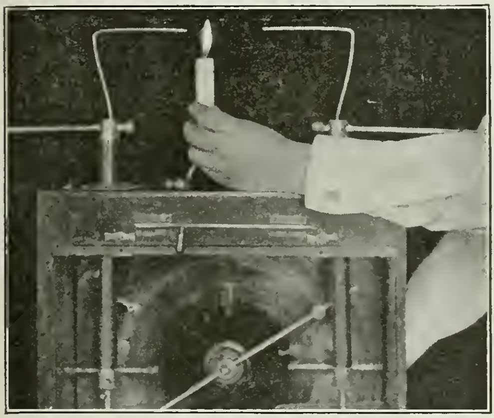


Fig. 17.—Candle-flame held between points of electrical machine. When the machine is not turned, i.e., when there is no charge, the flame burns straight up and sharp in outline.

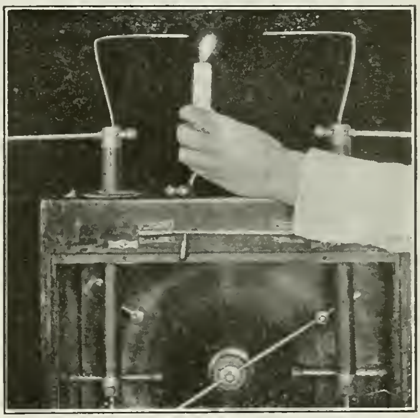


Fig. 18.—But when the machine is turned the candle-flame is blown sidewise. If the candle is held up level with the point the flame is blown out. The wind shows that electricity is leaking off the point.

wire attached to each side, or if a flash does occur, it should be possible to conduct the current to the earth by wire without injury to the building bearing the wire. In other words: If lightning is produced by a discharge of electricity, lightning rods must be a practical possibility.

After Franklin's results were published lightning rods began to be installed on farm buildings through the United States, and later in Canada, but in the early stages lightning rod companies knew very little of the laws of electricity, consequently were unable to instruct their men as to how buildings should be rodded, and, hence, in some cases, the rods did not produce the protection they were expected to. Besides, numerous swindles in connection with lightning rods were worked off on the farmers, so that in time lightning rods came into great disrepute. However, Sir Wm. Snow Harris, in England, devised a system of lightning protectors for ships, which completely did away with the one-time tremendous loss caused by lightning to the ships of the British Navy. So effective was his system that the late Queen Victoria bestowed a knighthood and an annuity upon him in recognition of his great service to the navy, and thereby to the British Empire. Throughout England, Germany and France lightning rods became the subject of study, and many buildings, especially costly ones like the great churches and cathedrals, were protected by lightning rods, so that the loss to buildings of this kind by lightning was almost completely overcome. This extensive use of the lightning rod in Europe, together with continued study in America, has had the effect here of drawing attention again to the subject.

In America the one man who has done more than perhaps any other to bring lightning rods again into favour is Mr. West Dodd, of Des Moines, Iowa. A man of great energy and scientific insight, he took up the lightning rod question twenty-five years or more ago, when rods were in disrepute, and pursued it with such tenacity and skill that he has overcome a hostile public sentiment and convinced the people of the Middle Western States that lightning rods are an unqualified success. His own State of Iowa reports 50 per cent. of its farm buildings rodded,

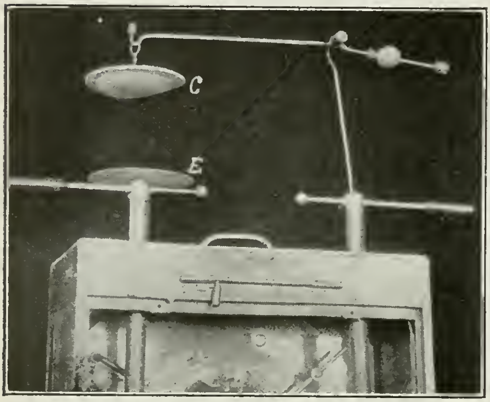


Fig. 19.—The electrical machine as modified by Mr. West Dodd for demonstrating the thunderstorm. Note earth plate E. and cloud plate C.

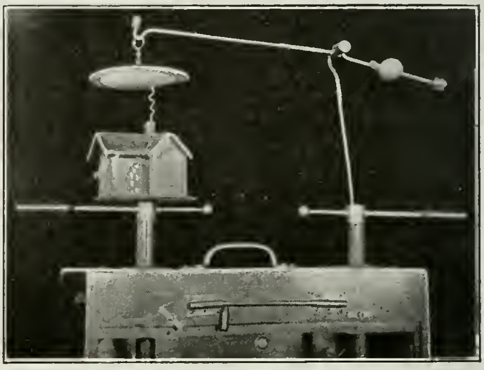


Fig. 20.—A toy house with metal chimney, screen door, eave-trough and balcony is set on earth plate and machine turned. Note flash to chimney and sparks down screen door—the door is constructed with air-gaps, in jumping which the current causes sparks. Dangerous to stand by screen door during thunderstorm.

perhaps the highest percentage of any similar area in the world. Motoring through that state for a distance of fifty or sixty miles, the writer verified this percentage by actual count. In his work Mr. Dodd adapted the electrical machine to demonstrate the thunderstorm and the lightning stroke, and then used toy barns, houses, animals and rods to demonstrate the phenomena of lightning and the efficacy of lightning rods. With this equipment he appeared before the insurance companies of Iowa and other states from time to time, and demonstrated scientifically that rods must be effective. His teaching bore fruit in numerous companies granting reduced rates on properly rodded buildings.

The Electrical Machine Modified to Represent a Thunderstorm.

Mr. Dodd attached a metallic plate to the negative side of the machine; to the positive side another plate which hangs a few inches above the first one. The lower plate represents the earth, and the upper one the cloud. (Fig. 19.)

When the machine is turned the "cloud" gradually becomes charged with positive and the "earth" with negative electricity, and by bringing the cloud and earth close enough together sparks, or flashes, occur which look exactly like the flashes of lightning seen during thunderstorms. After each flash the plates again become charged *gradually.*

Rods on Toy Buildings Prevent Flashes.

Here is a T-shaped house with metal gutter to the eave-trough, whence two conductor-pipes run down nearly to the ground. One conductor-pipe is connected with the metal floor of the balcony. The house, which has a screen door, is placed on the earth plate. (Fig. 20.) As the machine is turned a flash occurs to the chimney, and thence the current follows the gutter and eave-trough, then flashes to the screen door, which is so constructed that the current has air-gaps to jump,

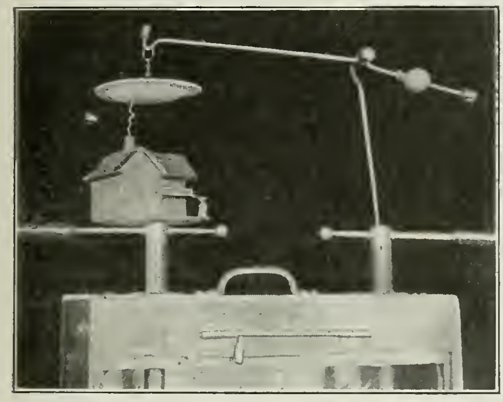


Fig. 21.—A woman stands under the balcony and is struck. Note short flash from balcony to woman's head. The gutter, conductor-pipe, metal floor of balcony and the woman form an easier path than that by the screen door.

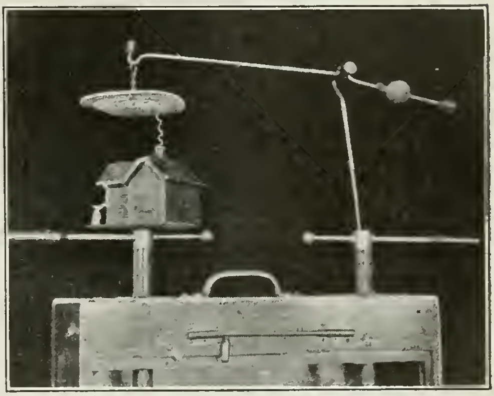


Fig. 22.—The woman goes to the rain barrel for a pail of "soft water" and is struck. This path is now the easiest for the flash.

making tiny sparks as it does so. From the door it flashes to the ground plate. Note that flashes or sparks occur only where the current jumps air-gaps.

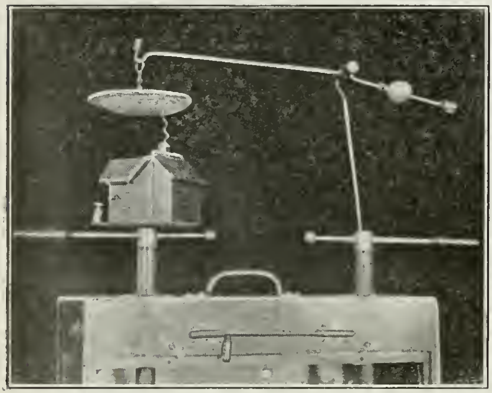
A little metallic figure, representing a woman, is placed in front of the screen door, and the flash strikes the woman instead of jumping the air-gap at the floor. If the woman stands under the balcony the lightning takes a new path. (Fig. 21.) Instead of going by the screen door it follows the eave-trough to the balcony floor, thence strikes the woman and passes to the earth. The new path offers less resistance than the old.

If the woman goes to the rain barrel for a pail of "soft water" the lightning takes another path still, following down the gutter, eave-trough, and conductor-pipe, and thence striking the woman. (Fig. 22.)

A copper wire without points is now put on the building, so it is in contact with the chimney and leads down to the earth plate at each end. The flash now follows the wire, and the woman is perfectly safe, standing at the eave-trough, under the balcony, or at the screen door. (Figs 23A and 23B.) The copper wire offers less resistance than any of the other paths, and naturally the flash follows the path of least resistance.

But if this wire is removed and another put on with two sharp points sticking upward towards the cloud, the flash is entirely prevented. (Fig. 24.)

If the lighted candle be applied to these points it is blown out as before, consequently, the electricity generated by the machine is leaking off these points and



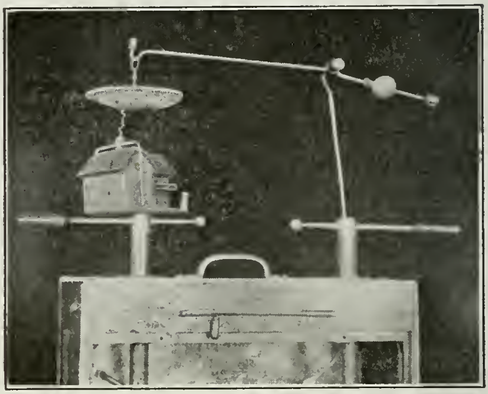


Fig. 23.—A wire is put along the ridge, touching the chimney and going down to the ground plate at each end of the house. The flash now goes down this wire, and the woman is safe at rain barrel, under balcony or at screen door.

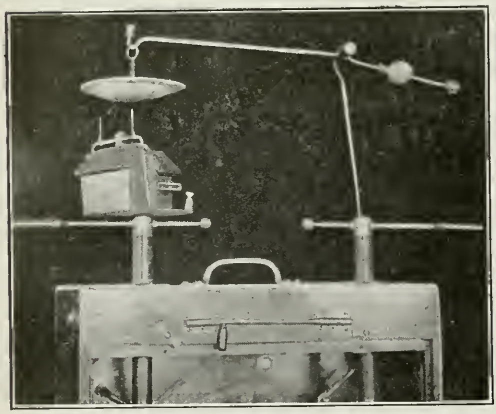


Fig. 24.—If, however, wire has uprights and points no flash can be produced, which is better still.

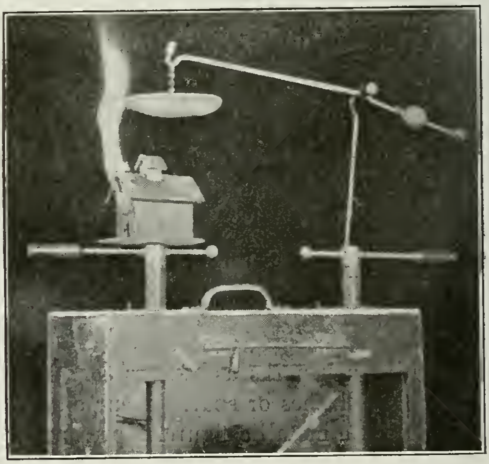


Fig. 25.—Barn with hayfork track, fired by flash. If track had been grounded current would have followed ground wire, and no fire would have occurred. If points had been used flash would have been prevented.

gradually neutralizing the opposite charge in the space between the cloud and the earth.

Here is a barn with cupola and hay-fork track. The flash enters the cupola, jumps to the track, and thence down at one end of the barn. If a little gasoline is put in the door at the end of the barn it is at once fired, just as hay would be. (Fig. 25.) As in previous cases, the wire without points will carry the stroke off without setting fire *if connected with hay-fork track*, while the one with points will prevent the flash entirely.

Metallic Roofs.

It is sometimes said that a metallic roof is perfect protection from lightning. If such a roof is put on one of these buildings, it is struck just the same as if it were an ordinary roof. (Fig. 26.) Note flash at stove (which is constructed with air-gaps to cause sparks). It is dangerous to stand by the stove during a thunderstorm.

If, however, a corner of this roof is connected to the ground by a wire, the current follows the wire. (Fig. 27.) No sparks at the stove now.

But a flash can be prevented from striking that metallic roof, as in the other cases, in two ways: First, by using lightning rod points: secondly by putting a sharp edged or notched ridge-board on the top. (Fig. 28.) We might here refer to the

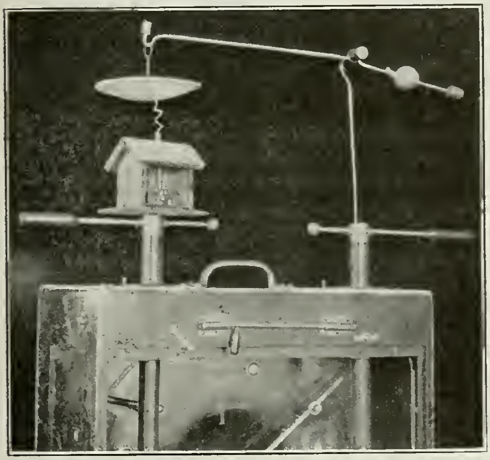


Fig. 26.—Metallic roof struck by lightning. Note flash down front of stove. The stove is constructed with air-gaps in jumping which current makes sparks. Dangerous to stand by stove during thunderstorm, if house is not rodded.

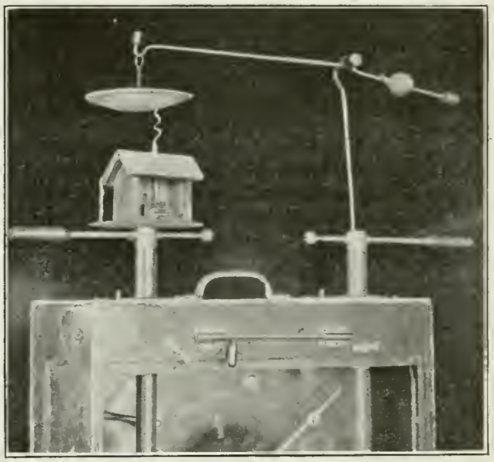


Fig. 27.—Metallic roof with one corner grounded. Flash still occurs, but goes down ground wire—no sparks at stove now.

practice of using a round metal form on the ridge of a metal roof. Nothing could be more dangerous than this so far as lightning is concerned unless points of some kind are provided. The round form prevents the electricity from leaking off, and consequently tends to store up a charge and cause a stroke. If instead of the round a sharp-edged form or one with teeth were used, it would be almost impossible for a metallic-roofed building to be struck by lightning, if two, or better, four, corners were connected with the earth by ground wires.

Wire Fences.

Here is a wire fence, which is attached to the earth-plate. As the machine is turned a flash of lightning jumps from the cloud to the wire and from the wire to the earth. (Fig. 29.)

If a horse is stood beside the fence, instead of the lightning jumping the air-gap from the wire to the ground it strikes the horse. (Fig. 30.)

If, however, the fence-wire is connected with the ground by means of a ground-wire the horse is perfectly safe. (Fig. 31.)

Moreover, if the ground-wire be let project above the fence, ending in a sharp point, no flash will occur. (Fig. 32.) The charge is neutralized by leaking off the point.

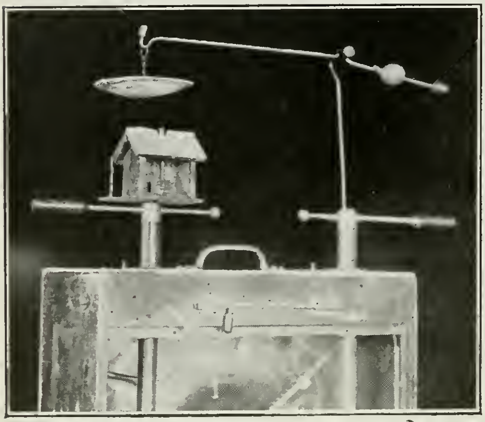


Fig. 28.—Metallic roof grounded, and with notched metallic ridge. No stroke can be produced. Ordinary lightning rod points would be as effective, and probably more durable.

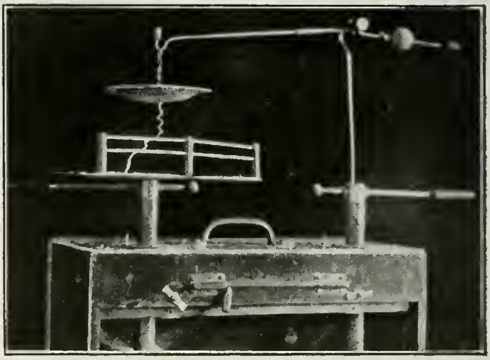


Fig. 29.—Lightning strikes a fence and jumps air-gap to earth.

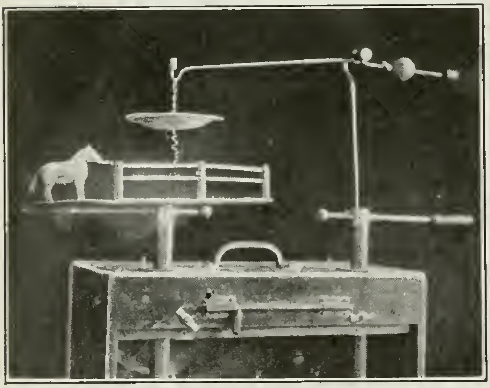


Fig. 30.—A horse standing by the fence, however, forms an easier path, and the horse is struck. Note flash from fence to horse's nose.

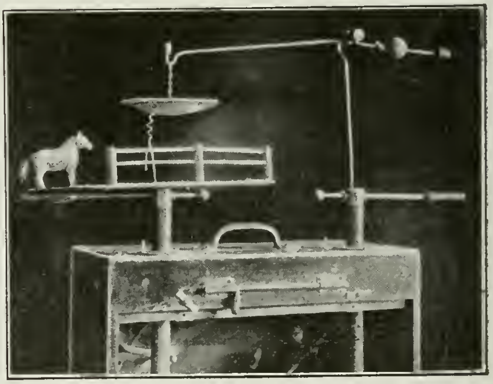


Fig. 31.—If, however, the fence wires are grounded, the flash follows the ground wire and the horse is safe.

Consequently, wire fences should be grounded, and the ground-wire projected above the fence if the stock is to be protected in the best possible way.

It is hard to conceive how any person could follow these experiments and phenomena and doubt the value of lightning rods. We have seen that by means of rods on these little toys we can either carry off a stroke without damage or we can prevent a stroke altogether. Hence, if in rodding our buildings we observe the same laws as have been observed in these experiments the buildings must be largely protected.

But, you say, in a real thunderstorm the clouds and earth are much larger, compared with the real buildings, than the cloud and earth in this experiment, and the electric charge is infinitely greater than that produced by this small machine. Quite so, but the real cloud and earth are 20,000 times as far apart as the cloud and earth of this machine, and this great distance requires the entire lightning charge to break through the atmosphere. Hence, anything that would relieve the electric pressure just a little bit would prevent a flash. Lightning rods *must* relieve the pressure if lightning is produced by electricity. Consequently, we expect that real lightning rods in a real storm would protect the buildings just as well as these little ones do in these experiments.

Why Strokes Sometimes Occur in Spite of Rods.

But, one is disposed to ask, if rods in many cases prevent strokes, why not in all? In the foregoing experiments the cloud and earth have in all cases been

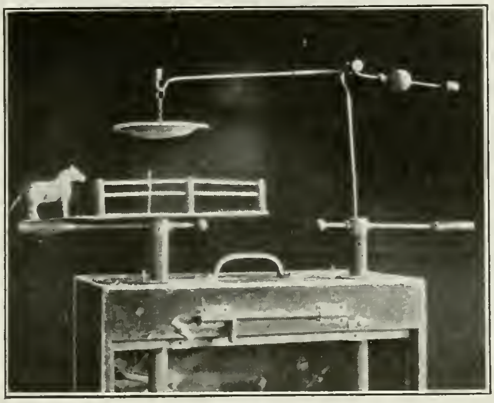


Fig. 32.—But if the upper end of the ground wire projects above the fence in a point, no flash occurs, which is even better.

charged *gradually*, and when so charged flashes between them can be prevented. However, the machine can be modified to unload its entire positive and negative charges to the cloud- and earth-plates in possibly one-thousandth or one-millionth part of a second. When this occurs the points cannot let the charge leak off fast enough and consequently a flash follows. This shows that it is *possible* for a rodded building in a real thunderstorm to be struck. Generally, real thunderclouds become charged gradually and lightning strokes can be prevented, but in rare cases a cloud receives an immense charge in a very small fraction of a second. This is sometimes brought about in the following way: Two clouds lie near each other. The buildings under the first are rodded, but not under the second. A flash occurs between the second and the ground, followed by a flash between the first cloud and the second. This impulsive rush changes the pressure in the first cloud so suddenly that the leakage does not neutralize the charge as fast as the difference in pressure increases, hence a flash occurs. But that flash is probably much weaker than if the rods had not been there, and in most cases of this kind the rods will conduct the current to the ground without damage.

The Cause of Thunderstorms.

Atmospheric electricity has been the subject of considerable study. In earlier days friction of the air against the earth and objects on it, and also evaporation, have been mentioned as possible causes of atmospheric electrification, but during the last few years another explanation has been advanced. It has been proven that the earth is always negatively charged, and that the air is a conductor, although a poor one, to be sure. Since a charge cannot reside within a conductor it follows that the charge on the surface of the earth must be transferred more or less quickly to the outside of the conducting atmosphere. Within the last four or five years the rate at which the earth loses its charge to the air has been measured by Dr. G. C. Simpson, of Simla, India, and although the rate of loss is small per square foot or per square yard, yet when the entire surface of the globe is considered it amounts to a constant current of more than 1,000 amperes! Despite this continual loss, the earth's charge is maintained at a uniform potential, consequently it follows that the earth must be receiving an amount of negative electricity equal to that lost. The idea at once occurs that the rain brings back the required negative charge. However, careful measurements, at half-a-dozen different places distributed over three continents, show that in all kinds of rain more positive than negative electricity is brought to the earth! This leaves the source of renewal of the earth's charge still unknown, and, moreover, offers no explanation of the existence of positive charges in the air, so that the difficulty surrounding the problem of atmospheric electricity has been increased rather than diminished.

We do know, however, that under certain conditions, when water vapour high up in the atmosphere condenses into minute drops these become charged with electricity. When one of these drops is formed from several smaller ones there is less surface for the electricity to be spread over, and consequently it becomes more dense. Thus it happens, that in the cloud there are drops of various sizes, some of which are more strongly charged than others. The weak charges appear negative to the stronger, and consequently the electricity has the effect of attracting the drops together more rapidly than they otherwise would unite. This accounts for the very sudden development of thunderstorms. When the condensation has gone on sufficiently the cloud becomes one great conductor. and the electricity leaves the surface of the drops and collects on the outside of the cloud. This produces another increase in intensity of the charge. Then, again, the cloud acts as one plate of a condenser, the earth as the other, and with the air between they actually form a great condenser similar in principle to the little plate condenser shown in Figure 13. Thus it is that such immense charges of electricity are produced in the cloud. As the positive gathers together in the cloud, the negative in the earth collects directly beneath, and the attraction of these unlike charges draws the cloud downward, so that all things are favourable to a violent flash once the electric pressure or attraction between the cloud and earth is sufficiently high to make the electricity jump the decreasing space between them.

Nature of Lightning Discharge.

But the lightning discharge is not a single rush in one direction. A steel spring or a violin string drawn aside and let go will fly away past the centre, then back, and continue to oscillate a large number of times, the oscillations gradually dying out as the energy is dissipated. That is just what happens in the lightning stroke. When the current breaks through, the discharging process goes too far, the charges on the cloud and earth becoming reversed, and these in turn discharge, and the reversing and redischarging is repeated over and over again, probably a million times a second, until the energy of the stroke is exhausted. The stupendous frequency of the oscillations makes the current travel almost entirely in the surface layers of any conductor it may follow.

Let us now study the conditions on the earth during a flash. Look at the frontispiece, page 2. Immediately you say, "I never saw the flash spread out like that either on the earth or in the cloud." Quite so. But if we return to our electrical machine, and on the earth plate set a flat tin dish containing moist earth, then wet one of our toy barns, set it on the earth in the tray and turn the machine, we see at every spark innumerable ramifications of the flash spreading out over the earth! When the pressure breaks through between the cloud and wet barn, the charge from all parts of the earth-plate is in such a hurry to make its way up to meet that from the cloud that it doesn't take time to follow all the irregularities of the earth's surface, but jumps through the air from point to point, causing sparks everywhere it does so, and the current reverses a few hundred thousand times during one flash.

Thus we get the idea that when a stroke occurs the earth for hundreds of feet around the object struck is in a highly electrified state and the electrification changes from positive to negative many times during the flash. Hence there is an alternating current to and from the object struck. This takes the path of least obstruction, following conductors with least resistance and self-induction, and often flashing or sparking from one to others near at hand. That's probably what killed the cattle—the current jumped the space between them and the fence, and the shock killed them. The death of the pigs is not so easily explained, as apparently they were not close to any other conductor—and this is not an imaginary case. The cut is from a drawing of Mr. West Dodd's, based on an instance that came under his notice, where pigs were killed in an open yard, although the stroke occured to the barn some distance away.

In an actual flash of lightning we do not see its ramifications on the earth and cloud, but from our experiment with the toy barn and tray of earth we know beyond peradventure of a doubt that during the flash there are currents from all directions to the earth focus, and by analogy we know the same must be true in the cloud. Did not the flash so blind its observer for the instant, sparks between conductors on the earth should readily be detected. So the earth- and cloud-ramifications in the frontispiece represent not streaks of light but alternating currents of electricity and the lines of force which produce those currents.

Why Newly Filled Barns Seem More Likely to be Struck.

In this connection we should like to deal with a phase of the subject about which there seems to be more or less misconception, viz., the claim that barns newly filled with hay or grain are more frequently struck and burned than any other class or condition of building. Whether such barns are more often struck remains to be proven, but there is perhaps little doubt that if struck they are more frequently burned than if empty. Most of us have no doubt heard the old explanation which runs something as follows: After the grain is stored in the barn it "sweats" and gives off vapour to the air, and this moisture ascending in a column above the barn forms the easiest path for the lightning flash, for moist air is a better conductor of electricity than dry air. Some vary it by saying "gases" are given off, which being interpreted must mean either vapour or carbon dioxide, for chemists state that there is no chemical action and chemically no gases are given off; while bacteriologists say that some carbon dioxide may be given off in case the hay or grain heat somewhat, which they do unless comparatively dry, but no other gas could be. Now carbon dioxide being heavier than air at the same temperature could not rise more than a few inches above the mow—just enough to allow it to become cool. Hence the explanation depends upon the water vapour. What has always puzzled us is to know how the vapour could escape from the barn fast enough to form a column, even in calm weather, much less if some wind is blowing. Besides, when a thunderstorm is approaching the atmosphere is usually so humid as to be oppressive, and air escaping from the barn would probably be drier than that outside. This would be particularly true when the rain begins to fall, for then the outside air is saturated, and hence any that might escape from the barn would tend to make that above drier than elsewhere. In view of these considerations we cannot see any possibility of the vapour in the barn or from the barn having any effect whatever in causing lightning strokes. But we have always hesitated to attack the theory because we had nothing to offer in its stead, except that hay and grain with their light leaves and chaff are easily ignited, and as they touch the barn in thousands of places, even a small spark anywhere in the building is almost sure to fire it. This, however, would not account for strokes on these barns being more frequent than on empty ones, if such be the case.

Perhaps the greater inflammability due to the presence of the hay and grain is sufficient explanation. We have seen on page 23, that when a lightning discharge occurs there are surgings of electricity on the conductors in that vicinity, which doubtless produce many tiny sparks, any of which occurring in the barn would ignite the dry leaves of the plants. Sometimes in cases of this kind it is said " the barn just seemed to take fire all over "—doubtless a case of many sparks each setting its own little fire. There may sometimes be another cause aggravating the danger, viz., that owing to the heating process in the mow the grain may be nearly hot enough to take fire itself, in which condition it is more easily ignited by a spark.

How to Rod a Building.

Let us now enquire: " When is a building properly rodded?" The first problem is, what kind of rod shall we use?

1. *Kind of Rod.*—Until recently iron and copper were the only two metals thought of in connection with lightning rods. Now aluminum also becomes a competitor, as there are rods of this material on the market. For a long time copper was considered the only metal for this purpose, the reason being that it conducts a steady current of electricity more than six times as well as iron, the size of wire being the same in both cases. But this difference may be overcome by using iron wire six times as large in cross-section as the copper. This, however, makes too heavy a cable. But the conductivity of steel is only about seventy per cent as great as that of iron, so that steel rods would have to be considerably heavier than iron to have the same conducting value. As standard copper rods weigh at least three ounces to the foot, the iron cable would have to weigh more than one pound and steel rods almost a pound and three-quarters to the foot to be as good conductors of steady current as the copper rods in general use. Hence it is not practicable to make iron or steel rods that will be as good conductors of steady current as the copper rods.

Self-Induction.

There is another phase of this problem, however. Between the years 1888 and 1892 Sir Oliver Lodge carried on an investigation of the phenomena of lightning, by means of laboratory experiments, and to his surprise, as well as that of many scientists and of the whole lightning rod fraternity, he found that an iron wire will carry off a sudden rush of electricity better than a copper wire of the same size! Every sudden discharge or current of electricity induces an opposite current along the same path. This is known as "self-induction." When the current ceases, self-induction again takes place, this time opposing the drop in current just as it formerly opposed the rise. Thus with an alternating circuit the self-induction is high, and increases with the frequency, becoming enormous in the lightning discharge, which oscillates about a million times per second. When a flash occurs the resistance of the rod may frequently be insignificant compared with that offered by self-induction. A steady current has no self-induction. While iron has greater resistance to the steady current than copper, yet the self-induction of the iron is less than that of copper in case of an electric spark or a flash of lightning. Basing his judgment on this and related facts, Lodge stated that, in his opinion, the day of copper lightning rods was done, although he added as a rider that in cities and towns where coal is burned he thought the iron rods would not prove durable, owing to the action of the fumes upon the zinc coating of the galvanized wire. We are inclined to think that even in the country the question of durability is an important one. Galvanizing is sometimes poorly done, and even if well done corrosion takes place wherever the rods are cut or scratched. The same does not apply to a copper wire.

But it seems to us that in this judgment Lodge paid attention almost entirely to one duty of the lightning rod, namely, to carry off the flash in case the building is struck, for in one place he says: "I have at present no great faith in the effective discharging power of a few points." By the data given at the commencement of this bulletin we have seen that lightning rods have another and a greater duty to perform, namely, the preventing of strokes from occurring. To prevent a stroke there must be a gradual flow of electricity along the rod to the point and into the air, or *vice versa*. As a matter of fact, it is easy to demonstrate that there is a steady flow along the wire when the points on the toy buildings prevent sparks. The same must be true in the real thunderstorm. Now, for steady current, copper rods have a higher conducting power than iron ones, hence, for preventing strokes copper rods are the better, while for carrying off strokes iron ones are the better. But copper rods are made heavy enough to carry the "impulsive rush" and iron ones conductive enough to carry the steady current, hence, durability is the criterion, and in this copper is indisputably superior to iron.

In Michigan the Protected Mutual will not accept a risk on a building equipped with iron rods, and the weight of copper rod on all of their buildings is at least 2½ ounces per foot. The efficiency of their rods, as already mentioned, is 99.9 per cent. The Patrons' Mutual, however, insures in its rodded class, whether the rods are of iron or copper—and many of their buildings are rodded with iron, and yet in eleven years they have had to pay only three lightning claims on rodded buildings, indicating about the same efficiency as with the Protected Company. So experience would seem to support what has already been said, viz., that rods of any metal will give good protection as long as they are in good repair and properly installed. So that the relative value of the rods depends upon their respective durability.

Combination Rods.

There are rods on the market made of a sheath of copper surrounding iron or steel centre. All these are even less durable than if made of iron alone, because of electrolytic action between the two metals and rapid rusting either with or without this action. Different farmers who have had rods of this style on their buildings and have examined the groundings from time to time have told us that in their experience with rods having copper sheath and strip of iron or steel in the centre, sometimes with two steel wires added for strength, the life of the iron has proved to be from ten to twelve years. On the 3rd of February, 1914, the writer personally inspected one of these rods that had been on a building eight years and found that in the portion of the cable running along the ridge of the barn the iron strip and the steel wires were almost completely destroyed by rust, in spite of the fact that both strip and wires had once been galvanized! Fig. 34 shows the result better than words.

a *b* *c* *d*

Figure 34.—The story of a copper-covered rod.

a. The new rod complete.
b. The new rod torn to pieces. Note the copper sheath, two No. 10 galvanized steel (iron) wires, and ½-inch strip of No. 20 galvanized iron.
c. All that was left of a rod that had been in use eight years. The sheath in good condition, but the steel wires and strip nearly all rusted away.
d. The rust taken from the sample one foot long shown in *c*.

The portions of the rods running up the gable ends were in fair state of preservation. The ground-rods were frozen in so that their condition could not be determined. One could hardly have anticipated such destruction up on the ridge of the barn, but the explanation is easy. During rains the water entered the sheath, wetting the iron, and after the storms the rods became heated, and moisture and warmth combined produce most rapid rusting, a phenomenon with which all are familiar. In much less than eight years the iron in those rods ceased to have any value, so far as that portion along the ridge was concerned. And it would seem impossible that the iron in the ground-connections, subject to perpetual moisture, could have escaped the effects of rust.

In the country great quantities of this type of rod have been used. What percentage of it has become defective we have no means of knowing. Of course, so long as the copper sheath remains intact there is protection, because the chief function of the iron is to add strength to the rod, its conducting power being but small as compared with that of the sheath.

Aluminum.

Aluminum is about half as good a conductor as copper, the size of wire being the same in the two cases. But if aluminum wire is twice as large in cross-section as the copper, then their conducting power is equal. Aluminum, so far as we can see, should prove just as durable as copper, although we must remember that it is a peculiar metal, and experience may bring out some practical weaknesses that as yet may not have developed.

So many questions are asked regarding the resistance of iron, copper and aluminum that it is thought wise to give a few comparisons. Figure 35 shows samples of six copper rods on the market in Ontario. In Figure 36 the two long samples, Nos. 7 and 8, are of iron, and the short ones, Nos. 9 and 10, of aluminum. These ten rods are compared in table below:

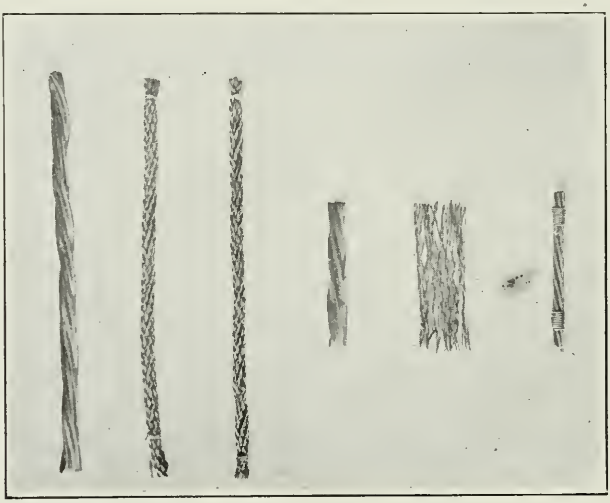
Comparison of Some Cables.

Rod No.	Construction.	Weight per Foot	Diameter of cable.	Actual area of cross-section of metal.	Resistance per 1000 feet.	Heat that one foot of the rod will stand before melting.	
		Ounces	Inches.	Sq. Inch.	Ohms.	Calories.	Melting Point.
Copper							
1	Sheath of No. 30 copper, 2¼″ wide, wrapped and twisted and locked around strip of No. 21 copper, .45″ wide, and two No. 10 copper wires	3.263	.55	.0566	.1348	9397	2012 F
2	28 No. 17 copper wires and a strip of No. 20 copper, ⅛″ wide.	3.250					
3	29 No. 17 copper wires.	2.65°	.40	.0460	.1659	7631	
4	Same as No. 1, but sheath not locked, strip being No. 22 and .50″ wide	3.28°					
5	31 No. 17 copper wires, woven in a flat ribbon	3.065		.0491	.1552	8152	
6	7 No. 9 copper wires ..	4.637	.35	.0714	.1071	12,880	
	1 No. 2 copper wire ...	2.869	.258				
	⅝″ copper tube, No. 22 gauge, used as uprights	2.500	.625	.0471	.1620	7199	
Iron							
7	12 No. 9 steel wires (home-made)	5.800	.45	.1225	.4954	24,389	2840° F
8	5 No. 7 and 1 No. 9 steel wires	4.620	.35	.0916	.6624	18,985	
Alumin'm							
9	19 No. 8 aluminum wires	4.504	.65	.2445	.0542	16,818	1157° F
10	7 No. 6 aluminum wires.	2.037	.50	.1443	.0952	7606	

Rod No. 5, the woven ribbon, is just on the 3-ounce limit for copper, and we may take its resistance and heat capacity as the standard requirements in these two respects. No. 3 is too light. Nos. 2 and 4 are almost identical with No. 1 in resistance and heat capacity because almost identical in weight. No. 6 has about 1½ times the standard amount of copper and is unquestionably the best of the six copper rods. Its resistance is lowest, meaning it is the best conductor. Its heat capacity is highest, its durability greatest. However, judging by data at hand it is probably a needless expense to use such a heavy cable.

The two steel (iron) rods are both much heavier than the standard copper, but their resistances are 3 1-3 and 4 1-3 times as great, showing that they are only about 1-3 and 1-4 as good conductors respectively of steady current as the standard. In heat capacity they, of course, head the list.

The aluminum rods have the lowest resistance, that is, they are the best conductors of steady current. The large aluminum has about twice the heat capacity of the standard copper, so that this cable, like No. 6, seems needlessly large. No. 10, however, is just a shade small, being rather low in heat capacity. So far as we



1 2 3 4 5 6

FIG. 35.—Six different makes of copper rod. For properties see Table

are aware, no specifications have heretofore been laid down as to the minimum weight for aluminum rods. To have the same heat capacity as the standard copper would require 2 1-7 ounces per foot, but in view of the fact that the melting point of aluminum is only 1,157 degrees F., while that of copper is 2,012 degrees F., it would seem prudent to require a little greater heat capacity than in the copper. Consequently I should be inclined to specify at least 2 1-4 ounces per foot for aluminum rods. Extensive use will be necessary to determine practically whether this will be ample, though so far as we can see it should be.

Iron has a melting-point of 2840°F, the highest of the three. That's one reason why the iron has such high heat capacity. The other reason is the weight of the rod. The aluminum has the lowest melting point of all. Whether this will be any practical detriment to rods of this metal also remains to be established by extended use.

In this comparison no attention has been paid to "surface," although much stress has from time to time been laid upon this by makers of various types of rods. Sir Oliver Lodge's experiments, which show that a thin broad strip has less self-induction than a wire of the same material and weight have been taken as an indication that we should have great surface of conductor, and durability and convenience of installation have sometimes been sacrificed to surface. We should not forget that when it came to the practical side of the question Lodge recommended the more rugged types of conductor, such as solid rod or strong cable, in explanation whereof he said: "It is because I doubt whether decently substantial conductors are in any real danger from heat that I have asserted the advantage of greater surface to be but small." Consequently shape of rod is immaterial, so far as efficiency is concerned, and a tape or other form designed for great surface has by reason thereof no practical pre-eminence over other shapes of rod.

Side Flashes.

Sometimes part of a lightning-charge will side-flash from the rod, jumping several feet of air gap in doing so. Why? The total obstruction to the current

7 8 9 10

Fig. 36.—Two iron rods (long) and two aluminum rods (short).

is made up of two parts, the resistance of the wire, and the self-induction. The more suddenly the current comes on and the higher the frequency of alternation the greater the self-induction, and this is the larger factor when a stroke occurs. The self-induction of a short air circuit is sometimes less than that of a long metallic circuit, hence the side-flash in such cases.

Groundings.

2. *Ground Connections.*—For an ordinary building, not an L or T, at least two groundings should be made, preferably at corners diagonally opposite, though this may be modified to meet conditions, e.g., to run near conductor pipe from eave-

trough and which should be connected to the cable as indicated later. Another factor that may sometimes influence the selection of the ground-rod locations is the presence of manure and the liquid from it. The ammonia in the manure will attack the copper rods, and in a few years eat them off. The heat of the decaying manure will hasten rusting of the iron rods. Consequently ground-rods should be located where there is no manure.

Some rodding companies in Michigan use a length of half-inch gas piping to protect their ground-rods. This pipe is first closed at one end by welding and then sharpened, after which it is driven in the earth point downward until the top is

Fig. 37.—The drill (in left hand) used in making groundings.

within a foot or so of the earth's surface. The cable is then shoved down inside the gas pipe till it reaches the bottom, and the pipe then flattened at the top till it presses firmly on the cable. The Patrons' Mutual of that State prefers that the groundings be thus protected before they accept the risk in their rodded class, and as already stated they have paid in eleven years only three lightning claims on rodded buildings. The Protected Mutual, on the other hand, will not accept a risk at all if they discover that the gas-pipe protection is used. They make two objections against it, one that the pipe acts somewhat as a choke-coil, the other that the cable is frequently eaten off at the top of the pipe by the electric current passing from the cable to the pipe, thereby putting the system out of order. Occasionally, however, their inspector overlooks a gas-pipe grounding and accepts a risk on a building so rodded. Since the 1912 report of the Protected Mutual they have lost their first rodded building by lightning, and curiously enough it was one with the gas-pipe groundings. On examination it was found that the cable was nearly disconnected, only two or three of the fine copper wires remaining intact. Whether the injury was done in closing the gas-pipe too tightly on the cable or by the current eating the wires off was not determined. It would seem that as yet this method of making groundings is open to some question and it would appear wiser to locate the ground-rods where there is no manure, then there is no need for the gas-pipe.

A simple way to make a ground-connection is illustrated in figures 37, 38 and 39. In figure 37 note the drill 10 feet long. It is a piece of half-inch iron rod, with point swedged to make it about five-eights or three-quarters of an inch

Fig. 38.—Drill down 10 feet.

Fig. 39.—Ground rod down 10 feet.

in diameter. An eye for a hand-hold is formed on the upper end of drill. A hole large enough for a pail of water is dug in the ground. The hole is filled with water, and the drill is placed in the centre of the hole and gradually worked downward. More water may be poured in if required. When the drill is down full depth (see Figure 38) it is withdrawn and the cable carefully slipped down into the hole (see Figure 39). The grounding shown in these figures was made while rodding a silo, and took probably twenty minutes after the hole was dug.

It is sometimes advised to dig a large, deep hole and bury a ground-plate to which the ground-rods are attached. This does not appear to be necessary in general farm conditions. In Michigan where the efficiency is 99.9 per cent. the ground-connections are made in a manner similar to that just described and shown in the photographs. If efficiency without ground-plates is 99.9 per cent. there seems to be no urgent need for them. Where the rock is near the surface and the soil becomes dry to the bottom during the summer a ground-plate would be of some value, especially if imbedded in coke, for coke, besides being a conductor, holds moisture well, but better results would probably be secured by sinking the ground-rod into a well or a good crevice in the rock, or a stream of water if one should be near. Sometimes in shallow soil a large flat stone is laid over the ground-rod "to hold the moisture." There is doubtless some virtue in this, though the ground-plate and other methods are better.

On an L- or T-shaped building there should be at least three groundings. Two of the damages suffered by the Protected Mutual happened in the following manner: Both buildings were T-shaped. There was a ground-rod at each end of the main part, and from the main system a cable ran along the ridge of the other wing and a point was placed about five feet from the end, but the cable was not continued further, there was no ground-rod for this part of the system. Later a telephone line was run into the house, entering near this stub end. The lightning flash struck the point on this wing, and divided, part following the cable and part jumping to the telephone line. If there had been another ground-connection for this portion of the system probably no damage would have occurred.

All ground-rods should go deep enough to be in perpetual moisture. In Michigan where rods are subject to insurance inspection it is insisted that ground-rods must go at least eight feet in the earth, and many are sunk ten feet.

Importance of Proper Grounding.

Here let a note of warning be sounded to everyone who is having his buildings rodded: Be present and *see* the ground-rods put down. Know for yourself that the rods are actually down eight feet or more. Do not take anybody's say-so on this point. Lightning-rod men, as a class, are as honest as any other class of the community, but an odd one is unscrupulous and will "scamp" the job if possible. We have a record of a case where the rodding agent instead of putting the cable eight feet straight down in the earth coiled it up and buried it in a small hole in dry earth, and the barn was burned by lightning the very day it was rodded. Nothing could be more dangerous. When electric power companies want to prevent the lightning charge from coming in on the line wires and damaging their machinery they make a "choke"-coil of several turns of the wire just inside the station and beside the line put a ground-wire separated from the line by a short air-gap. When the lightning charge follows the line to the station the "choke"-coil makes it so difficult for the sudden current to pass that it jumps the air-gap to the ground-wire in preference and thus escapes to the earth. Now the coil at the foot of the lightning rod acts just in the same way. It chokes the current back and makes it take some other path, down through the building, probably firing the building on the way. In a coil self-induction is very high, hence the choking effect.

Consequently, let us say again, look well to the groundings. They are probably the most vital part of the system. *See the ground-rods put in.*

3. *Systems.*—The cable beginning at one ground-rod should extend up the corner, make a gradual turn at the eaves, go up the edge of the roof to the peak, along the peak to the other end, down the edge of the roof to the eave, and down the corner to the other ground. All turns should be rounded rather than angular.

All the cables on a building should be connected in one system. Sometimes it is found that on an L-, T- or U-shaped building, for instance, the rods on the one part are not connected with those on the other. Numerous instances are reported where damage has occurred between these two systems, the lightning striking the one system and part of the current jumping across to the other. Consequently, divided systems should be scrupulously avoided. When a cupola is encountered the cable should go around rather than over it, the point on the cupola being connected to the cable below.

As the cables near the ground are often subject to injury by stock, implements, etc., they should be protected by wooden strips fastened together in suitable form and nailed over the cable from the ground up to a height of six or eight feet.

No Insulators to Be Used.

4. *Attachment.—Insulators should not be used.* The rods should be in metallic connection with the building. This method of attachment is in direct opposition to that practised when lightning rods were first used. It was then considered desirable to insulate the rods from the building by glass or earthenware insulators. As a thunderstorm approaches the entire outer surface of the building is charged with electricity, and by having the rods in metallic connection with the building the charge is conducted to the rods and thence to the points where it leaks off and neutralizes the opposite charge existing in the cloud.

Several methods are used for fastening the cable to the building. Some companies use copper nails, which are driven right through the cable. Others use staples, others clips which hold the cable tight to the building, and some use a clip which holds the cable out about an inch from the building, the claim for the last method being that with the rod standing out chaff, straw, and the like would not so readily collect between the rod and building, and thus a danger of fire is avoided in case strokes occur. At first the writer rather thought this point well taken, but after finding an efficiency of 999 cases out of 1,000 in Michigan where the rods were practically all fastened close to the building, and the three small damages that did occur all being due to other causes, we concluded that it would be rather difficult to secure any higher efficiency. While we say this, we see no particular objection to having the rods stand out from the building, unless it might be that the rod is more exposed and thus more subject to injury.

Points Twenty to Thirty Feet Apart.

5. *Points.*—At intervals along the cable on the ridge there should be placed uprights with points that will not corrode. These uprights should be firmly fastened to the cable. There is no absolute law as to the distance apart at which these points should be placed, but a rule frequently used as an approximate guide is that the distance between them shall not be greater than twice the combined height of the two uprights. By this rule if the points were five feet in height they would be placed about twenty feet apart. There is, however, a tendency among practical lightning-rod men to use shorter and shorter uprights, some as short as 26 inches, but with these short uprights the points are still placed twenty to thirty feet apart. Copper tubes of suitable size and weighing the same per foot as the rods make the best uprights. They are supported by standards in the form of tripods, thus being strongly braced.

The experiments with the little electrical machine have shown us that the flash selects angles and prominences, and we know that lightning shows the same preference in this respect. Consequently points should be placed near each end of the ridge, on or beside chimneys, and on cupolas and dormers. Those on or beside chimneys or cupolas should project above them at least eighteen inches.

On the uprights ornaments of one kind or another, such as bright balls and weather vanes are frequently placed. Scientifically and according to at least three manufacturers of rods in Ontario, the former are of no use in telling whether the building has been struck by lightning, as is sometimes stated by agents. The vanes are a weakness if they rotate on the upright, for in constantly oscillating with the wind they in time wear the uprights until they bend and sometimes even break off at the vane. Both balls and vanes add to the appearance, but the latter had better be dispensed with, unless they rotate on a stationary collar. When strong tubes are used as uprights there is no serious objection to the balls, for they are not likely to catch enough wind to do any damage.

Metallic Bodies Should Be Connected in the System

6. *Metallic Parts of Structure.*—Lightning-rod companies here differ considerably in practice. Some connect all metallic portions of the structure to the rods, others do not. The former is undoubtedly the better practice. If the metal body is a long one, like a steel track, roof-gutter, or eave-trough and conductor pipe, both ends of it should be connected to the rods, or one end to the rod and the other grounded. Where buildings are already rodded, but the rod runs straight from the peak to the ground, leaving the eave-troughs and conductor pipes unconnected and ungrounded, this could easily be remedied by connecting one end to the cable and grounding the other end by a new ground-rod.

Telephones should always be protected by "lightning arresters." This we believe is always looked after by the telephone companies.

Some Cases of Defective Rodding.

In this relation we wish to refer to an occurrence that took place in the township of Adelaide, County of Middlesex, during the past summer. Two barns belonging to Mr. Harold Currie were burned on June 6th, 1913. It was reported to us that they were rodded. We wrote to Mr. Currie at once. Here is his answer:

"Yours of August 25th to hand, and in reply wish to say that my two barns were burned by lightning on the night of June 6th, 1913. They were rodded, and the rods were in first-class condition with no dead ends. In fact, the Inspector of Insurance Company examined the rod after the fire, and pronounced it in good condition and there was not a break in it. Then, since receiving your letter, I pulled the end out of the ground to measure the length, and it was nine feet in the ground. Mr. ———, of ———, put the rods on five years ago. The barns were new and were upon cement and brick walls. Of course, one was struck and the other caught from it. As to the name of the rod I can't tell you, but it was a round cable of coppered wire. The barn that was struck was 56 ft. x 46 ft., and had three points on it, and the rod ran down at the north end only. This barn was also covered with Galvanized Iron Shingles, the Oshawa shingle, manufactured by the Pedlar People, and was troughed all to one corner where the conductor pipe ran down into the 4-inch tile which carried the water away. Now, Sir, I wish to state a few facts. I had in those buildings (at the time of the fire) a number of valuable race horses, and had just come from the barn and was standing at the door of the house watching the storm, and saw the lightning come down but could not tell whether or not it hit the barn, as it dazzled my eyes and staggered me back against the door. When I got my sight again there was no sign of fire, so I went into the house to go to bed, and in passing a window saw what looked like a lantern in the southwest corner of the barn. I am satisfied that the rods were not touched, but that the lightning went down the conductor pipe, which, by the way, had a length broken out by the wind on Good Friday, just at the top of the brick wall, and as this mow was filled with straw and summer bedding for the horses, it caught fire and burned fiercely. I am of the opinion that if the pipe had not been broken I would have had no fire. I was insured in the London Mutual Co. I have noticed since the number of barns that have the conductor pipe come down just to the bottom of the timber, which is a trap, for if lightning ever comes down that pipe it will surely go into the barn at that point.

"If there is anything that I have not made clear to you I will be pleased to answer any further questions."

Our reply to this letter was in part as follows:

"We are in receipt of yours of August 25th re the rods on your barns that were burned. We note that only one barn was struck, and the second caught from the first. Judging from your letter the rod ran down the gable from the peak at the north end, and not from the eaves. Is this correct? We also conclude that the cable ran along the peak of the barn, and that there were three uprights from this cable. Is this correct? Or having a metal roof, was any cable used except at the ground-rod?

"Did you examine the points or were they destroyed? Were any of them fused? We should be glad to have sample of the rods, also one of the points, a fused one if any were fused.

"We note that the rods were in good condition, but the system of rodding is very defective indeed. In the first place, there should have been at least two ground-rods. In the second place, with a metal roof, the cable *must* leave the roof at the eaves, because in a metal roof resistance and self-induction are both so small that the obstruction offered by the roof, and the air-gap at the corners may be less than that of a long cable from the peak, especially if air-gap is short on account of conductor-pipe, and, thirdly, one of the ground-rods should have been at the south-west corner, so that the conductor-pipe could have been connected to the rod. If the one ground-rod that was in had been at the south-west corner, and the conductor-pipe connected, as suggested, we are satisfied that your barn would have been saved.

"We are not sure that you are right in concluding that the rods were not touched. We know that whenever electricity has two nearly equal paths open to it, part goes one path and part the other. Probably part of the charge went down the rod and part down the conductor-pipe. It would appear that the bolt must have been a very violent one."

"The writer has just come back from Iowa and Michigan, where he has been investigating the subject of protection against lightning, and without going into detail, we are going to give you one or two facts learned on the trip. In the State of Michigan there are two mutual companies which insure buildings all over the State. One insures only rodded buildings, we shall call it the Protected Company. The other insures both rodded and unrodded, we shall call it the Unprotected Company, but it keeps its rodded buildings in a separate class, and this class is assessed for its own losses. Both these companies are very particular in having the buildings rodded properly. Neither one of them would have accepted your building in their rodded class, considering the rodding defective in the respects pointed out above."

Here is another illustration that shows the need of connecting metallic bodies to the rods: A barn was rodded, the cable passed down the end to the ground. Inside at a distance of about three or four feet was the end of a water-pipe. Under the water-pipe stood a cow. A bolt of lightning struck the rod and the cow was killed. Now what happened was probably this: Part of the charge side-flashed through the wall to the water-pipe, and from that to the cow.

The second damage suffered by the Protected Mutual is described by the Secretary in the following words: "The other damage in 1912 was on account of a large galvanized storage tank in the attic of the house, only a few feet below the rod, which ran along the ridge of the building. This tank was thoroughly grounded with gas-pipe, so that the lightning split and part of it followed the rafter down and jumped across to the tank. Had the tank been connected with the rod, we are satisfied this damage would not have occurred."

In nearly all cases where damage is done to rodded buildings it is found that the current has jumped an air-gap. The obvious remedy is to avoid possible air-gaps. If the end of that water-pipe had been connected to the cable outside the barn and the other end connected to the other "ground" the cow above referred to would doubtless have been perfectly safe.

On page 32 attention was drawn to the great importance of having the groundings properly made. The connecting of metallic parts of the structure to the systems is equally important. After the correspondence with Mr. Currie we observed a large number of barns where the gutters, eave-troughs and conductor-pipes were not connected in the system. We are satisfied this is one reason why the efficiency of rods in Ontario is only 92 to 94.5 per cent., while in Iowa it is 98.7

per cent., and in Michigan, under inspection, 99.9 per cent. In those two states they are much ahead of us in the art and science of rodding buildings.

Metallic roofs should be grounded at two *corners* at least, the cable being stapled or soldered to the metal roof at the eaves, and either points or sharp-edged ridge-boards should be used. It is not necessary to run the cable up to and along the peak. Simply fasten the uprights to the metal roof at the ridge. The metal roof of cupolas should be connected to the main roof. Conductor pipes from metallic roofs should be grounded. Under no circumstances should metal roofs be grounded from the peak, for if a stroke occurs low down on the roof the current will not travel upward to the peak, but will leave the roof at the lowest point.

A windmill on a barn should be connected to the cable, also the bottom end of the shaft either connected to the cable or separately grounded to perpetual moisture.

Wire Fences.

7. *Fences.*—A wire fence is not properly grounded, unless in large fields there is a grounding at least every twenty rods, though closer together is better, and in barn yards or small yards where cattle are herded, at every corner. Where fences are connected with a building there should be a grounding at the first post from the building, and moreover the ground-rod from the building should be connected with the fence. A fence grounding should consist of a rod or cable equal to three No. 12 wires or one No. 9 wire stapled over or connected with each lateral wire of the fence, and extending at least three feet into the ground. If the ground wires are allowed to project a few inches above the fence, strokes are prevented in the vicinity just as by the points on a building. The fence groundings should be made of the same material as the fence wires.

8. *Shade Trees.*—Where there are a *few* trees under which stock gather for shade it would be both wise and feasible to rod the trees. The same principles apply here as in general rodding.

Conclusion.

From the days of Franklin to the present time the value of lightning rods has been an undetermined quantity, physicists of course holding that they must be highly beneficial, the greater mass of the people, however, retaining an open mind, while some accepting the teachings of science rodded their buildings; and still others counted absurd the idea that rods and points could have any worth in preventing damage to buildings by lightning. From time to time practical data have appeared giving one side of a comparison, but lacking the other—*e.g.*, "A certain insurance company over a period of years has never paid a dollar of insurance on a rodded building damaged by lightning," but they were unable to tell what percentage of their risks were rodded, so no definite comparison could be made.

Now, however, the Department of Agriculture is pleased to present the data herein contained, giving complete comparisons, which prove unmistakably that lightning rods properly installed are almost absolute protection against lightning.

These practical results the farmers of Ontario can appreciate better than scientific statements, and with these at hand the Department can safely recommend the rodding of farm buildings in accordance with directions above given.

SUMMARY OF DIRECTIONS FOR RODDING.

The writer has omitted drawings purporting to show how to rod buildings. The proper method can only be decided after a close examination of each building in question, for then alone can one intelligently apply the principles already dealt with.

For convenient reference the directions for proper rodding are repeated without any of the explanations.

1. Kind of Rods.

Material—Copper, aluminum or galvanized iron, preferably the first because of durability. Aluminum may prove equally durable.

Combinations are not advised, because not as durable as single-metal rods.

Weight—Copper—At least 3 ounces per foot.
Aluminum—At least $2\frac{1}{4}$ ounces per foot.
Steel (iron)—At least $4\frac{1}{2}$ ounces per foot.

Form—Any form that will give durability and convenience of installation.

2. Ground-connections.

Depth—Down to perpetual moisture. At least 8 feet deep.

Number—On an oblong building, at least two.
On an L- or T-shaped building, at least three.
On a U-Shaped building, at least four.

Location—Preferably at opposite corners, though this may be modified to avoid manure, or to go down near conductor-pipe or other metallic portion of the structure. If conductor-pipe is on the side of the building the ground rods should be at the corners as above stated, the eave-troughs connected to it, and then the conductor pipe also grounded.

Ground-rods should not be bunched, but should be distributed as well as possible.

Method—In deep soil drill a hole at least eight feet deep and run cable down.

In shallow soil, attach cable to metallic ground-plate, which is put down as deep in soil as possible; or run it into a well or a stream or a crevice in the rock. If none of these are feasible, put cable as deep as possible and lay large, flat stone over it.

Caution—Be present, and see that ground-connections are properly made. The rest of the system may be inspected at any time, but the groundings only when they are being put down.

3. Systems.

Run cable from ground up corner to eave, thence to ridge, along ridge to other end, thence down to eave, thence to other ground, making a complete circuit.

All cables should be connected in one system.

No stubs or dead ends should be left ungrounded.

Caution—Cables should be protected from ground six or eight feet up by nailing boards around them.

4. Attachment.

    Fasten cable to barn with nails, staples, clips or metal "dispersers."
    Caution—Do not use insulators.

5. Points.

    Number—20 to 30 feet apart.

    Location—On ridge, first ones not over five feet from end.
    On or beside chimneys or cupolas.
    On dormers. Also on silos.

    Height—Four to five feet, except those on or beside chimneys, cupolas or similar prominences; these must extend at least eighteen inches above the highest part.

    Form—Strong tubes, of same weight and material as rods.

6. Metallic Portions of Structure.

    Roof-gutters—Top connected to rod, and bottom grounded.
    Eave-troughs and Conductor-pipes—Free end of eave-troughs connected to rod, and conductor pipe grounded.
    Hay-fork Track—Both ends connected to rod.
    Tanks—Connected to rod above, grounded below.
    Windmill—Connected to rod above, shaft grounded below.
    Metallic Roof—Grounded at two or four corners, not from peak under any consideration.
    Points should be used on the ridge and other prominences.

7. Wire Fences.

    In field—A grounding at least every twenty rods.
    In yards—At the four corners.
    At building—Ground at first post from building.
    Weight of Groundings—Equal to three No. 12 or one No. 9 wire.
    How Made—Stapled on posts in contact with all wires of fence, and extending at least three feet in the ground, and projecting above fence.

8. Shade Trees—Protect where feasible.

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ONTARIO AGRICULTURAL COLLEGE

BULLETIN 221

Food Value

OF

Milk and its Products

By

R. HARCOURT, B.S.A.,

Professor of Chemistry

TORONTO, ONTARIO, APRIL, 1914

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Ontario Department of Agriculture

ONTARIO AGRICULTURAL COLLEGE

Food Value of Milk and Its Products

R. HARCOURT

If the true nutritive value of milk and its various products were fully realized they would be more appreciated and much more freely used. They are cheap, palatable, easily digested, and highly nutritious. Excepting in the case of milk, and then only in the case of infants and invalids, they are rarely used as an article of the diet, but are regarded as a luxury to be used as a condiment. They are, however, foods of exceptionally high value, and can very profitably be made to take a more prominent place in our dietaries.

FOOD AND ITS FUNCTIONS.

A food may be considered anything that when taken into the body will build up its tissues and keep them in repair, or which is consumed in the body to yield force and heat. It is used to form the tissues and fluids of the body, such as muscle, blood and bone, to repair their waste, and, if in excess of the daily requirements, it may be stored in the body in the form of fat for future use. When food or body tissue is consumed in the system, the energy contained therein becomes active and manifests itself in the force or heat required by the body.

To be a complete food it must contain all the constituents required by the healthy growing animal. These are protein, fat, carbohydrates and mineral matter. The protein compounds are necessary for the building up of new and the repairing of the old tissue. When eaten in excess of what is thus needed they may be simply burned to produce force. The body tissue when broken down also yields energy. Familiar examples of protein are lean meat, white of egg, casein of milk and cheese and gluten of wheat. The fats and carbohydrates are used as a source of energy, and when eaten in excess of this requirement may be transformed into fat in the body. Fat is found in meat, lard, milk, oils; and the starches, sugars and woody fibre or cellulose form the bulk of the carbohydrates. The mineral matter of a food is absolutely essential for the formation of bone, and is also present in the tissues and fluids of the body.

The chief function of food in the adult is to repair tissue and to furnish energy to do work. Energy and heat are closely related, and in order to have some measure for expressing the amount of heat that a given food is capable of producing, the calorie is taken as a unit. Roughly speaking, this is the amount of heat required to raise the temperature of one pound of water 4 degrees Fahrenheit. One pound of sugar or starch would, if burned and all the heat utilized, raise 1,860 pounds of water 4 degrees in temperature. The fuel value of protein as it is ordinarily burned in the body is very nearly the same as that of one pound of carbohydrates, but fats have a fuel value of two and a quarter times that of protein and carbohydrates, or 4,220 calories per pound. Thus, while the protein of meat, eggs, etc., are the only materials in the food that will produce muscle, they have no greater value as an energy-producer than carbohydrates. Thus, the problem in arranging balanced dietaries is to use just enough protein to do the work which they alone can do, and use the cheaper fats and carbohydrates as the energy producers.

Very few, if any of our food materials form a complete and balanced food in themselves. The mother's milk is for the infant, but for the adult it is too bulky. Bread is as nearly complete as any of our ordinary foods, but it is a little low in the protein compounds. Milk used along with bread improves it in this respect and the two form a fairly complete and balanced diet. The best foods or diets are those which perform their function in the most thorough and complete manner; that is, with as little waste as possible and with the best physiological results.

There are, however, several other factors which must be considered in judging of the value of a food. These are: digestibility, palatability; they must agree with the system, and they must be reasonably cheap.

COMPOSITION OF MILK.

Milk, as supplied to the consumer, may vary widely in composition. But the average milk is slightly heavier than water, its specific gravity ranging form 1.029 to 1.034 at 60° F., and the following is possibly a fair average of the composition:

Water	87.5 per cent.
Protein: Casein	2.4 " "
Albumin	.7 " "
Fat	3.7 " "
Sugar	5.0 " "
Ash	.7 " "
Fuel Value per 100 gms.	67 calories

The proteins amount to about 25 per cent. of the total solids, which is a much larger proportion than exists in many foods, including meats. The casein is the most abundant constituent, and is readily coagulated by an acid, either by that found in the milk when it sours, or when an acid, as vinegar for example, is added. It may also be curdled or coagulated by rennet, and the curd thus produced is utilized in the manufacture of cheese. It differs from many other forms of proteins in the amount of phosphorus it contains. Besides the casein, there is a small amount of albumin present, which is very similar to that which occurs in blood and the white of egg.

The fats are commercially the most important of the constituents of milk. The color and opaqueness of milk are due mainly to globules of fat, which are very minute and almost numberless. These are held in the liquid in the form of an emulsion, which possibly helps to explain why the fat of milk is so easily absorbed when used as a food.

The sugar of milk is similar in composition to cane sugar, but it is not nearly so sweet. This sugar readily undergoes fermentation with the formation of lactic acid. This change always takes place when milk sours, and it is this acid which thickens the milk, due to the coagulating of the casein.

The ash material is made up of a great variety of compounds, but it is particularly rich in those required for building bone and to supply the mineral constituents of the blood.

Nutritive Value.

Milk is thus particularly adapted for use as a food by man for several reasons. It contains all of the four classes of nutrients—proteins, fats, carbohydrates, and mineral matter—in more nearly the proper proportions to serve as a complete food than any other food material. For the adult it is too bulky, and can well be used with a food rich in carbohydrates to supply the greater amount of energy exacted by the grown person. It is in a form well adapted for various uses in combination with other food substances, and in the preparation of various dishes for the table. Furthermore, at the prevailing prices it is an economical food.

Digestibility of Milk.

By digestibility of food several things are, or may be, meant. One is the proportion of a given food material or of each of its several constituents which an ordinary person may digest; another is the ease with which it is digested or the time required by the process. It may also mean whether the food material does or does not agree with the user.

Different people are differently constituted with respect to the chemical changes which the food undergoes in the process of digestion and in the effects produced. This is true in the digestion of milk as it is with other foods. With most people milk is a wholesome, digestible and nutritious food, there are others who are made ill by it, just as there are people who cannot eat eggs, fruits, or other materials without feeling ill effects. But this does not detract from the value of these foods for those with whom they do agree.

Taking up more particularly the question of the completeness of digestion, experiments show that different people vary in the amounts which they can digest from the same food. The differences, however, are not as great as might be supposed. The results, in so far as they apply to milk alone, and in comparison with other food materials, is summarized by Dr. Langworthy* as follows:—

"The protein of milk, especially when it is used with other food materials, is quite readily and completely digested. In this respect it is like the protein of ordinary meats and fish. The protein of vegetable foods is much less easily digested. Thus, in potatoes and whole wheat and rye flour it may sometimes happen that as much

*Farmers' Bull. No. 74, U.S.A. Dept. of Agriculture.

as one-fourth of the protein may escape digestion and thus be useless for nourishment. From one-sixth to one-tenth of the protein of wheat flour, corn meal, beans, and peas may in like manner be assumed to escape digestion, or rather to leave the body without being used for nutriment. These estimates assume that the materials are cooked and eaten in the usual way. Under the same circumstances, from nine-tenths to the whole of the protein of milk, meats, and fish are assumed to be digested. The digestibility of the fats is likewise variable. Sometimes a large part of the fat of the food fails of digestion. In general it may be assumed that about 5 per cent. of the fat of milk, meat, eggs, butter, and lard, and a considerably larger proportion of the fats of some vegetable foods, will usually escape digestion. When, however, the diet contains a very large amount of fat—for instance, when it consists largely of fat meat—the digestion is less complete. One way in which the fat of ordinary foods is digested is by being made into an emulsion in the intestine. The fat of milk is an extremely fine emulsion, and is thus in a sense "pre-digested," or in a partly digested form before it is taken into the stomach. This may help to explain why it is so easily digested.

"The carbohydrates, which make up a large part of vegetable foods, are in general very digestible. Cane sugar is believed to be completely digested, and this is assumed to be the case with the sugar of milk.

"The animal foods have in general the advantage of the vegetable foods in digestibility in that they contain more protein and their protein is more digestible. Milk ranks among the most digestible of the animal foods in respect to all its ingredients."

Effects of Cooking.

Cooking changes the texture of a food material and affects its digestibility to a greater or less extent. In general, it increases the digestibility of vegetable food materials. In the case of milk the experience of different persons with cooked and uncooked milk is quite varied, and the results of experiments are conflicting. The most common experience seems to indicate that cooking or boiling the milk makes the proteids somewhat more difficult to digest. There are, of course, exceptions.

Skim Milk.

The average skim milk contains nearly 10 per cent. of milk solids or nutritive ingredients, while whole milk contains about 13 to 14 per cent. The chief material removed from the milk in skimming is the fat. Thus, naturally, the skim milk must be richer in the valuable protein materials than the whole milk. The amount of fat left in the skim milk must of necessity vary with the completeness of the skimming, and frequently varies from less than one-tenth of one per cent. to as much as three-tenths or even four-tenths of one per cent.

The value of skim milk as a food is not generally appreciated. Taken alone it does not satisfy the sense of hunger, for very large quantities would be required to furnish the food materials desired: but it is a cheap source of very digestible proteins, and when taken with bread or used in cooking it forms a very nutritious addition to the diet. Quoting again from Dr. Langworthy's writing we have the following comparisons:—

"A pound of lean beef (round steak, for example) contains about 0.18 pound of protein and has a fuel value of 870 calories. Two and a half quarts, or 5 pounds, of skim milk will furnish nearly the same amount of protein and have about the same fuel value as the pound of round steak. Two quarts of skim milk has a greater nutritive value than a quart of oysters; the skim milk has 0.14 pound of protein and a fuel value of 470 calories. The nutriment in the form of oysters would cost from 30 to 50 cents, while the two quarts of skim milk would have a market value of from 4 to 6 cents, and a value on the farm of from 2 to 4 cents. An oyster stew made of one part oysters and two parts skim milk would owe its nutriment more to the milk than to the oysters. Bread made with skim milk would contain more protein than when made with water. A lunch or meal of bread and skim milk is very nutritious, as the following computation shows:

Composition and Cost of a Lunch or Meal of Bread and Skim Milk.

Food Materials.	Amount.	Estimated Cost.	Protein.	Fuel Value.
		Cents.	Pound.	Cals.
Bread	10 oz.	3	.06	755
Skim Milk	1 pt.	1	.03	170
Total	....	4	.09	925

"The commonly accepted standard for a man at ordinary muscular work calls for 0.28 pound of protein and a fuel value of 3.500 calories per day, so that the above lunch furnishes very nearly one-third of a day's nutriment and at a cost of about 4 cents. If whole milk were used instead of skim milk, the cost would be about 6 cents and the fuel value 1,080 calories, while the protein would remain the same in amount.

"The following lunch, such as might be obtained in a restaurant or lunch room, will serve for the purpose of comparison:

Estimated Cost and Nutrients of a Restaurant Lunch.

Food materials	Amount	Estimated cost	Protein	Fuel value
	Ounces	Cents	Pound	Calories
Soup	8	....	0.01	75
Beef	2	....	.02	275
Potatoes	2	....	....	100
Turnips	1	....	....	15
Bread	4	....	.02	300
Butter	½	....	....	100
Coffee:				
Milk	1	....	....	20
Sugar	½	....	....	55
Total	....	15 to 20	.05	940

"It will thus be seen that the 15-cent lunch containing nine different food materials did not have any greater nutritive value than the 4-cent lunch of bread and skim milk."

The constituent of our food which cost the most, has the greatest physiological value, and which is most apt to be lacking in ordinary dietaries, is protein. Skim milk has nearly all the protein of the whole milk. It has practically all the value of the whole milk for building and repairing tissues, for the making of blood, muscle and bone, and about half the value of the whole milk for supplying heat and muscular energy. When these facts are fully understood, skim milk will doubtless be more wisely utilized.

CREAM AND BUTTER.

Ordinary cream contains approximately about four and one-half times as much fat as an equal volume of milk, and slightly less protein and carbohydrates than whole milk. It is, naturally, chiefly valuable for its heat producing power, just as skim milk is valuable for its muscle-forming properties. When we consider that a pound of butter costs very little more than a pint of cream, and that the butter contains fully two and one-half times as much fat as the cream, it will be seen that cream is not an economical food.

Buttermilk.

The average composition of buttermilk is quite similar to that of skim milk, though it contains slightly less protein and sugar and a little more fat. It has, consequently, about the same value as skim milk. The acid developed in souring the cream gives it a sour taste and possibly gives to it some physiological effects not enjoyed by the skim milk.

CHEESE.

The cheese used in largest quantity in the homes of this country is the Canadian Cheddar. It was formerly made in the farm homes, but it has now become a big commercial enterprise and practically all of it is made in factories, of which there are over 1,000 in the Province of Ontario alone. In the year 1912 these factories manufactured 129,655,063 pounds of cheese, valued at $16,574,573.00. A large amount of this cheese is exported annually, and it is to be feared that very little of the best cheese finds its way into Ontario homes. Comparatively little of the soft, or what are sometimes called fancy cheese are made here, although it is estimated that probably one-tenth of the total amount of cheese consumed in the Province is made up of the numerous varieties included under this name.

Briefly, the general process of cheese-making is as follows: The casein of the milk is coagulated by rennet, forming a curd, which mechanically holds nearly all the fat of the milk. The curd is broken up and after heating to a temperature of 98 to 104° F., and developing a certain amount of acid, the whey is drained off. This contains nearly all the sugar and albumin of the milk. After allowing the curd to be still further modified by the action of acid and rennet, it is salted and pressed, and set away to ripen. During this "ripening" process the tough, rubbery curd is broken down into a material of a mellow and almost buttery constituency. By varying the proportion of butter fat retained or added to the milk, or by varying the methods of separating, preparing, seasoning, and handling the curd, and by changing the temperature and general conditions under which the curd is ripened, an almost innumerable variety of cheese may be prepared. Many of the soft or fancy cheese on the market are desirable foods, but, owing to the higher flavor common to many of these and to the fact that they are more expensive, they will always be used as condiments and can never take the place of Cheddar cheese as an article of food.

Nutritive Value.

Cheese is one of our most concentrated foods. More than one-fourth of its weight is protein, about one-third fats, and one-third water. It is not only valuable for the amount of protein, or muscle-forming material, and fat it contains, but, also because of the ease with which it can be kept and prepared for the table and for the variety of ways in which it may be served.

As a further indication of the high nutritive value of cheese, it may be pointed out that one-pound of cheese contains nearly all the protein and fat in one gallon of milk. Or, if we compare it with other protein foods, we find that one pound of cheese has nearly the same food value as two pounds of fresh beef, or any other fresh meat food, and it is also equal to two pounds of eggs or three pounds of fish.

Digestibility of Cheese.

Unfortunately, there is a widespread belief that cheese is indigestible, particularly in the sense of being hard to digest. Associated with this idea there is another popular belief that green cheese, or even cheese at any stage in the ripening, causes constipation. There is a marked difference between the tough, rubbery nature of the green cheese and the mellowed substance of the "cured" or "ripened" cheese. The former contains very little water-soluble material, whereas in a well-ripened cheese more than half of the protein may be soluble in water. It is a well known fact that the constituents of milk are very digestible and make an almost perfect food. Yet, even with this food there is a slight tendency to constipation, possibly due to the fact that, like cheese, it is so completely digested that there is very little residue left in the system. Again, with regard to the difficulty of digestion, it is hard to understand why the use of rennet, the development of a small amount of acid and the heating of the curd to about 100° F. should render the constituents of milk so indigestible as they are commonly regarded.

Another interesting question regarding the food value of cheese is with reference to whether cheese has a place as a staple food product, or whether it is to be used only as a luxury, or as a so-called appetizer. It may not, as is true with many other foods, "agree" with certain individuals, but cheese is too cheap and nutritious a food to be left out of our list of food substances for this reason. It is well known that with many European people cheese forms a large part of the diet, replacing meats as a source of animal proteids. It is, therefore, a question well worth considering whether we could not with economy use cheese in many ways to replace the more highly priced nitrogenous foods (meats) now in general use. This of course refers to the Cheddar cheese and not to the higher-priced soft or fancy cheese.

Owing to the widespread idea that cheese is indigestible, it may be well to include here a rather full statement of the results of some experiments carried out under the direction of the Office of Experiment Stations, United States Department of Agriculture, first, at the Wesleyan University, Middletown, Ohio, and second, in conjunction with Prof. Snyder at the Minnesota Expt. Station.

The work at Middletown was planned to include green and ripe cheese, and cheese made with different quantities of rennet and ripened at different temperatures. The diet in these experiments consisted of a basal diet of whole wheat bread and bananas, as these two articles have been thoroughly studied and the digestion coefficients have been determined. A total of 184 experiments were made and a total of 65 human subjects were used. Each experiment lasted three days. The subjects were mostly students of the Wesleyan University between the ages of 19 and 32 years. The results of the experiments are summarized as follows:—*

"The results of the several digestion experiments in the different series are summarized in the following tables. In these tables the results are given for the digestion coefficient of the fat and the availability of the energy, both in the total diet and in the cheese alone.

"The amount and exact composition of the basal ration used in the experiments is not given, for the reason that it varied in different experiments with the several subjects, and space will not allow its insertion. All of the data for the entire series of experiments are in the Office of Experiment Stations, Department of Agriculture, Washington, D.C., where they may be consulted by those who wish a more detailed account of the work. As previously mentioned, the basal ration was bananas and bread. The amount of cheese eaten per man per day varied somewhat, according to the appetite and preference of the subjects, but an average was not far from 0.5 to 1 pound per day. The exact amount eaten was in every case recorded, as were all other experimental data. While it is believed that the variations in the amount of the basal ration doubtless affected to some extent the digestibility of the cheese, it is thought best not to enter into this subject in this brief account of the work. From the character of the diet it will be seen that practically all of the fat and the greater part of the proteid came from the cheese.

Results of Digestion Experiments with Cheese Cured in Different Ways Added to a Basal Ration. Middleton Experiments.

Kind of Rations.	Age of Cheese	Digestibility of Proteids		Digestibility of Fat		Availability of Energy	
		In total diet	In Cheese alone	In total diet	In Cheese alone	In total diet	In Cheese alone
	Days	%	%	%	%	%	%
Low-rennet cheese held at 60° F. added to basal ration of bread and bananas	1	88.1	99.4	92.8	95.8	90.0	91.6
	9	86.3	94.3	92.8	95.4	90.0	88.9
	16	88.6	98.3	94.9	97.4	90.8	91.3
	30	86.8	95.2	92.4	94.3	89.6	87.7
	44	88.6	97.0	95.2	97.3	91.2	92.1
	58	88.1	96.9	95.3	97.2	91.0	91.8
	93	91.0	100.6	96.2	97.9	91.8	93.9
	128	87.6	96.1	93.9	96.5	89.5	88.4
	156	90.7	100.3	94.8	96.4	90.7	91.4
High-rennet cheese held at 60° F. added to basal ration of bread and bananas	1	89.1	99.7	92.8	95.3	90.8	91.4
	9	88.7	98.7	95.4	97.9	90.5	90.4
	16	88.6	98.3	93.9	95.3	91.1	92.0
	30	85.5	92.6	93.1	97.1	89.2	86.5
	44	88.4	97.8	95.0	96.4	90.7	91.1
	58	87.4	94.7	93.9	97.0	90.3	89.8
	86	89.0	97.2	94.3	95.9	90.8	91.4
	115	90.0	100.5	92.6	95.0	90.0	89.6
	142	91.1	100.4	94.5	96.1	91.1	92.5
Low-rennet cheese held at 40° F. added to basal ration of bread and bananas................	30	87.0	95.7	93.8	95.8	90.5	90.2
	44	88.1	96.2	94.4	95.4	90.8	90.9
	58	90.5	101.5	93.7	95.4	91.3	92.8

* Circular No. 166, Bureau of Animal Husbandry, U.S. Dept. of Agri.

Kind of Rations	Age of Cheese	Digestibility of Proteids		Digestibility of Fat		Availability of Energy	
		In total diet	In Cheese alone	In total diet	In Cheese alone	In total diet	In Cheese alone
	Days	%	%	%	%	%	%
Low-rennet cheese placed at 40° F. when two weeks old added to basal ration of bread and bananas...............	30	87.8	97.0	92.5	94.5	90.3	89.7
	44	85.4	91.6	94.6	96.6	90.4	89.6
	58	89.4	99.6	95.3	97.1	91.4	93.2
	128	89.9	101.1	94.9	97.5	90.7	91.5
	155	88.9	98.0	94.3	95.9	90.4	90.7
High-rennet cheese held at 40° F. added to basal ration of bread and bananas......	9	86.6	94.9	94.3	96.8	90.3	89.7
	16	87.1	95.4	91.7	93.1	90.1	89.3
	30	86.9	95.2	93.6	97.6	90.3	89.6
	44	88.0	97.2	94.0	95.3	90.8	91.3
	58	90.8	100.7	94.6	97.7	91.2	92.3
High-rennet cheese placed at 40° F. when two weeks old added to basal ration of bread and bananas...............	30	89.4	99.7	94.7	98.8	91.3	92.6
	44	90.4	101.8	95.2	96.6	91.5	93.5
	58	90.3	99.9	95.7	99.0	91.3	92.4
	115	89.9	101.2	94.5	97.2	90.5	91.0
	142	92.6	104.5	94.8	96.4	91.5	93.4
Low-rennet cheese held at 32° F. added to basal ration of bread and bananas.......	9	90.3	102.1	94.7	97.4	91.2	92.5
	30	86.0	93.9	94.2	96.2	89.9	88.4
	44	84.6	90.3	92.0	93.9	89.7	87.6
	58	88.1	97.3	94.8	96.6	91.2	92.4
High-rennet cheese held at 32° F. added to basal ration of bread and bananas.......	9	84.9	91.7	91.5	93.8	89.6	87.9
	16	89.7	100.4	92.7	94.1	90.9	91.6
	30	87.4	96.1	94.4	98.5	90.5	90.5
	44	89.5	100.1	94.5	95.9	91.2	92.7
	58	89.2	98.0	92.8	95.9	90.7	91.0
Low-rennet cheese, green curd, added to basal ration of bread and bananas.......	....	89.2	99.1	93.4	96.9	89.7	88.8

"The results in the table show that there is little or no difference in the comparative digestibility of cheese at different stages of ripening. The perfectly green curd was evidently as digestible and, so far as nutritive value was concerned, was as good a food as the same cheese at any stage of ripening. The casein of cheese either fresh from the press or thoroughly ripened is very highly digestible. The cheese was eaten in comparatively large quantities, and it was evidently well assimilated.

"A record of the health of each individual was kept, and also notes on the palatability of the cheese ration. At first 1,350 grams of bread were fed with 2,025 grams of bananas and 450 grams of cheese. The length of the experiment was three days, and this would make practically one-third of a pound of cheese per day. The bread was finally reduced to 1,200 grams and the cheese increased first to 525 grams and then to 600 grams for the three days. On the whole, the cheese was very palatable and, with a few exceptions, the amount given was not considered excessive by the person eating it. A number of the subjects wanted more of the cheese. The subjects of the experiments were about equally divided in the preference for a mild or a strong cheese.

"Contrary to general belief, the green curd did not appear to cause constipation. In fact, constipation resulted more frequently after the cheese had had time to become well ripened. There also seemed to be more distress from the cheese diet with the well-ripened cheese than with the green cheese."

Minnesota Experiments with Cheese.

The primary objects of the Minnesota experiments was to study the digestibility of older cheese than had been used in the Connecticut experiments, and to study the digestibility of other varieties, as well as the so-called condimental value of some of the more highly flavored varieties. In these experiments the basal diet was bread and oranges, which were previously studied. The duration of each experiment was, as in the Connecticut experiments, three days.

Summary of Results.

The results of the Minnesota experiments are shown in the following table:

Results of Digestion Experiments With Cheese of Different Kinds Added to a Basal Ration.—Minnesota Experiments.

(In each case the value represents the average of experiments with four subjects).

	Digestibility of Nitrogen.		Digestibility of Fat in total diet.	Availability of Energy.	
	In total diet.	In cheese.		In total diet.	In cheese.
	%	%	%	%	%
Old cold-storage cheese (435 grams added to basal ration)	92.53	91.79	91.04	92.33	86.13
Old cold-storage cheese (585 grams added to basal ration)	93.79	96.36	93.64	92.21	87.08
Green cheese (750 grams added to basal ration)	94.39	96.29	89.96	92.29	86.45
Green cheese (1,050 grams added to basal ration)	94.33	95.83	93.72	91.25	86.40
Roquefort cheese (520 grams added to basal ration)	93.13	93.57	91.04	92.40	87.15
Swiss cheese (605 grams added to basal ration)	92.67	92.19	90.84	92.00	84.38
Skim-milk cheese (1,000 grams added to basal ration)	95.10	96.65	88.55	90.47	79.68
Camembert cheese (605 grams added to basal ration)	91.65	88.65	89.17	92.87	83.59
Camembert cheese (240 grams added to basal ration)	91.07	83.22	80.86	92.25	74.95
Roquefort cheese (295 grams added to basal ration)	90.82	82.59	88.70	92.41	82.18
Cottage cheese (540 grams added to basal ration)	92.85	92.68	....	....	90.98

*Circular 166, Bureau of Animal Husbandry, U.S. Dept. of Agriculture.

"In the discussion of the results and the interpretation of the digestion coefficients it is believed that the calories should be taken as the indirect index of digestibility of the fats rather than the fat determinations.

"In the calculations of the results it was assumed that the bread and oranges had the following digestibility: Protein, 93 per cent.; carbohydrates, 98 per cent.; calories, 98 per cent.

"As so little fat was contributed by the bread and oranges, it was deemed best by Prof. Snyder, under whose direction the tables of results were prepared, not to make any special calculations for the digestibility of the fat of the cheese alone.

"The factor for the digestibility of the protein of the bread and oranges is higher than was found in the numerous experiments for bread alone, but it was assumed because it appeared from the first series of results that cheese in the ration increased the digestibility of the protein of the other foods. This assumption appeared to be verified by the later tests which had for their special object the influence of the cheese upon the digestibility of the basal ration.

"The work both at Middletown and in Minnesota, while demonstrating the same general fact of the high food value, actual and comparative, of cheese in all stages of ripening, does not give identical figures for the digestibility of protein in the total diet or in the cheese. A different basal ration was used in the Minnesota experiment from that used at Middletown. White bread was used in Minnesota, while whole-wheat bread, which has a decidedly lower digestibility, was used in the experiments at Middletown.

"Nothing unusual was noted in the health of the subjects used in the experiments at the Minnesota Experiment Station. One of the subjects believed before beginning the experiments that a cheese diet did not agree with him, but found that it had no ill effects.

"In considering the results shown in the table, it is apparent that all the kinds of cheese used in the experiments are very digestible. In comparing the old cheese with the green cheese the latter was evidently the more digestible, which was not the case in the Middletown experiments, where the slight difference was in favor of the well-cured cheese. However, the difference between the digestibility of green and cured cheese in either series of experiments is well within the limits of variation ascribable to personal peculiarity of the subjects and were to be expected in this kind of work.

"Particular interest attaches to the evident digestibility and food value of skim-milk cheese. This is a product which has not been viewed with very great favor by the public in general. The physical properties of cheese made from skim-milk have been such as to give consumers the impression that it was indigestible and, on the whole, of questionable value as food. The establishing of the actual food value of this comparatively cheap product will at some future time doubtless be of great economical importance. Skim-milk cheese made up in a way to be agreeable to the taste could be sold at a price that would attract the attention of the laboring classes. Cheese made from skim-milk and sold for whole-milk cheese is a fraud that is a positive injury to the dairy business; but cheese made from skim-milk and sold for what it is is worthy of serious consideration on the part of both producer and consumer. It is very likely that the time is not many years distant when a comparatively large quantity of cheese from skim-milk will be made with profit to the dairy industry and will be consumed at a pronounced saving by the laboring class in general.

"In the same connection attention is called to the food value of cottage cheese established by this work. This is another cheap and to many a very palatable product that could be introduced to a much greater extent in the dietary at a great saving in the total cost of food.

"In general, the table shows that all kinds of cheese, even the very high-flavored and so-called condimental cheeses, have a high food value. But the so-called condimental value of cheese when eaten in small quantities as a stimulus to the digestion of other foods was not demonstrated. Where the cheese was eaten in small quantities the digestibility of the basal ration fell below the assumed digestion coefficient. The fact that in the work done at Middletown the digestibility of the basal ration was increased in many cases at least is no evidence that cheese has any particular properties as a stimulant to digestion, as it has been shown that other foods, such as meat, might have the same effect. This is a physiological phenomenon that may perhaps be explained on some other basis than that of condimental effects."

Cheese as a Food.

The experiments described have not only shown that cheese, even green cheese, is very thoroughly digested and that it can, when properly arranged in the diet, be used in comparatively large quantities without causing any pronounced physiological disturbances, but they have also established the fact that cheese is a valuable food, and that it can be safely used as a substitute for other protein food in the diet. In connection with the use of raw cheese there is, however, one point that should be emphasized, and that is that it should be thoroughly masticated, otherwise the digestive juices do not readily penetrate the fatty matters of the cheese.

In this country cheese is used chiefly for its flavor or as a condiment, and little thought is given to the food value of it in the diet. However, in view of the facts established by the above experiments, housekeepers would be justified in going farther and using cheese as a source of protein material for the diet, or, in other words, use it as a substitute for meats. In doing this they will but follow the example of people in the older European countries, where long experience has not only established the value of the full cream cheese such as the Cheddar, but also the high value of skim milk cheese and the home-made Cottage cheese.

Estimates made by the United States Department of Agriculture show that the people of that country use about 175 pounds of meat annually per capita, besides fish and poultry, while the annual consumption of cheese is only about 4 pounds per capita. It is probable that if we had similar data gathered in this country the results would be about the same. Even granted that fresh meats are more palatable to most people, it is a question whether it is a good practice to use so little cheese when meats of all kinds are so expensive. There are some dishes that may be prepared in which cheese is one of the sources of protein, and, if such dishes were made to substitute meat once or twice a week a saving would be effected.

In order that the above phase of the question may be more clearly realized, a knowledge of the composition of cheese in comparison with other foods is desirable. But, since the market prices vary, it may be better to make the comparison on the basis of the amount of the food constituents that may be obtained in the different foods for a given amount of money expended. The following table shows the number of pounds of protein, fat, carbohydrates and the fuel value of one dollar's worth of a number of our common foods:

	Price.	Protein.	Fat.	Carbo-hydrates	Fuel Value.
		lbs.	lbs.	lbs.	Calories.
Milk	8 cts. per qt.	1.04	1.27	1.66	10,402
Skim-milk	10 " gal.	3.4	.30	5.1	17,070
Buttermilk	10 " gal.	3.0	.50	4.8	17,362
Butter	30 " lb.	.3	2.83	....	12,000
Cheese	20 " lb.	1.39	1.84	....	10,360
Beef, hind quarter	14 " lb.	1.10	1.31	....	7,563
Beef, flank	12½ " lb.	1.34	1.51	....	8,924
Beef, sirloin	24 " lb.	.69	.68	....	4,132
Veal, cutlets	22 " lb.	.91	.34	....	3,145
Mutton chops	20 " lb.	.67	1.44	....	7,326
Ham, cooked	40 " lb.	.50	.56	....	3,304
Eggs	25 " doz.	.79	.56	....	3,853
White bread	4 " lb.	2.10	.50	12.2	28,710
Flour	$3.00 per cwt.	3.25	.03	25.3	54,057
Rolled oats (in packages)	7 lbs. per 25c.	3.5	1.9	20.0	51,730
Farinas (in packages)	6 lbs. per 25c.	2.3	.24	18.7	40,070
Potatoes	90 cts. per bag.	2.18	.10	15.6	33,492
Beans	5 cts. qer lb.	3.90	.54	12.0	31,000

No attempt has been made to calculate the amount of digestible constituents, but it is probable that over 95 per cent. of the protein of the milk and meats, and about 80 per cent. of that of the cereals would be digested. The fat of the cereals would be less digestible than that of the milk and meats, and sugar of the milk would be almost entirely absorbed, while a considerable proportion of the carbohydrates of the bread and oatmeal would resist the action of the digestive juices. It is also quite probable that more energy would be required to digest the vegetable foods. However, after allowing for this, it is evident that the cereal foods are a cheap source of protein and carbohydrates and that it is because of the presence of the latter cheap heat-producing materials that this class of food has such a high fuel value.

Taking the figures as they stand, it is evident that milk furnishes protein and fat more cheaply than the various cuts of the meats. Skim milk and buttermilk, when they can be purchased, are particularly cheap sources of protein, and are probably the cheapest source of this constituent among all our foods. Butter is valuable almost entirely for the fat it contains, and as an energy producer is as cheap as any of the meats, while cheese as a source of protein and fat is very much cheaper than the meats. Thus, one dollar expended on cheese at 20 cents per pound will furnish about twice as much protein, nearly three times as much fat, and about two and one-half times as much energy as the same amount of money spent on sirloin steak at 24 cents per pound. From the above it is evident that one dollar spent on milk, or any of its products excepting butter, will furnish more protein, or muscle-forming material, and more energy, as indicated in the fuel value column, than fresh meats. Furthermore, there is no reason why the cheaper milk products should not at least partly replace the more expensive meats. There is, however, the whole problem of palatability to contend with and it is very doubtful if there are many people who will give up meats for milk products, unless these are put up in a form that is equally palatable.

Cheese as a Substitute for Meat.

From the standpoint of composition meat and cheese may be readily compared with one another. Neither one contains any appreciable quantity of the carbohydrates, and both are valuable for the protein and fat they possess. Furthermore, they are about equally well digested, and there is no reason to suppose that the nutrients of one are any more valuable than the other. One pound of cheese will, however, furnish just about as much actual nourishment as two pounds of fresh meat. Yet, it is extremely doubtful if cheese will ever entirely replace meat as a source of protein and fat, nor is it desirable that it should, unless strict economy in the diet is essential. Meat and gravy form a natural relish for the vegetables, just as cheese does for the breads. Both have their places in our dietaries. At the same time, economy would be effected if cheese was given a more prominent place in our diet and used in at least one meal a day with the deliberate intention of procuring the essential proteins from this source rather than from the more costly meats. Bread and cheese can be used in such amounts as to constitute what is called a balanced diet, i.e., in such amounts as to supply the right proportions of muscle-forming foods in comparison with the energy value. But fruit added to the diet would render it more attractive and palatable and favor digestion. It also tends to decrease the possibility of constipation. A case was investigated and reported by the Office of Experiment Stations, U. S. Department of Agriculture, of a man who lived for months upon a diet of bread, cheese and fruit, and who remained in good health and active and did not weary of the monotony of the diet. It will generally be found that the watery and refreshing fruits or succulent vegetables with their large supply of cellulose are a pleasant contrast to the concentrated and fatty cheese. Thus, when planning menus in which a cheese dish is the chief feature, pains should be taken to supply crisp, watery vegetables or fresh fruit salads.

Cheese Dishes and Their Preparation.

Cheese may also be cooked in a great variety of ways; but, owing to its concentrated and fatty nature, it must be mixed with other materials and cannot, like meat, be cooked by itself. There may, however, be many tasty dishes prepared by housekeepers who for one reason or another are interested in lessening the amount of meat which they provide or to substitute some other food for it. The problem with the average family may more often be the occasional substitution of other palatable dishes for the sake of variety, for reason of economy, or for some other reason than the general replacement of meat dishes by other things.

The following recipes for cheese dishes have been prepared by Miss Watson, Director of Home Economics, Macdonald Institute, Guelph, who has also made the calculation of the cost. The prices of the materials used in these calculations were about the present prices for the various articles in Guelph, which are as follows:

Porterhouse steak	25	cents	per	pound
Beef, as in hash, beef loaf	18	"	"	"
Butter	35	"	"	"
Cheese	20	"	"	"
Eggs	35	"	"	doz.
Milk*	7	"	"	quart

*Skim milk was charged at the same rate as whole milk, because the family buys whole milk, uses the cream for tea, coffee and cereals, and the skim milk for cooking.

Bread	4 cents per pound
Dripping*	18 " " "

With each recipe the total cost of the materials is given, also the cost per 100 calories and the cost per pound of protein. Like all such estimates, these calculations only give the relative cost. The housekeeper may estimate the comparative cost of the various dishes by taking into account the amount of materials used and the prices paid for the ingredients at any particular time. Furthermore, these recipes are not set down to be slavishly followed. The skillful cook may lessen the cost by reducing the number of eggs or by substituting less expensive fats for the butter, and will evolve many variations to suit the taste of the consumers.

Macaroni and Cheese. Baked.

1 cup macaroni.
2 cups skimmed milk.
3 tablsp. butter.
4 tablsp. flour.
1 cup grated cheese.
½ teasp. salt.
Pepper.
¼ cup dried crumbs.
1 teasp. butter.

Add 2 teasp. salt to 2 quarts water. When boiling rapidly, drop in the macaroni broken into inch pieces, and boil hard 20 minutes. Drain and pour cold water through to prevent sticking together.

Melt the 3 tablsp. butter in a saucepan; add the flour and stir over the fire until frothy; add the milk and stir constantly until it thickens and boils. Season to taste with the salt and pepper; add the cheese and cooked macaroni; mix carefully, turn into a baking dish.

Butter the crumbs by adding the teasp. butter and stirring over the fire; sprinkle them evently over the dish of macaroni and bake until thoroughly heated, about 20 min.

Note.—This may be served in a vegetable dish, without the crumbs and baking, but the macaroni must then be heated in the sauce.

Cost per 6 persons is	15.5 cents
" per 100 calories is	.92 "
" of 1 lb. proteid from this food is	$1.04

Welsh Rabbit.

1 lb. cheese.
⅜ cup water.
1 teasp. salt.
Cayenne.
Bread—10 oz.
12 pieces—3″ x 4″ x ½″

Prepare the toast, arrange on a platter and keep it warm. Grate the cheese, or chop it fine. Put the water, salt, cayenne and cheese into a frying pan; set it over gentle heat and stir constantly with the flat of a fork until the cheese melts and the whole is creamy. Lift from the heat, beat hard for a moment, pour it over the toast and serve at once.

Note.—The success of this dish seems to lie in the choice of a mild flavored cheese which melts well, and the slow raising of the temperature to the melting point, which permits of thorough mixing and beating.

Beer, ale, cider or ginger-ale, may replace the water. Onion juice or garlic may be used to flavor.

Cost for 6 persons is	22.5 cents
" per 100 calories is	.77 "
" of 1 lb. proteid from this food is	67.2 "

Milky Cheese Toast.

1 lb. bread.
3 cups whole milk.
½ cup grated cheese.
1 tablsp. flour.
1 tablsp. butter.
¾ teasp. salt.
Pepper.

Toast the bread and pack into a vegetable dish or arrange on a deep platter and keep warm.

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*Dripping was reckoned at the same price as meat, as it is usually purchased at the same price as the meat.

Put the milk to heat in a double boiler. Mix the flour and butter in a small bowl, and thin down with warm milk, a little at a time, until thin enough to pour easily. Add it to the hot milk, stirring constantly until it thickens. Season to taste and cook at least ten minutes longer. Just before serving time add the cheese, stir until it melts, pour it over the toast and serve at once.

Cost for 6 persons is	11.8 cents
" per 100 calories is	.56 "
" of 1 lb. proteid from this food is	67.8 "

Cheese Custard.

3 eggs.
2 cups skimmed milk.
1 cup grated cheese.
1 teasp. salt.
¼ teasp. mustard.
Pepper.
Bread—10 oz.
12 pieces—3″ x 4″ x ½″

Make the toast, arrange on a platter and keep warm.

Mix salt, pepper and mustard in the top of a double boiler. Add three eggs and beat enough to mix well; add the milk and cheese and mix thoroughly. Stand over the fire and stir constantly until hot, then stand in the hot water and stir until it thickens like custard (that is, until it begins to coat the spoon). Pour over the toast and serve at once.

Note.—This dish cannot be kept hot successfully. Better keep the family waiting for the dish than the dish for the family.

This may be used over soda biscuits, plain bread slices, or milk biscuits heated over, and split.

	Alone	On toast.
Cost for 6 persons is	16.5c.	19 c.
" per 100 calories is	1.7c.	1.1c.
" of 1 lb. proteid from this food is	$1.28	72.3c.

Cheese Soup.

4 cups skimmed milk.
1 cup grated cheese.
1½ tablsp. flour.
1 teasp. salt.
Pepper—black, cayenne, or paprika.

Reserve ¼ cup cold milk, and put the rest to heat in a double boiler. Mix the flour with an equal bulk of cold milk, and thin down with the remainder; stir this into the hot milk and stir until it thickens. Season to taste with the salt and pepper and cook 10 minutes longer. Add the cheese, stir until it begins to melt and serve at once.

Variations.—The seasoning may be varied with celery salt, allspice or mace. A little finely chopped onion or carrot, or celery may be boiled 20 minutes in a little water, and the water alone, or the whole, added to the milk before thickening. The water from dinner vegetables will serve the same purpose, replacing part of the milk.

Cost for 6 persons is	10.6 cents
" per 100 calories is	1.1 "
" of 1 lb. of proteid from this food is	76.1 "

Cheese Pudding.

12 pieces bread—10 oz.
2 cups grated cheese.
2 cups skimmed milk.
½ teasp. salt.
¼ teasp. mustard.
Pepper.

Toast the bread, and fit a layer into the bottom of a baking dish. Put next a layer of half the cheese; then a layer of toast covered with the remaining cheese; top with another layer of toast. Season the milk with salt and pepper; pour it over the contents of the dish; bake in a quick oven about 30 minutes and serve at once.

Note.—The quantity of milk will vary somewhat according to the bread used. Each person should determine the quantity suited to her conditions and change the recipe figure accordingly. The result should be a spongy mass.

Cost for 6 persons is	15.3 cents
" per 100 calories is	.77 "
" of 1 lb. proteid from this food is	66.7 "

Cheese Souffle.

3 tablsp. butter.
4 tablsp. flour.
⅔ cup milk.
4 eggs.
1 teasp. salt.
Cayenne.
⅔ cup grated cheese.

Separate the egg-yolks and whites, and set the whites aside to get as cold as possible.

Melt the butter in a saucepan; add the flour and stir until frothy over the fire; add the milk and stir constantly until thickened and cooked. Take from the fire, drop in the egg-yolks and mix thoroughly; mix in the cheese, salt and pepper, and set aside to cool.

When it is cold, beat the egg-whites stiff, add a little and mix it in to soften the mixture; add the rest and fold it in lightly to keep it as foamy as possible; turn into a buttered baking dish, and bake in a slow oven 45 to 60 minutes.

This needs a rather strongly flavored cheese.

Cost for 6 persons is	19.3 cents
" per 100 calories is	1.6 "
" of 1 lb. proteid from this food is	$1.55

Cheese Sauce.

2 cups skimmed milk.
¼ cup butter.
¼ cup flour.
½ cup grated cheese.
1 teasp. salt.
¼ teasp. mustard.
Pepper.

Bread—10 oz.
12 pieces—3" x 4" x ½"

Mix the salt and mustard in a saucepan; add the butter and melt it; add the flour and stir over the fire until frothy; add the milk and stir constantly until it thickens and boils. Add the cheese and stir until it melts; season to taste with pepper, and pour over the toast. Serve at once.

Variations—

1. May be used over soda-biscuits, split hot biscuits, poached eggs, hard-boiled eggs, or vegetables.
2. The butter may be replaced by sweet dripping or other fat, lessened in amount, or omitted. In the latter case the flour must be used as in cheese soup.
3. If this sauce is to stand any length of time, make in a double boiler and add the cheese just before serving.
4. A mild cheese is best, or at least only a small proportion of strong cheese.

	Alone.	On Toast.
Cost for 6 persons is	10.2c.	12.7c.
" per 100 calories is	1.0c.	.72c.
" of 1 lb. proteid from this food is	$1.33	$1.28

Cheese Gnocchi.

¼ cup butter.
¼ cup flour.
¼ cup cornstarch.
¾ cup cheese, grated.
2 cups skimmed milk.
2 egg yolks.
1 teasp. salt.
Pepper (black, cayenne or paprika).

Mix the flour, cornstarch and seasoning with enough cold milk to heat in a double boiler. Stir the mixture into the hot milk; stir constantly until it thickens, and occasionally for 15 minutes. Stir in the butter. Add the cheese and the egg-yolks and stir until the cheese melts. Turn into shallow buttered pan to cool.

When cold, cut into squares, arrange on a platter a little distance apart; sprinkle the rest of the cheese over the tops. Heat in a quick oven until the top cheese melts, and serve at once.

Note.—The mixture may be made some time before the meal hour.

Cost for 6 persons is	15.2 cents
" per 100 calories is	.94 "
" of 1 lb. proteid from this food is	$1.19

Scrambled Eggs and Cheese.

6 eggs.
1½ cup grated cheese.
1 teasp. chopped parsley.
1 teasp. salt.
Pinch of nutmeg.
Pepper.

Break the eggs into a bowl, and sprinkle the parsley on top of the cheese. Melt the butter in a frying pan over gentle heat. Turn in the eggs, and immediately sprinkle the cheese over them. With a broad-bladed knife begin to scrape the mass from the bottom as it sets. The object is to cook the mass without mixing the yolks and whites too thoroughly, and yet avoid hardening them. When the mass is jellied, turn at once into a hot vegetable dish, or over toast on a platter, and serve at once.

Cost for 6 persons is	26 cents
" per 100 calories is	2 "
" of 1 lb. proteid from this food is	$1.35

The following recipes of common dishes that do not contain cheese are given for comparative purposes:

Beef Loaf—With Gravy.

1½ lb. lean beef minced.
1 egg.
3 tablsp. dripping.
1½ teasp. onion juice.
1½ tablsp. chopped parsley.
1½ teasp. salt.
3 tablsp. flour.

Cost for 6 people is	30.1 cents
" per 100 calories is	2.31 "
" of 1 lb. proteid from this food is	82.9 "

Bacon and Eggs.

1½ lb. bacon	37½ cents
6 eggs	18½ "

Cost for 6 people is	56 cents
" per 100 calories is	1.23 "
" of 1 lb. proteid from this food is	$2.32

Note.—Above assumes that all the bacon fat is sent to the table and consumed.

Hash.

2 lbs. cold potatoes.
2 lbs. cold cooked lean beef.
3 tablsp. dripping.
1 cup water or gravy.
Salt, pepper.

Cost for 6 people is	25.4 cents
" per 100 calories is	1.46 "
" per 1 lb. proteid from this food is	$1.00

In the following table the various dishes the receipes of which are given above are arranged acording to the cost of 100 calories of heat:

1. Beef Loaf	2.31 cents
2. Scrambled Eggs and Cheese	2. "
3. Hash	1.46 "
4. Cheese Souffle	1.6 "
5. Bacon and Eggs	1.23 "
6. Cheese Custard on Toast	1.1 "
7. Cheese Soup	1.1 "
8. Cheese Gnocchi	.94 "
9. Macaroni and Cheese	.92 "
10 Cheese Pudding	.77 "
11. Welsh Rabbit	.77 "
12. Cheese Sauce on Toast	.72 "
13. Milky Cheese Toast	.56 "
Dishes to compare with:	
Cheese, Cheddar	.93 "
Cottage Cheese	.98 "
Bread	.33 "

On this basis of comparison beef loaf is the most expensive. Flour and bread, rich in starch, which has a fuel value equal to protein, have, however, much to do with the reduction in the cost of 100 calories in some of the other foods. At the bottom of the table the cost of 100 calories of heat in our ordinary Canadian cheese, cottage cheese and bread are given for comparison.

A comparison has also been made on the basis of the cost of one pound of protein in each of the various dishes. These are as follows:

1. Bacon and Eggs	$2.32
2. Cheese Souffle	1.55
3. Scrambled Eggs and Cheese	1.35
4. Cheese Sauce on Toast	1.28
5. Cheese Gnocchi	1.19
6. Macaroni and Cheese	1.04
7. Hash	1.00
8. Beef Loaf	82.9c.
9. Cheese Soup	76.1
10. Cheese Custard on Toast	72.3
11. Milky Cheese Toast	67.8
12. Welsh Rabbit	67.3
13 Cheese Pudding	66.7

Compare with:

Porterhouse Steak	4.00
Bread	.44
Cheese, Cheddar	.71

At the bottom of the above table the cost of one pound of protein in cheese, steak and bread are given. From this it will be seen that bread furnishes the cheapest protein, then cheese and steak in the order named. It is also evident that the cost per pound of protein in the various dishes must vary largely as one or other of these constituents predominates.

There are really two classes of foods in the above list, those which are valuable solely for their protein and fat, and those which contain a certain amount of the cheaper carbohydrate materials derived from bread, wheat or potatoes. Thus, the following are interchangeable dishes in the dietary, and may be directly compared with one another:

Hash—a mixture of meat and potatoes	with	Cheese Custard on Toast. Macaroni and Cheese. Cheese Pudding. Welsh Rabbit. Cheese Sauce on Toast. Milky Cheese Toast.
	or	
Beef Loaf and Bacon and Eggs.	with	Cheddar Cheese. Cottage Cheese. Scrambled Eggs and Cheese. Cheese Souffle. Cheese Soup.

Bread, as a representative of the cereals as a class, is one of the cheapest sources of heat and protein to the body, and cheese and milk, especially skim milk, are the cheapest source of animal protein. The two together can be used to make a well balanced diet, perfect in every way from the food ingredients' standpoint. but lacking in variety and in palatability. The physical condition of cheese renders it difficult to make into tasty cooked dishes without mixing with other materials, especially with eggs, and as eggs are among our most expensive foods, this naturally increases the cost of the cooked preparations. There are, all together, a great variety of ways in which cheese may be used as a condiment and as a cheap source of the proteins. Milk, both raw and cooked, has been used in this way for ages, but the true food value of cheese does not seem to have been as fully realized.

SUMMARY.

Milk contains all of the four nutrients—proteins, fats, carbohydrates, and mineral matter—in nearly the proper proportions to serve as a complete food. It is too bulky to form the whole food of an adult person, but it is well adapted for various uses in combination with other food substances, and in the preparation of different dishes used as food. It also has the advantage of being a cheap food.

Skim Milk is a cheap source of digestible proteins, and when taken with bread or used in cooking it forms a very cheap and nutritious addition to the diet. Two and a half quarts, or five pounds, of skim milk will furnish nearly the same amount of protein and have about the same fuel value as a pound of round steak. Buttermilk has about the same nutritive value as the skim milk, and both substances are so cheap that they could be used in large quantities with economy.

Cheese is one of our most concentrated foods. More than one-fourth of its weight is protein, about one-third fat, and one-third water. It is not only valuable for the amount of protein, or muscle-forming material, and fat it contains, but, also because of the ease with which it can be kept and prepared for the table and for the variety of ways in which it may be served.

Unfortunately there is a wide-spread belief that cheese is indigestible, but extensive experiments have fully demonstrated that it is as fully digested as milk or meat. With this in mind, it may be pointed out that one pound of cheese will furnish about as much protein and fat as one gallon of milk, or as much nourishment as two pounds of fresh meat, two pounds, or fifteen eggs, or three pounds of fish. It may not agree with every person, but the same may be said of many other foods. Yet it is not desirable that cheese should entirely replace these other protein foods, unless strict economy in the diet is essential. Meat and gravy form a natural relish for vegetables, just as cheese does for the breads. Both have their place in our dietaries. At the same time, economy would be effected if cheese was used in at least one meal a day with the deliberate intention of procuring the essential proteins from this source rather than from the more costly meats.

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Ontario Department of Agriculture

FRUIT BRANCH

BULLETIN 222

CURRANTS

AND

GOOSEBERRIES

By

E. F. PALMER, B.S.A.

TORONTO, ONTARIO, APRIL, 1914

BULLETIN 222] [APRIL, 1914

Ontario Department of Agriculture

FRUIT BRANCH

Currants and Gooseberries

E. F. PALMER

The purpose of this bulletin is to give, in as few words as possible, some idea of the extent and importance of the currant and gooseberry industries of the Province, and the most approved methods of culture for the home garden and commercial plantation.

Both the currant and the gooseberry favor a northern climate and do not thrive in hot and dry climates. They are a complete failure in the Southern States of the Union and along the Gulf coast. Ontario seems especially adapted to the culture of these fruits and they can be grown successfully over the greater part of the Province. Some varieties will be found tender in certain districts but there are excellent hardy varieties which will thrive well in the lesser favored localities.

The area of small fruits under cultivation in 1901 is given in the Dominion census as 8,116 acres, and for 1911 Ontario is credited with 13,940 acres, an increase of 71.7 per cent. This includes all small fruits, strawberries, currants and gooseberries, raspberries, etc. In 1910, Ontario produced 2,019,319 quarts of currants and gooseberries or practically sixty-five per cent. of the total production for Canada. The production of strawberries for the same year (fiscal year 1911; crop year 1910) is given as 9,386,135 quarts, and of other small fruits 6,844,253 quarts. The increase over 1901 in the production of all small fruits is figured to be 12.4 per cent. or a little over two million quarts.

A blank form with questions pertaining to currants and gooseberries was sent to the various county representatives and out of twenty-seven replies received, representing twenty-seven counties, only two reports stated that currants were grown to any extent commercially in that county, and five others reported a few commercial patches. The report concerning gooseberries showed even less interest, seven counties reporting a few commercial patches. No reports, however, were received from Halton, Wentworth, Lincoln and Kent counties concerning these fruits.

Every county reported that both currants and gooseberries were grown in the home gardens to a greater or less extent, some counties very little, others quite extensively. Every county with two exceptions reported currants profitable, and with three or four exceptions, gooseberries were also reported profitable. Only about half of the counties stated that the patches were cultivated, pruned and sprayed, and that, not generally, there being on the whole a lack of interest on the part of the fruit growers and farmers concerning those fruits.

From the Rainy River District a most encouraging report came, stating that currants and gooseberries have been very successful where they have been tried.

Fig. 1.—Picking Industry and Lancashire Lad gooseberries in Mr. J. E. Henry's orchard. Note the wide distance between the rows to facilitate spraying.

Various causes were assigned for the lack of interest in the different counties, the chief ones being lack of help, excessive railroad rates to markets, poor transportation facilities involving several changes in transit for express shipments, little demand for the fruit, and no profits.

The currant and gooseberry have had a share in the increased acreage of small fruits, but, while the area devoted to these two fruits has been gradually increasing, and is doing so especially at the present time, they have not yet been given the acreage and cultivation that they deserve. The public, as a whole, has not been educated to a correct appreciation of these fruits as a valuable addition to the more ordinarily used kinds, and further, as they are among our hardiest cultivated fruits, their value in the northern districts where tree fruits grow with difficulty or not at all, is hard to estimate. Both fruits are easily grown, and this fact together with their value for culinary purposes should insure there being at least a few bushes in every home garden. If the fruits were grown at home, when possible, instead of being bought, much larger quantities would be consumed.

Where it is possible then, one cannot do better than grow these fruits for home use. When it is not possible to grow them the opportunity for the commercial grower comes in, and it is to the commercial grower that the urban population must look. And while the urban population has increased tremendously during the ten years previous to 1911, yet the increase in the production of currants and gooseberries has been only twelve per cent. In other words the urban population—the consuming population—has increased and is increasing much more rapidly than the planting of these fruits. As indirect proof of this one has but to compare prices ten years ago with those now being received by the growers. In 1901 growers received eighty cents to $1 for black currants. For 1912 and 1913 the returns were $1.75 to $1.95 per eleven quart basket, an increase of practically 100 per cent. Red currants and gooseberries, too, have shown greatly increased returns. In 1900 red currants could hardly be given away, while for 1912 and 1913 they averaged to the grower sixty-five to seventy-five cents per eleven quart basket of good quality fruit.

Many growers at present claim that the money to be made out of currants and gooseberries is small. In this regard I would like to quote a paragraph from Mr. L. B. Henry's address before the 1913 Ontario Fruit Growers' Convention. Mr. Henry spoke as follows: "A few years ago the price of currants went down so low that they became unprofitable. Black currants were selling in 1899 and 1900 at sixty-five cents for a twenty pound basket, and at that time you could not sell red currants at any price. But from that time up to the present prices have steadily risen until in the last two years we have been getting very fair results from these crops. In fact as high as ten-and-one-half cents per pound; lately some at six-and-one-half cents and red varieties less."

There is little doubt that if growers now gave more attention to their gooseberry and currant plantations, the added returns would more than justify the extra outlay. There are no fruits that respond more quickly to good treatment than currants and gooseberries. They will stand a good deal of neglect, but if we want large fruit and productive bushes, we must take good care of them.

There is another point to remember too in connection with planting currants and goosberries. It is this: that though these fruits may sometimes return comparatively small profits yet they serve or should serve as a "filler-in" crop. That is, varieties should be planted which will mature their fruit when there would otherwise be a slack time in the fruit season. The labor is then profitably employed where otherwise it would practically have to "kill time"—an expensive operation for the grower, constituting an overhead charge on the orchard that is very seldom included in estimates of cost of production, etc.

When commercial growing is undertaken several points have to be carefully considered, chief among which are the facilities for gathering and marketing the fruit. Naturally a near market is desirable since it reduces the cost of shipping, but where no near market is available, this need not prove the deciding factor in the location of a site as currants and gooseberries, especially gooseberries, will ship long distance with little or no injury. Other small fruits will not begin to stand the same length of shipment.

Origin and History of the Currant.

The currant, as compared with some of our other fruits, is of comparatively recent origin. Before the middle of the sixteenth century it was apparently unknown to cultivation, and it was during the fifty years following that it received its modern improved form. Further, it is only during the past half century or a little better, that there has been any extensive improvement of the fruit in this country. Previous to this time currants were simply currants and were commonly known as reds, whites, and blacks. During later years, however, keener competition in the markets has brought about considerable improvement both in size of fruit and in quality. Many new varieties have been originated, though there are growers who still believe that the old Red Dutch variety is superior to any of the more recent introductions. Culture and fertility often appear to have a greater influence on this fruit than parentage, and it is undoubtedly true that with good culture the Red Dutch will surpass the newer varieties under neglect.

The cultivated varieties of the red and white currants are derived from *Ribes rubrum,* a native of the northern parts of America, Europe and Asia. Varieties of the black currants are derived from *Ribes nigrum,* a native of northern Europe and Asia. Although not found in America in the wild state, the black currant seems to have found no difficulty in adapting itself to our conditions. One variety of black currant, the Crandall, comes from an American species *Ribes aureum,* better known as the flowering currant. It is, however, a different species from the ordinary black currant.

The currant is in all cases a northern plant, found in cool damp situations, and it objects to any radical change from these conditions. It does not prosper in hot and dry climates, for though the plants may look well, they are comparatively unproductive. Favoring a northern climate as it does, the currant succeeds well over a very wide area in Ontario. For this reason, and also being easy of culture, it is one of the best fruits for home planting. Anyone who has the space should grow sufficient at least for home use.

For various reasons the currant is not so generally used in Ontario as most of our fruits. Few people care to eat it in the raw state as most varieties are too acid for dessert purposes. When cooked, it is usually made into jelly and for jelly making it is unsurpassed. In the colder parts of Ontario where tree fruits do not succeed so well, the currant, on account of its hardiness and ease of culture, as stated above, finds considerably more favor.

Origin and History of the Gooseberry.

Like the currant, the gooseberry was apparently unknown to the ancients, and it was probably about the sixteenth century that it was first cultivated in Europe. Since that time a wonderful improvement in the size of the fruit has taken place. The Dutch are thought to have made the first marked improvement, but its present development has been largely brought about in England.

Varieties of English and European gooseberries are derived from the species *Ribes Grossularia*, a native of north Europe. Varieties of this species have not succeeded well in America until lately, being very subject to Gooseberry Mildew which was thought to be very difficult of control. The past few years, however, have demonstrated that the mildew can, if properly treated, be successfully combatted.

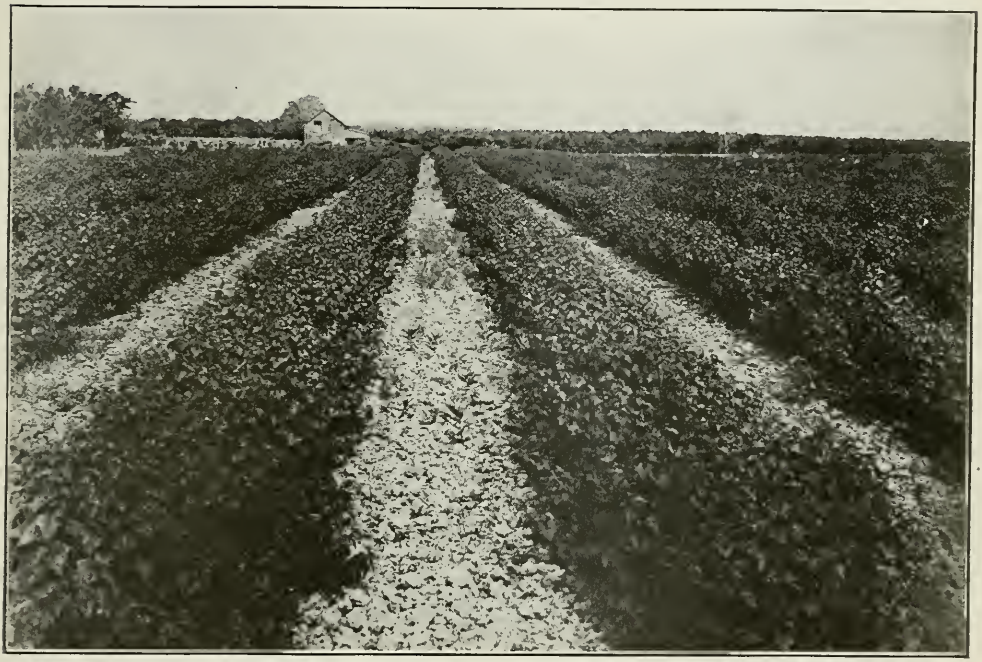

Fig. 2.—Black currant plantation of Mr. J. E. Henry, Winona.

The American gooseberries are derived chiefly from *Ribes oxyacanthoides*, a species native to America. Concerning the origin and history of our American varieties, W. T. Macoun, Dominion Horticulturist, Ottawa, writes in his bulletin on bush fruits, 1907, as follows:—

"As late as 1846 no cultivated varieties of American species of gooseberries were mentioned by writers, the first reference according to Bailey, being in 1849, in the *Northern Fruit Culturist*, by Goodrich, where the author writes: 'We have it from good authority that native sorts have been discovered both in New Hampshire and Vermont well adapted to garden culture.' In 1847 the Houghton's Seedling was exhibited at a meeting of the Massachusetts Horticultural Society, this being the first improved form of the native gooseberry of which there is a record. This variety was originated or found by Abel Houghton, Jr., Lynn, Mass. It is probably a seedling of the native species, *Ribes oxyacanthoides*. The first improvement on the Houghton was the Downing, a seedling of the Houghton, which was originated by Charles Downing, Newburgh, N.Y., and first brought into notice in 1853. It is thought by some authorities to have been a hybrid between Houghton and *Ribes Grossularia*, the European species. The Downing is still more largely planted in America than any other variety of gooseberry. This is doubtless largely due to the fact that comparatively little has been done towards improving the gooseberry in America during the past fifty years. The most work seems to have been done by Dr. Wm. Saunders, Director of the Dominion Experimental Farms, the originator of the Pearl, Red Jacket, and many other seedlings and crosses not yet on the market. These varieties were all originated in London, Ont. There is a good field for work in improving the native gooseberries, as there is no apparent reason why the size should not be equal to the best English varieties. The quality of the American varieties is considered by some to be better than the average English gooseberry, but the flavor is not nearly as good as the best English sorts."

FIG. 3.—Red currants and corn in a Burlington orchard.

The native species of gooseberries in Canada are found growing very far north, so that eventually its culture, as with the currant, will extend to those districts where other bush fruits and tree fruits are too tender to stand the long and severe winter.

The gooseberry as now grown is objectionable on account of its thorns, and though this may seem a trifling objection to many, yet it is an important consideration when picking times comes around. Breeding and selection will, no doubt, in time produce a good commercial thornless gooseberry. An English variety has been recently introduced which is said to be thornless. Also at the Central Experimental Farm, Ottawa, there are several young seedlings which are perfectly free of thorns, though probably it will be some time before a commercial thornless variety is originated from them.

For culture in Ontario, the American gooseberries, perhaps, have most to recommend them, the mildew being the great drawback to the English varieties. American varieties have vigor, hardiness, ease of propagation, and superior quality, being inferior only in size, which selection and breeding should overcome in time. The English varieties, however, have been largely planted of late years, as good methods have proved that the mildew can be effectually controlled. Then, too, the jam factories are taking large quantities of these varieties, and it is probably to this fact mostly, that the stimulus in planting English gooseberries is owing. Also English gooseberries usually bring a higher price on the market on account of their sizze and fine appearance.

PROPAGATION.

The Currant.—Currants are usually propagated from cuttings. The cuttings should be made about six to eight inches long and care taken to make the base of the cutting square across and just below a bud. This facilities cal-

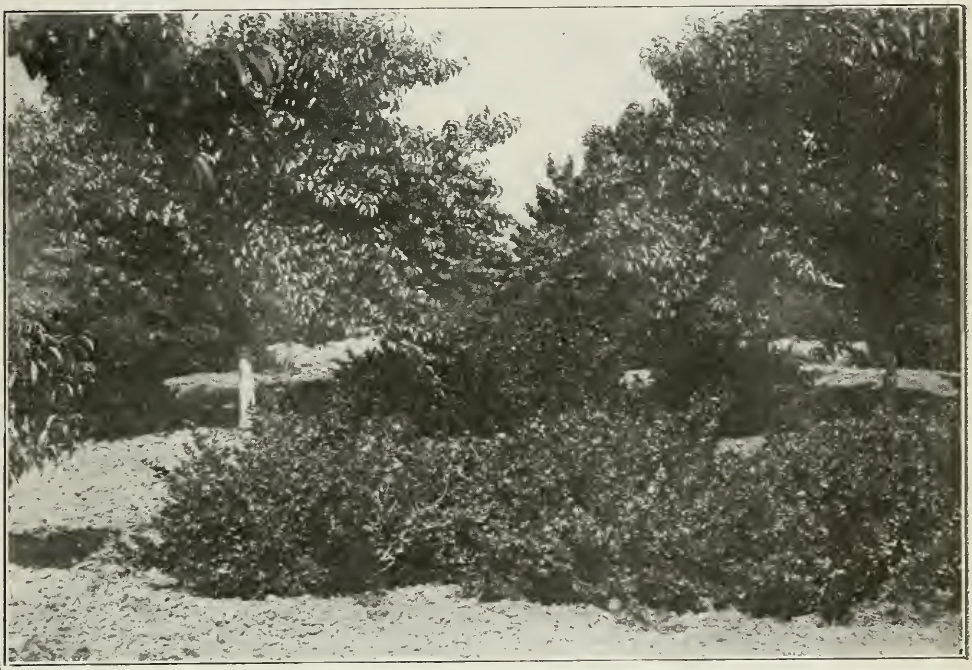

FIG. 4.—Whitesmith gooseberries growing under peach trees. Orchard of J. E. Henry, Winona.

lusing over of the cut and therefore rooting. The upper cut should be made at least half an inch above the top bud so that there is no danger of the wood drying out past that point. A strong growth is desired from the top bud, and if the wood is cut closer than half an inch, the growth is likely to be weakened.

After the cuttings have been made as described, they may be planted right in the nursery row—the usually recommended plan—or they may be heeled in. Another method, and one which is possibly better than either of the foregoing, is that followed by Mr. J. E. Henry of Winona. He takes the cuttings in the late winter and stores them in the cellar, thoroughly covering them with damp sawdust which holds moisture better than sand. This covering with sawdust encourages a mass of rootlets to start. Early in the spring the cuttings are set out.

If the method of taking the cuttings in August or the beginning of September and planting right in the nursery row is followed, they will be ready to start a good growth the following spring—providing the fall has been favorable. It is well, however, to cover the cuttings with a strong mulch to prevent heaving caused through intermittent freezing and thawing of the ground. The cuttings are placed six to eight inches apart in furrows about three feet apart, and in a well-drained location where there is no danger of standing water at any time. The furrow should be deep enough so that only the top bud or two of the cutting is above ground. This is important as the more of the cutting there is below ground, the more roots will be formed and the stronger the plant will be. There is also danger of the cutting drying out too much before rooting if too much of it is exposed. Place the cutting in the furrow in a slanting position and firm the earth well about them. In a favorable season these cuttings should callus well before winter and perhaps throw out a few roots. During the winter it is advisable to mulch the cutting well as previously stated. Cultivation should be thorough and should begin as early in spring as possible, and be continued throughout the season.

If the cuttings are heeled in over the winter, they should be tied in bundles and buried upside down with soil to the depth of two or three inches over them. This heeling in upside down induces callusing of the cutting as the base is nearer the surface than if right side up, and gets more heat and air. In a few weeks the cuttings should have callused well, and they may be left here over winter if a little more soil is spread over them to prevent them drying out; or if the season is favorable, they may be planted out in the nursery; or they may be buried in sand or sawdust over winter in a cool cellar.

The method, however, which I think has most to recommend it, is that followed by Mr. Henry. It involves less labor and handling of the cuttings, and there is no danger, either, of the cuttings becoming harmed through bad weather conditions during the winter. Also, if one may judge from the plantations of cuttings and currants on Mr. Henry's place, it produces plants as good as, or better than any other method.

The Gooseberry.—Gooseberries are propagated by cuttings and by layering. As cuttings are apt to be very unsatisfactory, being hard to start into growth, layering is probably the safest and best method to use. Propagation by cuttings would be essentially the same as for the currant so that it need not be again discussed. American varieties give fairly satisfactory results by the cutting method. Both English and American varieties are sometimes propagated from green wood cuttings in greenhouses.

Where mound-layering or layering, as it is more commonly called is practised the bushes should be pruned severely in the autumn. This will induce a strong growth of young wood the following season. Early in July when these shoots have about completed their growth, earth is heaped around and through the bushes, most of which operation can conveniently be done with the use of a plow. The work is completed by heaping up earth until only the tips of the shoots are above ground. The earth is then well packed leaving a mulch of loose soil on top to conserve the moisture.

American varieties will have rooted well by autumn, when the separate plants may be transplanted to the nursery row at once or left till the following spring. English varieties will not be ready for transplanting till the following autumn as they usually take a year longer to root well. As with the American varieties, the plants may then be separated and planted out in nursery rows. It is advisable especially in the more northern sections, to delay planting till the spring, or else heavily mulch the transplanted plants to prevent unfavorable weather conditions heaving them out.

Soil and Location.

Currants and gooseberries are surface feeding plants, which fact largely determines their soil requirements.

Currants will do well on most soils, but prefer a cool, moist, fairly heavy soil, as their natural habitat would indicate. A rich well-drained clay loam will be found most suitable. Gooseberries require a similar type of soil, though a little heavier and moister. In dry soils gooseberries are apt to suffer from premature falling of the foliage, thus exposing the fruit so that it becomes scalded by the sun's rays. The surface of light soils, unless shaded by trees, gets very hot in summer, which is not best for the fruit as it induces mildew. A northern exposure is to be preferred for both currants and gooseberries as such a location is not so likely to suffer in a dry season. A northern site too, may in part offset the disadvantage of an unfavorable soil.

Some reduction in the intensity of the sun's rays will be found advantageous, especially with gooseberries, shading and the cooler atmosphere helping to control the mildew. Gooseberries, too, are susceptible to sun scalding. They scald very easily if left out in the hot sun, or if the bushes are very open. Currants and gooseberries therefore often thrive well in the orchard. One of the most successful growers of gooseberries in the Niagara district has part of his gooseberry plantation in the peach orchard. He considers this block of gooseberries as the most profitable he has, and says that the plants thrive better under the peach trees and bear far better than where the fruit is grown in the open; also the fruit is cleaner and freer from mildew, and the pickers find their work more agreeable in the shade of the peach trees. Further, there are two crops coming off the land—gooseberries and peaches. This shading is, of course, most satisfactory and necessary in those districts, such as the Niagara, which have a much warmer climate than that naturally favored by gooseberries. Mulching tends to accomplish the same end, since it keeps the soil shaded and cool. The above remarks apply equally as well to currants, which will also be found to do better in shaded locations, especially in the southern parts of our Province.

The same grower, in discussing further his gooseberry plantation in the peach orchard, states that in his experience English gooseberries thrive best on sandy loam soil. This is somewhat contrary to the generally accepted practice, but is likely explained wholly or in part by the shade from the peach trees, which would offset the need of a heavier soil, that is, a cooler soil. Mr. R. B. Whyte of Ottawa states that: "Mildew, the great enemy of the English gooseberry in this country, results from planting in sandy soils. The roots of gooseberry bushes run close to the surface and consequently they become scorched. They should be planted in soil that wont heat, such as heavy clay loam." This apparently conflicts with the statement of the Niagara fruit grower, but, as noted above, the shading probably accounts for the difference in opinion.

Planting.

Preparation of the Soil.—Thorough preparation of the soil is necessary before planting currants or gooseberries. They are heavy feeders so that the land should receive a heavy dressing of well-rotted stable manure, be plowed deep, and subsoiled if necessary. The manure, if well worked in, will help in putting the soil in the desired condition.

Time to Plant.—Fall planting is generally to be recommended as currants and gooseberrries start growth very early in the spring. Also they can be planted comparatively early in the fall—September—giving the plants ample time to become established before cold weather sets in. Spring planting, if done early enough, has few objections, but the trouble is that, there being so much other work to be done at that season the planting is liable to be neglected until after the plants have started growth, for, as stated above, currants and gooseberries start growth very early in the spring. This check will seriously affect the first season's growth.

Distance of planting.—The usually recommended distance of planting is four feet apart in the rows with the rows six feet apart. Currants are often given a little more room, especially the black currants, which are stronger growers. If it is intended to cross cultivate the land, five feet apart each way will be found a good distance to set the plants. Cross cultivation is commonly only needed at intervals. Allowing the plants plenty of room will facilitate spraying and picking. Planting six by six feet would, perhaps, be a better distance to recommend generally for red currants and gooseberries, and seven by seven feet for black currants. Mr. J. E. Henry, of Winona, has his black currant rows seven feet apart with a nine-foot space every third row, this extra large space being partly to facilitate spraying with a power sprayer.

The following table shows approximately how many plants to the acre there will be with different distances of planting.

DISTANCE.	PLANTS.	DISTANCE.	PLANTS.
3 ft. by 5 ft.	2,900	5 ft. by 7 ft.	1,240
3 ft. by 6 ft.	2,400	5 ft. by 8 ft.	1,100
4 ft. by 4 ft.	2,700	6 ft. by 6 ft.	1,200
4 ft. by 5 ft.	2,200	6 ft. by 7 ft.	1,040
4 ft. by 6 ft.	1,800	6 ft. by 8 ft.	900
4 ft. by 7 ft.	1,550	7 ft. by 7 ft.	900
4 ft. by 8 ft.	1,360	7 ft. by 8 ft.	780
5 ft. by 5 ft.	1,740	7 ft. by 9 ft.	700
5 ft. by 6 ft.	1,450	8 ft. by 8 ft.	680

When planting gooseberries under trees, Mr. L. B. Henry of Winona, recommends the following method: "Supposing that the trees are twenty feet apart, plant two bushes in each tree row, placing the bushes six-and-one-half feet from each tree with a seven-foot space in the centre. This gives more room than when planted in the open, but the bushes will grow larger in the shade."

Planting.—The soil should be in a fine mellow condition as deep as plowed, and then marked both ways the required distances with furrows in one direction. It is well to make the furrows deeper than the plants are to be set so that a little fine top soil may be placed under each plant. Root prune the plants before setting as the roots are usually more or less bruised and torn from digging out of the nursery row. The plants will root stronger from smoothly cut roots than from jagged and frayed ends. Set the plants a little deeper than they were in the nursery row. Pack the soil firmly about the roots with the feet. It is very essential that this firming of the soil be thoroughly done, as otherwise there is danger of the soil drying out the following summers. Also the soil being in close contact with the roots allows of the plant making a stronger start. After firming the soil, a layer of loose fine earth should be at the surface to act as a mulch and prevent the packed soil beneath from drying out. This mulch also helps to keep the soil beneath cool and moist.

When a few plants only are to be planted for home use, care must be taken to dig a hole big enough so that the roots of the plant may be well spread out. If a spade is just used to pry a hole in the ground and the plant set in that it cannot be expected to thrive.

Choice of Plants.—Strong, well-rooted one-year-old plants are as good as two-year-old plants, and cost less money. It is, however, essential to have them well-rooted. One-year-old plants are easily set, suffer less check in transplanting

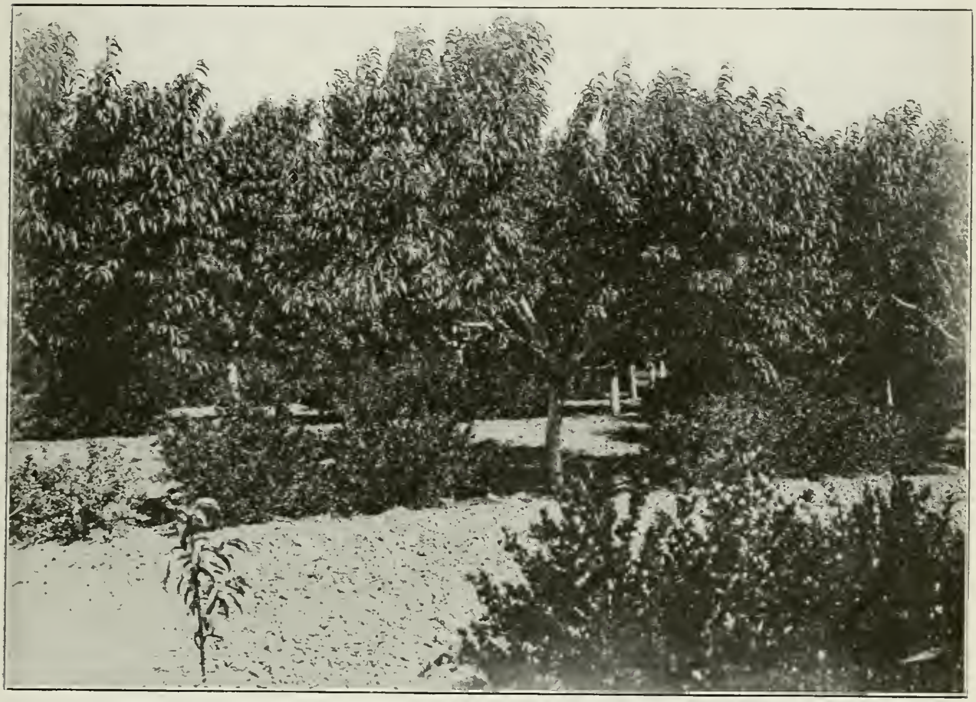

Fig. 5.—Another view in Mr. Henry's peach orchard, showing English gooseberries interplanted.

than two-year plants, and make a better growth than they would during the same time in the nursery row. Two-year plants are quite often the cull stock left at the end of the first year after the best year-old plants have been sold. They are grown for a second year and then often sold as No. 1 two-year-olds.

Subsequent Cultivation.

Conservation of moisture, and coolness of soil, especially for gooseberries, are two very important considerations with these fruits, hence cultivation must be thorough and frequent. Where the climate will permit, a very good plan is to plow the land in the fall, leaving a furrow down the centre of each row to drain off the surplus moisture. This plowing and also all further cultivations must be shallow, as the currant and gooseberry are both surface feeders. When the plants are young cultivation in the middle of the rows may be fairly deep, but as the roots extend across the rows, and take up practically all of the land, the cultivation will have to be shallower else the roots will likely suffer considerable injury. If this fall plowing is found to be doing any considerable damage it should be discontinued, and the land worked up with the aid of harrow tooth or spring tooth cultivator. If the land is properly disked, plowing may be omitted.

The land should be worked down with a cultivator or disc as early as possible in the spring whether plowed the previous fall or not. As a rule spring plowing will be necessary if fall plowing is not done. Later cultivations should be given, especially after heavy rainfalls, to keep the top soil in a fine, loose condition so as to conserve the moisture and keep the land cool. About a week after the crop has been harvested all cultivation should cease in order to allow the young wood to ripen up thoroughly before winter sets in.

Plenty of moisture and a cool soil are especially important in gooseberry culture so that its cultivation should, if anything, be more thorough than that of the currant. Both moisture and a cool soil are important factors in controlling gooseberry mildew.

Fertilizers.

Currants and gooseberries are gross feeders and must have their food readily available and close at hand, as the roots do not spread far or deeply. Thorough cultivation should therefore be supplemented with liberal applications of fertilizers. Barnyard manure is best with perhaps potash and phosphoric acid applied extra in some form. Manuring need not be heavy, of course, until the plantation has come well into bearing, when annual applications should be made. There is little danger of over-fertilizing the currant or gooseberry plantation; in fact, as usually grown the fertilizer end of the industry is one of the most neglected. Cultivation and manuring must be thorough if good results are to be obtained from these fruits. They will thrive fairly well under neglect, but there are no fruits that will respond more quickly or fully to proper treatment.

Apply well-rotted barnyard manure in the fall and supplement this with a dressing of potash and superphosphate early in spring, especially if the supply of manure has been deficient. Card states in his book of bush fruits that currants contain about 0.11 per cent. of phosphoric acid and 0.27 per cent. of potash, while stable manure contains only about one-third more potash than phosphoric acid, hence the need of additional potash. The Massachusetts State Experiment Station found that applications of potash fertilizers increased in every case quality and productiveness of currants.

Pruning.

Currants.—Proper pruning of currants is essential to the production of good crops of high quality fruit. The fruiting habit of red currants and black currants differs somewhat, so that the pruning of one is slightly different from the other. Red currants bear their fruit on spurs from wood two or more years of age, while the black currant bears the most and best of its fruit on wood of the previous season's growth. Hence in pruning black currants we must look to the production of a plentiful supply of young wood, and in red and white currants, two and three year wood. Older wood produces inferior fruit.

The old plan of training the plants to a tree form is now seldom used. The plants are less productive, and if attacked by the currant borer, the whole plant is destroyed instead of one or two shoots. The bush form plan is the generally used one.

In pruning red currants the object in view should be to practice a system of renewal, having vigorous young growth always coming on to take the place of the older branches as they become unproductive. Branches four and five years of age are less productive and should be removed. Two and three-year wood is the most productive and therefore most desirable.

Some pruning may be necessary at the end of the first year after planting to get the bush into shape and regulate the number of main stems to be left. From four to eight main stems properly distributed will bear a good crop of fruit and future pruning should have in view the maintenance of this number of branches two and three years of age and a few others coming on to take their places. It is safe to plan to keep all wood over three years old cut out. Some growers, according to Card, in "Bush Fruits," recommend that no wood over two years old should be left. Broken branches and unnecessary young growth should also be cut out, or shortened back so as to form fruiting spurs.

The young vigorous shoots that are to take the place of the older canes should be shortened in to prevent the bush from becoming straggly, and to force the development of fruit spurs evenly along its whole growth instead of mostly at the ends of the branches. Thus the load of fruit will be more evenly distributed, and the bush will be able to support a large crop of fruit without breaking down.

Pruning may safely be done any time when the wood is dormant though, perhaps, it is as well to delay pruning until shortly before growth begins in the spring. This avoids any chance of the wood drying back and, if there has been any winter killing of unripened wood, it can then be observed and cut out. Also buds are easily injured in late spring pruning. Pinching back the young growth is followed in some countries, the object being to develop fruit spurs. In this climate it might have the tendency to force buds into growth that would not become well ripened before winter set in.

The pruning of black currants varies from that of red currants only in so far as the main object is the production of plenty of one year wood. Pruning is therefore usually more severe than for the red currant as practically a complete renewal of wood has to be obtained each year. Old growth must be kept well cut out.

Gooseberries.—Mr. W. T. Macoun, Dominion Horticulturist, in his bulletin on Bush Fruits, discusses pruning the gooseberry as follows:—

"As the gooseberry makes much more wood than it is desirable to leave, severe pruning is necessary. English varieties are usually trained to a single stem, but this is not necessary, although the freer circulation of air when trained in this way may help to prevent the spread of mildew. The usual custom in America is to grow the gooseberry in bush form. The bush should at first be brought into a good shape by leaving a few of the strongest shoots regularly distributed to make an open head. Five or six of these shoots are quite sufficient to leave at first. As the bush gets older, new shoots are allowed to grow to take the place of the older ones, as the pruning should be done with a view to having only vigorous bearing wood. Fruit is borne on year-old wood and from spurs on older wood. It usually is not desirable to have any wood more than three years old. The best time to prune is in the autumn or winter. The weakest young shoots should be cut off at the ground, also all the stronger shoots not required for fruiting or to take the place of the older branches to be cut away. The side shoots from the older branches should be headed back or cut out altogether so as to maintain a fairly open head, making it as easy as possible to pick the fruit and yet leave sufficient wood to produce a good crop and to shade the fruit from the sun, as in a hot, dry time gooseberries are liable to be injured by scalding. When branches are more than three years of age they should be removed to make way for younger wood. It is advisable to cut out all branches which touch the ground as there will then be a better circulation of air, and the fruit will be kept off the ground. Gooseberries will often begin to bear the second year after planting, but there will not be a full crop until the fourth season. If the soil is kept in good condition by an annual application of well-rotten barnyard manure in the autumn, harrowed in the following spring, and if the bushes are kept sprayed and well pruned, the plantation will not need to be renewed for many years."

The important point to remember is that the finest fruit is borne on the young wood. After two or three years of bearing the wood begins to fail and produces inferior fruit in smaller quantities. There should always be strong, vigorous growth coming on to take the place of the older wood as it is cut out. Also excessive sunlight induces mildew, as well as scalding. and in pruning this point should be carefully borne in mind. The bush must be kept fairly open to facilitate picking, etc., but at the same time the fruit thrives better where it is shaded from the direct rays of the sun.

Renewal of Plantation.

In commercial planting it is unusually recommended to renew the plantation of both fruits after eight to ten years. The bushes will live and bear much longer than this, but they will not be as vigorous and bear as much or as fine fruit as younger bushes. However, with good care, liberal fertilizing, and proper pruning, bushes may be kept in a profitable condition for many years.

It is a safe rule to replant as soon as the first trace of waning vigor is detected. The advantage of young and vigorous plants will more than repay the cost of replanting. Bushes in the home garden may be renewed and reinvigorated by cutting back to the ground and manuring heavily.

Picking.

In picking red currants care must be taken to see that the pickers do not strip the fruit off the stem, leaving the stem attached to the bush. When the fruit is stripped off in this manner, the skin is often broken and the fruit quickly spoils. Pickers should be instructed to take the whole bunch off intact. Varieties of currants which have a long clear space of stem at the base of the clusters, as for example, Fay, have quite an advantage, as they can be easily picked without crushing any of the fruit. Black currants are picked by stripping the fruit, leaving the cluster stem on the bush.

The thorny nature of the gooseberry bush complicates the picking of the fruit to some extent, and apart from making the picking a more or less disagreeable task, it increases the cost of the operation. When picked green, the fruit may be stripped off, the picker wearing gloves to protect the hands. After stripping, the fruit is run through a fanning mill to clean out the leaves. Ripe fruit is too easily crushed to be gathered and cleaned in this manner. The berries must be picked singly. For jam-making gooseberries are picked as soon as they reach full size, but before they begin to soften—"hard ripe."

Currants and gooseberries should never be picked when they are wet, as if packed up and shipped in that condition they will soon spoil. For near markets currants should not be picked until almost fully ripe, while for a distant market, the fruit should be picked while still firm, though colored.

Pickers are usually paid about fifteen cents per eleven quart baskets for red currants and gooseberries, and, as they will pick from ten to twelve baskets in a day under average conditions, they make fairly good money at it. Thirty-five cents per basket is paid for black currants, four to five baskets a day being the average pick.

YIELDS.

Bailey, in his Farm and Garden Rule Book, gives the average yield to be expected from currants and gooseberries at 100 bushels per acre. For gooseberries this seems very low.

In his book on bush fruits, Card estimates that under proper management the currant ought to yield from 100 to 150 bushels per acre, while he records a yield of 320 bushels per acre. Such a yield is, however, out of the ordinary, and should not be taken as a basis for estimates.

Mr. W. T. Macoun, of the Central Experimental Farm, Ottawa, states that the Rankin's red currant, the largest yielder with them, averaged for four years at the rate of 8,107 lbs. or over 202 bushels per acre. The Red Dutch averaged over

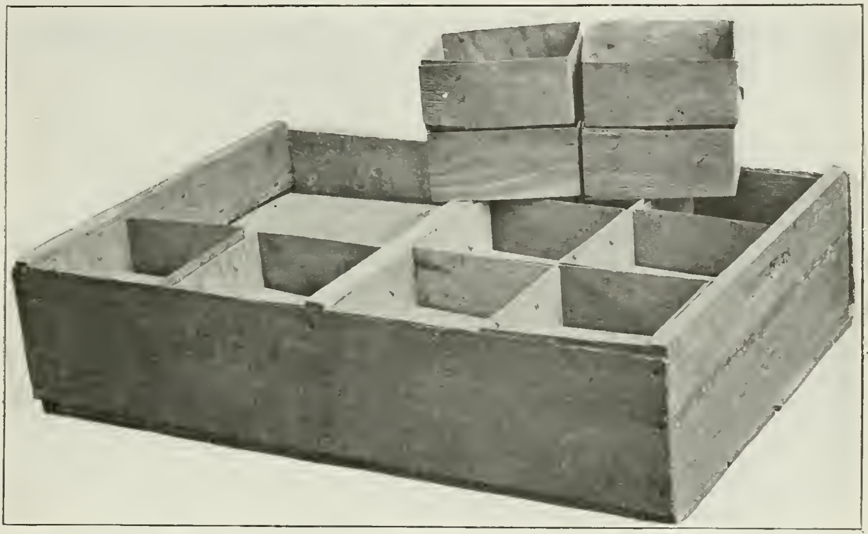

FIG. 6.—Crate commonly used in British Columbia for shipping currants. The dimensions of the crate are 23 in. long, 16½ in. wide and 5⅞ in. deep, and it holds twenty-four 4-5 quart baskets 5¼ in. by 5¼ in. by 2 in.

183 bushels to the acre, the Saunders black currant 163 bushels, and the Kerry 159 bushels per acre.

With gooseberries, Card estimates that full grown vigorous plants ought to yield from five to eight quarts per plant, or roughly speaking, from 300 to 500 bushels per acre, with plants four by six feet apart. At the Central Experimental Farm, six bushels of Pearl Gooseberry have averaged over a period of five years at the rate of 310 bushels per acre, while the highest individual yield was estimated at a rate of over 680 bushels to the acre. These bushes were planted six feet by four.

Mr. L. B. Henry, of Winona, states that their Whitesmith patch of 600 bushes planted in the peach orchard averaged six quarts each, or 112 bushels for the whole patch. Estimating this per acre, plants five feet by seven, the yield would be about 230 bushels. These figures are not as high as those given by Card, but are mostly actual figures, and therefore entirely reliable, and indicate what yields may be expected under intelligent and proper management.

Markets and Prices.

Prices for currants and gooseberries are uniformly higher now than they were several years ago, and there is every indication that prices for good fruit will remain good. Twelve or fourteen years ago currants could hardly be disposed of at any price, while during the last two years, prices on the Toronto markets have ranged from sixty-five cents to $1 and over per eleven-quart basket for red currants. In 1900, the growers received sixty-five cents per twenty lb. basket for black currants, while the ruling price during 1913 was $1.50 to $1.75 per eleven-quart basket, much of the fruit selling at $2. White currants find practically no sale whatever.

Mr. L. B. Henry, Winona, was kind enough to supply the writer with the following prices taken from their shipping books:—

Black currants, 1901, 80 to 90 cents; 1912-13, $1.75-$1.95.
Red currants, 1901, 50 to 60 cents; 1912-13, 60-75c.
Gooseberries (English), 1912-13, 90 cents to $1.
Gooseberries (American), 55 to 60 cents.
(All prices net to grower per eleven-quart baskets, f.o.b. shipping point.)

Prices in detail on the Toronto market during the season of 1913 were as follows:—

Toronto Market, 1913.

Date.	Red Currants.	Black Currants.	Gooseberries.
July 4	....	....	$0 65 to $1 35
10	$0 65 to $0 85	....	60 to 1 25
15	75 to 85	....	75 to 85
22	85 to 1 00	$1 50 to $1 75	85 to 1 00
29	85 to 1 00	1 75 to 2 00	75 to 1 00
Aug. 13	75 to 85	1 00 to 1 50	....

All prices given for 11-quart basket.

Jas. E. Parnall, Western Market Commissioner for Ontario, reported from Winnipeg on August 8th, 1912, as follows:—

"A few crates of red currants coming forward from Ontario, arriving in good condition. Demand good, selling from $3.20 to $3.40 per crate of 24 boxes. Market wants more. Some Washington currants in, costing, laid down here, $2.75 per crate of 16 quarts. Size and quality of fruit not equal to Ontario fruit, but appearance and size of package about equalizes the appearance and quality of fruit. Had our fruit been in same class of packages better prices would have been realized, for in some cases the bottom boxes were damaged."

The McNaughton Fruit Exchange, Winnipeg, out of mixed cars of fruit sold as follows:—

Aug. 3.—Red currants, $1.90, 6 qt. basket.
Aug. 13.—Red currants, $3.05, per 24 box crate; fruit a little over-ripe.
Aug. 15.—Black currants, $1.60 per 6 qt. basket.
Aug. 16.—Red currants, $2.10 per 24 box crate; fruit in bad shape.

The prices given are wholesale for 1912. 1913 figures are not available, as Ontario had no markets commissioner in the West that year. However, prices during 1913 ranged uniformly higher than for 1912.

Currants and gooseberries, if picked at the right time, and properly handled will stand long distance shipment such as to the Western market with very little, if any, deterioration. When they arrive in bad condition, the fault can usually be traced to over-ripe fruit, picking when wet, or careless handling and improper loading of the car. Of course part of the trouble, too, can often be traced to poor transportation facilities cars being from one to several days too long on the journey out.

Apart from the markets briefly touched on in the foregoing remarks, the jam factories are taking increasingly large quantities of currants and gooseberries each year, at fairly remunerative prices. The English gooseberries are favored by the factories on account of their larger size.

Packages.

Currants and gooseberries are usually sold in the eleven quart basket, and for local markets such a package will suit. For long distance shipment, however, currants should be put in packages where there will not be such a great bulk of

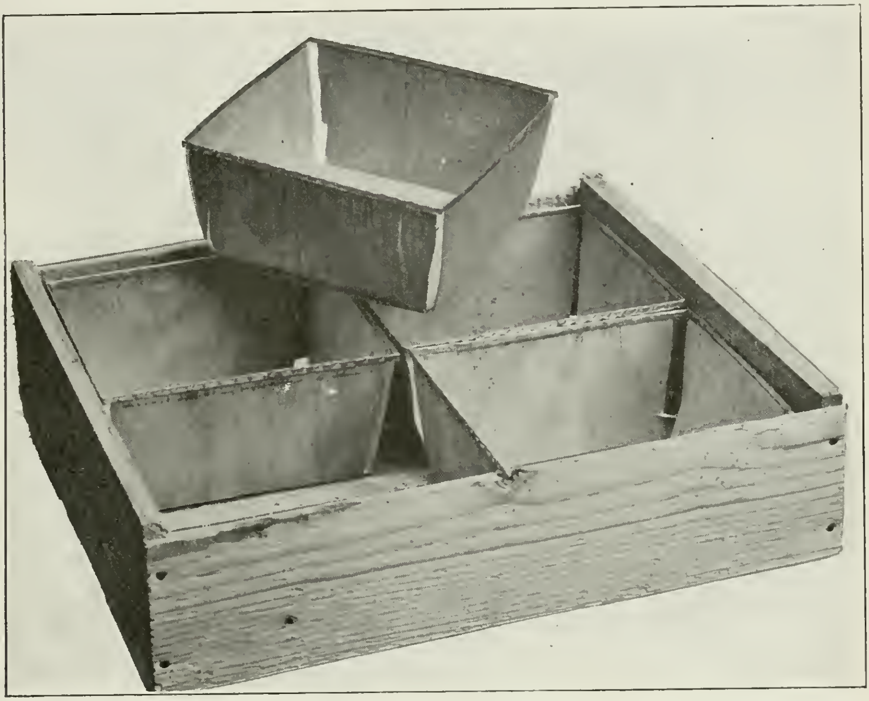

Fig. 7.—Crate commonly used in British Columbia for shipping plums and prunes. Used also for shipping currants and gooseberries. Dimensions 15¾ x 15¾ x 4¼, to hold four Veneer Tin Top baskets as shown.

fruit together as in the eleven quart basket. If packed in the twenty-four box crate, they will carry much better and arrive in a much more satisfactory condition. Gooseberries may be shipped to the west satisfactorily in the eleven-quart basket. Two types of fruit packages commonly used in British Columbia for shipping currants and gooseberries are shown in the accompanying illustrations.

In this regard it might be well to note what Jas. E. Parnall has to say in reference to packages in the paragraph quoted above. He states that Ontario fruit was better quality than the American fruit, but this was equalized by the inferior appearance of the Ontario packages. It would appear from this that Ontario growers are actually losing money through shipping their currants and gooseberries in the present packages. Appearance of package counts for a great

FIG. 8.—Fay.

deal with the ultimate consumer and it is the tastes of the ultimate consumer which, in the final analysis, have to be catered to.

Costs and Returns.

Following are the figures of two leading fruit growers, and although any such figures can be merely approximate and not actual results, yet they are valuable as showing reasonably accurately the cost of the various cultural operations, and the probable returns under proper management.

Mr. Robt. Thompson, St. Catharines, was kind enough to furnish the writer with the following estimates:—

	One acre Red Currants	One acre Gooseberries
Rent of land per year (one acre)	$10 00	$10 00
Taxes	2 50	2 50
Preparation of land	4 00	5 00
Cultivating during season	3 40	3 40
Spraying materials	14 00	14 00
Pruning	4 00	8 00
Fertilizers	18 00	18 00
Picking and packing	70 00	60 00
Crates and marketing	50 00	25 00
Cost of management	15 00	15 00
Depreciation and annual share of cost of plants and planting	22 00	30 00
	$212 90	$190 90
Selling 200 24-box crates red currants at $1.60	320 00	
Selling 300 11-qt. baskets gooseberries at $1.00		300 00
Net profit	$107 10	$109 10

Mr. Thompson further estimates that the cost of plants and planting for one acre of currants (1,400 plants to the acre) is $76, and gooseberries (1,320 plants to the acre) $208. The last items of expenditure given, $22 and $30, in the tabulated estimates are reckoned as a fair proportion for each year to bear of depreciation and the initial cost of plants and planting as noted above. The yields given are those to be expected from patches four to eight years planted in the case of currants and five to ten years with gooseberries.

The figures given below were supplied through the courtesy of Mr. L. B. Henry, Winona:

	One acre Black Currants	One acre Gooseberries
Rent of land per year (one acre)	$15 00	$15 00
Taxes	2 00	2 00
Preparation of land	5 00	5 00
Cultivating during season	5 00	5 00
Spraying and materials	5 00	10 00
Pruning	10 00	10 00
Fertilizers	15 00	15 00
Picking and packing	70 00	60 00
Baskets and marketing	19 00	28 00
Cost of management	25 00	25 00
Depreciation and annual share of cost of plants and planting	20 00	30 00
	$191 00	$205 00
Selling 200 baskets black currants at $1.75	350 00	
Selling 350 baskets of gooseberries at 90c.		315 00
Net profit	$159 00	$110 00

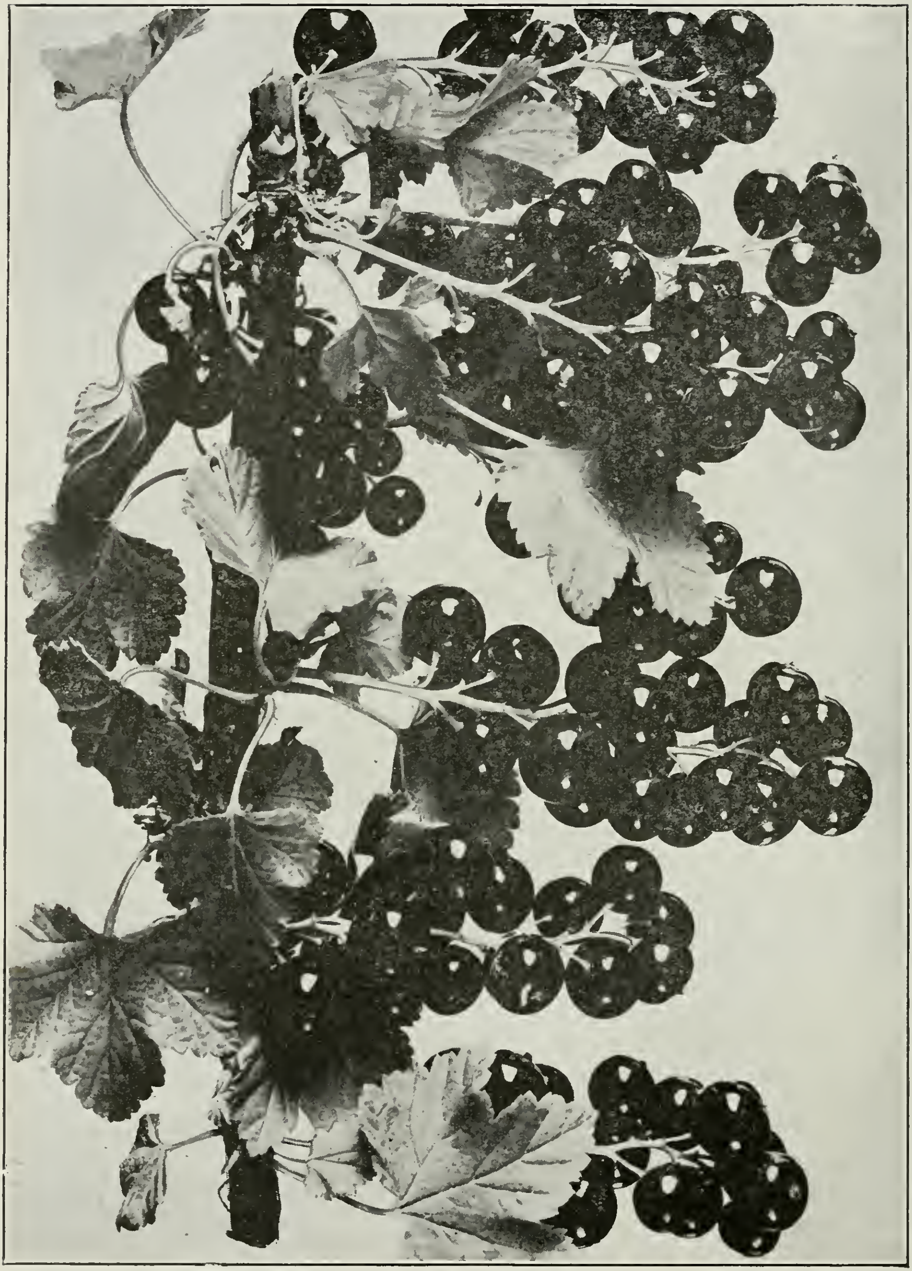

Fig. 9.—Wilder.

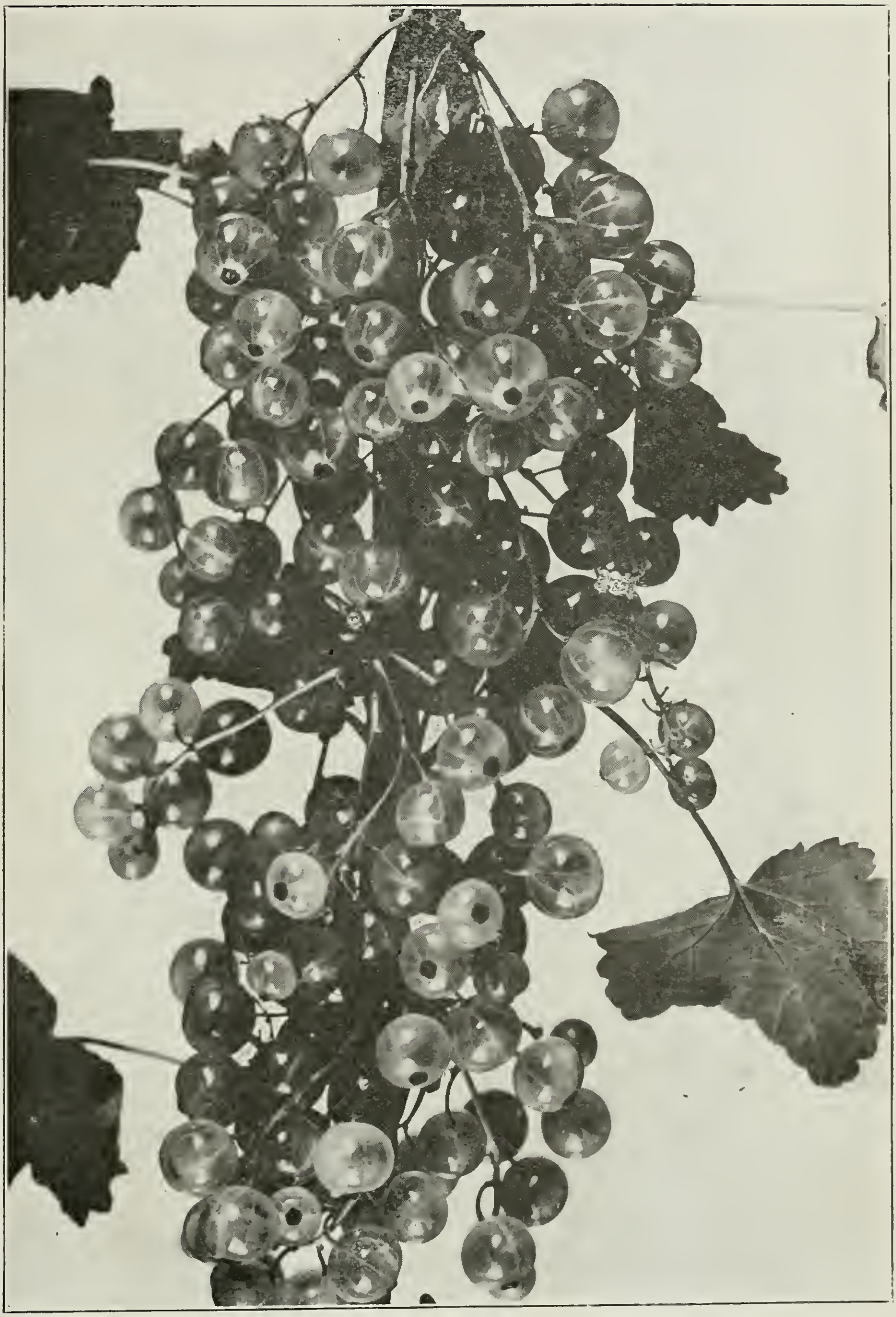

Fig. 10.—White Grape.

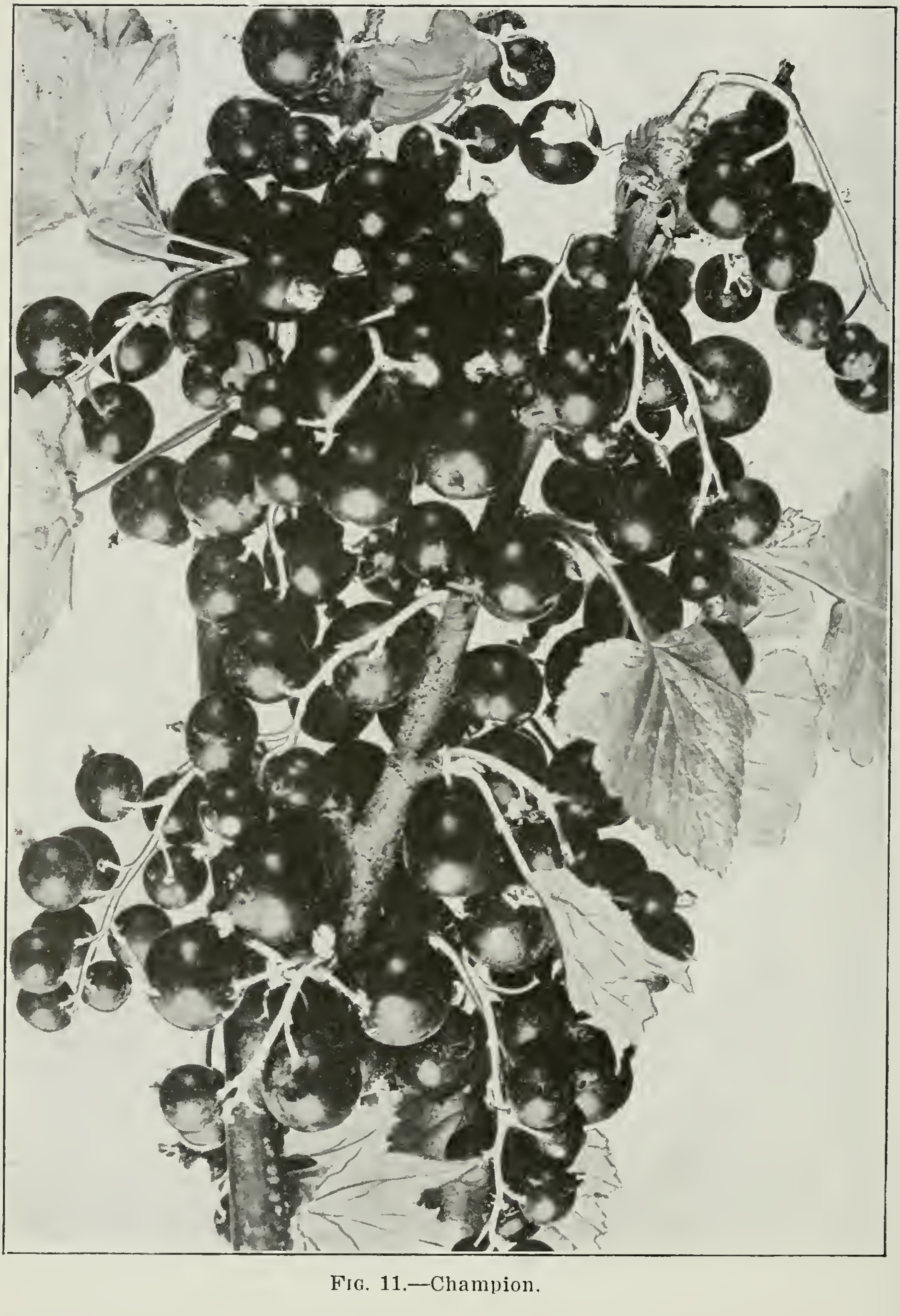

Fig. 11.—Champion.

Mr. Henry states that the initial cost of plants and planting would be $72.50 for black currants (1245 plants to the acre) and $190.25 for gooseberries (1,200 plants to the acre). As in Mr. Thompson's estimate, the last item of expenditure is intended for depreciation and a fair annual share of the above initial expenditure.

Mr. Henry's currant figures are for the black, and Mr. Thompson's for the red varieties, hence the difference in yields and returns.

Uses of Currants and Gooseberries.

The currant is unequalled for jelly-making, and for this purpose the red varieties are preferred on account of their higher color. The currant, also, owing to its acidity is valuable for addition when cooking, preserving, or making jelly from other fruits lacking acidity or sprightliness. Black currants are especially adapted to the making of jam and pies. They are also considered to be of medicinal value in cases of inflammation or soreness of the throat, and moreover, the beverage said to allay this inflammation is an exceedingly pleasant one to drink under any circumstances. Black currant jam and red currant jelly would be welcome additions to any home.

The gooseberry is pre-eminent as a stewed fruit and for pie-making, either from fresh or canned stock. They make excellent jelly also. In the fresh and fully ripe state they are a most desirable fruit for eating out of hand, especially the English varieties, and there is no doubt that in time this quality of the gooseberry will be more generally appreciated. It is a great pity at the present time that more of this fruit is not consumed in this way. Those who know rank the gooseberry as one of the finest dessert fruits if allowed to ripen on the plant, and as there are none of the ill-effects usually attendant on the eating of the green fruit one need have no fear on that score.

Varieties.

The selection of varieties is an important point and should be given careful consideration. Some varieties succeed well in some localities and are highly recommended by the growers of that district, while they are looked upon as a more or less failure in other localities. It is well, therefore, when deciding upon what varieties to plant to make careful enquiry as to what varieties are succeeding best for that district. For example: Mr. Macoun has found that the red currants of the Fay type are too tender for the Ottawa district. The Versaillesse, Fertile d'Angers, Fay, Cherry, and Wilder amongst others have all been found to suffer from injury to the buds during winter.

No technical descriptions of varieties will be attempted in this bulletin, the commercial value only of the different varieties being considered. For technical descriptions the reader is referred to "Fruits of Ontario," published by the Department of Agriculture.

Red Currants.—The usually recommended varieties of red currants for Ontario are: Cherry, Fay, Red Cross, Victoria and Wilder, and to this list I would add Greenfield (recommended by Mr. W. T. Macoun) and Perfection.

Of the above varieties the *Cherry* and *Fay* are probably the most extensively grown in Ontario. They are very similar in appearance except that the bunch of the Cherry is more compact. The stem of the Fay is longer than that of the Cherry, thus facilitating picking. Both are heavy croppers and very desirable varieties.

The *Wilder* is largely planted in the States, and is highly thought of there, but is comparatively little planted in Ontario as yet. It is certainly worthy of

Fig. 12.—Black Victoria.

Fig. 13.—Eclipse.

Fig. 14.—Downing.

more general planting in this country for the milder districts as it has been found tender in fruit bud at Ottawa. Its mild flavor and good quality make it an excellent sort where a table fruit is desirable.

The *Red Victoria* is one of our best currants for all round purposes. It combines long, well-filled bunches of good-sized fruit of medium quality with hardiness and productiveness. It will succeed well where Cherry, Fay and Wilder would be tender.

The *Red Cross* is one of our newer varieties. It is becoming popular for market and home use on account of the large size of the fruit and its productive habits. An objection to it is that the bunches are of only small to medium size.

Perfection and *Greenfield* are comparatively little known, though they are two very promising varieties. The Perfection is a strong grower, though reported to be rather slowgrowing when young. It is a very productive variety bearing exceedingly bright, attractive-looking fruit of very large size in well-filled clusters. It should prove a very desirable and profitable variety for home and market purposes. The Greenfield, originated by S. Greenfield, Ottawa East, Ont., is described by Mr. Macoun as being a productive variety of very large fruit, well-filled bunches, quality above medium. Mr. Macoun, in recommending it, says: "I do not know whether it could be obtained in the trade, but we could supply cuttings to anyone who might write for them."

The *Prince Albert,* a late variety, bearing fruit of medium size in long, well-filled bunches, should perhaps be included in the above recommended list. It is a good late variety and would be found useful in lengthening out the season.

White Currants.—Except for home use, the planting of white currants is not to be recommended, as there is practically no demand for them on the market at the present time. The *White Grape* variety will be found excellent for home use, being mild and of very good quality. For eating out of hand it is one of the most desirable varieties, whether red or white.

Black Currants.—Black Victoria, Champion, Lee, Boskoop Giant, Saunders and Naples are the usually recommended varieties. Mr. W. T. Macoun considers that five varieties, Kerry, Clipper, Eclipse, Climax and Collin's Prolific which have been under observation at the Central Experimental Farm are equal to or better than the varieties generally planted throughout the Province. The first four of these were originated by Dr. William Saunders from seedlings which he took from London, Ont., to the Central Experimental Farm at Ottawa in 1887.

Mr. L. B. Henry, in discussing the varieties of black currants before the 1913 Fruit Growers' Association Convention spoke as follows: "As regards black currants, I only grow one variety, having found it to be the best with us, that is the *Black Naples*. It is a strong and vigorous grower and is very prolific. The buds are borne on short clusters and very well distributed over the bush.

"The *Champion* is not so vigorous. It comes in about five days to a week later than Naples and this may be a point in its favor, as it can be planted along with the Naples and will make a yield that will surprise you. But we have found one fault with it—the fruit does not ripen evenly; that is to say, the fruit may be ripe on some parts of the bush and partly green on the other sections and for that reason it requires more time to pick the fruit properly.

"The *Victoria* is another black currant which is very well known. It is very vigorous, perhaps more so than any other variety I have mentioned, but in our district it is not as heavy a cropper as Naples or Champion. I have no doubt some of you will think that is wrong, because I have heard that Victoria in some districts is one of the best currants there."

Fig. 15.—Houghton.

The Victoria ripens unevenly like the Champion and is also of late season, though not quite as late as Champion. The fruit is large, but in medium-sized clusters only.

The *Boskoop Giant* black currant has been attracting considerable attention of late, and if it lives up under general culture to advance promises, it should prove one of our most valuable commercial varieties combining, as it does, size and quality of fruit, size of bunch and productiveness. It is most highly commended by growers who have given it a good test.

The *Saunders,* another of Dr. Saunders' seedlings, is a most promising commercial variety, and has been under general culture for some years now. It is a very productive variety and a strong grower.

Kerry is considered by Mr. Macoun to be one of the most promising for commercial purposes on account of its great productiveness and quality of fruit. *Clipper* and *Climax* are also strong growing productive new varieties of medium to late season, and with *Eclipse,* an early season currant, are very highly thought of at the Central Experimental Farm, Ottawa. In a table Mr. Macoun has worked out, based on the productiveness of the different varieties of black currants, Saunders comes second, Kerry third, Clipper sixth, Eclipse seventh, Collins' Prolific eighth and Climax ninth. Three other varieties, Ogden, Ontario and Eagle, occupying first, fourth and fifth places respectively, are not considered as good as the former varieties for various reasons, such as quality, evenness of ripening, etc. It is worthy of more than passing notice that the usually recommended varieties occupy the last half of the table mentioned, which included thirty-three varieties. Lee is twenty-second, Champion thirtieth, Victoria thirty-first and Naples thirty-third. Locality, of course, might have something to do with this low showing of these varieties, though Mr. Macoun thinks not, but thinks the newer varieties, Kerry, etc., are simply better.

If Kerry, Clipper, Eclipse and Climax cannot be obtained from any of the nurseries, cuttings can be secured from the Central Experimental Farm, Ottawa. Collins' Prolific has been on the market for some time, and is considered one of the best commercial late varieties, though, quality and productiveness combined, it is not equal to the former varieties.

GOOSEBERRIES.—Pearl, Downing, Red Jacket, Smith's Improved, of the American varieties, and Whitesmith, Industry and Keepsake, of the English varieties, are generally considered to be the best.

The *Pearl* and *Downing* gooseberries are very similar in size and appearance, the Pearl averaging perhaps a little larger. These two and the *Red Jacket* or *Josselyn* are the three most popular gooseberries of American origin. They are all free from mildew, vigorous and very productive. The Downing is probably the most widely planted in Canada. The *Smith's Improved,* a seedling of Houghton, originated on the American side and is well recommended by American growers. It is not as well known in Ontario as the Pearl and Downing, but is highly spoken of by several Canadian growers. L. B. Henry highly recommends it, placing it before Red Jacket.

Houghton, an American variety not included in those recommended, is a very productive variety of good quality, sweet-flavored fruit, and until the advent of the Downing, it was the most popular gooseberry. The fruit, however, is small, though it is a very hardy variety and perhaps should therefore be included in the recommended list. It will thrive where many of our otherwise better varieties will suffer from the severe winters, probably being the only variety of merit that will thrive in the Prairie Provinces.

Fig. 16.—Whitesmith.

The *Whitesmith* is probably the best of the English varieties grown to any extent in Ontario. It, and *Industry,* are commonly supposed to be freer from mildew than other English varieties. The experience of Mr. Macoun was that they both mildewed rather badly at Ottawa. Thorough spraying, however, will control the mildew.

Mr. R. B. Whyte, of Ottawa, has several very promising varieties of English gooseberries and seedlings of the same in his garden. The value of those that succeed with him for other parts of the Province is, however, hard to estimate, as the conditions under which his gooseberries grow would be impracticable for commercial culture. His best varieties and seedlings are, however, certainly worthy of trial.

THE MOST IMPORTANT DISEASES OF CURRANTS AND GOOSEBERRIES.

L. CAESAR, PROVINCIAL ENTOMOLOGIST.

Powdery Mildew of the Gooseberry (*Sphaerotheca mors-uvae*).—This disease is the greatest obstacle to the successful growing of European varieties of gooseberries in Ontario. It attacks the American varieties also, but only to a very small extent, and is sometimes found on currants, rarely doing much damage to them. Affected gooseberry plants show the disease first on the young leaves and tender tips of the new growth. It then spreads to the young fruits soon after these are formed. All the diseased parts are soon covered over with a white powdery substance from which numerous summer spores are carried by the wind from place to place. Later in the season this whitish covering begins to brown and thicken, forming a dense felty coat over the affected parts including the fruit. In this brown substance the winter spore cases are formed and from these in spring the disease is spread. As a result of the fungus the growth of the twigs is stunted and the affected fruits drawfed and rendered useless. Frequently nearly the whole crop is ruined.

It is usually believed that warm climates and lack of air circulation favor the disease.

Means of Control.—Bordeaux mixture has given poor results. Potassium sulphide, 1 ounce to 2 gallons, has given fair satisfaction, but the best results have been obtained from lime-sulphur. At least three applications should be given. The first should be shortly before the buds begin to burst, using the same strength as for the dormant spray on apples, namely commercial lime-sulphur diluted about 1 gallon to 9 or 10 gallons with water, or a specific gravity strength of about 1.030. The second application should be soon after the leaves appear, but before the blossoms open. Use lime-sulphur specific gravity 1.015 (commercial diluted 1 gallon to 20). The third shortly after the fruit has set. Use lime-sulphur specific gravity 1.010 (commercial 1 gallon diluted to 30). The fourth application may be made in about 10 days after the third and may be a little weaker. Care should of course be taken to see that every particle of the plants is covered each time. It will also help to prune the plants or support them so that no branches will rest on the ground.

Currant Anthracnose (*Pseudopeziza ribis*).—This disease attacks the various kinds of currants, being most destructive on the white and red, and usually doing much less damage to the black. It seems to be only rarely found on the gooseberry. The leaves alone are attacked. On them the disease causes small brown areas, chiefly on the upper surface. When these spots are very abundant the leaves become a sickly yellow color and drop off, thus interfering with the plant's power to store up food for the coming season.

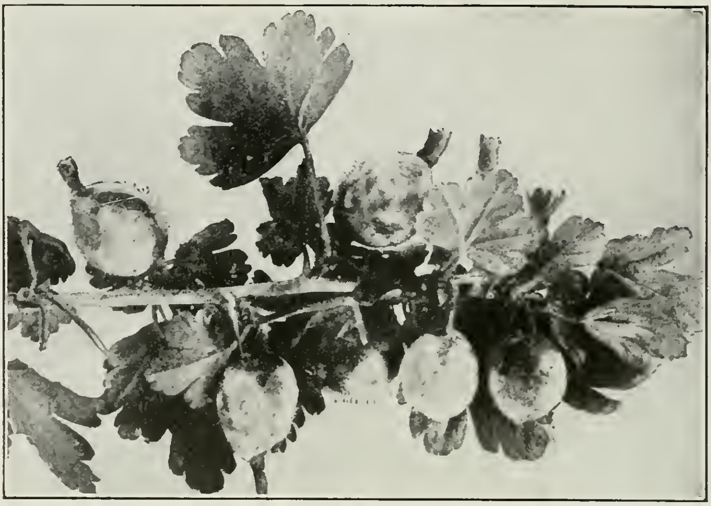

FIG. 17.—Powdery Mildew of Gooseberry. (After Close.)

Means of Control.—Very few careful tests of control measures have been made, but there is little doubt that the first three applications mentioned above for the control of gooseberry mildew, followed by a fourth application as soon as possible after the crop has been harvested would control the disease. Bordeaux mixture

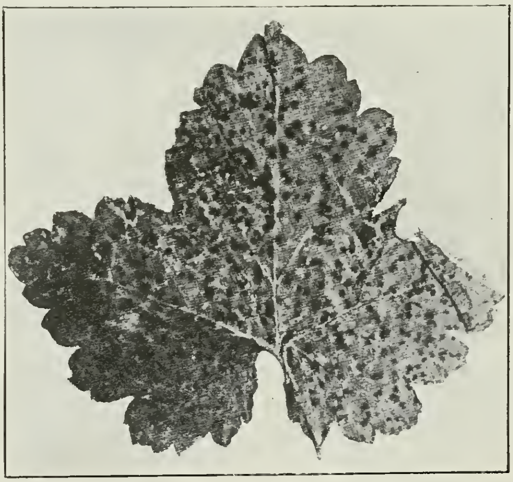

FIG. 18.—Currant Anthracnose on Leaf.
(After Duggar.)

4-4-40 or lime sulphur may be used. If the latter is chosen the first application may be at the strength mentioned above for mildew, but the second application need not be stronger than specific gravity 1.010 (commercial 1 gallon diluted to 30), nor the third than about 1.009 (commercial 1 gallon diluted to 33 to 35) nor the fourth than about 1.008 (commercial 1 gallon diluted to 35 to 40).

Currant Leaf-Spot (*Septoria ribis*).—This disease attacks the various kinds of currants and gooseberries, and seems to be quite common throughout the Province. As it, like the one mentioned above, causes spots on the leaves and when very severe in its attack causes them to turn a sickly yellow color and drop, much after the manner of the Anthracnose, it is very easy to confuse the two diseases. A microscopic examination, however, shows that the spores are very different in appearance. Moreover the spots caused by Anthracnose are, as a rule, brown throughout, while those caused by the Leaf-spot have usually white or grayish-white centres and brown borders.

Means of Control.—Some tests with lime-sulphur made by the writer show that the disease can be prevented by spraying. For best results at least four applications should be given. The first before the buds burst, using lime-sulphur specific gravity strength 1.030 (commercial 1 gallon diluted to 9 or 10); the second just before

Fig. 19.—Currant Leaf-spot. (Original.)

the blossoms appear, specific gravity 1.010 (commercial diluted 1 gallon to 30); the third soon after the fruit is set, specific gravity 1.009 (commercial 1 gallon to 33 to 35); and the fourth as soon as possible after the fruit is picked, using a slightly more diluted strength. Bordeaux mixture instead of lime-sulphur has also been used satisfactorily to control the disease.

THE CHIEF INSECT PESTS OF CURRANTS AND GOOSEBERRIES.

L. Caesar, Provincial Entomologist.

The Imported Currant Worm or Currant Sawfly (*Pteronus ribesii*).—The most common and destructive insect attacking both currants and gooseberries in Ontario is the Imported Currant Worm or, as it is commonly called, the Currant Sawfly. The larvæ are greenish caterpillars almost three-quarters of an inch long when full grown and with black heads and many black spots over the body. The adults are four-winged insects known as Sawflies. The female is about the size of a house fly and has a black head and conspicuous honey-colored body; the male is smaller and blackish. Adults appear soon after the leaves come out and lay eggs in chains along the veins of the underside of the leaves. These soon hatch and the young larvae feed on the foliage, often being most numerous in the central parts of the plants, and doing much damage there before attacking the outer leaves. The foliage in many a plantation is almost entirely destroyed, only the main veins and the fruits being left. There are two broods in a year, the larvae of the second appearing about the time the currants are ripening. When the larvae are full grown they enter the ground and make earthen cocoons. The winter is spent in there.

Means of Control.—Fortunately this pest is easily controlled by spraying with arsenicals. The first application should be with 2 pounds of Arsenate of lead to 40 gallons of diluted lime-sulphur. or of Bordeaux mixture applied just before the

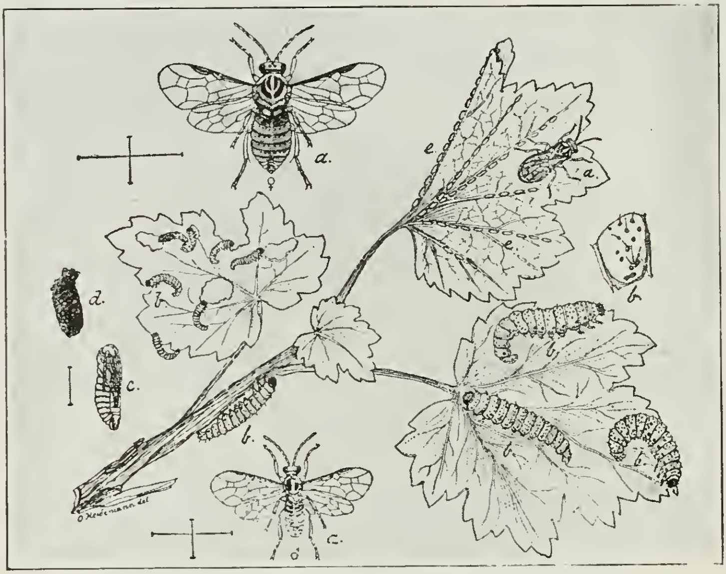

Fig 20.—Imported Currant Worm: (*a*) Female and male adults enlarged (the lines to the left show the natural size); (*b*) larvae, those to the left immature, the others about mature; (*c*) pupa enlarged; (*d*) cocoon formed in the soil; (*e*) eggs laid on under surface of leaf. (After Lugger.)

blossoms appear and repeated soon after the fruit is set. See to it that all the inner and lower leaves are covered. The lime-sulphur or Bordeaux is added to control diseases. If the second brood is seen to be present, hellebore, 1 ounce to 1 gallon of water, should at once be used. The hellebore should be fresh, as it loses strength if exposed to the air. It is unsafe to use arsenicals on the fruit at this stage.

The Imported Currant Borer (*Aegeria tipuliformis*).—Most currant and, to a lesser extent, gooseberry plantations are attacked by a borer which works in the canes, especially in the larger ones. Affected canes not infrequently become sickly and in the following season die. The borer is the white larva of a clear-winged moth about half an inch in length, blackish in color with several narrow yellow bands around the body. It looks somewhat like a wasp. In Ontario the moths appear in June and may often be seen in considerable numbers on the leaves. They lay eggs in the axils of the leaves or on any little opening on the canes and the young larvae on hatching bore into the pith where they feed till full grown.

They winter here. If an infested cane is cut through the darkened pith shows clearly the work of the borers. There is only one brood each year.

Means of Control.—It is impossible to do anything against this pest by spraying, and the only practicable means of control seems to be not to grow currants in tree, but in bush form, and to practise a system of pruning by which the wood is not allowed to become old, but is removed after bearing one or at the most two crops, and new shoots allowed to grow up to take their place. All prunings must be burned before the end of May, or the moths will emerge from them. Any dying or sickly canes should also be promptly removed throughout the season and either burned or the borers inside them killed.

The Currant Aphis (*Myzus ribis*).—The leaves of currants and, to a lesser extent, of gooseberries are often severely attacked by green plant lice, aphids, which feed upon the under surface and cause the leaves to curl downwards. The parts

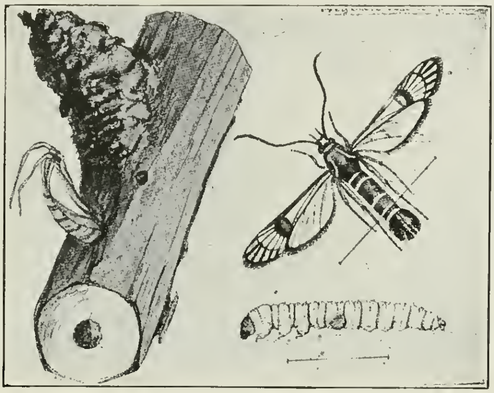

Fig. 21.—Imported Currant Borer; moth, larva and empty pupae case still attached to exit hole. The dark hole in the end of the cane shows where the larva has tunnelled in the pith. (After Lugger.)

of the upper surface between the veins are usually elevated in large irregular blisters that are often reddish in color. Affected leaves in many cases are so much weakened that they die. The aphids pass the winter in the egg stage. Eggs are very small, black and glossy and are placed in the axils of the buds and the wood. They hatch a few days before the buds burst and the young aphids at once proceed to feed upon the developing buds and leaves. Reproduction in early summer is very rapid, and enormous numbers of the insects may be found. Natural enemies, however, both parasitic and predaceous, usually bring them under control in midsummer.

Means of control.—Arsenical mixtures are useless as aphids are sucking insects; hence contact poisons must be applied. Of these probably the best is Black Leaf 40, a tobacco extract. The only objection to this is that it is somewhat expensive. It should be used with lime-sulphur as soon as the eggs have hatched, that is, a day or two before the buds burst. This will destroy most of the insects and, if another application combined with the lime-sulphur or Bordeaux mixture is given just before the blossoms come out, almost every aphid can be destroyed. Of course, in the latter case the spray must be shot up from beneath so that the under surfaces may be covered. The lime-sulphur or Bordeaux is added with the object of controlling diseases (see under Leaf-spot above). Kerosene Emulsion or Whaleoil Soap, 1 pound in 6 gallons of water, may be used instead of Black Leaf 40, but should not be combined with lime-sulphur. It is almost useless to spray after the leaves have become curled because it is then impossible to hit all or nearly all the aphids.

RED SPIDERS (*Tetranychus bimaculatus*).—Red Spiders are mites that feed on the under surface of the leaves of numerous plants. They have sucking mouth parts and cause currant leaves to become brownish or reddish-yellow in color and therefore unhealthy in appearance. Such leaves in dry weather, when the plants need them most, dry up and die. The mites have the habit of spinning a very fine web on the undersurface of the leaves, beneath the protection of which they feed and lay their eggs. Red Spiders are not all red, as one would expect; frequently most of them are a pale green or nearly transparent whitish color. They can just be seen with the naked eye. The eggs are like little glistening drops of dew. The spiders winter in the soil around the base of the plants.

FIG. 22.—Currant leaves curled by aphids. (After Close.)

Means of Control.—If lime-sulphur is used for the various spray applications mentioned above and the under surface of the leaves is well covered there will be little trouble from this pest. Wet weather also helps to control it, as the mites thrive best in dry seasons.

SAN JOSÉ AND OYSTER SHELL SCALES.—Currant bushes frequently, and gooseberry bushes sometimes, are severely attacked by either the San José or Oyster Shell Scale. If no remedial measures are taken the former of these insects will soon kill affected plants, and the latter will weaken them and occasionally cause their death. For a full description of the appearance and habits of these insects see Bulletin No. 219.

Means of Control.—Prune the bushes out well so that every part can be thoroughly sprayed and use lime-sulphur, specific gravity strength 1.032 to 1.035 (commercial lime-sulphur 1 gallon to about 8), a little while before the buds burst. Very badly infested bushes should receive two applications before the buds burst.

Many other insects and diseases attack currants and gooseberries in Ontario, but as they seldom do much damage it has not seemed desirable to give an account of them here.

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Ontario Department of Agriculture

ONTARIO AGRICULTURAL COLLEGE

BULLETIN 223

Fertilizers

In Relation to Soils and Crop Production

By

R. HARCOURT, Professor of Chemistry

A. L. GIBSON, Demonstrator in Soils

TORONTO, ONTARIO, MAY, 1914

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ONTARIO AGRICULTURAL COLLEGE

Fertilizers

IN RELATION TO SOILS AND CROP PRODUCTION

By R. Harcourt and A. L. Gibson.

INTRODUCTION.

On our comparatively new lands, and in general farm practice where a judicious rotation of crops is followed, and where grain is fed on the farm and the manure properly cared for, it may not be necessary to use commercial fertilizers; but where the nature of the crops grown prevents rotation, and where very little farmyard manure is produced, they may be required. More and more each year it is found that the increased cost of production and the consequent need of producing maximum crops, and the growing demands of the larger towns and cities for garden and fruit products of high quality, are causing market gardeners and fruit growers to consider seriously the advisability of using some form of fertilizer. This has created a demand for information concerning these substances which it has not been easy to fill; for experience has shown that the farmer must possess a wide knowledge of plants, soils, and the fertilizers themselves before he can properly use them.

To intelligently and economically use fertilizers, it is essential that the farmer understands the needs of the crops, their power to gather the essential plant food constituents from the soil, and the purpose of their growth, i.e., whether the object is to produce an immature plant for early market, or whether maturity is required. He must also know something about the available supply of plant food in the soil and the nature of the fertilizer being used. These fertilizers are expensive, and unless they are intelligently applied in conjunction with very thorough cultivation they will not give their best results. They cannot take the place of cultivation; for they are food materials, and can only aid the growth of the plant as they are absorbed by the roots, and these cannot develop fully in a poorly cultivated soil.

Because of the wide variation in the amount of available plant food in soils, the differences in the needs of plants, and the necessity of the farmer gaining some definite information regarding the nature of the fertilizers he is using and the effect of these upon crops grown, we strongly recommend those who contemplate using fertilizers to commence in a small way and prove for themselves whether they can or cannot use these substances with profit. The object of this bulletin is to point out some of the main features regarding plants, soils, and fertilizers, which should be known in order that the work may be done intelligently, and to indicate briefly how experimental plots may be arranged to show whether special fertilizing materials are or are not required.

THE PLANT.

Most young plants start from a seed, which contains an embryo, or germ, that is extremely rich in albuminoids, fat, phosphates, and potash. The seed also contains a store of food, in the form of starch, fat, etc., intended to nourish the young plant until the roots and leaves are sufficiently developed to gather their own supplies. The future health and vigor of the plant will depend on: (1) the amount of food available to the tiny rootlets sent out by the young plant; (2) the temperature of the soil, (3) an abundance of sunshine, and (4) a sufficient supply of oxygen. The plant requires oxygen for respiration, and it gives off carbon dioxide as a result of the oxidation of its food, that is, it breathes; it gives off water from its leaves, or lungs, it assimilates food, and it even excretes waste material. In all this it is very similar to the animal. But it even goes further, and collects its food from the simple substances, such as carbon dioxide, and various soluble salts found in the soil, and from these builds up the complex sugars, starches, fat, and albuminoids which are essential for the life processes of the plant and which are the only foods of the animal. It is subject to improvement by selection and breeding, as is the animal, but, unlike the animal, it is entirely dependent upon the supply of food constituents within its reach, and it has no way of drawing attention to its wants, excepting as its appearance may make them known to the careful and trained observer. A clear conception of the fact that an infant plant, like the infant animal, requires warmth, air, sunshine, and an abundance of easily absorbed food, will greatly aid in understanding the conditions under which it will make the best growth.

Food of Plants.

The plant's food is derived from the atmosphere and from the soil. From the atmosphere it gathers carbon dioxide and oxygen, and some plants, through outside agencies, are able to collect nitrogen. Nearly fifty per cent. of the dry matter of a plant is made up of carbon which is entirely derived from the carbon dioxide of the air. Although this compound forms but 3 or 4 parts in 10,000 parts of the atmosphere, the quantity is sufficient, owing to the wind continually bringing fresh supplies to the leaves. Thus there is an abundance of air around the leaves of the plant, but, if the soil is not open and porous, there may not be enough in contact with the roots, for it is worthy of note that air in the soil in which crops are growing is as essential to the life of plants as air in the stable is to the animal. This ventilation of the soil is necessary to supply oxygen required in germination of seed, to permit the roots to live, for they, too, must breathe, and to supply this life-giving element to the millions of little organisms in the soil which are busy preparing soluble food for the plant. The ventilation of the soil is also required to supply free nitrogen for the use of nitrogen-fixing germs, and to remove the excess of carbon dioxide which is being continually set free in the soil.

From the soil the plant derives nitrogen, chiefly in the form of nitrates, the ash substances, and water. Fortunately, although ten elements are essential for the growth of the plant, there are only four that particularly interest the farmer, as the other six are usually found in abundance. These four are, nitrogen, potassium, phosphorus, and calcium. A continuous supply of all the essential elements of plant growth is absolutely necessary; for, if one constituent is absent, or present in an insufficient quantity, no matter what amount of the other nutrients may be available, the plant cannot be fully developed. Consequently, just as a chain is only as strong as its weakest link, so the crop-producing power of a soil is limited by the essential nutrient present in relatively the smallest quantity.

Function of Plant Food Constituents.

In the absence of *nitrogen* the plant makes no appreciable growth. With only a limited supply, the plant commences to grow in a normal way, but as soon as the available nitrogen is used up, the lower and smaller leaves begin gradually to die down from the tips and all the plant's energy is centered in one or two leaves. Nitrogen is one of the main constituents of protein, which is possibly the most valuable part of a plant. It is also a constituent of chlorophyll, the green coloring matter of plants; hence with a limited supply of nitrogen, the leaves will have a sickly yellow color. Plants with large, well-developed leaves are not suffering for nitrogen. An abundance of this substance will produce a luxuriant growth of leaf and stem, but it will retard maturity, and, with cereals, will frequently cause the crop to "lodge." Therefore, when crops such as cereals, tomatoes, potatoes, etc., are to be matured, an over supply of nitrogen is injurious: but with the crops such as lettuce, cabbage, etc., which are harvested in the green condition, an abundance of nitrogen will, other fertilizing constituents being present, tend to produce a strong vigorous growth, and give crispness or quality to these crops.

Potassium, or potash, as it is commonly called, is one of the most important and least variable of all the elements of the ash of plants. It is quite evenly distributed throughout the leaves, stem, and seed, and generally occurs in the entire plant in the largest proportion of any of the essential ash constituents. The function of potassium is apparently to aid in the production and transportation of the carbohydrates. The flavor and color of fruits is generally credited to potassium. In fact, this element seems to supplement the action of nitrogen by filling out the framework established by the latter. Potash with nitrogen is always an important fertilizer with special crops where the object is to produce sugar, starch—as with sugar beets and potatoes. It is also apparently essential for the formation of protein, and, thus, indirectly aids in formation of all organic matter.

Phosphorus, in the form of phosphates, is found in all parts of the plant, but tends to accumulate in the upper parts of the stem and leaves, and particularly in the seed. Its function is apparently to aid in the production and transportation of the protein. It also seems to aid the assimilation of the other plant food elements. An insufficient supply of phosphoric acid always results in a poorly developed plant, and particularly in a poor yield of shrunken grain. Nitrogen forces leaf and stem growth, and phosphoric acid hastens maturity.

Calcium, or lime, is a constituent of the stem rather than the seed, and seems to impart hardiness to the plant. It has been noticed that soils containing an abundance of lime usually produce well nourished crops that are capable of withstanding unfavorable climatic conditions, as drouth and early frosts, better than are crops not so well supplied with lime. The exact function of lime is not clearly understood, but it seems to aid in the construction of the cell walls. According to some authorities, its absence is felt in less time than either potassium or phosphorus. It is claimed that a supply of lime is just as essential to the plant in order that it may form cell walls from sugar and starch, as it is for the formation of bone in animals. It also has a very decided influence on the mechanical condition of the soil, and is a liberator of plant food, particularly potash, held in insoluble forms in the soil.

There can be little doubt that a proper balance in the supply of these four important plant nutrients has a very decided influence on the nature of the plant produced. Each has its own particular work to do, and the absence or deficiency of any one of them will cause the death or the incomplete development of the plant. Moreover, they are absorbed during the early stages of growth; for a cereal crop contains at the time of full bloom all the nitrogen and potash which is found in the mature plant; the assimilation of phosphoric acid continues somewhat later. It is thus plain that crops require a good supply of these important constituents of plant growth in a readily available form if they are to make a proper development.

Differences in Food Requirements.

Again, plants, like animals, differ very much in their requirements and in their ability to secure that which they need. Cereal crops contain much less nitrogen than legumes, but they have more difficulty in securing it. The autumn sown cereals have both deeper roots and longer period of growth than those sown in the spring, and consequently are better able to supply themselves with the necessary ash constituents. The spring tillage for barley, oats, and garden crops aid nitrification in the soil, therefore these crops have less difficulty in securing nitrogen. Barley, however, has a very short period of growth and is shallow rooted and cannot rustle for its food to the same extent as oats. Corn and the root crops are not only spring sown, but have a much longer period of growth than the cereals, and will thus have command of the nitrates produced during the whole summer. They have fairly good root development, but may not always secure all the potash and phosphoric acid required for the production of a full crop.

The striking characteristic of all the legumes is the large amount of nitrogen, potash, and lime found in them. However, although they contain fully twice as much nitrogen as the cereals, because of the power they possess of making use of the free nitrogen of the atmosphere, they have comparatively little difficulty in securing the required amount. On the other hand, they have difficulty in collecting potash. Consequently, it may sometimes happen that legumes suffer for want of this constituent on the same soil that cereals would find an abundance.

It will thus be seen that plants differ widely in composition, range of root, period of growth, and in their ability to gather that which they need from the soil. These are facts which a farmer should be familiar with in order that he may intelligently manure the soil and plan the rotation of crops he wishes to follow in a manner that will give the best possible results.

THE SOIL.

But a knowledge of the plant and its requirements alone is not sufficient. It is very important that the farmer should know something about the constituents of the soil and the manner in which they may be brought into solution.

Soils are formed from rock by the prolonged action of water, frost, and air, combined with that of vegetable and animal life and their products. It is not necessary to go into details regarding the action of these various agencies. It is sufficient to point out that through their combined action, extending over thousands of years, the rocks have been broken down and their materials more or less separated by water into gravelly, sandy and clayey soils, and all the mixtures of these so commonly found throughout the Province. In these soils there is practically all the potash and phosphoric acid that was present in the original rocks. They are differently distributed, as, for instance, clays are richer in potash than sands; but the rocks are the sole source of the natural supply of these and all the other ash constituents essential for the growth of plants.

Drainage.

It must not be forgotten that the soil is the home of the plant, and if the plants are to make good growth, the home must be congenial. The factors that make it so are an abundance of readily available food, water, air, and a suitable temperature. To secure this good drainage is of primary importance. No soil can be warm or well aerated that is full of water. Nor will the organisms that bring about the decay of the organic matter exist in such a soil. Hence, good drainage must precede all other work in endeavoring to get the maximum results from the soil.

Decaying Organic Matter.

Nitrogen is derived from the air and is incorporated into the soil largely by means of plants. Consequently, the natural richness of a soil in nitrogen is almost entirely dependent upon the amount of decaying organic matter present. Through careless cultivation, this original supply of nitrogen may be depleted; or by growing plants, particularly legumes, the nitrogen gatherers, it may be increased. There is an almost unlimited supply of nitrogen in the atmosphere, and man has been given the means of gathering this and incorporating it in the land. As a result, the amount of this element in the soil, more than any other plant food constituent, is within the control of the farmer. Moreover, the addition of organic matter to a soil has a very much wider bearing than the simple addition of nitrogen; for, in its decay the vegetable acids and the carbon dioxide formed tend to bring the insoluble potash and phosphoric acid into an available form. Humus, which has such a wonderful effect on the mechanical condition of the soil, and which so increases its water-holding capacity, is also a product of the decay of organic matter. In fact, the presence of an abundance of decaying organic matter is practically indispensable. It is the source of nitrogen; the acids liberated in its decay make available the important ash materials which would otherwise be useless; it warms the soil; increases its capacity to hold water needed to dissolve the plant food; and improves its physical condition. Without the presence of organic matter and the associated germ life and the proper conditions for their action, a soil cannot produce its best results, no matter how rich it may be in all the essential constituents of plant growth.

Lime.

Lime materials not only furnish calcium, which is essential for the growth of crops, but they have the power of improving the mechanical condition of both sands and clays. This they do by binding the materials more firmly together. In the case of sands, lime thus renders them more compact and improves their water-holding power. With clays, the tenacity of which is largely due to the fineness of the particles, the lime causes the fine particles to adhere to one another, and these aggregations make the soil act like one composed of larger particles. Hence, it improves the mechanical condition, renders the soil more easily cultivated and it is better aerated. Frost and humus also improve the physical state of sticky, impervious soils; but lime is possibly the most potent agency, and it is certainly the agency most readily controlled by the farmer.

Lime also corrects, or neutralizes, the acid which naturally forms in soils, especially those rich in decaying organic matter. Experience and investigation show that many of the soils of this Province are gradually being depleted of their natural supply of lime, leaving them in an acid or "sour" state, which is detrimental to the development of many crops, and absolutely prevents the growth of alfalfa, clover, or the plants of the leguminous family in general.

Lime materials are also necessary for the useful and beneficial bacteria and other organisms of the soil. They supply these organisms with the element calcium, which appears to be just as essential a food constituent for them as it is for the higher plants. Furthermore, in improving the physical state of the soil, lime produces good air and moisture conditions which are so essential to the well-being of these organisms upon whose activity the availability of the plant food in the soil so largely depends. Thus it will be seen that decaying organic matter and lime are very important constituents of soils. In fact, their presence is fundamental. Without these the soil is practically useless no matter how much other plant food may be present. In one sense it may be correct to speak of the soil as a reservoir of plant food, to be drawn on for the growth of successive crops, but it is equally correct to regard it as a busy, complex manufacturing establishment in which all the various parts must work together under proper conditions to bring the store of plant food into a form available to plants. To bring this about is the object of cultivation.

Losses of Plant Food by Leaching.

These combined agencies, while beneficial, are destructive unless means are taken to prevent loss by drainage. They tend to bring nitrogen, lime, magnesia, potash, etc., into a soluble form, which, unless taken up by plants, is lost in the drainage water. As proof of this, we have the familiar fact that water taken from underground drains or from wells is "hard" because of the lime which it holds in solution. Consequently, a surface soil is generally poorer in lime, and frequently in potash, than the subsoil. The complete impoverishment of the soil is prevented by the presence of certain constituents which combine chemically with the liberated plant food substances, and by the conservative action of vegetation. The plant is continually collecting from the soil and subsoil dissolved or easily soluble matter, storing these in its tissues, and at its death leaving them in the surface soil. But even with the best of management there is some plant food leached from the soil.

However, according to a well known law, Nature allows nothing to be lost, and these leached-out materials are, through various agencies, at least partially, made to accumulate in great beds of limestone, phosphatic rock and potash salts. It is these accumulations of past ages that are to-day furnishing the main constituents of fertilizers. Who knows but what the plant food which is being annually leached from our fields will come into use in future ages.

Losses of Plant Food in Crops.

But the leaching away of plant food is not the only way in which these materials are lost from the soil. The vegetable and animal produce of the land are frequently consumed off the land which reared them. A partial return of the plant food thus taken from the soil is made by the application of farmyard manures, but the sale of vegetables, fruit, grain, animals, and animal products, the congregating of men in towns and cities, and the difficulty in employing sewage with profit; and the loss of fertilizing constituents from farmyard manure before it is applied to the land, all tend to make the return of the manurial constituents to the soil incomplete.

Some soils are naturally so rich in the elements of plant food that when the crops are properly rotated and "catch" crops used to economize this natural wealth of fertilizing constituents, it may be a long time before the soil needs special manures; but, if the land is naturally poor, or injudiciously cultivated, or if special crops of like nature have to be grown year after year on the same ground, it may soon need some extra manure.

On naturally poor soils it may be necessary to make a complete return of all the elements of plant food removed by crops; but in most soils there is an abundance of some one or more of these elements, and a partial manuring will consequently suffice. With intensive farming, where thorough cultivation is practised, a good system of rotation followed, where little grain is sold and some food is purchased in its place, and every care taken of the manure, the land may even gain in fertility. These, however, are not the conditions which exist with the gardener and fruit grower, and they must of necessity purchase manure of some kind.

MANURES.

Manures may be defined as anything that when added to the soil increases the amount of available plant food in a reasonable length of time. Generally speaking, they may be divided into two classes: general and simple manures.

The *general* manures include farmyard manure, the various products of the abattoirs, and substances of vegetable origin. These materials not only furnish plant food, but contain varying quantities of organic matter. The *simple* manures supply only one plant food substance and constitute what are generally known as the mineral fertilizers.

Farmyard Manure.

Farmyard manure is the most popular manure on the farm. Its action is three-fold: First, it supplies plant food; second, it supplies organic matter, the importance of which has been referred to in a previous paragraph; and, third, it possibly serves as the main source of supply for the re-seeding of the soil with those desirable organisms which bring about decay in the soil. The composition of farmyard manure will vary according to the kind of animals contributing to it, the quality of the food, and the nature and proportion of the material used as bedding.

In the case of a full grown animal neither gaining nor losing in weight, a working horse for instance, the quantity of nitrogen and ash constituents voided in the manure will be nearly the same as that in the food consumed. In cases where the animal is increasing in size, is producing young, or furnishing wool or milk, the amount of nitrogen and ash constituents in the manure will be less than that in the food; that is, it will be in direct proportion to the quantity of these substances which has been converted into animal increase. Thus, with fattening cattle, sheep and with work horses more than 95 per cent. of the nitrogen and ash constituents in the food are voided in the manure. The pig retains a larger proportion of the nitrogen, but no more of the ash constituents. A milking cow retains a still larger proportion of the nitrogen and ash, but the best (yield) in animal increase is obtained in the case of a young calf, when 70 per cent. of the nitrogen consumed is built into new tissues of the body and only 30 per cent. excreted as manure.

The amount of nitrogen voided in the urine is always greater than the quantity contained in the solid excrement, and in the case of the fattening animals it may be three or four times as much. This will vary according to the diet. If the food is nitrogenous and easily digested a large proportion of the nitrogen will occur in the urine. If, on the other hand, the food is one imperfectly digested the nitrogen in the solid excrement may form a larger quantity. When horses are fed on poor hay the nitrogen in the solid excrement will somewhat exceed that contained in the urine, but when grains or other concentrates are fed there will be a large excess of nitrogen in the urine.

The ash constituents are quite differently distributed in the solid excrement and urine. In the former is frequently found nearly all the phosphoric acid and a greater part of the lime and magnesia, while the urine contains a greater part of the potash. Horse urine is the exception to the above rule as it contains a rather notable amount of lime.

It is evident, then, that if the urine carries such a large proportion of the nitrogen and potash it should be carefully preserved. The simplest and easiest way to accomplish this is to use plenty of bedding in the stall. In city stables sawdust and other woody materials are frequently used, and if dried are good absorbents. In the country, straw is still the most common absorbent, but on many farms where peaty materials are plentiful it might be well to use some of these dried substances to aid in the absorption, and increase the amount of nitrogen in the manure.

Treatment of Manure. The treatment of manure is very important. As stated above, the greater part of the nitrogen and potash are found in the urine, consequently, if the liquid is lost or the manure is washed with water and the washings are allowed to drain away, serious loss of nitrogen and potash will occur. Again, it may also be pointed out that the nitrogen in the urine is largely in the form of urea, a compound that is speedily changed by fermentation into ammonium carbonate. This compound is volatile, consequently loss of nitrogen easily occurs, and chiefly, while the manure is still in the stable. German experimenters have pointed out that in the case of horses and cows the loss may amount to 30 per cent. of the nitrogen voided by the animal. The best way to diminish this loss is by liberal use of bedding so as to absorb all of the liquid. For this purpose dried peat would be especially valuable. This material is found in large quantities in many parts of the Province and in many cases might be very profitably used as an absorbent in the stable.

Farmyard manure readily undergoes decomposition; the nature of the products formed depend on the amount of air admitted or excluded. If the manure is thrown loosely into a heap it becomes very hot and rapidly wastes. The organic matter in this case is virtually burned, or is "firefanged" as it is commonly termed, and ammonia is one of the products lost. If, on the other hand, the manure is consolidated and kept thoroughly moist so that air is excluded; the mass ferments with but little rise in temperature, and nitrogen gas is volatilized. The loss of organic materials will be far less with this kind of fermentation than in the previous one, but in both cases nitrogen is given off from the manure. Experience proves that there is the least waste of manurial constituents when the manure is preserved in a box stall. It has been shown that a quantity of food and litter which in a box stall yielded 10 tons of manure containing 108 pounds of nitrogen yielded when carried daily to a heap only 7.5 tons, containing 64 pounds of nitrogen.

Undoubtedly, especially on heavy lands, the best returns from the manure can be got when it is put on the land and at once plowed in. The losses that are inevitable when manure is stored would be prevented and a greater amount of organic matter added to the soil. Naturally, this is not always possible, but when the manure must be kept it should be made without delay into a solid heap or mass and must not be allowed to get dry. The practice is sometimes followed of drawing manure to the field during the winter months as fast as it is made. Provided the land is not too hilly, or too clayey, this will give good results. It is evident, however, that this method does not prevent losses, but is recommended to economize labor. When the manure is drawn to a field and put in a big heap care should be taken to make the heap as firm as possible, and, theoretically, it should be covered with earth, but this under our conditions of labor is impossible.

The returns from the application of farmyard manure are not so quick as may be got from certain forms of fertilizers. This is because the materials must undergo decay before the plant can use them, which will take some time in the soil. The total amount of the three most important constituents in the manure will naturally vary with the conditions which have been mentioned. The nitrogen will vary between .45 and .65 per cent. or even higher if produced by highly fed animals. The amount of potash may vary between .4 to .8, and the phosphoric acid from .2 to .4. Thus, one ton of farmyard manure will contain from 9 to 13 or 14 pounds of nitrogen, 8 to 16 pounds of potash, and 4 to 8 of phosphoric acid. Possibly a good figure to carry in mind would be that one ton of manure contains 10 pounds of nitrogen, 10 pounds of potash and 5 pounds of phosphoric acid.

Experience shows that no manures can quite take the place of the farmyard manure. It is what may be spoken of as the natural return to the soil of the constituents taken from it. All other substances are in a sense supplements, materials added to make good some special deficiency in the soil, or to supply some plant food constituent particularly required by the crop to be grown. Hence, the care and treatment of the farmyard manure is fundamental in all good agriculture.

Guano.

Guano is the dried dung of sea birds, together with portions of their feathers, bones and the refuse of their food. This material accumulates on islands or near the coast in tropical climates. The chief deposits have been found in North and South America, Africa, Australia, the West Indies and Islands of the Pacific. Some of the original deposits are now exhausted. Where the deposits of Guano have been got from rainless districts, or at least, where they have not been subjected to the leaching action of water, they are rich in nitrogen and may contain from 7 to 11 per cent. of nitrogen and 5 to 15 per cent. of phosphoric acid. Where they have been subjected to a leaching action, the amount of nitrogen is very much reduced, and as the phosphates are not soluble, these materials have increased in proportion. This makes the chief difference between the two forms of guanos that are brought into the country. There is, however, comparatively little of this material brought into Ontario, as most of the small supply which now remains is taken to the European countries.

One feature that has lent value to the guanos is that the nitrogen is largely in the amide and ammoniacal condition and is thus very quickly brought into an available condition. In this respect it stands next to the nitrates.

Dried Blood.

Dried blood from our large slaughter houses is frequently used as a manure. It is one of the richest of the organic nitrogenous materials in nitrogen and it is one of the best since its physical character is such as to permit of its very rapid decay in the soil during the growing season. It contains 9 to 12 per cent. of nitrogen and a small amount of phosphoric acid. Dried blood is frequently applied along with nitrate of soda when a fairly large continuous supply of the nitrogen is wanted throughout the growing season.

Dried Meat Meals, or Meat Guanos.

This material is another source of high grade organic nitrogen and consists of meat scraps, or of nitrogenous materials from the slaughter houses. When relatively pure it contains from 13 to 14 per cent. of nitrogen and thus compares favorably with blood.

Bones.

Bones form a very important manure, particularly on soils which show a deficiency of phosphoric acid or for crops that require considerable quantities of this constituent. They are valuable as they contain nitrogen and phosphoric acid. *Ground raw bones* may contain about 30 per cent. of organic matter, with perhaps 3 to 4 per cent. of nitrogen and about 20 per cent. of phosphoric acid. Raw bones, however, also contain considerable fat. This ingredient is objectionable since it hinders the decomposition of the organic matter after the bones are applied to the soil, and it also renders it practically impossible to reduce the bones to a finely divided condition before applying. For this reason, and also in order to extract gelatine, they are submitted to the action of steam under pressure and thus robbed of their fat and some of the gelatine and brought into a condition to be easily reduced to a fine state. This *steamed bone* meal will contain 1 or 2 per cent. or under some methods of extraction even more, nitrogen, with from 20 to 25 per cent. of phosphoric acid. The phosphoric acid is chiefly in the form of tri-calcic phosphate, which is insoluble in water; consequently, the finer the bones are ground the more rapidly the material will come into solution in the soil. Bones are particularly valuable for their phosphoric acid, and are usually classed as a phosphatic manure.

Tankage.

Tankage is a nitrogenous product and consists chiefly of dried animal wastes from slaughter houses. It varies somewhat in composition since it includes otherwise unsalable parts of the carcass, as bones, flesh, hair, hoof, horn, etc. The keratine substances do not decompose readily in the soil, consequently, while tankage may be approximately as rich in nitrogen as dried blood and meat meals, it is not so valuable because it does not give as quick returns. It usually contains a varying quantity of phosphoric acid.

Fish Manure.

The bodies of fish are highly nitrogenous and their bones contain large quantities of phosphates. Sometimes the refuse from the fish canneries is incorporated in these fish manures. In general, the most objectionable feature to them is the oil which they contain, as this hinders the fermentation and decay of the materials by repelling the water.

Naturally, this manure varies widely in composition. American dried fish refuse is said to contain about 7 per cent. of nitrogen and about the same amount of phosphoric acid.

Vegetable Refuse.

Certain forms of vegetable refuse, as oil cakes, husks, etc., which are left after the oil is extracted from certain seeds are sometimes used as a fertilizer. These materials are frequently highly nitrogenous and contain a considerable quantity of phosphates and potash. Some of them decompose slowly in the soil and are not quick acting manures. These materials are usually used as cattle feeds, but in some cases owing to the presence in the seed of poisonous or unpalatable substances, they are used in the making up of certain forms of fertilizers. They may contain as much as 5 per cent. of nitrogen, 1 to 2 per cent. of potash and 2 to 3 per cent. of phosphoric acid.

Simple or Mineral Manures.

Besides the organic materials which have been discussed, we have a number of other substances, generally of mineral or artificial origin, which are employed as fertilizers. These may be divided into nitrogenous, phosphatic and potassic.

Many of the organic materials already described contain variable quantities of the chief manurial substances, but those about to be dealt with are as a rule intended to supply only one important element of plant food. Their use makes it possible for the farmer to apply one or more elements of plant food that may be necessary on his farm, and thus obviates the need of purchasing other elements which he may not require.

NITROGENOUS FERTILIZERS.

Although four-fifths of the atmosphere is nitrogen and thousands of pounds of this element are over every acre of land, it is the most costly plant food substance. As has been pointed out, the growing of leguminous plants makes it possible for the farmer to gather some of this immense supply. Hence, the more the leguminous crops are introduced into the rotation, the more this free nitrogen is incorporated into the soil. Through this agency the soil may be enriched in nitrogen, and every effort ought to be made to gather some atmospheric nitrogen and thereby reduce the amount that has to be provided from other sources.

The most important nitrogenous fertilizers are: nitrate of soda, sulphate of ammonia, and calcium cyanamid. These are all soluble in water, and should be used as a direct food to the plant and not to build up a reserve in the soil.

Nitrate of Soda.

Sodium nitrate (nitrate of soda, Chili saltpetre) occurs in enormous deposits in Peru and Chili. It is found in rainless districts and comparatively near the surface. The raw material is found beneath a covering of sand, gypsum, clay and gravel, which is usually removed with the aid of gunpowder. The crude material thus exposed varies from a few inches to 12 feet in thickness and is broken up and carried to the refinery where it is purified by crystallization. The material is then put up in sacks containing 200 pounds and in this form is shipped to all parts of the world. The product supplied for agricultural purposes contains approximately 95 per cent. of real sodium nitrate and consequently yields about 15.6 per cent. of nitrogen. It is extremely soluble and diffusible and is at once available to plants, hence the greater part should be applied when the crop is sufficiently grown to be capable of assimilating it, otherwise, since it is not retained by any constituent of the soil, considerable loss in drainage may occur.

Ammonium Sulphate.

When organic nitrogenous substances are submitted to destructive distillation, that is, heated strongly without access of air, the nitrogen which they contain is to a large extent expelled as ammonia. Therefore, when coal is heated by destructive distillation in the preparation of coal gas the nitrogen which it contains is vaporized in the form of ammonia. Ammonia is also got in the same way from coke ovens, and to some extent in the preparation of producer gas and water gas. The ammonia thus secured is passed into sulphuric acid and ammonium sulphate is formed. This crude material is then more or less purified and sold under the name of "Ammonium Sulphate." In the form in which it is used as a fertilizer it usually contains about 20 per cent. of nitrogen.

Ammonium sulphate is not so quick in its action as nitrate of soda, because it has to undergo nitrification, or change into nitrates, before it can be absorbed The presence of calcium carbonate is essential for this change, consequently, it should not be applied to soils deficient in lime, and furthermore, its use is always associated with a rapid depletion of the soil in lime. Nitrate of soda is best applied in several small dressings during the growth of the plant, whereas ammonium sulphate may be applied at once, even before the crop is sown, without fear of loss, because in various ways it is retained by the soil. The usual quantities of either of these materials applied is from 100 to 200 pounds to the acre but with such crops as mangels and potatoes and many garden crops larger quantities may be used.

Calcium Cyanamid.

Calcium cyanamid is one of the newer forms of nitrogenous manures. It is prepared by heating calcium carbide to a very high temperature by electricity and passing the nitrogen of the air over it. The resulting compound is somewhat bluish black in color and contains about 15 per cent. of nitrogen. It also contains calcium equivalent to 70 per cent. of slaked lime. Many of its former disadvantages are being overcome and it will doubtless become one of the most valuable of our nitrogenous manures. At present it is used principally as a constituent of mixed fertilizers.

Calcium Nitrate.

Calcium nitrate is another of the newer products in which the nitrogen of the atmosphere is put into a commercial form. Little or none of this compound has been used in this country, although it is becoming a somewhat common product of commerce in some parts of Europe.

Nitrogen in the Organic Form.

Considerable difference of opinion exists as to the value of organic nitrogen. From a purely plant food standpoint, organic nitrogen has no higher value than the available nitrate nitrogen, since it must be changed into the nitrate condition before it can be assimilated by the plant. The value of organic nitrogen as a plant food compared with quickly available forms lies in the fact that as it gradually decomposes, it forms a gradual supply of available nitrogen to the growing plant over a long period. It should be remembered, however, that many organic nitrogenous manures are so complex that their decomposition is extremely difficult and they are of little service to increase the crop yield. Among these slowly available nitrogenous substances may be mentioned rags, hair, skin, horn, crushed hoofs and leather. Of the more valuable and easily rendered available forms of organic nitrogen may be mentioned feeding cake refuse such as rape cake, dried blood, tankage and wool waste. The value of organic material in improving the physical nature of soils is a well established fact, but to buy large quantities of nitrogenous organic fertilizer as a source of organic matter to the soil cannot be considered economical. Farmyard manure is a cheap source of organic matter, but where it cannot be produced its place may be taken by growing a catch crop of rye, mustard or clover ready to be plowed under as green manure.

In brief, we may say regarding the three forms of nitrogen that if during a rotation a quick result is needed within one season a supply of nitrate and ammonia nitrogen will be most effective. On the other hand, if the effect of the manure is required only after considerable time and then a gradual supply is needed, organic nitrogen would be most suitable.

PHOSPHATIC MANURES.

Several materials are used as a source of phosphoric acid. Chief of these are superphosphate, bone meal, ground rock phosphate, and basic slag. The bone meal has been referred to under organic manures and need not be discussed here.

Ground Rock Phosphate.

This material differs from those of animal origin mainly in the fact that it is not combined with organic matter and is more dense and compact in its structure. The phosphate is got in South Carolina, Florida, Tennessee and some of the Eastern Provinces of Canada. It varies in composition, but contains from 25 to even 40 per cent. of phosphoric acid (P_2O_5). The phosphoric acid in this material is in the form of the tricalcic phosphate, and therefore insoluble in water, and is very slowly rendered available. Fine grinding is the means used to increase the solubility. Dependence is placed upon the acids formed by the decaying organic matter to bring this material into solution.

Basic Slag.

Basic slag, or Thomas phosphate, is a very finely ground, heavy black powder. It is a by-product in the manufacture of steel from iron and contains from 12 to 20 per cent. of phosphoric acid (P_2O_5). The availability of the phosphoric acid in the crude basic slag varies greatly, even as much as from 20 to nearly 100 per cent. Consequently, care must be exercised in the selection of the material that is to be prepared for use as a fertilizer. The better forms on the market contain from about 11 to 13 per cent. of available phosphoric acid. This is in the form of tetra-calcic phosphate, which appears to be more soluble under soil conditions than the tri-calcic phosphate. The standard for fineness is that 80 per cent. of the material should pass through a sieve with 10,000 openings to the square inch.

Superphosphate or Acid Phosphate.

Years ago, when phosphoric acid was recognized as an essential plant food constituent, bone meal was the chief source of this material. To increase its availability the bones were ground to a very fine powder, but even this did not make it quick enough in its action. To improve it in this respect a method was introduced whereby the most of the insoluble tri-calcic phosphate of bone was converted into soluble mono-calcic phosphate. This was accomplished by treatment with sulphuric acid and the product became known as superphosphate or acid phosphate. Gradually the cheaper rock phosphate has replaced the bone meal in the preparation of the acid phosphate, until to-day comparatively little of the bone meal is being used for this purpose. The bone in the finely ground condition is really too valuable applied direct to be used in this way, especially as the tri-calcic phosphate of the rock material treated with the sulphuric acid forms just as available a form of plant food as would be got from the bones. Most of the superphosphates on the market contain about 14 to 16 per cent. available phosphoric acid. The chief advantage of this material over the undissolved forms is that the phosphoric acid is quickly available. Basic slag cannot be used for this purpose because it contains a large amount of iron, and under the treatment with sulphuric acid phosphoric acid would be converted into the iron phosphate, which would be much more insoluble than in the form in which it was originally held. The ground bone and basic slag are not quick enough in their action to fully meet the needs of quick growing crops, but may be used with such crops as grow through long periods, as meadows, orchards, vineyards, etc. The rock phosphate will be still slower in its action, and should be applied to soils that are fairly rich in organic matter, because under these conditions the phosphoric acid may be brought into solution by the acids which are formed in the decay of the organic matter. Basic slag should also be applied to soils rich in organic matter, or even to those which have a tendency towards sourness, as it contains a considerable amount of lime.

Superphosphate, on the other hand, should never be applied to soils that are inclined to be sour, because it is of an acid nature. The chief advantage of the superphosphate over the other forms is that it contains soluble phosphate which dissolves on being placed in the soil, and is thus more evenly distributed through the ground than can be done by mechanical distribution. In a longer or shorter time it is reverted to the insoluble form in which it was originally, but in the meantime it has become so distributed through the ground that the roots can come more in contact with it and it is better absorbed.

POTASH MANURES.

Until the discovery of the potash mines in Germany in 1860, wood ashes were the chief source of this constituent as a fertilizer. To-day, practically all potash salts used in the world comes from the famous mines in Germany. It is placed on the market in a variety of forms, but the chief materials that reach this country are kainite, muriate of potash and sulphate of potash.

The *kainite* is a crude salt containing about 12.5 per cent. of actual potash, which is largely in the form of the sulphate. Along with it, however, there are large quantities of ordinary salt and small percentages of chloride and sulphate of magnesium. Freight rates make it almost prohibitive to bring this product inland.

Wood Ashes.

Wood ashes are valuable as a source of potash and previous to the opening of the potash mines in Germany were very much sought after. Good unleached ashes should contain at least 5 or 6 per cent. of potash and from 1.5 to 2 per cent. of phosphoric acid (P_2O_5). The potash is is an excellent form to serve as a plant food and is immediately available. Valuing the potash at 5 cents per pound, which is about the cost of it in sulphate of potash, wood ashes are worth 25 to 30 cents per hundred, or $5 or $6 per ton for the potash alone. But they also contain some phosphoric acid, and 25 to 50 per cent. of the whole of the material is carbonate of lime.

Leached ashes are ashes that have been exposed to the weather and usually have lost all but about one-half of one per cent. of their potash. The phosphoric acid and lime, however, remain unchanged.

Muriate of Potash.

Muriate of potash or potassium chloride is more generally used than any of the other salts. It varies somewhat in composition according to the method of manufacture, but the product most commonly met with in this country contains about 50 per cent. of actual potash. The chief impurities are common salt, and certain insoluble matters which are not injurious. All the potash in this material is immediately available.

Sulphate of Potash.

This salt is usually from 90 to 95 per cent. pure and therefore contains an equivalent of from 48 to 51 per cent. of actual potash. It is preferable to the muriate for certain crops. Thus, the muriate is not recommended for potatoes, sugar beets and tobacco. The sulphate, however, costs from $7.00 to $10.00 per ton more than the muriate. Possibly if the muriate of potash were applied some time before planting the ill effects attributed to this material might be overcome. The potash manures may be applied some time previous to the seeding or planting, but should not be plowed down. They react with other compounds in the soil and are fixed or so firmly held by the soil constituents that there is no fear of heavy loss by leaching. Early applications give the material a chance to become diffused through the ground so that it can come in contact with the roots as they spread themselves throughout the soil.

LIME.

The chief forms in which lime is used to-day are: quick lime, carbonate of lime and marl. Hydrated lime is slaked lime screened and is too expensive to use for liming soils. Air-slaked lime is a mixture of slaked lime and carbonate of lime. The amount of the latter substance present is dependent upon the length of time the lime has been exposed.

Quick Lime.

Quick lime, or fresh burnt lime, is more active than the carbonate and, possibly, where there is a great deal of acid to neutralize, it may be preferable to the other forms. It hastens the decay of the organic matter. On deep swamp soils this may be a decided advantage, but on light arable soil it may be a disadvantage. Unless there is a large amount of acid to neutralize, it should not be applied at heavier applications than about a ton per acre. This may be dropped in heaps on the field at convenient distances for spreading, covered with a little soil and allowed to slake, and then spread with a shovel. It should not be plowed down but thoroughly worked into the soil by surface cultivation.

Marl and Carbonate of Lime.

Marl is rich in carbonate of lime and may contain traces of phosphoric acid. The chief marl beds in this Province are associated with our swamp lands. The carbonate of lime is simply ground limestone rock. Some experiments seem to indicate that the dolomite rock is more valuable as a fertilizer than the purer limestones. To secure quick results limestone should be finely ground. We have, however, large quantities of dust from the stone crushers preparing stone for roadmaking that is very suitable for this work. It is not all fine enough to act quickly, but nearly 50 per cent. of it will pass through a sieve with 10,000 openings to the square inch. This material can be procured at 50 cents per ton in carload lots. The freight charges will, in many cases, be greater than the cost of the materials; consequently, as it can be procured in a number of places in the Province, care should be exercised in purchasing at the nearest point and thus reduce the cost of transportation. In applying ground limestone rock it is well to remember that it takes practically two tons of this material to supply as much calcium as one ton of quick lime. The ground rock is not so active as the quick lime and therefore may be applied in very heavy quantities without doing any harm.

Gypsum.

Gypsum, land plaster, or sulphate of calcium, exerts a similar effect to that of lime in improving the mechanical condition of clay soils. It serves as a source of calcium, as a plant food, and it serves to stimulate the beneficial soil organisms on the roots of leguminous plants like the clovers, alfalfas, peas, beans, etc. In these ways it acts in the same manner as lime, but gypsum will not, like lime, correct or neutralize the acid of a soil. Nor does it hasten the decay of organic matter as does the quick lime. As an aid to the growth of the legumes it may be applied at the rate of 300 to 500 pounds to the acre. If used to "lighten," or improve, the physical condition of clay soils heavier applications will be required.

Salt.

Agricultural salt was formerly used in this Province in considerable quantities, but of late years very little has been applied. It supplies no essential plant food constituent and its value appears to be due to indirect action, and thus it acts more as a stimulant.

HIGH-GRADE FERTILIZERS.

Fertilizers may also be divided into high-grade and low-grade materials. Nitrate of soda, sulphate of ammonia, and dried blood are, for example, standard or high-grade nitrogenous materials. They are so classified because they are fairly constant in composition and furnish nitrogen in some constant and definite form, which will act the same under like conditions. Further, they are rich in nitrogen and the element is immediately or quickly available to the plant. Ground rock phosphates differ in this respect from the above mentioned nitrogenous substances, because, in the raw state, the phosphoric acid for which they are valued, though present in large quantities and quite constant and definite in its form of combination, is not available to plants. After it has been treated with sulphuric acid and converted into superphosphate it is high-grade, owing to the fact that the phosphoric acid has been rendered available.

The various German potash salts, such as muriate of potash, sulphate of potash, etc., are also high-grade, since the composition of each grade and kind is practically uniform in its content of potash, which will always act the same under all conditions, and since they are richer in potash than any other potassic compounds suitable for making fertilizers.

LOW-GRADE FERTILIZERS.

The products which are included in the second class differ from the first, in that they may not only vary in their composition, but the constituents contained in them do not show a uniform rate of availability. Different samples of bone derived from the same source, treated in the same way, and ground to the same degree of fineness, would be high-grade, but because these conditions differ, bone from various sources cannot be depended upon to act the same under similar climatic and soil conditions. The same is true of tankage; but it varies also in the proportion of its two main constituents, nitrogen and phosphoric acid, and in the rate at which they become available to plants. In this class we must also place fish scrap, wood ashes, and the miscellaneous substances that may be used in building up mixed or complete fertilizers.

GUARANTEES.

It is, therefore, evident that mixed fertilizers manufactured from these two classes of raw material differ in value; for the nitrogen from nitrate of soda or dried blood will act quicker and is worth more than that from ground leather or horn. In the making of the ordinary complete fertilizers of commerce, in which nitrogenous, potassic, and phosphatic materials are all mixed together, it is impossible for the purchaser to judge of the nature of the materials used by the appearance, weight, or smell of the mixture, and, furthermore, he can form no idea of the probable amount of plant food constituents present.

To aid in the intelligent purchase of fertilizers the Dominion Government have enacted a law whereby it is made illegal for any manufacturer or manufacturer's agent to offer for sale any fertilizer without giving a guarantee of the amount of plant food constituents contained therein. According to our present Fertilizer Act "Every brand of fertilizer offered for sale in Canada shall bear a registration number, which shall be permanently assigned to the particular brand or species of fertilizer for which it is issued. The number shall be granted by the Minister on the application of the manufacturer of such brand of fertilizer, or his agent, and on payment of a fee of two dollars."

"The registration number must be affixed by the manufacturer, or agent, in a plain and legible manner, to every package of fertilizer sold or offered for sale, and shall constitute an identification of the brand. In addition to the registration number there must be legibly printed, on every package of fertilizer sold, the statement set out in Schedule A to this Act. This condition shall be held to be fulfilled if a printed tag, bearing the registration number and the statement required, is securely attached to the package."

"Any purchaser of a registered fertilizer may obtain from the Minister an analysis of the fertilizer as delivered to him, by making application for such analysis, accompanied by a sample of the fertilizer of at least one pound weight, and taken in accordance with the directions given in Schedule B to this Act, and on payment of a fee of one dollar.

"If any fertilizer is imported for the personal use of the importer, and not for sale, this Act shall not apply thereto, but such importer may secure an analysis of the fertilizer, as delivered to him, on application to the Minister and on payment of a fee of five dollars. The sample submitted must be taken in accordance with the requirements of section 10 of this Act."

SCHEDULE A.

Statement to be attached to package.

1. (Name of brand.)
2. (Registration number.)
3. (Name and address of manufacturer.)
4. (Analysis, as guaranteed by the manufacturer.)
5. Notice. Any purchaser may have an analysis made by the Department of Inland Revenue on payment of one dollar. Samples must be taken in conformity with the regulations. For regulations address the Deputy Minister of Inland Revenue, Ottawa.

SCHEDULE B.

Instructions for taking samples of fertilizers to be submitted for analysis in accordance with Section 10.

"Samples of fertilizer submitted by a purchaser for analysis must be inclosed in glass jars or bottles, and properly sealed. The samples must be taken in the presence of the vendor or of his representative.

Process of Sampling.

"In lots of five tons, or less, portions shall be drawn from each separate package, and from at least ten packages; or if less than ten packages are present, all shall be sampled. In lots of over five tons, at least ten per cent. of the packages shall be sampled. The portions so taken shall be thoroughly mixed in the presence of the parties interested, and from this mixture the sample sent to the Minister is to be taken; and must bear the signature of vendor and purchaser; and at the same time a duplicate sample is to be left with the party whose goods are inspected, subject to the call of the manufacturer or agent."

In compelling the manufacturer to guarantee the amount of plant food in a fertilizer, the Government have done what they can to aid the farmer to purchase intelligently. But to make use of this data the purchaser must be familiar with the terms used and know the commercial value of the different plant food constituents.

Statement of Guarantee.

The statement of a guarantee should be as simple as possible. All that is required is the per cent. of nitrogen, potash and available phosphoric acid. The amount of insoluble phosphoric acid may also be given, but as little value is placed on this part of the material it is not important. Sometimes, however, the per cent. of nitrogen is given and its equivalent of ammonia. This is simply two ways of stating the same fact. Again, phosphoric acid may be quoted in terms of "water soluble," "citrate soluble," "available," "insoluble," and "total." Out of all of these statements the only one that is required is the "available," or, if we want to know the amount of other forms of phosphoric acid, the "insoluble" may be included. The potash is also very often stated in two ways, as "potash" and as "equal to sulphate of potash." This again is a statement of the amount in two ways. In rare instances the fuller statement may be of interest to a purchaser. Unfortunately, the Act does not limit the number of times and ways the manufacturer may state the same thing in the guarantee, and consequently he is within his rights in multiplying the number. The purchaser, however, will do well to remember that no matter how complex the guarantee may be the valuation should be made on the three items: (1) "nitrogen," (2) "available phosphoric acid," and (3) "potash." This fact is recognized in the concise statement used in speaking of a fertilizer as being a 3-6-10. The meaning is that it contains 3 per cent. of nitrogen, 6 per cent. of phosphoric acid, and 10 per cent. of potash.

Trade Names.

The need of a guarantee is emphasized by the great number of different brands of fertilizers on the market. The trade name given a particular brand is usually an indication of the crop to which it should be applied, as "Potato Manure," "Grape and Small Fruit Special," "Orchard Special," "Tobacco Grower," etc. Doubtless these preparations are well adapted to the requirements of the plants, but it is impossible to make any one mixture that will give the best results with all kinds and conditions of soils. The trade named substances are useful and are an attempt to furnish a fertilizer that is properly balanced for the particular crop named. This, however, does not mean that any fertilizer named for a particular crop will under all conditions give the best results.

To use fertilizers intelligently it is absolutely necessary that a study be made of the fertilizers themselves and the crop and soil requirements. The first can only be got by studying the literature on the subject and by observation. The second can be best got by reading and experimenting.

CALCULATION OF THE VALUE OF FERTILIZERS.

The true money value of fertilizers cannot be estimated. This would be measured by the increased crop produced and it is manifestly impossible to fix a value to any fertilizer which would be correct under the varying conditions of climate, soil, crop, season, and method of use. It is important, however, for the farmer when purchasing a fertilizer to have some system of calculation whereby he may be able to tell whether that fertilizer is selling at a price according to its true market value, or not. In other words, he should know if he is getting his money's worth according to the trade value. In the case of purely mineral fertilizers it is evident from previous reading that the value depends upon the amount and condition of the nitrogen, phosphoric acid and potash present. Now, if we consider a simple mineral fertilizer like nitrate of soda, which we buy only for the nitrogen it contains, it is readily seen that according to the market price of this mineral we can fix a "unit value" for nitrogen. Any unit may be adopted, but the unit most conveniently adopted in the trade is stated as being one per cent. on the basis of a ton, or 20 pounds. Thus, if nitrate of soda containing 15 per cent. of nitrogen is selling at $55.00 per ton, the price of a unit of nitrogen is found by dividing $55.00 by 15 per cent.=$3.66 per unit.

Similarly, superphosphate selling at $16.00 per ton and containing 16 per cent. available phosphoric acid gives the price for a unit of available phosphoric acid at $\frac{\$16.00}{16}$ =$1.00 per unit.

Again, muriate of potash selling at $41.80 per ton and containing 48 per cent. potash gives the price for a unit of potash at $\frac{\$41.80}{48}$=87c. per unit.

According to these calculations we have the following unit values:

Nitrogen	$3.66 per unit.
Available phosphoric acid	1.00 " "
Potash	.87 " "

Knowing a value for each of these units we can now readily estimate from the guaranteed analysis which accompanies a fertilizer whether it is being offered for sale at a legitimate price, or not.

Two potato manures of the following composition, respectively, are placed on the market at the prices mentioned, and it is required to ascertain which is better value.

No. I.

Price $32.00 per ton.

Analysis:	Nitrogen	4 per cent.
	Available phosphoric acid	8 " "
	Potash	10 " "

No. II.

Price $30.00 per ton.

Analysis:	Nitrogen	2 per cent.
	Available phosphoric acid	6 " "
	Potash	12 " "

From the above unit values the value of these two fertilizers would be estimated as follows:

I. Nitrogen	4 per cent., or 4 units, at $3.66	=	$14.64
Available phosphoric acid	8 " " " 8 " " 1.00	=	8.00
Potash	10 " " " 10 " " .87	=	8.70
	Actual value per ton	=	$31.34
	Price charged per ton	=	32.00
II. Nitrogen	2 per cent., or 2 units, at $3.66	=	$7.32
Available phosphoric acid	6 " " " 6 " " 1.00	=	6.00
Potash	12 " " " 12 " " .87	=	10.44
	Actual value per ton	=	$23.76
	Price charged per ton	=	30.00

No. 1 is satisfactory value at $32.00 per ton, while No. 2, although offered at a lower price, is still $6.24 above the actual value.

Many farmers make the mistake of assuming that a manure of a low price is economical. This, however, is not necessarily the case; indeed, it is usually found that the high-grade manures are in reality the cheaper when valued according to their composition.

Unit Values.

In making a valuation of any fertilizer it should be thoroughly understood that the unit prices for Nitrogen, Phosphoric acid and Potash are based entirely on the market values of the raw fertilizers supplying but one of these plant food elements. These unit values may vary in the different raw fertilizers according to their percentage, composition and price, as follows:—

Unit Values of Nitrogen.

Fertilizer	†Price per ton.	% Nitrogen or Units of Nitrogen in one ton.	Price per Unit of Nitrogen.	Condition or kind of Nitrogen.
Nitrate of Soda	$55 00	15	$3 66	Nitrate
Sulphate of Ammonia	70 00	19	3 68	Ammonia
Calcium Cyanamid	48 00	15	3 20	Organic
Dried Blood Meal	55 00	11	5 00	Organic

The unit value of organic nitrogen may be obtained from other manures such as Meat Meal and Tankage, which are sold chiefly for their nitrogen content. One per cent. ammonia is equivalent to four-fifths of one per cent. of nitrogen. Thus, if the nitrogen is stated as per cent. of ammonia, to convert to per cent. nitrogen multiply by 4-5, or more accurately .823.

Unit Values of Soluble or Available* Phosphoric Acid.

Fertilizer.	†Price per ton	% Phosphoric acid, or units, in one ton.	Price per unit of phosphoric acid.	Conditions or kind of phosphoric acid.
Superphosphate	$16 00	16	$1 00	Acid
Basic Slag	18 00	12	1 50	Basic or Alkali

Unit Value of Insoluble or Slowly Available Phosphoric Acid.

A unit value for insoluble phosphate in the organic form can be obtained from the price of bone meal containing 2.5 per cent., or units of nitrogen, and 23 per cent. or units of insoluble phosphoric acid, at $30.00 per ton. 2.5 units of nitrogen at the highest unit value (in the organic form) would be $3.68 per unit = $9.20. Subtracting this from $30.00 ($30.00—$9.20) = $20.80 for 23 units of Phosphoric acid; = 90 *cents per unit of insoluble organic phosphoric acid.*

The market price of Ground Rock Phosphate would establish a unit value for insoluble mineral phosphate which has not been treated with strong acid. Though this kind of phosphate is a popular fertilizer in some places, as yet it is rarely used in Ontario and the price is seldom quoted at present.

* By available phosphoric acid is meant that which is soluble in water or very weak acid. In the case of a phosphate fertilizer which has been treated with very strong acid the phosphate which remains insoluble is considered of little or no value.

Unit Values of Potash.

Fertilizer.	†Price per ton	% Potash, or units in one ton.	Price per unit of potash.	Condition or kind of potash.
Sulphate of Potash	$50 30	47	$1 07	Sulphate
Muriate " "	41 80	48	87	Muriate or Chloride

From the study of the use of the different kinds of Nitrogen, Phosphoric Acid and Potash which has already been given, it will be realized that the fertilizer supplying the cheaper unit value is not necessarily the best to use. Each fertilizer has its own particular use which should be considered in conjunction with its cost.

OBJECT OF EXPERIMENTING WITH FERTILIZERS.

The proper and profitable use of fertilizers will only come with considerable experience. There is no better way for the farmer to familiarize himself with the peculiarities of his soil, the characteristics of his crops and the various constituents of fertilizers than by actual experiments. Considering all the different conditions existing it is unwise for the farmer to use large quantities of these expensive materials without proving that they will give profitable results. These experiments may be of a very simple nature and the time and labor required in conducting them is practically negligible. An examination of soil in the laboratory often provides valuable information on which to base experiments and the results of fertilizer applications on similar soils are a useful guide. In practice, however, no two soils of the same class are found exactly alike, and each field may be looked upon as having its own peculiarities. Hence, it is most important that the farmer should find out what is the best and most profitable treatment on his own farm.

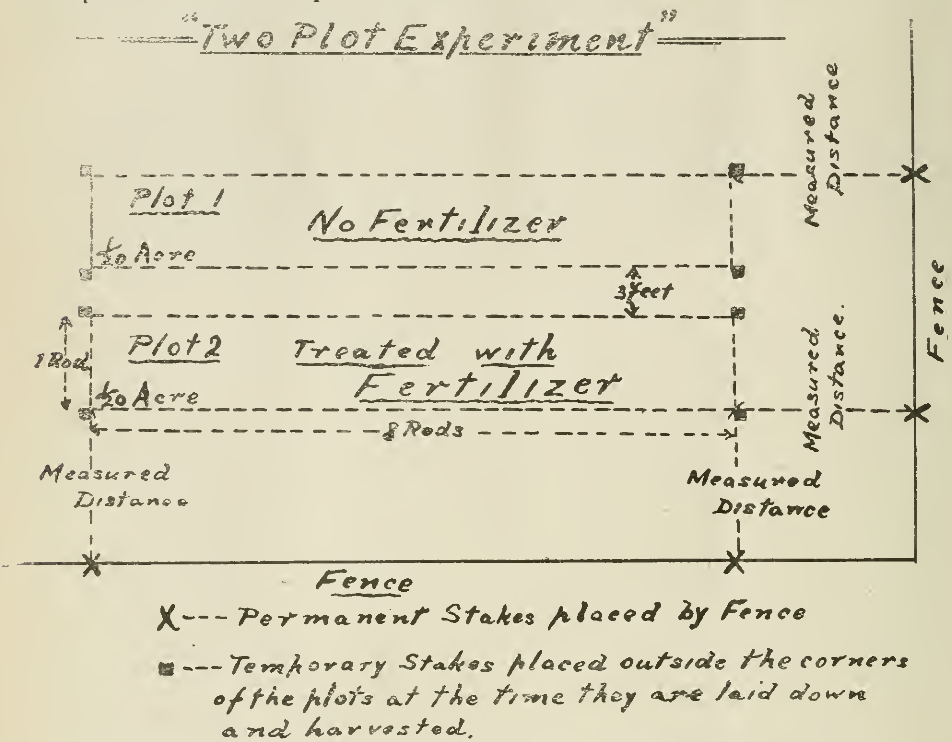
Furthermore, when the experiments include the use of the simple materials, such as nitrate of soda, muriate of potash and superphosphate, the experimenter becomes familiar with the fact that he is dealing with three distinct constituents of plant growth. It is to be feared that in many cases purchasers of mixed fertilizers do not fully realize the fact and buy the material more from the name it bears than from any definite knowledge of the amount of nitrogen, phosphoric acid and potash that may be in the fertilizer. Again, carefully conducted experiments enable the experimenter to note the effect of the different constituents upon the growth of the crops. This in itself is valuable, because it helps him to form some idea of the needs of a growing crop from its appearance.

In this way the experiments not only help to make clear the peculiarities of the soil and crops, but they also aid the experimenter to become more familiar with the fertilizers themselves. Thus, properly conducted experiments should lead to the more intelligent and economical use of these expensive materials.

† The above prices were quoted in the spring of 1914 for ton lots from the Toronto warehouses. These prices may vary considerably each year, and in different places, and the farmer should calculate the unit values accordingly.

HOW TO EXPERIMENT WITH FERTILIZERS.

The important question in using any fertilizer is "Will it pay?" This can always be answered by a simple "Two Plot Experiment." The details of conducting such an experiment are as follows: Select a uniform area of soil and carefully measure out two plots as illustrated.



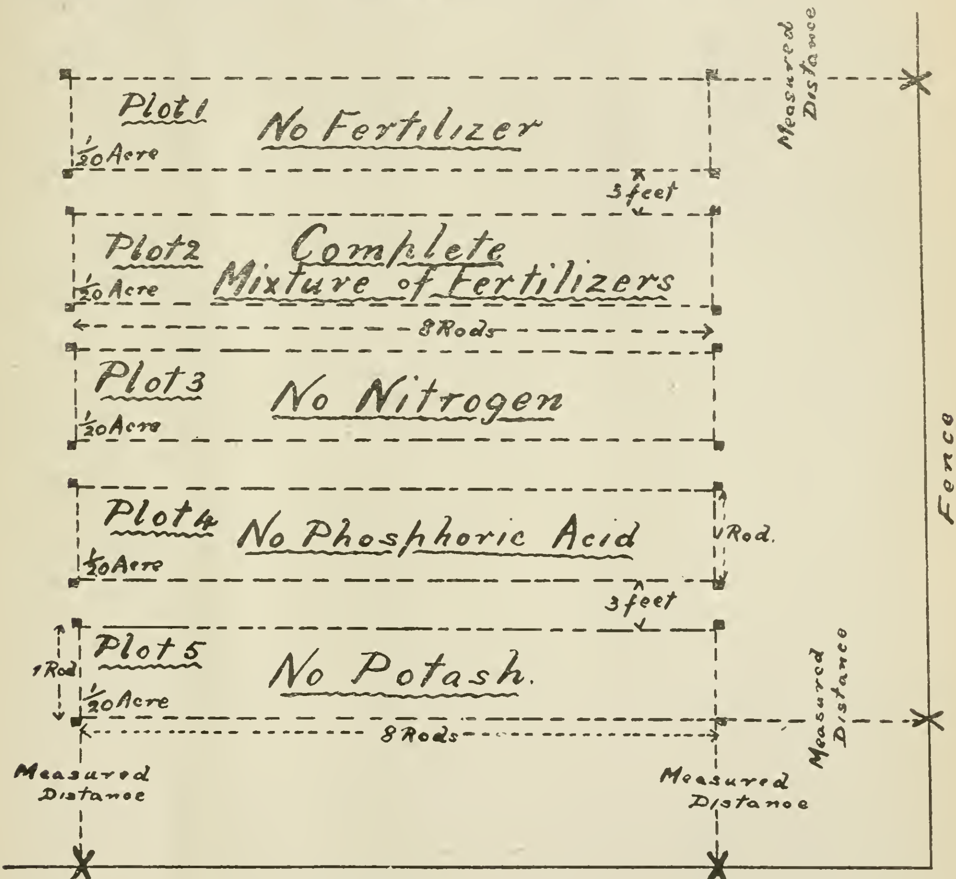
The exact position of the plots in the field should be noted by measured distances from the corners of the plot to permanent stakes by the fence, as shown. Stakes left at the corners of the plot invariably become misplaced through intertillage during the growing seasons and being unnoticed may cause damage to harvesting implements. The plots should be a sufficient distance from the fences of the field so as to be free of the headlands and well away from any trees. Keep the boundaries of the plots at right angles. There should be a dividing strip between each plot, so that the treatment of one plot will not be contaminated with that of another and the results will be entirely separate. The size of the plots may vary according to the convenience of the experimenter, but one-twentieth or one-tenth of an acre is usually most satisfactory for farm crops. If no platform scales large enough to take a waggon or cart is available, the difficulties of dealing with the harvest of large areas are too great. With small areas, greater accuracy is required owing to the multiplication of any errors in calculating quantities per acre. Fertilizer plots with vegetables and market garden produce may be very small. The shape of the plots should be long and narrow rather than square so as to ensure a better uniformity of soil. Where the crop is in drills particular attention should be taken to see that the same number of rows are in each plot.

Regarding the "Two Plot Experiment" under discussion, both plots are prepared in exactly the same manner, receiving an application of farmyard manure like the rest of the field. Plot No. 1 receives no fertilizer and is a check result of untreated land identical to Plot No. 2, which receives the dressing of fertilizer.

This experiment should simply prove whether the fertilizer being tested was profitable to use or not for that particular soil and crop. In judging the result it should not be forgotten that an increased yield does not necessarily mean an increased profit. The cost of the fertilizer and its application should be deducted, though apart from this very little more expense is entailed in dealing with a maximum as compared with a minimum crop.

The "Two Plot Experiment" is best suited to the testing of any complete fertilizer mixture containing nitrogen, phosphoric acid and potash. If, however, more detailed information is required regarding the deficiency of a soil in one

"Five Plot Experiment"



X --- Permanent Stakes by Fence

■ --- Temporary Stakes placed outside the corners of the plots at the time they are laid down and harvested or more plant food constituents we would recommend the "Five Plot Experiment" here illustrated and laid with the same detail as previously mentioned.

Plot 1, is a check receiving no fertilizer.

Plot 2, receives a complete mixture of nitrogen, phosphoric acid and potash at the rate of:

	Per Acre.	1/20 Acre.
Sulphate of Ammonia	150 lbs.	7½ lbs.
Superphosphate	400 "	20 "
Muriate of Potash	150 "	7½ "

Plot 3, receives a mixture of phosphoric acid and potash only, at the rate of:

	Per Acre.	1/20 Acre.
Superphosphate	400 lbs.	20 lbs.
Muriate of Potash	150 "	7½ "

Plot 4, receives a mixture of nitrogen and potash only, at the rate of:

	Per Acre.	1/20 Acre.
Sulphate of Ammonia	150 lbs.	7½ lbs.
Muriate of Potash	150 "	7½ "

Plot 5, receives a mixture of nitrogen and phosphoric acid only, at the rate of:

	Per Acre.	1/20 Acre.
Sulphate of Ammonia	150 lbs.	7½ lbs.
Superphosphate	400 "	20 "

Sulphate of Ammonia is recommended as a source of nitrogen in this experiment because it is more suitable for mixing with Superphosphate and Muriate of potash, and all the fertilizers can be applied in one operation.

The results of a "Five Plot Experiment" show whether a complete mixture of nitrogen, phosphoric acid and potash, or a mixture of any two of these ingredients is most profitable in the proportions used. The leaving out of nitrogen, phosphoric acid and potash in Plots 3, 4 and 5, respectively, will also show which of these constituents is most needed for that particular soil and crop. The proportions in future applications can thus be adjusted so that the plant food most needed for the same soil and crop will suitably predominate in the mixture.

In every case, however, the main principle of the successful use of fertilizers should not be forgotten, namely, *Fertilizers cannot take the place of Farmyard Manure but are merely to supplement its deficiencies in supplying the right proportion of available plant food. Never discard Farmyard Manure for the use of fertilizers entirely, but, whenever possible use the two together. If Farmyard Manure cannot be obtained every effort must be made to supply organic matter by means of catch crops plowed in as green manure.*

MIXING OF FERTILIZERS.

From what has been said it will be realized that as the farmer's knowledge of fertilizers increases, especially through experimenting, the more he will desire to apply fertilizers according to the requirements which he finds necessary in his own practice. He will naturally prefer to use the simple fertilizers and to make up his own mixtures in the proportions which his experiments demonstrate to be most profitable. In some instances he may find that an application of only one or two plant food constituents produces the greater profit. Very often the expensive nitrogenous fertilizers can be economically dispensed with. This is especially true where leguminous crops have been largely used in the rotation, thereby increasing the nitrogen content of the soil, as previously described. Thus, providing the farmer sufficiently understands the use and properties of the simple fertilizers, it is a decided advantage to make up his own mixtures according to the requirements of his soil and crops. Home made mixtures can be made up at a minimum cost. The nature and availability of fertilizers can be considered in making up a mixture. A farmer knowing exactly what he is applying is enabled to read his results more intelligently and to improve future applications.

There is no reason whatever why the farmer should not use Tankage, Dried Blood and other offal from the pork-packing and slaughter houses as a basis in his mixtures and as a source of organic nitrogen and phosphate.

How to Mix Fertilizers.

It is highly important that fertilizers be thoroughly mixed. Unless a farmer is prepared to carry out the work efficiently home mixing will prove a failure. In mixing manures the following directions should be followed: Select a clean, dry floor, preferably of concrete, and spread out the fertilizers in the required proportions in a heap. By means of a broad shovel turn the heap completely several times until thoroughly mixed and crush finely any lumps. The mixture should be finally passed through a fine riddle or screen (of one-eighth inch mesh) such as is used for sifting sand or gravel in making cement. Should a mixture form only a small quantity to cover a large area, the bulk should be increased to at least half a ton per acre by adding a quantity of sand or fine dry earth. This ensures more even distribution on applying.

Fertilizers Which Should Not be Mixed.

Some manures cannot be mixed on account of chemical action being thereby set up which results in a loss or depreciation of the fertilizing ingredients. To avoid this trouble do not mix the following:

1. Lime, wood ashes or basic slag with any manure containing ammonia, such as Sulphate of Ammonia, Farmyard Manure, or any organic manure.
2. Lime, Wood Ashes or Calcium Cyanamid with any fertilizer containing soluble phosphate, such as Superphosphate or Dissolved Bones.
3. Nitrate of Soda with Superphosphate or Dissolved Bones, except for immediate application, and under no circumstances if the Superphosphate or Bones be not in a fine dry condition.
4. When fertilizers of a crystalline nature like the potash salts are mixed with Superphosphate or Basic Slag, a hard, cement-like mass is likely to result if the mixture is not spread within a few hours. This can be avoided by adding a quantity of sawdust, dry peaty material, or earth.

APPLICATION OF FERTILIZERS.

The successful use of fertilizers depends largely on the method of application. Uniformity and evenness of distribution on the land is all important. It is common where Nitrate of Soda has been used as a top dressing to see lines or patches of darker green and stronger growth, especially in the case of a hay or cereal crop. This is due to the uneven distribution of the supply of nitrogen and represents where the Nitrate of Soda fell thicker during the process of sowing. To obtain even distribution by hand it is necessary to increase the bulk of fertilizer to at least 10 cwt. per acre by adding sand, fine earth or ashes and to divide the mixture into two parts. Application is then accomplished in like manner to the sowing of seed broadcast, one part of the mixture being sown lengthwise and the other part crosswise.

The use of a machine for sowing fertilizers will always accomplish better and quicker work. There should, however, be sufficient work of the kind on the farm to justify the expense of such a purchase. Many types of machines are made and nearly all work well, provided the fertilizers are fine and dry. Those machines, however, which possess moving parts working in the fertilizers are very apt to clog when sowing mixtures of a wet or sticky nature.

Sowing fertilizers broadcast is as a rule preferable to sowing in the drill. Broadcasting is quicker and brings about more even distribution. Thus, the crop grows more uniform and healthy with more extensive root, than when the manure is concentrated immediately under the plants.

When to Apply Fertilizers.

Broadly speaking, the time of application will depend upon the nature of the fertilizer, together with the use for which it is required and the nature of the crop.

Farmyard manure and insoluble organic fertilizers in general can be applied with advantage in the late fall. Before these can become available to the plant they must undergo a process of decomposition or decay. By applying in the fall there is not only a saving of time in the spring, but decomposition sets in without delay and the possible benefits to be derived that season are thereby increased. To obtain the full action of Lime and Basic Slag during the next season their application is also made in the fall.

Usually all soluble fertilizers are applied in the spring. Except in the case of Nitrate of Soda, the best time is about two weeks before seeding or planting. This will permit of the fertilizers being thoroughly mixed with the soil during the working up of the seed bed and any injurious effects which accompany immediate application are avoided.

In order to reduce loss by leaching to a minimum, Nitrate of Soda is best applied as a top dressing after the young plants have appeared above ground and when the growth needs stimulating.

Always select a calm day for sowing fertilizers. Early morning and sundown when the wind is low are the most suitable times.

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Ontario Department of Agriculture

VEGETABLE GROWERS' ASSOCIATION

BULLETIN 224

Greenhouse Construction

By

S. C. JOHNSTON, B.S.A., Vegetable Specialist
Ontario Department of Agriculture.

TORONTO, ONTARIO, SEPTEMBER, 1914

BULLETIN 224] [SEPTEMBER, 1914

Ontario Department of Agriculture

VEGETABLE GROWERS' ASSOCIATION

Greenhouse Construction

By S. C. JOHNSTON, B.S.A

INTRODUCTION.

Recognizing that the production of vegetables under glass has been and is rapidly becoming one of the important branches of agriculture, the Ontario Department of Agriculture, at the request of the Executive of the Ontario Vegetable Growers' Association, deemed it advisable to investigate the types of construction of green houses used by American growers. This investigation work covered the principal vegetable growing districts of the Northern and Eastern States, and the following report is intended to convey to the prospective builders some of the details of construction which may help to solve the problem of what is the most economical form of house to build, and other points which should be carefully dealt with before the house or houses are begun. The object of this investigation trip was to find the lightest, most durable and most economical type of construction backed by the experience of growers in all parts of the states visited. Over one hundred greenhouse plants were visited and the experience of the several growers taken, and all information possible was gathered which might be of use in this line.

The growing of vegetables under glass is yearly becoming one of the very important ends of the vegetable grower's business. Intensive cultivation of the land out of doors during the summer months has increased the demand for large quantities of fresh produce during this period. and gradually the consumer has begun to want fresh vegetables on his table the year round. The building of structures covered with glass and supplied with artificial heat have been introduced, and by their use the vegetables are grown to perfection, thus supplying the demand for vegetables each day of the year.

The greenhouse business in Ontario, of course, has not advanced to the degree that it has in the United States, but within the last five years there has been an increase in the building, and there has been considerable improvement in the forms of construction. At the present time in Ontario there are several large plants devoted entirely to the production of vegetables, and a considerable number of the vegetable growers in all districts of the Province have small plants from which they take several crops of lettuce during the season and later use as a starting house for their field crops for the summer. At the present time large quantities of greenhouse-grown vegetables are annually imported into Ontario from the United States. These are principally tomatoes, cucumbers, and lettuce, and by referring to the reports of the Department of Customs it has been found that during the winter months of December, January, February, March, April and May the imports into Ontario alone for the one vegetable, tomatoes, have amounted to in the neighbourhood of $10,000 per month. The other above-named crops come in probably at the lesser rates. A certain percentage of these vegetables are grown under glass by men working large establishments, and who devote practically all their time and ability to the production and selling of indoor-grown crops. Ontario growers are not producing one-half of the indoor vegetables which are being consumed in the Province at the present time, and the demand is increasing daily. Growing these crops under glass is not the easiest occupation to be found. No amateur should be misled and think there is a fortune in greenhouse vegetables. Because the crop has to be grown under artificial conditions, and because these conditions are many and of a very intricate nature, the grower has to be on the alert the whole season through to prevent as far as possible the many causes which check the growth and development of the tender plants in the middle of winter. Heating, ventilation, methods of planting, etc., are conditions which he can control, providing a first-class greenhouse is erected at the start. The grower should build the very best construction his means will allow. A cheaply-built house is always a source of worry and expense, and the time has come when durability is looked into far more than initial cost. We hear complaints on all sides of the inability to secure competent labor at a reasonable or unreasonable cost. From the gardener's standpoint this is principally because he has work for men during only six or seven months of the year. Progressive growers in several parts of the States have overcome the labor problem by building a greenhouse plant and thus employ a certain amount of help the year round. During the summer months, when the greenhouse does not need so much attention, these men are available for work on the outside. The grower is money in pocket by making at least a certain part of his land produce both winter and summer. In this way his help is steady, and the labor problem does not bother him.

CO-OPERATIVE BUILDING.

In the vicinity of Cleveland, Ohio, there are several ranges which have been built on a co-operative scheme. Several growers having money to invest in greenhouse lines formed a co-operative society, and with the bulk of their capital built a large range and are producing vegetables only. They have a range of modern construction, and it is being managed by a competent grower who receives a stated salary for his services. He is directly responsible to the Board of Directors, and has practically free charge. This co-operative idea spread, and now three large ranges are being conducted along these lines in a very satisfactory manner from a financial standpoint to all concerned. Two of the three have enlarged their plants already, and the other one will be added to in the coming season. Dividends are large, and there is a feeling that the investment has been wise. Why not this same idea in some parts of Ontario?

LOCATION.

To the persons who are starting a new house or range, certain points must be looked into carefully. Nowadays any point which means a saving of labor is considered a good investment, and for this reason the greenhouse should be located in the best possible place from a labor-saving standpoint. Possibly the securing of fuel at a reasonable cost is the largest item for consideration, and next to that the marketing of the produce. Where the grower is at liberty to start his plant close to a railroad—either a steam or an electric line, which will haul freight and express—he has considerable advantage over those who cannot. The proximity to a railroad which assures good service is a very valuable asset to a greenhouse

Boiler Room Located so as to Minimize Hauling Operations.

grower, and should be carefully looked for before an extensive plant is built. Long hauls of fuel and supplies mean an added outlay of capital which should be invested in the plant. At the present time as much of the hauling operations are being eliminated as possible and being done by means of having a switch right on to the owner's place, and in the majority of new plants running up on a trestle so that the coal can be unloaded into the coal hoppers or bins with the least possible amount of handling.

A few years ago it was considered a wonderfully up-to-date plant which had the car unloaded outside the boiler house door and the coal then hauled in by means of wheelbarrow or dump cart. That is all changed, and the coal is simply dumped, with very little labor, into the bins located close to the boiler. The vegetable grower marketing his produce at a local market spends much of his time on the road, and for this reason good roads are a necessity and a benefit to the vegetable grower, as they allow the produce to be taken in in a much shorter time than over rough, rutty roads. The buying public are now demanding quality rather than quantity, and will not accept bruised tomatoes or crushed or wilted lettuce. The grower who carries his produce over a good road realizes more for it than the one who has had to jar his goods over stones and through ruts. Growers in some parts of the States have done much toward securing better means of travel to and from their market, and claim that they are making considerably more than in the old days.

Prospective greenhouse builders looking for a location should consider this point and select a site either on or close to a good road.

The growers in some districts do not attempt to sell their produce locally. They ship by express to cities and towns within a radius of 150 to 200 miles. To them quick, safe and certain service is necessary, and they use both electric and steam roads; some even build switches into their plants from an electric line for fast service. With the coming of radials into Ontario, and the increasing demand for greenhouse vegetables, the grower does not of necessity have to locate his plant close to the market of one large city. A central location with the aid of electric and steam roads will give him the whole of the Province as his market. To the man who wishes to build a house or range on the piece of land he now has there are certain other points which apply to him as well as the man seeking a new location. First and foremost the plant must not be built in a low place. Several plants visited this year were giving trouble by being too low and too close to a stream which flooded very much in the spring. Several plants had crops totally destroyed by being in the path of an extra strong spring freshet. Again, the houses should not be located so as to receive the full force of the prevailing winds. This has been overcome by some growers by the planting of quick growing trees to form a windbreak, or in other cases by simply building a high, tight board fence to break the direct force of the wind. To sum up, the points to be considered in choosing the location and site for a greenhouse plant are as following:—

1. Long hauls and re-handling increase the cost of production.

2. Proximity to railroads lessens hauls and handling, thus lessening cost of production.

3. Good roads mean good quality and better returns.

4. Low places should be avoided, and care taken not to locate where there is any danger of spring freshets.

5. Being in the direct path of the prevailing winds increases fuel consumption. Where possible windbreaks of trees should be used, or high, tight board fences should be built.

FOUNDATION AND WALLS.

The most important part of any structure is its foundation. A first-class superstructure having a poor foundation will cause more trouble than a first-class foundation at the beginning. Builders should aim to have a strong foundation of the very best materials. This should be of concrete, as a permanent structure is required, and as a rule should be eight inches in thickness and should be set in the ground sufficient depth to give a good foundation and be below the frost line. The walls should be of concrete, wood, wood and shingles, or siding or concrete blocks. As a rule the walls are not built higher than two feet, while some prefer them three and others wish only one foot of wall, the remainder being of glass. Twenty-four inches of a solid wall seems to be about the right height, and this allows four feet for side wall ventilation purposes where six feet eaves are used. Wood in any form is rapidly being replaced with some form of concrete, either solid or as concrete blocks. Both forms are substantial, and will give satisfaction. Some growers prefer the concrete blocks because they can make them during the winter months when not busy. The only point to remember in making blocks is to make them so as to fit exactly to the pipe or iron gutter supports. Concrete work of any description should be carefully done so as to give the outside walls an attractive appearance. As the foundation is to be lasting it should be smooth and uniform, so that the whole plant will have a pleasing appearance. Some growers prefer a three-foot wall of solid concrete, and while this is not advisable on account of the need of plenty of side ventilation, those who so desire should leave openings about every ten feet in order to facilitate the handling of rhubarb roots, manure, or soil. These should be fixed with a small door and should be built so as to fit snugly. Much time can be saved by the use of these doors in bringing in the season's supply of rhubarb roots or new manure for the beds or benches.

DRAINAGE.

Some soils require drainage around the walls to prevent frost action. These should be of 2 or 2½ inch tile and set at base of foundation on the outside. Care should be taken to secure a good outlet for these drains. These drains are usually set one foot away from wall. Some growers use posts for their side wall supports. These are only advisable under certain conditions. Where only a temporary house is needed whole cedar posts set 3 ft. in the ground, 4 ft. apart, are what are usually used. Tile drains are needed both inside and out, as mentioned before. In these houses the walls are usually sheeted with inch lumber, then grey building paper one thickness and clap boards, or Manitoba sheeting or shingles used for the outside. Shingles are not advised because they will curl with the sun's heat. Clap boards or siding cost practically the same and will last longer and give less trouble. Tar paper should never be used on the walls as the fumes will kill the plants inside.

HEIGHT OF EAVES.

During the past five years there has arisen considerable controversy among greenhouse builders and growers as to what was the best height at which to have the eaves. Here, again, there seems to be various opinions which suit only individual conditions. Years ago it was considered almost necessary to have no side to the greenhouse at all, running the sash bars down to the plate, which was nearly always set on top of the ground. Since then great advances have been made in construction and we now find greenhouses and eaves ten feet from the surface of the ground. This is rather high, and is the idea of one man, and he claims he has the best. It is quite common to see eaves six to six and one-half and seven feet in height in large commercial plants. This, as with many other points in greenhouse construction, is modified to suit conditions and to cut down the cost of production. High eaves are built in the first place to allow plenty of head room for growing plants, such as tomatoes or cucumbers, which need stakes or trellis work for support. To give this necessary head room the eaves are usually built six and one-half or seven feet. This gives ample room for glass sides and also side ventilators. It is recommended on any house thirty feet or over that the eaves be placed at least six feet above the level of the surface soil. Lower eave plates than this cause endless knocking against the roof members and greatly hamper the economic handling of plants.

DIRECTION OF THE RIDGE.

Different ideas are prevalent with regard to the direction of the ridge of a greenhouse. Many experienced growers prefer to have the ridge run east and west, and many others have a preference toward having the ridge run north and south. In the old style house, where the sash bars were heavy and close together, there was more room for argument on this question, but to-day, when the wide houses are being built of materials which cut down the possibility of shade to a minimum, it seems that houses running east and west and north and south give equally as good results. The question of the direction of the ridge is an open one, and, as said before, different growers prefer each. It seems that this point has been given altogether too much attention, and the result of investigation regarding it leads to the following conclusion: Build the house facing either south or west, according to the location which you have. While men favor both east and west and north and south, the majority seem to favor east and west. but can give no specific reason for so doing.

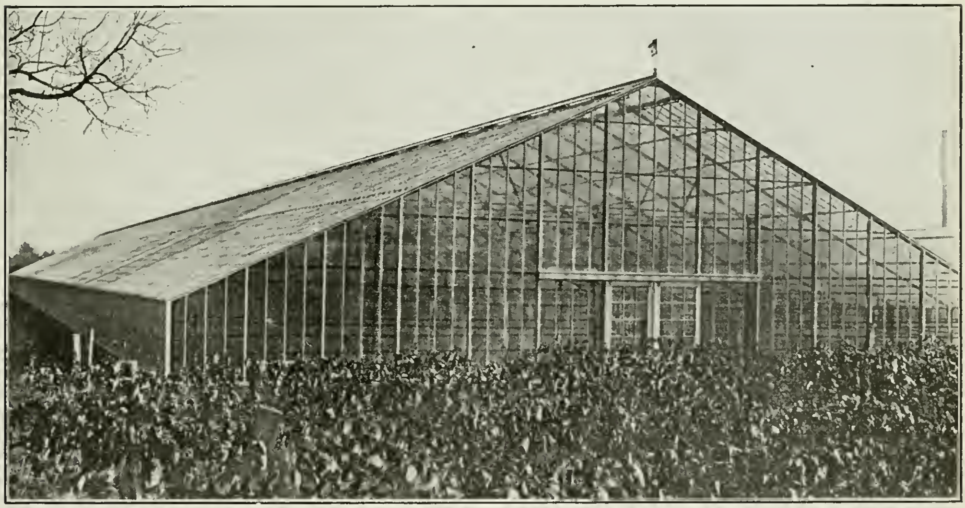
Previously only narrow, low roofed houses were used, but wider ones are now the only ones in demand. The change from 14 ft. to 75 ft. houses can plainly be seen here.

WIDTH OF HOUSES.

Practically all greenhouses built up to the last fifteen years have been of comparatively narrow widths. This has been due largely to the mistaken idea that the plants should be located as near the glass as possible. During later years this idea has been misproven, and houses are now being built much wider. The large greenhouse growers are convinced that better returns can be received from houses of a wider span than from the old fashioned narrow ones. In houses having a wider span, and of necessity higher eaves, the volume of air is increased, the glass surface is proportionately increased, and the working cost of the greenhouse is lessened. The volume of air is increased due to the increased length of the sash bars and the increased height of the eaves, and this is what greenhouse men require for successful growing—more air. It is an experiment no longer, but an actual cultural necessity, to have plenty of air over the plants. The plants grow better in every stage, and are not so liable to suffer so much from the sudden lowering of temperature. With the increased length of sashbar, etc., the glass surface is increased, and this admits more light and also makes adequate ventilation easy.

With the higher eaves the ventilating apparatus can be easily placed and operated, taking up practically no room in the house. The working cost or crop costs are several per cent. cheaper in wide houses than in the old narrow ones, because the houses have higher eaves, and cultural operations can be carried on close up to the sides without fear of bumping into the sash bars, etc., as is common on going into the narrower houses.

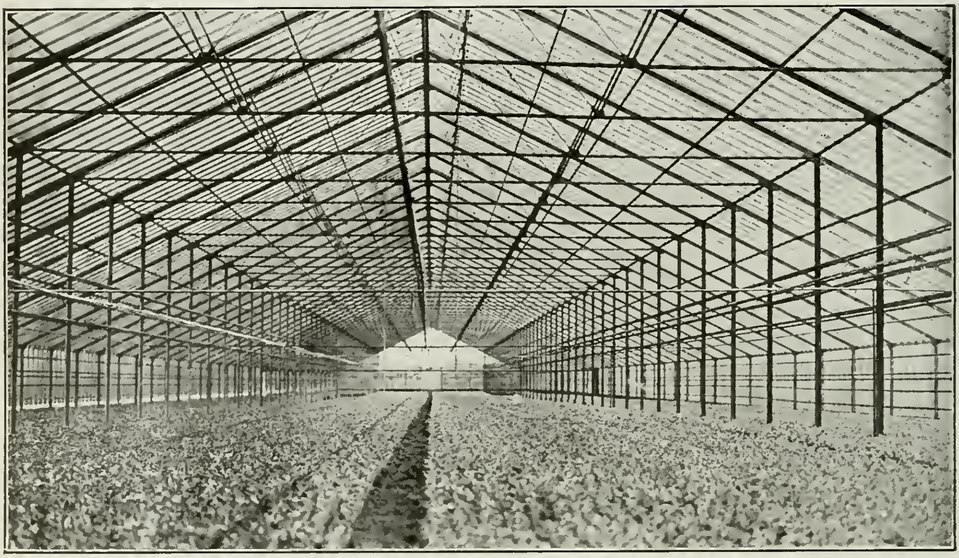
Widths of houses are arbitrary to the builder. The prevailing width of house being built at the present time in the United States seems to be seventy-five feet. Many plants have passed from the twenty foot width to the twenty-five



Seventy-five foot houses are preferred by the majority of large growers. The doors in this 75 x 460 ft. house admit all cultivating machinery.

foot and then to the forty foot, and experienced men seem to agree that the seventy-five foot house gives them as nearly a perfect house as they can get. The forty foot house has been built extensively by many vegetable growers, and gives entire satisfaction; but as soon as the seventy-five foot house has been operated a season 95 per cent. of the growers will have no others.

The increased facilities of handling materials, supplies and soil cut down the cost of production in the wider houses at a greater rate than in the narrower houses. Conditions alter cases. For this reason the man who is starting a small plant could not afford to build the length of house in keeping with the wide houses, and for this reason he should insist on getting just as wide a house as his means will allow. For the man growing greenhouse products during all the winter it is not economical to build a house less than forty feet in width. Much better that he build over forty feet in width and not so long, than a long narrow house which prevents the easy handling of all parts of work, etc. It is cheaper by far to add to a wide house after a few years than to tear down a long narrow house and rebuild it. Narrow houses have their place, quite true, and many are making good returns from large plants of narrow houses; but, on the other hand, they are seeing the point of the wide house, and in many cases rebuilding. For the grower on ten acres of land who wishes to have a house to grow lettuce in during the winter and use as a plant house towards spring, it is just possible that a house twenty-five feet



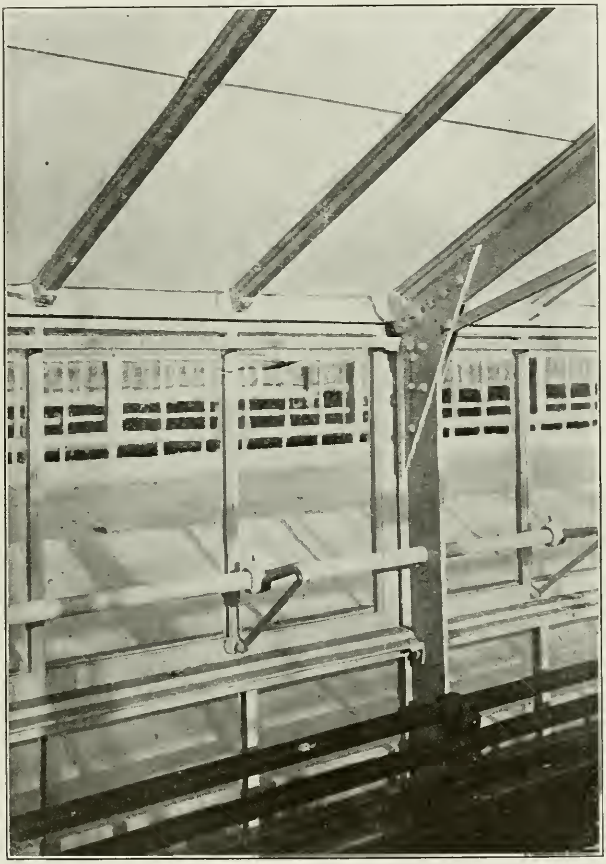
In wide houses the crop can be handled with minimum expense. Horse-drawn implements were used to prepare the land here for this crop. Interior of previous view.

in width will give as good results where the heating and ventilating are carefully looked after. On the whole it will pay any man who is building a greenhouse at all to put up a house of wide span, because he has more room, better control of ventilation, less chance of disease, and the heating cost of the wide house is considerably less than that of the same width made up of several narrow houses.

IRON FRAME CONSTRUCTION.

Possibly this form of construction is receiving more attention at the present time than any other. Growers in many sections of the United States are finding that the best is none too good, and the iron frame greenhouse meets with their approval better than any other. Prominent vegetable growers in the vicinities of Boston, Rochester, Erie, and Philadelphia, who are competent men on greenhouse construction details, favor this form, and back it up by securing more houses as their demand increases. They are the best judges as to the value of these houses.

Description.—In houses of the iron frame construction all possible parts are constructed of iron. Flat iron posts bolted together set in concrete form the supporting members for eaves, etc. Flat iron rafters run from these wall supports to the ridge, being held together with angle iron purlins. The sash bars are of wood and are attached to this iron frame work. In a few words, this construction simply is a frame of iron which supports the sash bars on which the glass is laid. It has been found that metal cannot take the place of wood in manufacturing; owing to the expansion and contraction of the metal in different weathers.



Iron frame construction—showing the iron member which acts as the supporting part of the house. Solidity is the feature here.

For this reason wooden bars are used to support the glass, and thus breakage is checked.

Different manufacturers vary somewhat in the forms of iron that are used, some using flat iron others T iron and others ordinary galvanized pipe for their supporting members. The majority of growers seem to favor the flat iron rafter house, that is a strip of iron runs from wall post to the ridge at intervals of eight feet four inches or thereabouts. As a rule this distance has been found to be the farthest apart that these iron members may be set without sacrificing strength and support. These iron frame houses are all bolted together, so that once the structure is properly erected the house is strong and substantial. Houses of this construction practically cut out all supports in the house, and this is what the vegetable grower requires.

Houses 40 ft. in width may be constructed with no central supports whatever from the ground, using only a form of compression trussing which holds the house together and down. A house 75 ft. in width will require but two lines of supports with braces and struts.

WIDTHS.—These iron frame houses can be built any width a grower wishes. It is not economical to use this form of construction in a house under forty feet in width, but it is not advised to build over 75 or 85 ft. in width. Many houses 75 ft. in width are being built throughout the States, as well as a few in Canada, and this width seems to be an economical one to use. Houses 40 ft. in width with no supports save the truss work also are very much in favor.

ERECTION.—These iron frame houses are all manufactured in separate pieces in foundries, iron parts cut required lengths, all holes bored and the house in many cases set up to see that everything fits before being shipped on to the builder. The parts are all properly labeled, and a blue print of the plan of the houses showing details which accompanies each house gives the exact position for each member. It is no trouble to erect one of these iron frame houses, for the whole house goes together in sections, and once one section is satisfactorily erected the remainder of the house goes together like clock work. Growers differ as to whether it is more economical to erect the house by means of home labor or by letting the contract to a construction company whose employees do nothing else but erect these houses. One grower in the vicinity of Boston purchased a house from another grower, took it down and re-erected it for himself, and says he had no trouble whatever; in fact he claims to have made a better job than some of the construction firms would have done. Another grower near Erie erected a house 75 by 460 ft. from start to finish, and one would not wish to see a better house. A man with average mechanical ability can erect a house of this construction with very little trouble, but whether it will pay him to do so rather than let the contract to a firm who make a business of this erection is a question. Some progressive men told me that they were money in pocket when they gave the construction company the contract to do all the work on the house. They claimed that they more than made what it cost them to erect the house by being free from all worry, and being able to look after the selling of the produce on other parts of their plant. It is simply as the man himself looks at it, and whether he has the time to look after the erection himself and bear the responsibilities of having it go together in good shape.

Ontario growers should use this form of construction in preference to others under certain conditions. In the first place these houses cost in some cases more to build than other forms of houses of other construction. The initial cost is high, there is no question about it. But this must be borne in mind by all prospective builders: that once one of these houses is up it is up to stay, and will last as long as the grower and still have a further lease of life. Houses which cost much less to build at the start soon show effects of wear and tear. In ten to fifteen years time they need many repairs, and in many cases require new stock all through. Not so with greenhouses in which a framework of iron is used. They are still giving entire satisfaction at the end of thirty years' service. The iron greenhouse gives a solid house which no wind can blow in or out. This has been proven in Ontario and in parts of the United States during the past two years. The iron work when properly made and erected can weather the worst of storms. No vibration of glass is seen in a windstorm, in fact practically no motion is felt in any part

Iron frame houses are easily erected. All parts are bolted together in order to have a solid frame. The eave supports are set in concrete first and then the iron rafters are raised to position. This view shows house in various stages of erection.

of the house. The average grower will think on the face of things that a house of this form of construction will cost more to heat.

This has been tried out by growers themselves, and they have found that once they get a house to the correct heat it costs considerably less to keep it there. The iron frame houses are usually built wider and higher, and the volume of air helps a lot in lessening the fuel bill; but the very fact that the iron frame house is so rigid and in this way allows no openings for air to get in, no spreading of joints or pulling out of nails or breaking of sash bars with over-load of snow, the cost of heating one of these houses is cut down in some cases one-half that of the same area under houses of other construction. The advantages of iron frame greenhouses and the merits of this construction may be summed up as follows:

1. Cost of upkeep very small as compared with other forms of construction.
2. Solidity. The houses of this form have been in use thirty years and are still in good condition.
3. Cost less to heat.
4. Glass breakage is considerably less.
5. Lack of columns.
6. Minimum shade.

Objections.—The main objection to houses of this construction is that of initial cost. This is often higher than that of inferior forms. To offset that the growers should figure that these are permanent houses built to stay. The upkeep is cut down because there is very little in the house to wear out. Iron frame houses are about as good an insurance as any grower can get for good crops. If he cannot grow crops in these houses he cannot in any other, that is certain. Growers agree that the best is none too good, and a poor thing is dear at any price; and those who have used houses of this stamp recommend them without any hesitation as being the lightest, brightest and most economical houses on the market.

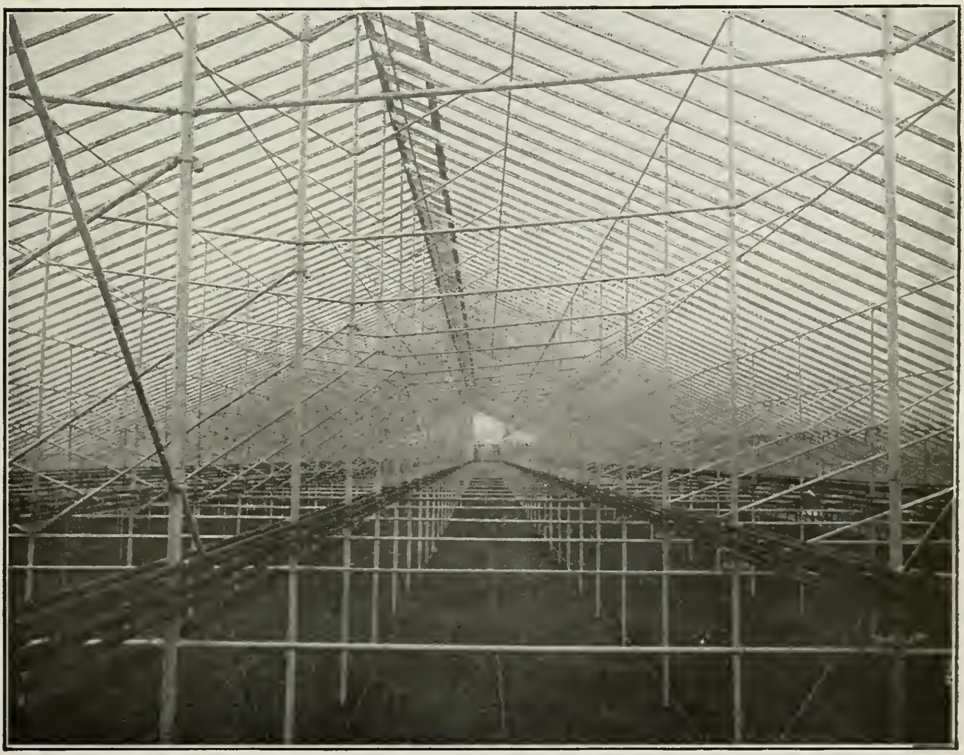
PIPE FRAME CONSTRUCTION.

For growers having limited capital or those not desiring to build the first class construction as described previously the pipe frame construction is considered as a good investment. This form of construction has met with approval in many parts of the States during later years and many houses of this style are to be found in Ontario. However, the growers in the United States who have had these houses are now building houses using the iron frame construction and the majority state they have better houses and are more satisfied with results. Men intending building small houses which will be used only as plant houses will find this form of construction best suited to their needs in many cases. The cost is not so high as those of the iron frame style but the difference is not so much as to warrant building a large range of the pipe frame construction. Both forms are giving good service but the preference is toward the more substantial and lasting form of houses.

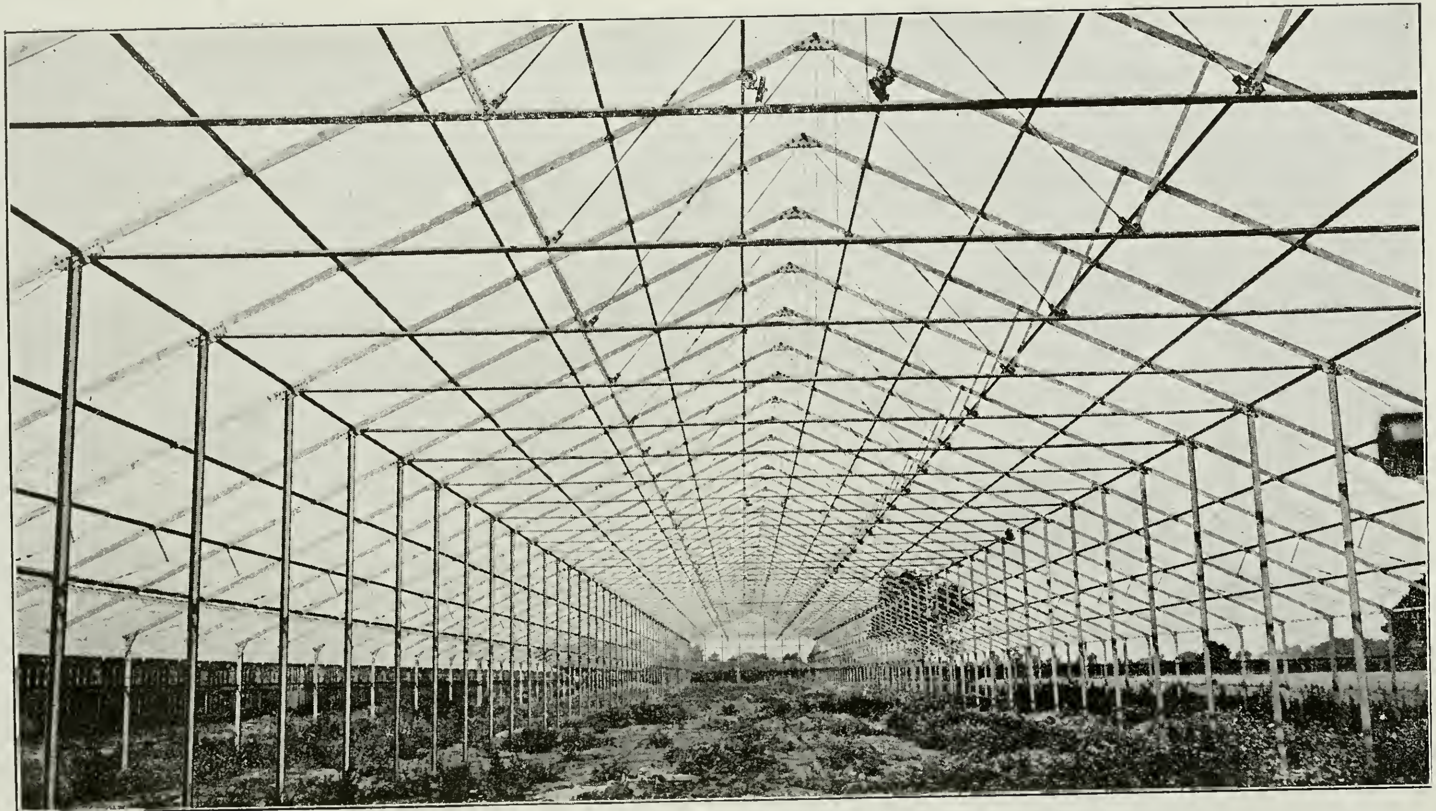
DESCRIPTION.

In this form of construction all the supporting members are made of iron pipe—eave or gutter supports, purlins and purlin supports. Galvanized iron pipe is used in all cases and all supporting members are set in concrete to a sufficient depth to make them solid. Wooden sash bars are placed on this frame work and held in position by means of a metal band or clasp which goes around the pipe purlin and is held to the bar by two screws.

Pipe frame construction, showing the network of pipes necessary to insure safety. Compare these views with the one on the next page.



Interior of largest pipe frame greenhouse in Canada.



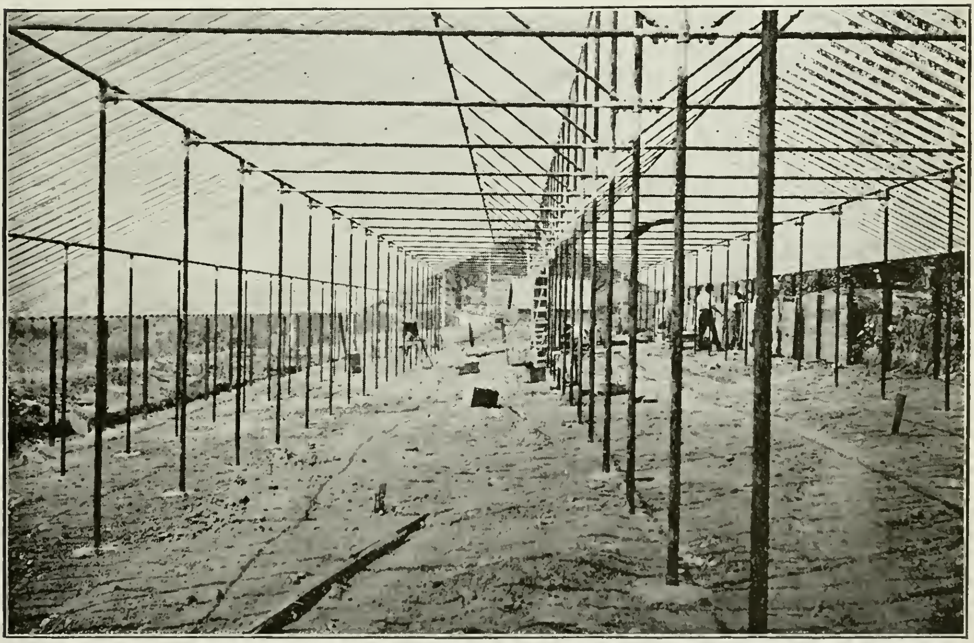
This house is 75 x 460 ft. in size, and as can be seen, two rows of supports are necessary with the iron frame construction, leaving 40 ft. clear in the centre.

ERECTION.

Here again any one with ordinary mechanical ability can erect one of these houses. Pipe can be bought cut and threaded as required by a local man and the grower can erect his own house. Care must be taken to have all parts set in line and at the correct height. A slight variance in setting supporting members will give endless trouble. Supporting members should be set on a solid foundation preferably concrete, and should be filled in around with concrete to a depth of eight inches. Usually growers have the concrete work come up above the surface of the ground some five inches to prevent the surface water from rusting the pipe. A common method is to place an ordinary field tile around the base of the pipe allowing it to come up above the surface and filling it in with concrete and moulding it off on top.

Supporting members have to be set so that there is a purlin every eight feet on the sash bar. These purlins have to be supported every eight feet. It has been found that to increase this distance increases the risk of solidity in the house. In some cases this has been tried with some degree of success but the grower took considerable risk in building such a house.

The purlins do not of necessity need to have their supporting members come directly from the ground in all cases. By using a V or Y brace the ridge support will carry two purlins as well. This does away with two rows of columns. In cases where this brace is used there should be a brace running from the eave support to the ridge support usually of three-quarter or one inch pipe held in position by split T's. These should be set high enough from the ground to permit operating



Angle iron purlins are sometimes used. The Y brace is used to lessen the number of supports.

crop, etc. Gable ends should be securely braced in this form of construction. The lack of these braces has been the cause of much damage in several large houses. During severe windstorms the end would give and the force of the wind would tend to wreck the whole house. Horizontal bars in the end should be used and these again supported from the lines of purlin supports. One and one-half inch and two inch pipe are usually used for supporting members and one inch and one and one-quarter as purlins depending on size and shape of houses.

MODIFICATIONS.

Instead of using the pipe purlins some growers have used angle irons. These are bored to fit screws which are attached to each sash bar. This method is used by some men and they claim to have a stronger house than with the pipe, claiming there is some danger of weakness at the coupling. The rigidity of the angle iron is said to overcome this. The difference in cost is very little, the angle iron costing a trifle more than the pipe. This modification is being used and is giving satisfaction in several large ranges but is not common.

OBJECTIONS.

The objection to houses of this form of construction is that a house of any size there are so many supporting members that the ground in the house cannot be cultivated with horses as easily as with other forms of construction. This appears to be true in large houses. Horses cannot be used with the same freedom as in houses requiring fewer supporting members. Some claim the columns being so close help to give more shade. Others claim there is very little difference.

Pipe frame houses have more material in them which must be kept up thus increasing running expenses. The same degree of solidity can not be found as in houses of the iron frame construction and there seems to be more danger of glass breakage in these houses than in the iron frame houses.

MERITS.

A very economical house for the man requiring only a small house to be used with raised benches. Cost of a small house is considerably less than if the construction were of iron frame.

ALL WOOD CONSTRUCTION.

This form of construction is practically out of date at the present time. It cannot be used economically because of the limited age of wooden parts. Wooden posts, usually cedar, are set four feet apart to form the side walls and the houses made very narrow requiring but few supports for the ridge. These have been found to be small trees cut required lengths, split cedar posts or two by four inch scantling.

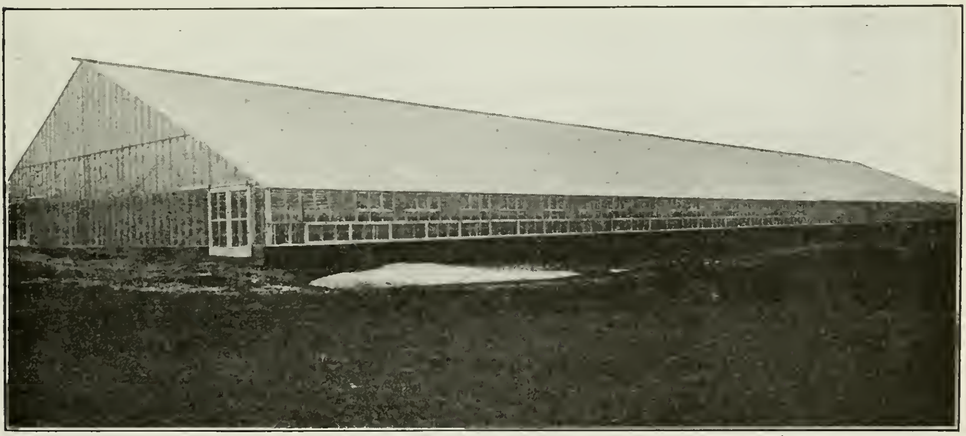
Hot bed sash usually form the glass covering and these houses are sometimes called sash houses. This form of house is not to be recommended as a greenhouse. As a house used as a substitute for hot beds or cold frames it may be of some use in the early part of the season when it can be heated with a coal or wood stove. Many gardeners have used these houses in previous years and know their limitations and no gardener is advised to build one.

SIDE HILL HOUSES.

Some years ago it was the custom to build a greenhouse on a side hill, using the side of the hill as one side and having the glass run on a gradual slope to the bottom of the hill. These were thought to be excellent houses, this probably being that one side of glass was saved and that the house was always free from heavy wind storms, etc., owing to its peculiar location. Of recent years this idea has been entirely changed, and the side hill houses are practically a thing of the past. Growers now demand light on both sides of the roof and also demand good side ventilation. This cannot be had with ordinary side hill houses. Another objectionable feature of houses built on the hill side is that the beds or benches all must be on different levels as one goes down the hill. This entails extra labor and prohibits the possibility of horse cultivation. There are those who stick to the side hill house, but they are a very small minority, and the general opinion of growers is that the upright two sided greenhouse is what is required. Some men have ideal locations for greenhouses of the hill slope style but refrain from building, because they realize that they are money in pocket by paying for increased ventilation and the decrease of labor cost.

VENTILATION.

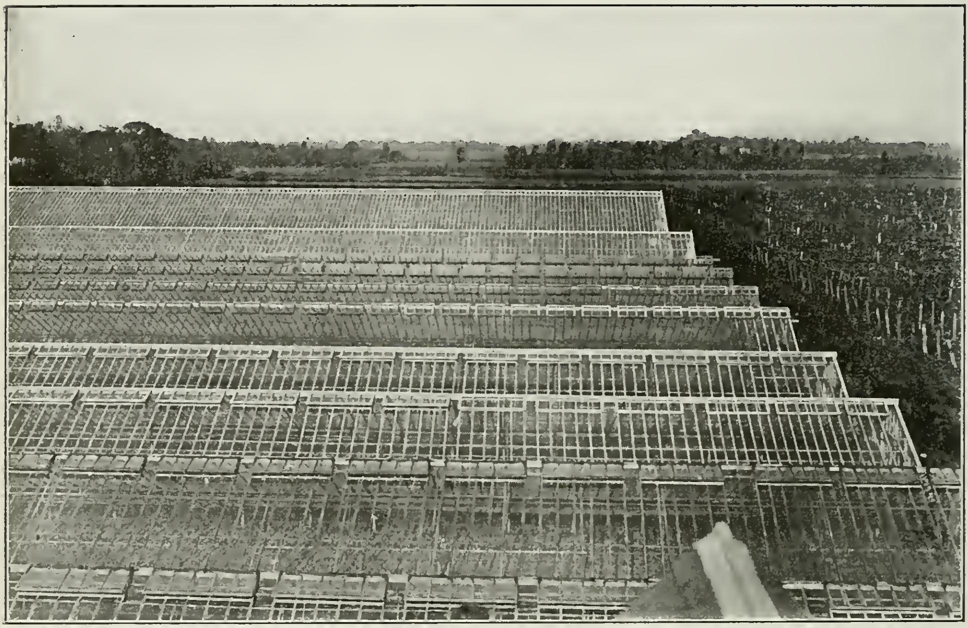
Ventilation of the greenhouse is a necessity for the growing of any crop. Too much attention cannot be given this part of construction, and the most approved



Side ventilation is necessary in large plants. Continuous runs of ventilator are usually located at the eave or lower. Usually made to open out, but some have them opening both in and out.

arrangements and forms of ventilating apparatus should be carefully inspected before the installation of any. Ventilators are now being used on both sides of the house and in continuous runs, both sides of the ridge, and also in continuous runs, or in broken or alternate runs. Gable end vents are also being advocated and used by some progressive growers. These are not common as yet, but some men claim to have had a marked degree of success with them. They are arranged in different ways and as yet seem to be more the ideas of individual growers.

Side Ventilation.—The eaves of the greenhouse should be built high enough to permit the installation of plenty of ventilators along the side. Particularly where the summer crop of cucumbers is to be grown. This crop, for best results, requires side ventilation as well as ventilation of the ridge. There are various ways of setting those side ventilators and a brief description of each may be of value. The ventilator may take up practically the whole of the glass surface of the side of the house or it may be limited to less. As a general rule too much ventilation on the side cannot be had. Some growers prefer one continuous run of ventilation, three or six lights in length and two or three lights wide. Others claim to have equal success with about one-half the amount of ventilation given by means of making the ventilators come alternate with equal sized spaces of stationary glass. Side ventilators are used either opening directly beneath the eave plate or opening from a header set right below the eave. Both give satisfaction and both have

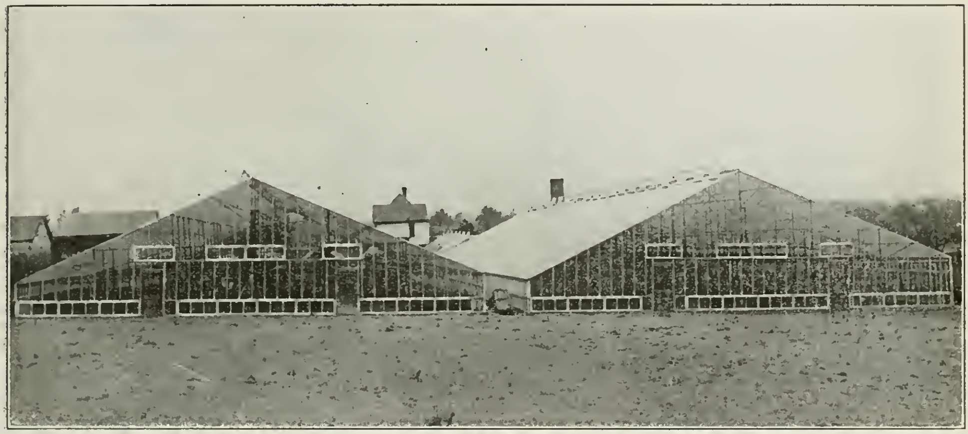


Ventilators at the ridge may open from the ridge or from a header. Both ways are good. The majority prefer them to open from ridge. Continuous runs or broken runs as shown are in favor.

their advocates. Possibly those preferring the ventilator to be continuous and opening from the header are in the majority.

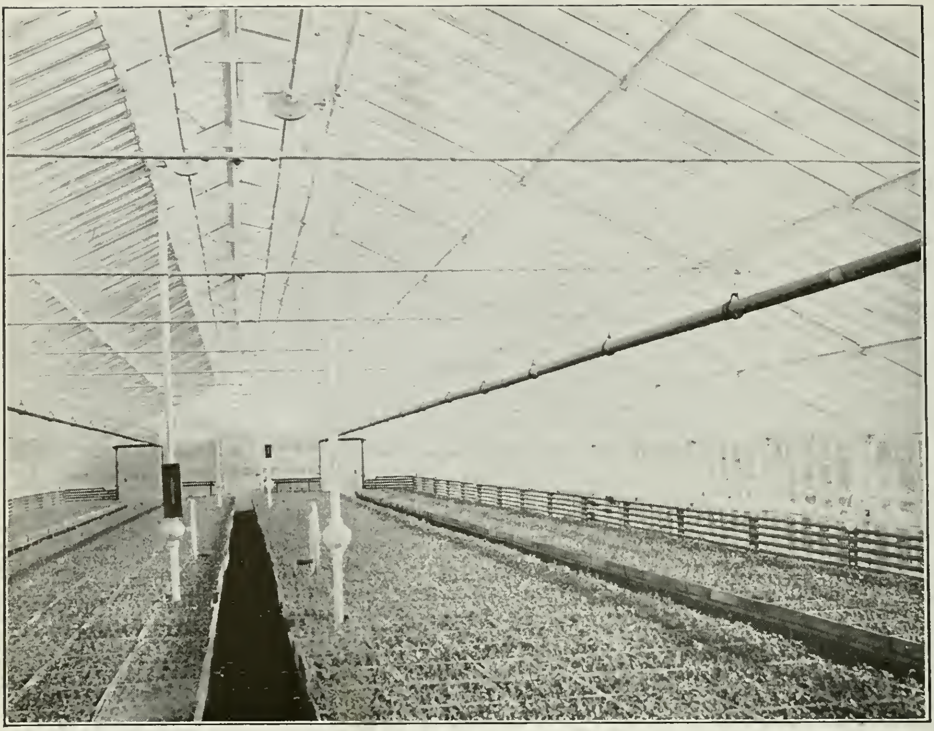
Ridge Ventilation.—This placing of ventilators has been in use since greenhouses were built on any scale and they are still a necessity. The ventilators in this case are attached in two ways, namely, from the ridge board or from the header set between the sash bars. In this way the vents open out from the ridge and from the headers or more easily explained opening back to back and away from one another. From this arrangement we have in the case of one opening from the header the air admitted in one large opening and going straight down into the house and in the case of those opening from the ridge the air is admitted through two openings, the air being deflected against the ventilator on the opposite side before going down. In this way the force of the air is broken.

Where ventilators open from the header there is greater danger from the rain getting in even if the ventilator is partially closed. Where the ventilator opens from the ridge the air can come in with very little danger of any rain getting in. An important point to be considered in ridge ventilation, whether ridge or header type, is that both lines should work separate in order that in the case of a strong wind from one side the ventilators on that side may be closed, while the others will remain open and complete ventilation of the house still be carried on. Some growers complain that the ridge type of ventilators allow an inward rush of air which has caused severe checks on the plants, while in the header type this rush is broken and the air admitted is distributed evenly through the house.



Gable end ventilation as yet is the idea of some one grower. This shows the arrangement of the ventilators which open out. Houses also have ridge and side ventilators.

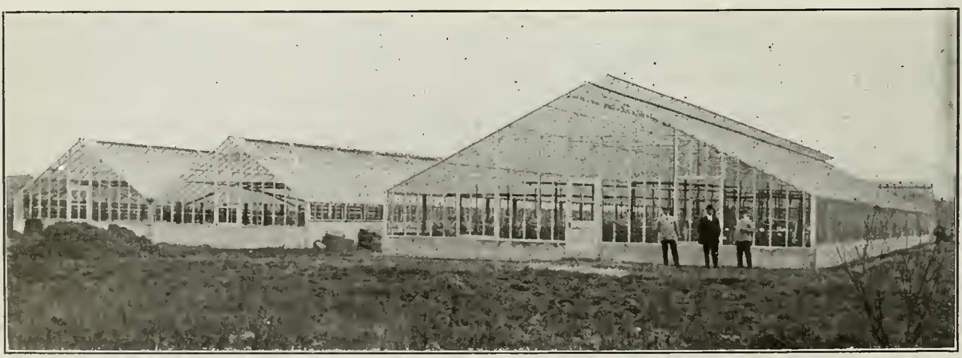
Gable end ventilation is probably more or less of an experiment as yet, but it is being advocated by some plant owners. They would advise a continuous or broken line of ventilators on a wide, high house set in a horizontal position or two or three small vents in a perpendicular position. In both cases these vents should be above the door. It is quite possible that very little more ventilation will be needed in many houses than that given by the door, which should be built sufficiently large enough to be used for admitting a waggon. All forms of ventilators are usually operated by a system of ventilating machinery which is controlled by a wheel or a chain driving some form of gear which by revolving will open the ventilators. Many forms are on the market, and it is difficult to choose as each and every device has its exponents. In large houses a system running 150 to 200 feet should be secured in order to open the maximum amount of glass with minimum labor. For the smaller houses, growers in many cases do not buy ventilator machinery, but have some appliance such as an iron rod with holes drilled in it, which, when the vent is opened fit on to nails set on the plate. These may be all right in some cases, but as a general rule, in any house 20 by 60 ventilating apparatus will pay for itself in the amount of labor saved. Where two systems are necessary to open up the glass they should be located so that both can be operated from the one point, preferably the centre of the house, instead of being located at both ends of the house thus necessitating extra labor.



Double ridge ventilation and side ventilators on both sides are found in this house. Ridge ventilators operated in centre of house by two gear supports.

JOINED OR SEPARATE HOUSES.

At the present time there is considerable controversy about the merits of joined or separate houses. Growers in the east use separate houses almost entirely while those around Chicago have used ranges of joined houses. It appears on investigation that where wide houses are being built, separate ones are used entirely.



Joined and separate houses are often found in the same range. In such cases the grower nearly always prefers the separate house and advocates this arrangement only.

Ranges of narrow houses are giving good satisfaction but the growers are building their new ones of wide separate houses. The merits of the separate houses may be given briefly as follows:

(1) Side ventilation is recognized as a necessity among vegetable growers, and this can be secured amply by having separate houses.

(2) Different temperatures may be kept in different houses thus enabling the growing of crops requiring several degrees difference in temperature.

(3) Heating systems can be built so as to shut off entirely one house if the occasion should so demand.

(4) Disease is not so liable to spread from one house to another.

OBJECTION TO JOINED HOUSES.

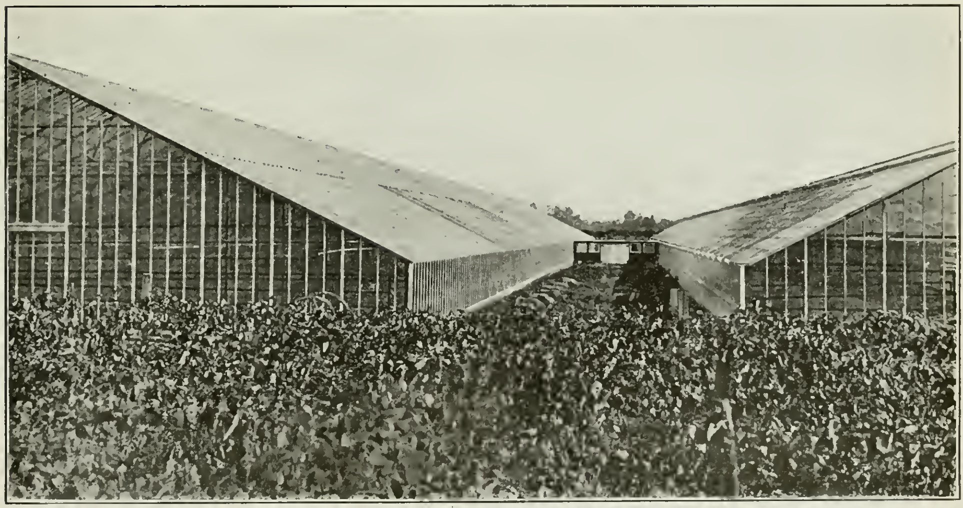
(1) Where the range is large adequate side ventilation cannot be secured.

(2) Unless glass partitions are erected in joined houses different crops requiring high and low temperatures cannot be successfully grown.

(3) Heating cannot be regulated in case of accident, etc.

(4) In joined houses disease will spread quickly from one house to another.

In regard to the heating of the two styles of houses it is claimed by owners of large ranges that there is very little difference in the cost. Of course some claim



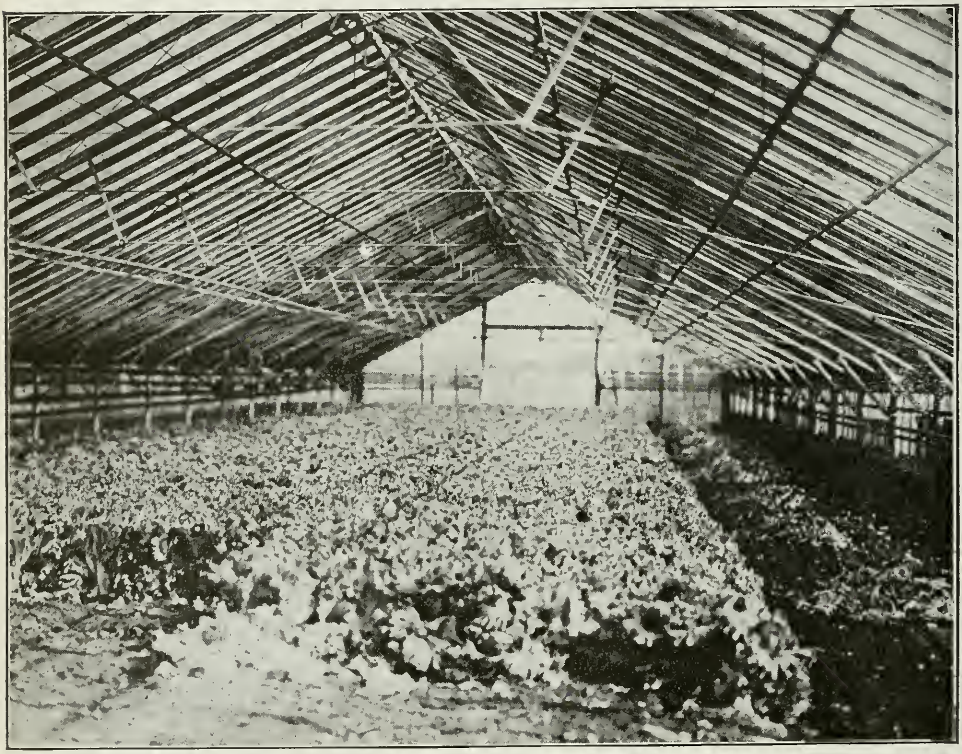
Large houses built separately are usually joined by an alley house from 10 to 30 ft. in length. The space between the houses is often utilized for hot beds, cold frames, and for such crops as corn, squash, staked tomatoes or rhubarb.

exorbitant saving on their particular houses but this cannot always be verified. On the whole separate houses can be heated with practically the same cost as houses on the connected style.

Alley houses are usually built connecting the separate houses for convenience of carrying supplies, etc., and the heating main is usually carried through these minimizing the loss of heat.

WALKS.

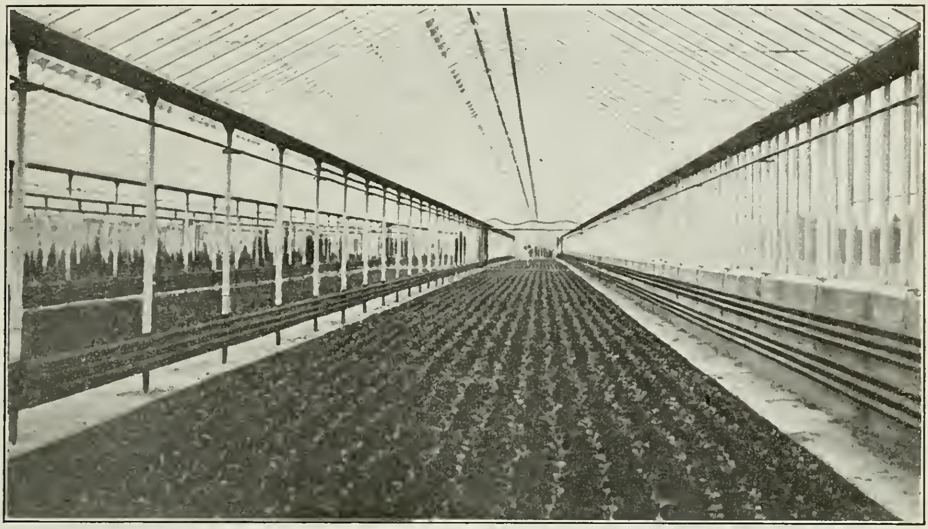
In the majority of large plants visited, no permanent paths or walks were to be found. In all houses having raised benches a path would be found in between beds. The growers at the present time seem to be eliminating everything that hinders the most intensive cultivation of the soil under glass. Where all crops are grown on the soil, and where horses are used to prepare the soil for the crop, no paths are to be found, because they would be more of a hindrance than a help. Sufficient room is left at intervals in planting the crop to allow for passage between. In the majority of cases the ordinary greenhouse soil is trodden down until it becomes solid for walking. In some cases men lay a ten or twelve inch board down the house and use this for a walk. Never a slat walk 18 inches or two feet, this would be a waste of productive soil. In other houses concrete walks are to be found. These are usually about 12-15 inches wide, and are made on either side of



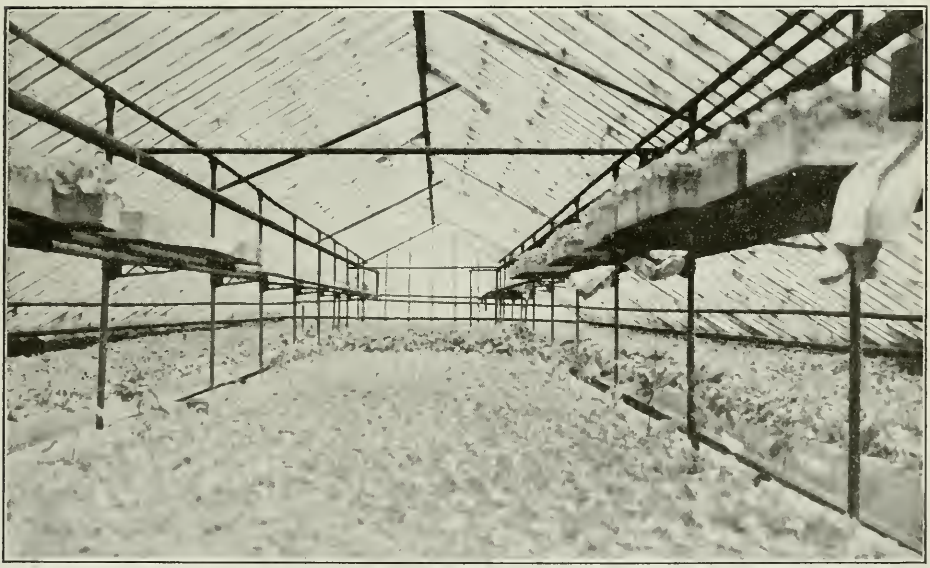
Walks are usually 12 to 15 in. wide, allowing ample room for crop to grow.

a line of purlin supports, or as close to the gutter supports as possible, leaving all room possible for the growing of the crop.

More elaborate houses have a concrete walk with a 3-5 inch side, which acts as a side for the bed, being 3-4 inches high. These walks are never more than 18 inches in width. Where a house is fitted out in this manner there is usually some good reason for it, which usually amounts to the grower having easy access to a sand or gravel pit or that the paths are a necessity to accommodate the visitors. In making concrete walks the foundation should be down about 5-6 inches. Coarse stones and gravel will do for this, and should be made at the ratio of 6-1 with cement. A smooth surface on top is necessary, no stones being allowed to come near the surface. A well pounded cinder path will give satisfaction, but is not so good as concrete where a path is absolutely necessary.



Concrete walks should be placed so as to enable ease of cultivation. Eaves should be high enough to permit walking under. This view is of ten acres under glass near Toledo, Ohio.



Raised benches are necessary where rhubarb is forced. In narrow pipe frame houses iron supports are often clamped to the supports to make a shelf for early plant boxes.

BEDS OR BENCHES.

A question which must be decided before the heating system is installed is whether the crops are to be grown on beds or benches. For many years it was taken for granted that the crops must be grown as close to the glass as possible, and for this reason the houses were built with short sides and the crops were grown on benches raised up from the surface of the soil to about four or five feet, thus bringing the plants fairly close to the roof. During late years this idea has almost entirely disappeared, and lettuce, tomatoes, and cucumbers are set in the soil as it has been enclosed by the glass house. No raising of beds is to be found in any of the larger plants where vegetables are grown extensively. There are certain points in favor of both of these methods and it may be of interest to go over them briefly here. In a greenhouse 75 by 200, for example, all operations of cultivation, etc., are carried on by means of horses. Plowing, harrowing, disking and spreading of manure, lime or fertilizer are all done by means of horse drawn implements, and for this reason no raised benches are found in houses of this kind. It is quite obvious why plants can be handled quicker and with less labor on ground beds and such operations as tying of supports, staking or even transplanting can be carried on much more satisfactorily. Growers find that they can grow any crop just as satisfactorily on solid beds as on the raised benches used by many growers for years.

In case of a small house, say 22 by 80, where the grower is not making a specialty of indoor crops, but is using the house more as a plant house for early plants such as cabbage, tomatoes, onions and celery, etc., the raised benches are very often used with success. Conditions are entirely different in houses of this width, and it is quite possible that better results may be had from raised benches for starting early plants. Watering can is controlled more easily and that is a prime necessity in a plant house. In houses of this size, and using raised benches, their height from the soil will depend on the grower's individual ideas. Some prefer them only two and one-half feet from the surface, others three feet up to four feet. A very good bench is one raised three feet from the top of the surface soil. Heating pipe will have to be laid under this to get the best results, and as a general rule a section of the return runs are brought back under the benches. Where it is desired to force rhubarb in the greenhouse the raised benches serve the purpose better than any other method. There is sufficient room for the plants, the heat can be controlled, the plants are out of the way, and the darkening can be controlled as well.

Points against the use of raised benches are:—

1. Initial cost is very high and so is the upkeep, as the benches are continually rotting out.

2. Cultivation cannot be easily handled.

3. A great deal of space is wasted by paths, etc.

Raised benches seem to be the best thing for the small greenhouse grower, because he can force his rhubarb or grow his mushrooms under them, and he is not pressed for time, etc., and uses the house more as a plant house, making what returns he can during the winter months. For the commercial grower the solid beds are recommended and give entire satisfaction on good soil which has the proper drainage, etc.

The benches are supported by cedar posts or by solid concrete supports, the latter being fitted with an enlarged base which sits on the ground and supports either wooden or concrete sides. Ordinary pine or hemlock is often used for these benches, but most florists prefer cypress on account of its lasting powers, and pecky cypress is coming into favor more each year. Pipe supports are now being used considerably for the support of benches, and give very good satisfaction. The width of the bench, etc., would determine the size of bracing of pipe. Benches for use in vegetable houses usually have six to eight inches of soil.

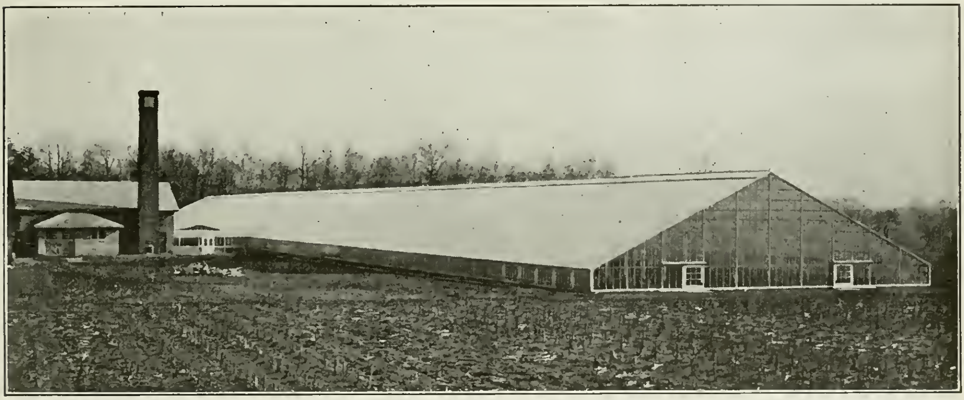
WORKROOMS.

Not the least important part of the greenhouse is the workroom. The crop has to be handled right in the plant several times before it can be shipped out, and all or most of this work must be done in the workroom. Greenhouse men are beginning to realize that this room must be a permanent, well built structure, sufficiently large to handle all the crop, and not become congested at any time.

Usually the workroom is located close to the boiler room in as central a position as possible. The boiler house will have to be set according to the location of the plant, so as to heat economically each part of the house or houses. As a general rule the workrooms are built to one end of the boiler room. Light, airy, convenient rooms are best.

A brief description of some rooms seen might be of value.

R. Yonkers, Grand Rapids, Mich. Boiler room and workroom end to end. Building constructed of concrete blocks laid with red mortar, size 30 by 50 feet. Angle iron rafters with truss supports, several large casement windows, concrete floors throughout with drains, concrete wash tubs and a bench for dripping at



Greenhouse plants require good workrooms. More attention is being paid to them each year. Each labor-saving device should be well considered before being installed.

right hand of tub. A small division is made to form an office in which all accounts, etc., are kept. The whole room is lighted with electricity. Door on front is large enough to allow waggon or motor truck to be backed in and loaded handily from the packing floor. All woodwork is painted and the whole inside is of a pleasing appearance and spotlessly clean.

R. L. Reutenik, Cleveland, Ohio. Workrooms located along ends of houses. Concrete floors and wooden walls. Here again permanent wash tubs and tables are found. Here the waggon is backed into another shed which is at one end of the workroom and the bottom of the waggon is set lower down than the floor of the workroom so that the boxes do not have to be lifted so high in loading. This room is also well lighted and fairly airy.

Goldwood Greenhouse Co., Cleveland. New plant with boiler room and work room together. Concrete is used as main form of construction, plenty of windows, electrically lighted and wash tubs, etc. The particular point is that waggon may be backed into excavated part and goods may be loaded on the level. No lifting whatever is needed on this account.

The builder in Ontario will do well to realize the importance of these large airy rooms. Small cooped up workrooms are not an advantage and the produce tends to become mangled. The points mentioned particularly about the above houses are labor savers and have been well considered before they were adopted. Men who have to drive their produce to market have found out that lettuce loaded in a fairly warm room and securely covered has a better selling value than lettuce carried out into the frosty air to be loaded. Little points like these are what are making money for these men in the greenhouse business on the other side and some might well be copied here.

GLASS AND GLAZING.

Too much importance cannot be given by the builder to these points. The outside surface of the greenhouse is that which receives the direct blows, and it must be strong enough to withstand the severest storms.

There are many grades of glass on the market which have been sold as suitable for greenhouse building. Ordinary window glass will not do; a stronger grade is necessary. A heavier grade of glass is used for greenhouses. The glass should be carefully gone over and all lights having flaws or whorls in them should be discarded. Burning of the crops underneath will result from the strength of the sun's rays. Another point which should be remembered here is that of evenness of edge. This is absolutely necessary where success is expected with butted glass.

Sizes 16 by 24 inch glass is the most popular size in the U. S., while many growers use even a larger size. Some using as large as 20 by 30 in districts where there is litle danger from hail or from very severe wind storms. 16 by 24 is used in different ways laying it the 16 inch way and the 24 inch way, thus placing the sash bars 16 inches apart and 24 inches apart. Some growers claim that there is considerably less breakage when the bars are laid to hold the 16 inch glass. In other sections it seems to be the rule to use glass the same width as above, but 12 inches in length. This still gives the bars 16 inches apart, but makes the joints come just twice as many as with the 16 by 24 inch glass. This method uses the same amount of supports, but is not in favor by the majority of growers owing to the fact that there are such a number of joints or laps whichever the case may be. Growers prefer the 16 by 24 inch glass, and take the chance of heavy breakage bills. In Ontario, glass 20 by 20 inches in size is the most popular among those having plants of any size. This gives a good light, and is convenient for use with bar and cap, which is the common method of putting on the glass in Ontario houses. Owing to the square there is double the chance of securing a tight fitting joint, as the four sides of the glass may be fitted. This is a good size of glass to use, giving plenty of light, and being not too large so as to increase the breakage cost; 16 by 16 inch glass can also be used and for the same reasons. It is not advisable to use glass of a larger size than 16 by 24 in Ontario, and most growers will not chance that size, preferring to take a little more shade but lessening the repairs and using either 16 by 16 or 20 by 20.

Butted or Lapped Glass.—Butted glass is commonly to be found on greenhouses in Ontario, and means that the sash bar is so constructed as to allow the glass to be laid on, one light butting against the next one up, and then a wooden strip which fits on to the bar is screwed on, and this holds down the side of the glass.

Lapped glass is commonly, almost entirely, used in the United States. This means that the glass is laid up in the same manner as shingles, one light overlapping the one underneath it. The lap is usually 3/16 or ¼ inch. Any more makes a poor job and dirt collects in the small space, and becomes very unsightly and causes a certain amount of shade. With the lapped glass construction the glass is usually bedded in putty, while with the bar and cap no putty is used nor no glazing point. A zinc strip attached to the gutter or eave holds the bottom light in place and the others above rest on it. If lapped glass is to be laid, only first class greenhouse putty should be used. Ordinary putty secured from a hardware store will not do. It will crack and peel off in about two years time, necessitating going over the whole house again.

This grade of putty will cost a few cents more per pound but will save in the long run. It cost some growers in the States this last year several hundreds of dollars to re-putty their houses because they used an inferior putty at the start. This can be procured from any reliable firm who make and handle greenhouse materials.

Glass should be laid convex side up or with the bowed side to the weather. practically all American houses are equipped with lapped glass, and practically all Ontario houses have butted glass. The butted glass is handier in some cases to put on in case of breakage, and yet the close fits and the jagged edges sometimes found tend to cause more breakage. If there is any jar or move of the frame one piece of glass is pushing against another in the case of the butted glass, whereas with the lapped glass the one light has a chance to slide on the one beneath before it will break. Lapped glass properly bedded in putty will give a warmer house than the butted one. There is always an opening between the best butted glass, and this allows for the escape of warm air and permits rain and moisture to get in. More unsightly houses, due to collecting of dirt on the lights which has run in through the butt opening and down the inside of the light, will be found than from dirt collected under the lap in a well bedded house.

The objections to lapped glass encountered more than anything else was that it was awkward to fit a broken light. This point was admitted by many growers, but they have a counter claim that the breakage is not one-quarter that of a butted glass house. The glass in the latter is simply shoved in at the bottom, thus shoving all the lights up until there is sufficient room for the light being replaced.

Glass comes in boxes holding 100 square feet. There is always more or less breakage in them, but the builder should insist that he is given D. D. English 21 oz. glass or he should get double strength (D.S.) American glass.

HEATING.

Hot Water Heating.—The heating is the next point which must be considered. Hot water and steam are the two sources of heat for greenhouses yet. A great deal can be said for and against each kind of heating, and it is a problem to say which is used the most. Both systems have been improved in the last 10-15 years, and both systems are built to give maximum service. Hot water heating may be divided into two systems; the gravity system and the pressure system. In the gravity system the water circulates from the boiler through the coils and back into the boiler again, because after it reaches a certain point there is a drop in the pipe system and the water naturally seeks its own level. The pressure system is where there is some device which forces the water on its own course over the pipe system. This is usually a mercury generator or some form of pump. Both of these machines have their advocates, and many have success with either. The gravity system has its limitations, however, and the first one is that the water cannot be carried over 150 ft. of coil away from the boiler with good success. Some plants are working to-day at 200 ft. away from the boiler, but the best results are not being obtained because of overloading the boiler. Some growers claim that the highest point of the heating system should be at the boiler, thus giving the water a drop all the way into the boiler again. The pipes should have a drop of ten inches per 100 ft., for successful running of the gravity system. With the mercury generator or some form of circulator the water can be forced over 400 ft., this being over twice the distance of the gravity system. The pipes do not need so much grading in this form of heating. In this system the water is forced through at a greater rate than by gravity, and it comes back to the boiler containing more degrees of heat than that which has passed over the system working according to the laws of gravity. This point means more than is often thought, and should be investigated thoroughly before any system is selected. The longer the water takes to travel around a heating system the less number of degrees of heat it contains when it again comes to the boiler. All this water has to be heated over again, and thus it is quite apparent the more degrees the water has to be raised in temperature the more units of heat required and this falls back again and increases the consumption of coal.

The gravity system is to be recommended for small houses such as 30 or 40 by 100 or 150 but may be used up to 30,000 square feet of glass. For larger houses, and where there are several in a range and hot water is wanted, some form of circulator is recommended. There are some good pumps on the market, and as a rule they are run by steam. A small steam boiler is necessary for the pump alone. One of these is giving good service at the Goldwood greenhouse near Cleveland, Ohio. Another method used in the vicinity of Rochester is that of a centrifugal pump operated by a ⅕ h.p. electric motor. This system has given entire satisfaction, and the cost for power is very small. This method is not a common one and should be inquired into thoroughly before being attempted. Hot water heating is never recommended for plants having much over 100,000 sq. ft. of glass but this will no doubt be overcome in the future.

Steam Heating.—For long houses and for large houses or large ranges the use of steam is advised. In these cases where the heat has a long way to travel it can be carried to a better advantage and with a less cost of fuel by the steam system. There are several systems of steam heating which may be installed, but there are only two of these that have been satisfactorily applied to greenhouse heating. These are the high pressure and the low pressure systems.

The low pressure system is used to a great extent and this is one that operates at a pressure of 1-10 lbs., usually 5-6. This works by gravity and the condensation is carried back to the boiler without any circulator of any kind. This system necessitates that the boiler must be several feet below the lowest return in the house. This is the limiting factor for this system as it is not always convenient to have the boilers in a pit as this entails. This pit may be overcome and the boilers placed on a level with the houses by the addition of a steam trap which lifts the water into the boiler from the returns. This arrangement is found in many plants giving good satisfaction. Here again the steam pump may be used to draw back the condensation but the steam trap is more effective and is less liable to get out of repair.

The other system of steam heating used in greenhouses to some extent is known as the high pressure system and is where over ten pounds of pressure is carried at the boiler, reducing it as desired for the houses and bringing the condensation back by means of steam traps or pumps. This system should only be attempted on large ranges and then installed by men competent to do so.

A vacuum system of heating is being installed in some plants and works on the principle of high pressure at the boiler and by the use of reducing valves and vacuum pumps the steam passes through the coils in the houses at atmospheric pressure or under. This form of heating for large plants is recommended as the most economical now, but must be properly installed by competent men to be worked successfully.

ADVICE TO PROSPECTIVE BUILDERS.

(1) All construction companies keep a staff of men whose business it is to give all information in regard to their forms of construction. They are there for the builders' benefit.

(2) Find out all about the different makes before making your selection.

(3) Do not give an order for material until you are satisfied it is exactly what you require.

(4) If in doubt ask or write some grower who will give you an unbiased opinion and knows whereof he speaks.

(5) Successful growers follow the rules "the best is none too good" and "a poor thing is dear at any price."

(6) Construction companies are used to building large ranges and will give you the benefit of their experience in regard to location, site, etc.

(7) Insist that all the accessories such as nails, ventilating apparatus, putty, paint, etc., be of first class and that they are properly used.

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ONTARIO AGRICULTURAL COLLEGE

BULLETIN 225

Swine

By

G. E. DAY, B.S.A.
Professor of Animal Husbandry

TORONTO, ONTARIO, NOVEMBER, 1914

BULLETIN 225] [DECEMBER 1914

Ontario Department of Agriculture

ONTARIO AGRICULTURAL COLLEGE

Swine

By G. E. DAY, B.S.A.

PART I.

THE PLACE OF THE HOG UPON THE FARM

The swine industry occupies a rather peculiar position in many localities. Swine multiply rapidly and come into use for breeding at an earlier age than other farm animals; consequently, it takes only a short time for farmers to increase or decrease their stock, as the case may be.

Fluctuations in Hog Supply.—When, owing to scarcity in the supply of hogs, the price for hogs goes up, we find farmers increasing the number of breeding sows, and in a very short time the supply of hogs coming to market increases to such an extent that the price is likely to break. If the decrease in price is very severe, the farmer becomes disgusted, and the chances are that many farmers will sell their breeding sows and practically go out of the business. This unloading process adds to the burden of the market, and general demoralization is apt to follow. By and by, after the market has absorbed the excessive supplies thrown upon it, a scarcity occurs again, owing to so many having gone out of the business of hog raising, and prices once more reach a high level. This is a signal for farmers to rush again into hog raising, and overstock their farms in many cases, so that once more the market becomes top-heavy, and the history of the hog market repeats itself.

Now, it is altogether probable that very few of those who were tempted to rush into the business on account of high prices obtained any profit from the venture. They paid high prices for breeding stock, but by the time they had hogs ready for the market the decline in prices began, and before they were through they were selling their hogs at a loss.

Profit from Hogs.—The man who makes money out of hogs is the man who has hogs to sell when prices are high, whose farm is never over-stocked, nor yet entirely depleted of its supply. He knows how many hogs his farm will carry to advantage under average circumstances, and he practises a wise conservatism. When prices are high, he has a good profit, when they are low, his profit is small, but the average is fairly satisfactory. He may slightly expand or contract his operations at various times, but he never "plunges."

The "plunger" is apt to find himself "in" when he ought to be "out," and "out" when he ought to be "in." The other man is "in" at all times, but never to such an extent as to be seriously damaged when the market goes wrong.

It is not the object of the writer to urge farmers to feed more hogs—far from it. Every farmer must be his own judge in this matter, and many farmers should never attempt to raise hogs, owing to the fact that either the man himself is not adapted to the business or his conditions are unsuitable. Nevertheless, it is true that a few hogs might be kept profitably upon many farms where they do not find a place to-day.

Hogs a By-Product.—Generally speaking, the hog may be regarded as a by-product of the farm, or, in other words, he is a means of marketing the by-products of the farm. In the cattle feed lots, we find him utilizing the corn which the cattle have failed to digest and which otherwise would be wasted. In the dairy district, he is the means of obtaining good value for skim milk, buttermilk, and whey. Where mixed farming is practised, he consumes any dairy by-products, small potatoes, and various other unmarketable substances, and gleans the stubble fields, returning to his owner cash value for substances that are completely neglected on many farms. Even the cottager frequently utilizes him to obtain a cash return from kitchen refuse and table scraps. It is as a consumer of by-products and so-called worthless materials that the hog shows to the best advantage from the standpoint of profit.

Advantages of Home-grown Feeds.—The farmer who raises most of his own feed is in a much better position to feed hogs, or any other class of stock, than the man who has to purchase all his feed. The farmer who grows his own feed may not get any more than market prices for the grain or other produce consumed by the hogs, and may still have a fair profit through selling his produce at market prices in the form of pork; but the man who buys his feed can have for profit only what he obtains in excess of the market value of the feeds consumed by the hogs. Thus the farmer who grows his feed has two sources of profit, namely, the grower's profit, or the profit obtained by selling his produce at market price; together with the feeder's profit, or what he obtains for his produce in excess of market price by selling it in the form of pork. The man who has to buy all the produce which he feeds his hogs can have only the feeder's profit, and under unfavorable conditions this profit may be so small that it will scarcely pay for the labor involved.

Raising Pigs.—Another point worthy of consideration is the fact that under favorable conditions and skilful management, young pigs can be raised for feeding at a lower cost than that for which they can be bought. This point will be dealt with more fully in another place but is mentioned here as one of the factors which help to explain why some people can make hog feeding profitable, while others cannot.

Judgment Needed.—One of the great difficulties in connection with the swine industry is the fact that so many people are not content to engage in the undertaking except on a large scale, and the people who can handle hogs in large numbers and make the business a financial success are comparatively few. The average farmer is safer to handle hogs in rather small numbers, and use them as an adjunct to his other farm operations. Used in this way, and handled with a reasonable degree of judgment, the hog will give a good account of himself in adding to the revenue and the profits from the farm. A very few years' experience should enable a farmer to determine just about how many hogs he can raise to advantage. Some farms will carry very large numbers owing to the system of farming which is carried on, but for many of the smaller farms one breeding sow is plenty.

Hogs and Dairying.—The hog fits in especially well upon dairy farms where skim-milk, buttermilk, or whey has to be fed upon the farm. Perhaps no animal will give as high returns for dairy by-products consumed as the hog, and no feed gives a finer quality of bacon than dairy by-products. It is also worthy of note that the man who has skim-milk is in a better position to raise pigs than the man who has none, for the reason that it is difficult to find a satisfactory substitute for skim-milk for young pigs just after weaning.

Pure-bred Hogs.—What has been said in the preceding paragraphs has no reference to the raising of pure-bred hogs for breeding purposes, but applies simply to the production of market hogs. The breeders of pure-bred hogs understand their business, and know about how far their conditions warrant the extension of their operations, so that it is not so necessary to offer suggestions to them along this line. It is true that the breeder of market hogs always has a use for pure blood, but it is not every person who can make a success of breeding pure-breds to supply the demand for breeding stock, and the average farmer is safer to adhere to producing market hogs.

Summary.—To sum up, it may be said that the hog is especially valuable for consuming the by-products of the farm, and the number of hogs carried to advantage upon a farm is governed very largely by the quantity and character of the by-products to be consumed. When carried in appropriate numbers, the hog is an exceptionally economical producer of meat, preventing waste, and giving cash returns for substances that are frequently wasted, or which have little market value. Trying to take advantage of fluctuating market prices by alternately over-stocking and under-stocking with hogs is seldom a financial success. The man who consistently follows up the business upon conservative lines is the man who is well satisfied with the hog as a source of profit.

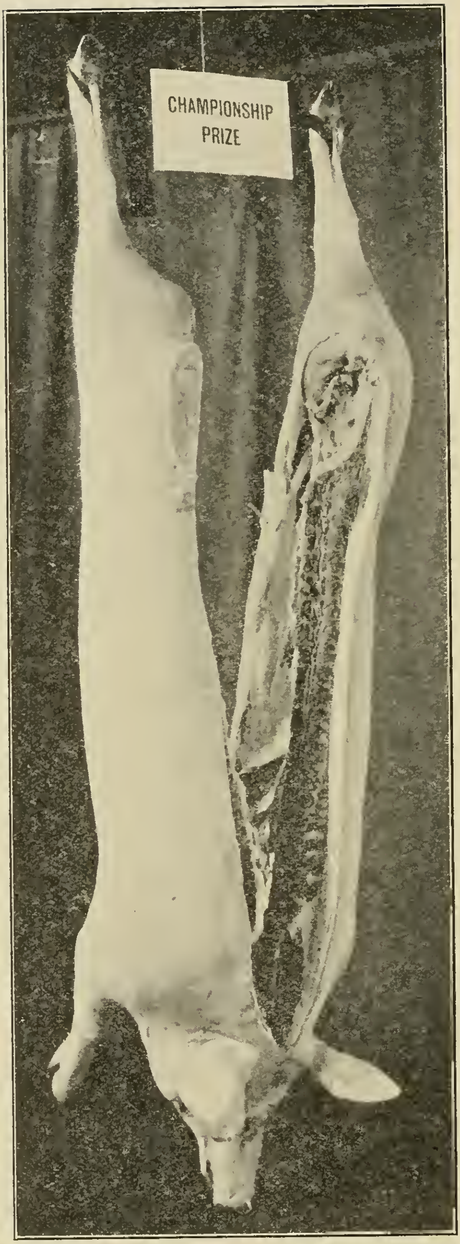
PART II.

TYPES OF SWINE

There are two well-defined types of hogs, which are the outcome of local conditions and market requirements,—namely, the fat or lard type and the bacon type.

Reasons for Two Types.—The fat or lard type of hog is the product of the "corn belt." Corn feeding has a tendency to produce fat at the expense of muscle or lean meat, and corn is the principal hog feed of the United States. Most of the hogs of the United States are grown in the great corn-producing States, and it is here we find the lard type in its highest degree of perfection. This type plays an important part in the exports of the country.

But, in addition to the demand for the products of the lard hog, there is an important demand, both at home and abroad, for a leaner class of meat. In some of the large cities of England this demand has taken a definite form, and what is known as the "Wiltshire side" is especially designed to meet this demand. A hog suitable for manufacturing into "Wiltshire sides" is known as a "bacon hog," and breeding stock of a type suitable for producing bacon hogs is said to possess bacon type. Bacon hogs cannot be produced successfully under a system of corn feeding, and hence we find the bacon hog produced in greater numbers in countries where the feed for the hog is more varied in character, and where the conditions are less favorable for producing the lard hog than they are in the United



Champion bacon carcass, Provincial Winter Fair, Guelph.

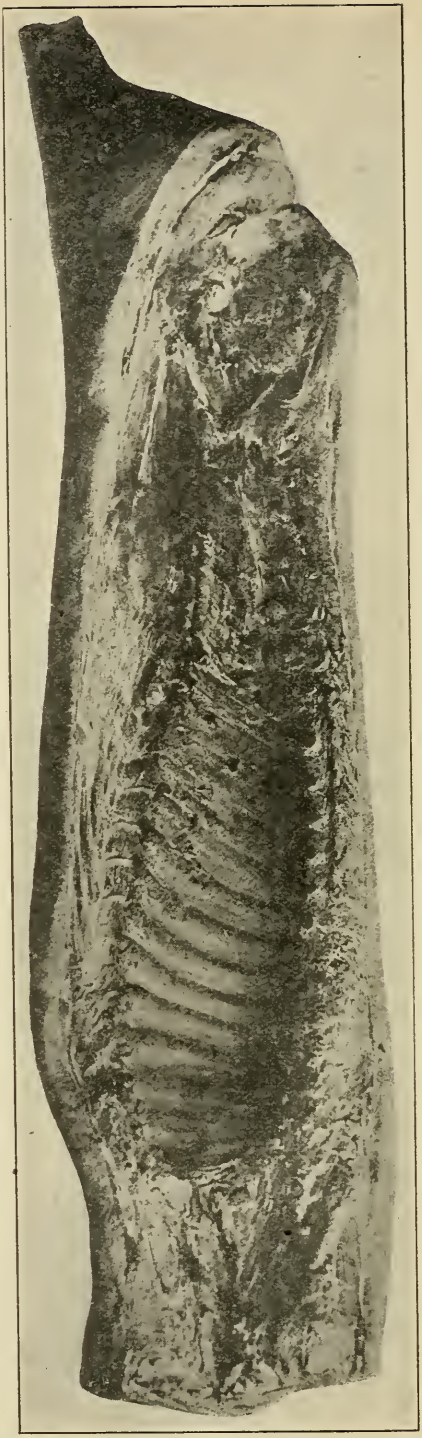
States. The countries sending the greatest number of Wiltshire sides to Great Britain are Denmark, Canada, and Ireland. Generally speaking, hogs cannot be grown so cheaply in Canada and Denmark as they can in the United States, particularly in the corn belt; but, on the other hand, Wiltshire sides usually command a higher price per pound in England than the meat of the lard hog. This higher price for finished product affords some protection to the swine industry in Canada and Denmark, and it was to escape direct competition with the American product in Great Britain that Canada and Denmark engaged in the production of bacon hogs and the manufacture of Wiltshire sides. Such an arrangement seems to be the part of wisdom, each country devoting its attention to the type of hog which it can produce to best advantage.

The Bacon Type.

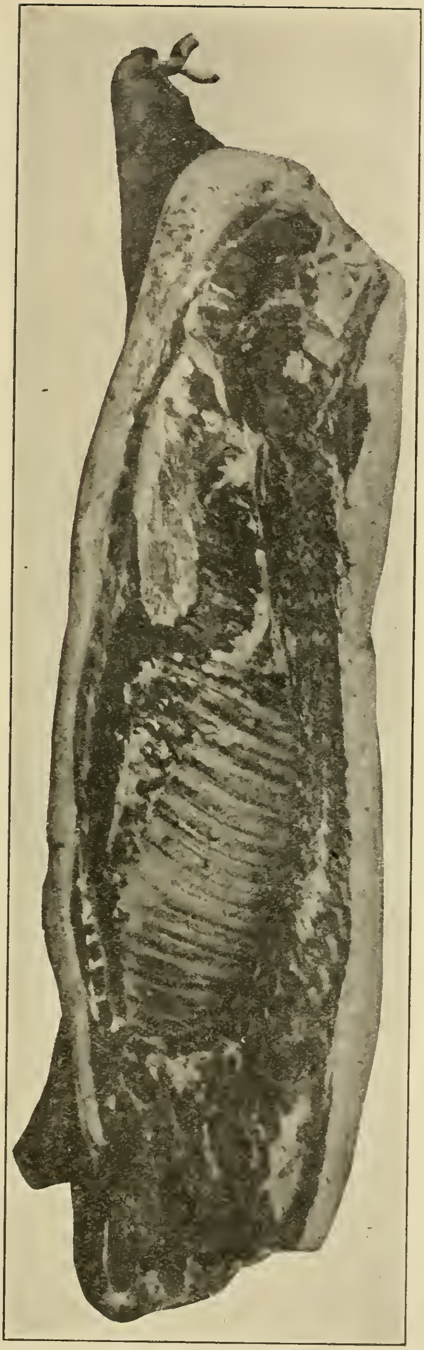
To produce a good Wiltshire side of bacon requires a hog of certain definite peculiarities as to weight, condition, and conformation. The customers for this

Fig. 1.—Pair of export bacon hogs.

class of bacon are extremely fastidious, and, if the bacon does not come up to the standard in every particular, it is very heavily discounted in price. As a rule, the weight limits are usually fixed at 160 pounds to 200 pounds live weight. It is true that a hog may weigh slightly more than 200 pounds and still make a very good Wiltshire side, but most hogs are inclined to be too fat after they pass the 200-pound mark, and consequently this is fixed as the limit, though it is not strictly adhered to. As to condition, it is possible to have the hog too thin or too fat. When the carcass is split down the back, the layer of fat along the back should run from an inch to an inch and a quarter in thickness, and should be as uniform in thickness as possible from the loin to the neck. The most valuable meat in a Wiltshire side is the upper part of the side from the ham to the back of the shoulder, including the upper corner of the gammon or ham, the loin, and the upper half of the ribs. The lower part of ham and the flank and belly meat are



An ideal Wiltshire side of bacon, showing how the side is trimmed and the shape in which it is placed upon the British market.



A side of bacon which is too short and decidedly too fat for a Wiltshire side.

not worth as much per pound as the upper portions, and the shoulder and neck are comparatively cheap parts.

Conformation.—In form, the bacon type of hog is very different from the lard type. It is longer in the leg and body, has less thickness and depth of body, and is lighter in the shoulder, neck, and jowl. The hog should be long from the back of the shoulder to the ham, but comparatively short from the back of the shoulder to the snout. Along with the length, however, the hog must have sufficient depth and thickness to denote constitution. No matter how long in body it may be, if it has long, coarse legs, and a narrow, cramped chest, it is an undesirable type to breed from. A trim belly is desirable, because the belly meat is cheaper than the upper part of the side. In judging sows that have produced several litters of pigs, some allowance must be made in this connection.

A fine, smooth *coat of hair* denotes thriftiness and good quality of flesh. Wrinkles on the skin, if at all marked, indicate coarse-grained flesh. Softness or

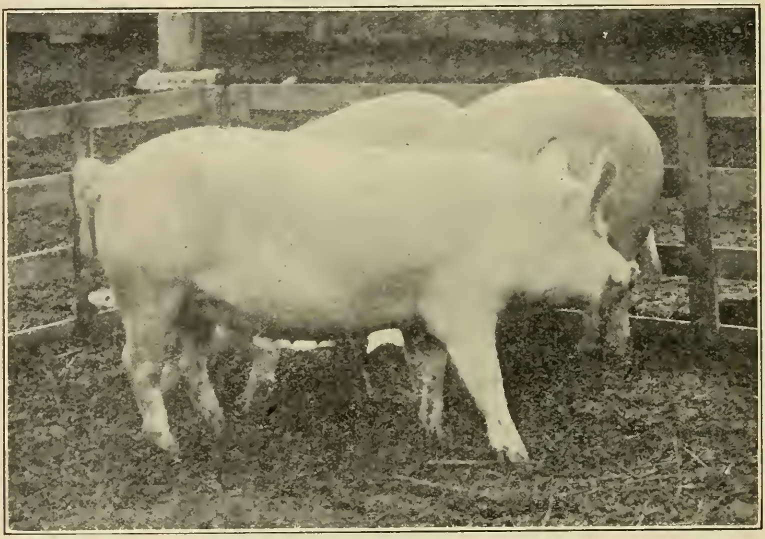


Fig. 2.—Bacon type. Note light jowl, neck and shoulder.

flabbiness of flesh denotes too much fat in proportion to lean. There is a marked difference between the handling qualities of a finished bacon hog and a finished lard hog, the former being much firmer to the touch. The bacon type of hog has heavier bone than the fat or lard type, but very coarse, puffy looking bone denotes poor quality of flesh and is often associated with poor feeding qualities. Though the bone is fairly heavy, the legs should present a clean-cut appearance.

The *jowl* has very little market value. A heavy jowl denotest tendency to put on too much fat. Good width of jowl is desirable from a feeder's standpoint, but it should be very trim and neat.

A long, scrawny *neck* indicates weak constitution and slow feeding qualities. On the other hand, a short, thick neck with an arch, or crest of fat on top, such as is commended in the fat hog, will cause the side of bacon to be heavy at the shoulder and neck end and this is the cheap end of a side of bacon. The neck should be of only medium length, and should possess no tendency to arch on top.

The *shoulder* of the bacon hog is somewhat upright, making the animal comparatively short from the back of the shoulder to the snout, but long from the back of the shoulder to the rump. The shoulder is a cheap part, and, therefore, should be rather light. It should be very compact over the top, should be no wider than the back, and should blend smoothly into the body at all points.

The *back* carries the most valuable meat, but it should not be wide, because a wide back invariably carries too much fat for a Wiltshire side. It should possess medium width, and should carry its width evenly throughout. The top line should be slightly arched, the highest point being over the loin.

The *loin* is the most valuable cut in a Wiltshire side, and should be as wide as the rest of the back, full, strong, and well packed with flesh.

The *spring of rib* of a bacon hog is very characteristic. It should spring out boldly from the backbone, then turn sharply and drop in an almost vertical direction, giving a flat, straight side.

From a packer's standpoint, a bacon hog cannot have too long a *side*, but the breeder must exercise care that he does not secure this extreme length at the expense of constitution. It is well to avoid extremes of all kinds. It is absolutely necessary, however, that the hog should have good length of side, much more than is found in the fat type.

The *rump* affords a valuable cut, but a flat, broad rump indicates the presence of too much fat. The rump should be the same width as the back, should be very smooth, and slightly rounded from side to side over the top.

Great, broad, bulging *hams* are not wanted on the bacon hog. Such hams carry too much fat, and require severe trimming in preparing the side of bacon for market. The ham of the bacon hog is smooth and firm, and tapers toward the hock. The flesh should be carried well around the bone, leaving no bareness of bone on the inside of the thigh.

Bacon Breeds.—The leading breeds of the bacon type of swine are the Tamworth and Large Yorkshire.

DESCRIPTION AND SCALE OF POINTS FOR BACON TYPE.

A. General Appearance:

	Counts.
Size—Well developed for age	5
Form—Long, smooth, all parts proportionately developed so as to give the impression of a well-balanced, strongly-built animal. Top line, strong; under line, straight; belly, trim and neat	10
Quality—Hair, fine; skin, smooth, showing no tendency to wrinkle; bone, clean and strong but not coarse; flesh, firm and smooth, with no flabbiness at jowl, foreflank, belly, or ham	10
Condition—Well covered with firm flesh, especially along back and loin, but not heavily loaded with fat	6
Style—Active and sprightly, walking without a swaying movement, and standing up well on toes. Breeding animals should show strong character	4

B. Head and Neck:

Snout—Medium length and moderately fine	1
Face—Broad between eyes; poll, broad and full	1
Eyes—Good size, full and bright	1
Jowl—Fair width and muscular, but very neat, showing no flabbiness	2
Ears—Moderately thin, and fringed with fine hair	1
Neck—Medium length and muscular, but possessing no tendency to arch on top	2

C. Fore Quarters:

Shoulders—Smooth, somewhat rounded from side to side over top, and very compact; no wider than back, and not running back on side so as to shorten distance between shoulders and ham	6
Breast—Good width and full	3
Fore Legs—Set well apart, medium length, and straight; pasterns, upright; bone, clean and strong; feet, medium size and strongly formed	4

D. Body:

Back—Medium width, rising slightly above the straight line, and forming a very slight arch from neck to root of tail	6
Loin—Wide as rest of back, strong and full, but not unduly arched	5
Ribs—Good length and moderately arched	4
Side—Fairly deep; long, smooth, and straight between shoulder and ham; a straight-edge laid over shoulder point and ham should touch the side throughout	8
Heart Girth—Full, but not flabby at fore flanks, filled out even with side of shoulder; there should be no tucked-up appearance back of fore legs, nor droop back of shoulder top	5
Flank—Full and low	2

E. Hind Quarters:

Rump—Same width as back; long and slightly rounded from a point above hips to tail, and somewhat rounded from side to side over top	4
Ham—Full without flabbiness; thigh, tapering towards hock without wrinkles or folds, and carrying flesh well down towards hock	6
Hind Legs—Medium length; hocks, set well apart, but not bowed outward; bone, clean and strong; pasterns, upright, feet, medium size and strongly formed	4
Total	100

The Fat Type.

The fat or lard type of hog is characterized by a compact, thick, deep, smooth body, remarkable for its depth and thickness rather than its length. There should be a proportionate development of the different parts, and all parts should blend smoothly together, giving what is called compactness of form. The hams, back, and shoulders are the most valuable parts from a market standpoint, and should be largely developed. The market hog should be fattened to a high degree, because lard is an important consideration with the packer, and a well-fattened hog will dress a larger percentage of its live weight than one which is not well finished, which is another important point with the packer.

Quality is denoted by fine hair, smooth, clean skin, rather fine, clean bone, and even distribution of flesh. There should be no wrinkles in the skin, the jowl should be broad, plump, and full, but not flabby, and the belly should be reasonably trim, that is, not sagging or baggy in appearance. In breeding animals, some allowance would have to be made for sows which had produced several litters of pigs.

The animal should be able to walk freely, without apparent effort, and the *pasterns* should be short and upright.

The *snout* should be moderately fine, the face wide between the eyes, and the poll wide and full. Width between the eyes and fullness of poll denote a good feeder. The *eye* should be full, bright and of good size, and there should be an absence of creases and folds of fat about the eyes. The size and shape of the *ear* varies in different breeds, but the ear should be fine, soft, and generally somewhat small.

The *jowl* should be full, broad, deep, smooth, and firm, carrying its fullness well back toward the point of the shoulder. The *neck* should be short and deep, and should blend smoothly into the shoulder at all parts.

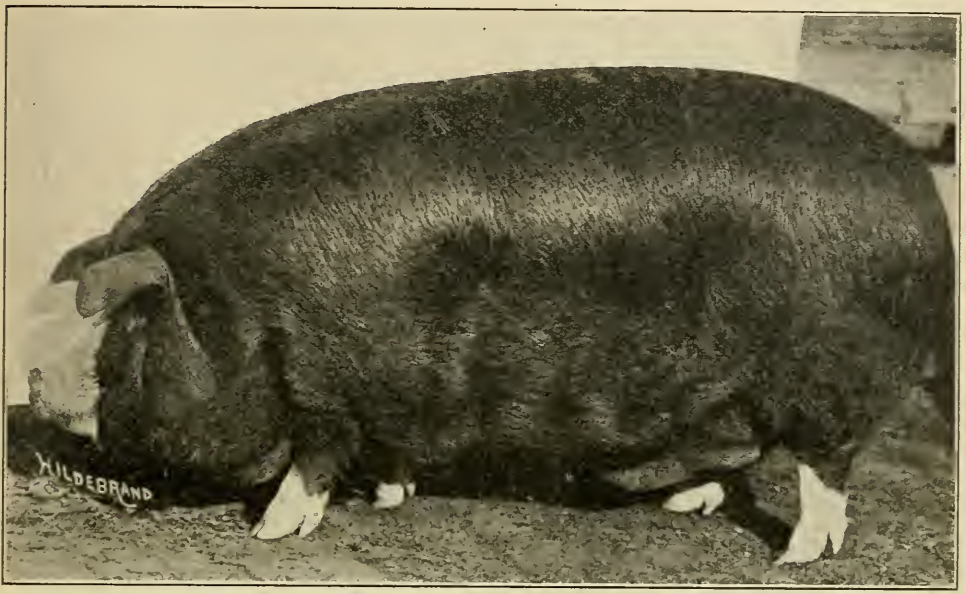


Fig. 3.—Champion barrow at the International Live Stock Exposition, Chicago. This hog shows practically perfection of form from the fat or lard type standpoint.

Fig. 4.—Grand champion pen of barrows at the International Live Stock Exposition, Chicago.

The *shoulder* of the fat hog has considerable market value, and hence should be largely developed. It should be broad, deep, and smooth; compact on top, blending smoothly into the body, and being well covered with flesh over all its parts. The *breast* should be wide, deep, and full, denoting constitution; and the fore-legs should be set well apart, short, tapering, and straight. The *pasterns* should be upright, the bone rather fine and clean cut in appearance, and the feet strongly formed.

Along the region of the back and loin lie some of the most valuable cuts, and, therefore, large development is asked for in this region. The *back* should be broad, straight, or very slightly arched, medium length, uniform width from shoulder to ham, thickly fleshed, even, and smooth, without creases or lumps. The *loin* should be broad, strong, full, and thickly and smoothly fleshed. The *ribs* should be well sprung, and the side deep, smooth, and even between shoulder and ham.

The *heart-girth* should be large, the animal being full back of the shoulder, and deep and full at the fore flanks. The hind flank should also be deep and full.

The *ham* is another important consideration from a packer's standpoint. It should be broad, deep, plump, smoothly and heavily fleshed, with the flesh carried

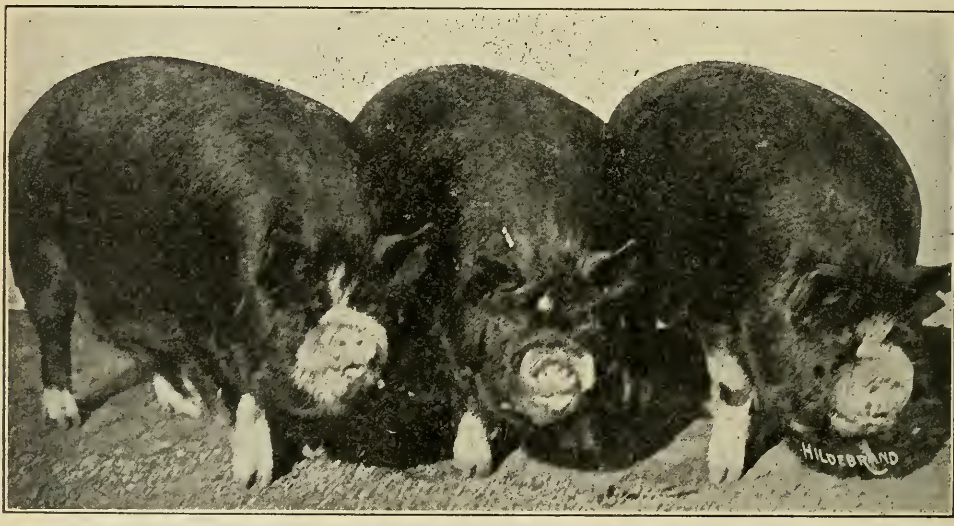


Fig. 5.—Champion pen of Berkshire barrows at the International Live Stock Exposition, Chicago.

well down towards the hock on the inside as well as at the rear. The *rump* should be the same width as the back, long, smooth, and slightly rounded from the loin to the base of the tail. The *hind legs* should be short, straight, set well apart and squarely under the body, with bone, pasterns, and feet as already described.

The above description gives a fairly clear impression of the general type of the fat hog, and shows how well the type meets the requirements of feeders in the corn belt.

Breeds of the Fat Type.—Poland-China, Berkshire, Chester White, and Durco-Jersey are the most popular breeds of the fat type. Others of less importance in America are Cheshire, Victoria, small Yorkshire, Essex, and Suffolk.

The Hampshire is intermediate between the lard and bacon types, and the same may be said of the more lengthy type of Berkshire.

Description and Scale of Points for Fat Type.

A. General Appearance:

	Counts.
Size—Well developed for age	5
Form—Deep, thick, smooth, low set, good length, but compactly built, standing on well-placed legs. Top line straight, or slightly arching; under line straight; belly, trim and neat.	10
Quality—Hair, fine; skin, smooth, showing no tendency to wrinkle; bone, clean and fine; flesh, smooth and mellow, but showing no flabbiness	10
Condition—Deeply and evenly covered with flesh, but not overdone for the purpose for which the animal is intended	6
Style—Active and sprightly, walking without a swaying movement, and standing well up on toes. Breeding animals should show strong character	4

B. Head and Neck:

Snout—Moderately fine	1
Face—Broad between eyes; poll, broad and full	1
Eyes—Good size, full and bright	1
Jowl—Full, broad, deep, smooth, and firm, carrying fullness back near to point of shoulder	2
Ears—Medium size, fine, and soft	1
Neck—Short, thick and deep. Rounding and full from poll to shoulder top	2

C. Fore Quarters:

Shoulders—Broad and compact on top, deep, well fleshed, blending smoothly with neck and body	6
Breast—Wide, deep and full	3
Fore Legs—Set well apart, short, tapering, and straight; pasterns, upright; bone, clean and fine; feet, medium size and strongly formed	3

D. Body:

Back—Broad, straight or very slightly arched, medium length, uniform width from shoulder to ham, thickly fleshed, even, and smooth, without creases or projections	8
Loin—Broad, strong, full, and thickly and smoothly fleshed	5
Ribs—Long and well sprung	4
Side—Medium length, deep, smooth, even between shoulder and ham	6
Heart Girth—Large, full back of shoulder, and deep and full at fore flanks	5
Flank—Deep and full	2

E. Hind Quarters:

Rump—Same width as back, long, smooth, slightly rounded from loin to base of tail	4
Ham—Broad, deep, heavily fleshed, plump, and reasonably smooth; flesh carried well down to hock on inside as well as at rear	8
Hind Legs—Short, straight, set well apart and squarely under body; bone, fine and clean; pasterns, strong; feet, medium size and strongly formed	3
Total	100

Relation of Breed and Type to Economy of Production.

Probably the most extensive tests with breeds of swine have been conducted by the Ontario Agricultural College and the Iowa State Experiment Station. At the Ontario Agricultural College, five tests were conducted in which six breeds of swine were compared as to the amount of feed required for 100 pounds gain live weight. At the Iowa Experiment Station, three tests were made in which the same six breeds were compared as to the amount of feed required for 100 pounds gain live weight. The results of these two series of tests are, therefore, of considerable importance. In the Ontario tests, only the meal is considered in four of the tests, such feeds as dairy by-products and green feed, which were the same for all breeds, being omitted. In one test, the results are given in terms of dry matter.

Ontario Feeding Trials.—Following are the results of the Ontario tests:

MEAL CONSUMED PER 100 POUNDS GAIN IN WEIGHT.

1st Test.

	Pounds		Pounds
Berkshire	398	Duroc-Jersey	424
Tamworth	400	Chester White	452
Poland-China	417	Yorkshire	468

2nd Test.

	Pounds		Pounds
Berkshire	327	Chester White	340
Tamworth	331	Yorkshire	341
Poland-China	333	Duroc-Jersey	358

3rd Test.

	Pounds		Pounds
Yorkshire	350	Chester White	378
Berkshire	370	Tamworth	378
Duroc-Jersey	376	Poland-China	383

4th Test (Dry Matter).

	Pounds		Pounds
Berkshire	318	Chester White	337
Tamworth	331	Duroc-Jersey	337
Yorkshire	335	Poland-China	350

5th Test.

	Pounds		Pounds
Berkshire	409	Chester White	433
Yorkshire	422	Tamworth	462
Duroc-Jersey	426	Poland-China	474

Before any comment is made on the Ontario results, we will look at the Iowa results, which are based upon dry matter.

Iowa Feeding Trials.—Following are the results of the Iowa tests:

POUNDS DRY MATTER CONSUMED PER 100 POUNDS GAIN IN WEIGHT.

1st Test.

	Pounds		Pounds
Duroc-Jersey	386	Poland-China	424
Yorkshire	398	Chester White	460
Tamworth	403	Berkshire	462

2nd Test.

	Pounds		Pounds
Duroc-Jersey	337	Poland-China	392
Yorkshire	365	Chester White	394
Berkshire	381	Tamworth	407

3rd Test.

	Pounds		Pounds
Poland-China	441	Chester White	506
Berkshire	481	Duroc-Jersey	506
Yorkshire	505	Tamworth	558

These results suggest some difficult questions. Why, for instance, do Berkshires, Yorkshires, Duroc-Jerseys, and Poland-Chinas range all the way from the top to the bottom of the list in the different tests; and why should an average of the Ontario tests give a rating of the breeds which is entirely different from an average of the Iowa tests? The averages have been purposely omitted, because they are entirely misleading in a case of this kind. For example, one breed may suffer from some unfavorable circumstance in one or more of the tests which is in no way related to or influenced by the breeding of the animals, yet this circumstance may seriously affect the standing of the breed in question.

Eliminating averages and looking over the individual tests with an unprejudiced mind, we can scarcely escape the conclusion that the factor which placed a certain group at the top in any of the tests was in no way related to the breed represented by that group.

The point is further emphasized by a test reported by Professor Burns in Texas Bulletin 131. In this test "razor backs" or scrubs were fed against good average Poland-China grades. The Poland-China grades made more rapid gains and sold for a higher price per pound, but the cost of producing 100 pounds of gain was practically the same for both, being approximately $6.02 for the scrubs and $5.94 for the grades, a difference of two twenty-fifths of a cent per pound.

If any person wishes to test the question further, let him take 8 or 10 pigs of the same litter, divide them into two groups as nearly even as possible, and feed the two groups exactly the same. The question of breed cannot enter into such a comparison, but in almost any such test it will be found that there is a difference in the amount of feed required for 100 pounds gain in the two groups.

Bacon and Fat Types Compared.—Another interesting point brought out in these breed tests is the fact that the bacon type is able to hold its own against the lard type in economy of production. Take the two bacon breeds, Yorkshire and Tamworth, in the Ontario tests, and compare their standing with such breeds as the Poland-China, Chester White, and Duroc-Jersey; or take the Yorkshire in the Iowa tests and compare it with the other breeds. So far as breed tests go, therefore, they fail to demonstrate that it costs any more to put a pound of gain on a hog of bacon type than it does to put a pound of gain on a hog of lard type.

Conclusion.–Breed tests, therefore, have served a useful purpose in demonstrating that no one breed is superior to all other breeds in ability to make cheap gains. A healthy, thrifty hog will make economical gains no matter what breed it represents.

PART III.

INVESTIGATIONS WITH SWINE

It is out of the question to review in detail all the work of experiment stations in swine feeding, but there are certain phases of the work which may be dealt with profitably in a somewhat general way. The problems which face the swine feeder are numerous, and the experiment stations have been working for years to find solutions for some of them. To solve any problem in stock feeding is a tedious matter, because animals differ so much individually in their ability to utilize feed, that it requires many repetitions and the employment of large numbers of animals to answer an apparently simple question. Great care is necessary, therefore, in interpreting the results of live-stock experiments, and it will not do to draw general conclusions where only a limited amount of work has been done.

Influence of Feed upon the Body of the Pig.

In his excellent book, "Feeds and Feeding," Professor Henry gives an account of work done along this line by Sanborn at the Missouri Agricultural College, Henry at the Wisconsin Experimental Station, Shelton in Kansas, Duggar in Alabama, and Fortier in France.

Corn, which is the standard hog feed of the United States, is a feed rich in carbohydrates, or fat-forming constituents, but rather low in protein, or muscle-forming constituents. It is also low in ash, or bone-forming material. The question arose, therefore, whether a feed such as corn would not have a tendency to produce more fat in the body of a hog than would feeds which contain a higher percentage of protein and ash. Without going into details, it may be said that corn was fed in opposition to mixtures containing such feeds as dried blood, wheat middlings, peas, skim-milk, bran, and cow-peas, which are feeds much richer than corn in protein.

Results.—The methods employed in the investigation varied somewhat, but the general results were as follows:

1. The pigs fed the protein-rich ration generally dressed a somewhat lower percentage of their live weight than those fed the corn ration.

2. In nearly every case, the pigs fed the protein-rich ration had the largest quantity of blood, and in every case they had heavier livers than the others. Their kidneys were also heavier, as a rule, though there were some exceptions.

3. In the Wisconsin and Kansas experiments, the tenderloin muscles were removed and weighed, and in both cases these were heavier in the case of the protein-fed pigs. The tenderloin muscle is an indication of the amount of lean throughout the carcass, and hence it was demonstrated that the carcasses of the protein-fed pigs contained more lean than the others.

4. As a rule, the corn-fed pigs gave more leaf-lard than the others.

5. At the Wisconsin and Kansas stations, the breaking strength of the thigh-bones was tested by a machine designed for such purposes, and in every case the bones from the pigs fed the mixed ration proved stronger than those of the corn-fed pigs, the difference being as high as 32 per cent. in one trial.

Limitations.—Though the experiments described demonstrate very clearly that it is possible to modify the carcass of the pig by a judicious selection of feeds, we must not assume that lean or fat can be developed to any extent which the feeder may desire. Nature has set a limit in this connection, and what may be accomplished by the feeder in the way of developing lean meat cannot go beyond a certain point. The theory that any breed of hogs can be fed in such a way as to produce choice bacon for the English market is not borne out by these or any other experiments, nor by the experience of practical breeders who really understand the demands of the market.

A peculiar feature of swine is their tendency to develop fat. If the very best specimens of the bacon type are fed largely upon corn, they quickly assume the fat or lard type, and in one or two generations of such treatment the tendency to become shorter in side and thicker in body becomes so firmly fixed that it is very difficult to change them back to the bacon type again under any system of breeding and feeding. On the other hand, breeders of bacon hogs know that it requires careful selection and feeding to maintain the type. Even under the most favorable conditions there is a tendency for the bacon type to change gradually in the direction of the fat type, unless care is exercised in selection. It is safe to say, therefore, that it is easier to increase the proportion of fat in a hog's carcass than it is to increase the proportion of lean, and that the extent to which the lean may be increased by the character of the feed is very limited and is fixed by the individuality of the animal. Further, any attempt to increase the amount of lean through feeding must be started when the pig is very young in order to be successful.

Causes of Soft Bacon.—In the manufacture of "Wiltshire sides" Canadian packers have experienced a great deal of difficulty with sides turning soft in the process of curing. In a soft side the fat is soft and spongy, and sometimes the lean is affected. A really soft side is practically worthless, and even a slight degree of tenderness detracts very seriously from the value of the bacon.

The Ontario Agricultural College, Guelph, and the Central Experimental farm, Ottawa, Canada, have conducted exhaustive experiments in connection with the causes of soft bacon, and following are the principal points brought out in the investigation:

1. *Lack of Maturity.*—Generally speaking, the more immature a hog is, the greater the tendency to be soft. Almost invariably the largest percentage of softness occurs among the light sides of bacon.

2. *Lack of Finish.*—Thin hogs have a marked tendency to produce soft bacon. Marketing hogs before they are finished is, no doubt, responsible for a great deal of softness.

3. *Unthriftiness* in hogs, no matter what the cause may be, almost invariably produces soft bacon.

4. *Lack of exercise* has a tendency to produce softness, but this tendency can be largely overcome by judicious feeding.

5. *Exclusive meal feeding* is perhaps one of the most common causes of softness, especially when hogs are not given exercise. Some kinds of meal are more injurious than others, but wherever exclusive meal feeding is practised and the exercise is limited, more or less softness is always sure to result.

6. *Corn.*—Of the grains in common use, corn has the greatest tendency to produce softness. Its injurious tendency can be modified by mixing it largely with other meal, or by feeding skim-milk, green feed, and roots, but its tendency to produce softness is so strong that it must be regarded as an undesirable food for bacon hogs.

Corn appears to give a good quality of meat in the case of the lard hog, but it must be remembered that the bacon hog is marketed at lighter weights and in thinner condition than the lard hog, and possibly this may explain why corn is unsatisfactory for feeding bacon hogs. It is possible also that the difference in the methods of curing may have an influence.

7. *Beans* seem to have a more marked effect than corn in producing softness, and should not be used for finishing bacon hogs.

Various Grains, Meals and By-products.

Corn.—Corn is essentially a fat forming feed, and is not a good bone and muscle former. The evil effects of exclusive corn feeding are most conspicuous in the case of young growing pigs or in the case of breeding stock, especially sows during the period of gestation. Corn may be fed either whole or ground, results of experiments varying widely as to relative merits of the two methods of feeding. Bulletin 106 of the Iowa Experiment Station reports results of two years work upon different methods of feeding corn, and the following extracts are taken from the conclusions published in the bulletin: "The fastest and most profitable gains were secured by feeding dry ear corn until the hogs were close to 200 pounds in weight. Then, if the hogs were to be fed longer and the weather permitted, the most profitable gains were secured by changing them to soaked shelled corn . . . It proved useless to grind corn for hogs of any age when the weather was warm enough to permit soaking. In every case where grinding has shown a saving of corn, simply soaking twelve hours in water has shown a still greater saving."

Fed by itself, corn does not give very large gains with hogs. Figures compiled from a large number of tests show an average of 10.25 pounds gain in weight from a bushel of corn. Young pigs fed on corn alone often become dwarfed, over-fat, and weak in bone. In such cases, the addition of bone meal, or even hardwood ashes, to the corn ration, will effect a marked improvement. The greatest improvement, however, is effected by the use of foods rich in protein along with corn. Supplementing corn with foods rich in protein has been tested by many experiment stations, and in every case the hogs have made greater and cheaper gains than when corn was fed alone. Among the most effective feeds to supplement corn are the by-products of packing houses, such as blood meal, meat meal, and tankage. These products are all extremely rich in protein, and must be fed in small proportions to be economical. Pea meal, linseed meal (ground oil cake), soy bean meal, wheat middlings, barley, skim-milk, as well as alfalfa and other pasture crops, have all been used with corn to excellent advantage. The richer the supplementary feed is in protein, the smaller the proportion it is necessary to use.

Peas, or Canada Field Peas.—This grain is comparatively little known in the United States, and is used to a smaller extent for pig feeding in Canada than it was some years ago, mainly owing to the high price it commands for other purposes.

At the Utah Experiment Station, hogs fed upon ground peas and bran, equal parts, made an average daily gain of 1.09 pounds and required 363 pounds of meal for 100 pounds of gain; while hogs fed corn and bran made an average daily gain of .63 pound and required 455 pounds for 100 pounds of gain.

At the South Dakota Station the daily gain of pigs fed whole soaked peas was 1.21 pounds, and for soaked corn meal 1.40 pounds; but the grain required for 100 pounds gain was 421 pounds for the pea group and 458 pounds for the corn lot.

The Ontario Agricultural College found that feeding pea meal alone was injurious to pigs, the heavy, close nature of the meal making it indigestible. This peculiarity of pea meal is generally recognized. Pea meal alone was less satisfactory than corn meal alone, but when mixed with one-third of its weight of wheat middlings it gave much better results than corn meal.

Pea meal is very rich in protein and should make a good supplementary feed with corn.

Barley.—Barley is richer in bone and muscle-forming constituents than corn, having a higher percentage of ash and protein. In fattening constituents it is scarcely equal to corn.

The Wisconsin Experiment Station reports two feeding trials with barley and corn. In the first trial the grains were fed alone, and in the second they were fed with skim-milk.

The first of the two trials shows that it required 471 pounds of barley to produce 100 pounds of gain, and 435 pounds of corn to produce 100 pounds of gain.

In the second trial it required 330 pounds of barley and 398 pounds of skim-milk for 100 pounds of gain, and 306 pounds of corn and 371 pounds of milk for 100 pounds of gain. In each trial, therefore, it required more barley than corn for 100 pounds gain.

The South Dakota Station found barley and corn practically equal as pork producers, it requiring 453 pounds of corn and 457 pounds of barley, respectively, for 100 pounds of gain.

Colorado and Ontario experiments were in favor of barley as compared with corn.

The first Wisconsin trial gave the most marked results in favor of corn, and it is worthy of note that the hogs in this trial averaged over 200 pounds in weight at the commencement of the trial. Where younger hogs were used, barley made a better showing as compared with corn. There is little doubt that, considered as a fat former, corn is superior to barley, and hence well-grown pigs should be able to stand exclusive corn feeding much better than younger pigs. The writer's experience would lead him to prefer barley to corn as a meal ration for growing pigs, and this view is borne out by the experiments noted. The extensive use made of barley for swine feeding in Canada, Great Britain, Denmark, and other countries, is strong evidence of its value.

One disadvantage of barley is the fact that it is not eaten so readily by pigs as one might wish, and should be mixed with some other feed, to increase its palatability. Barley is well adapted to mixing with corn as a ration for almost any class of pigs.

Wheat.—Wheat has been experimented with, more or less, as a feed for swine, and results show that there is comparatively little difference between wheat and corn in feeding value. Wheat contains less fibre than barley, but ground wheat alone can hardly be regarded as a satisfactory ration, owing to the fact that it is likely to cause digestive troubles. It gives much better results when mixed with other meal, and combines well with corn. As a general thing, feeding sound wheat is out of the question, owing to its relatively high price. It is only under exceptional circumstances that it can be counted among feeds for swine.

The Wyoming Station secured better gains for feed consumed from wheat than from corn in each of two tests, reported in Bulletin 74.

Frosted Wheat.—In some years, considerable of this product is placed upon the market. In the northern belt, wheat may be sufficiently injured by frost to render it unfit for milling, and yet be practically equal to sound wheat for feeding purposes. Frozen wheat varies much in character, depending upon the degree of maturity reached by the grain before being frozen.

In his evidence before the Committee on Agriculture, J. H. Grisdale, of the Central Experimental Farm, Canada, gives details of swine feeding experiments with frozen wheat, fed alone and in combinations. The following table brings out the principal points:

Character of Ration	Average Weight of Pigs at Commencement	Average Daily Gain	Pounds Meal per 100 Pounds Gain
	lbs.	lbs.	lbs.
Lot 1. No. 1 Frozen Wheat 2 Parts, Shorts 1 Part	99.1	.76	390
Lot 2. No. 1 Frozen Wheat 2 Parts, Corn 1 Part	76.	.77	370
Lot 3. No. 2 Frozen Wheat 2 Parts, Corn 1 Part	118.2	1.03	390
Lot 4. No. 2 Frozen Wheat only	140	1.23	360
Lot 5. No. 2 Frozen Wheat only	85	.71	380
Lot 6. No. 2 Frozen Wheat 2 Parts, Barley 1 Part	104.1	.81	410
Lot 7. No. 1 Frozen Wheat 2 Parts, Oats 1 Part	112.1	1.02	390
Lot 8. No. 1 Frozen Wheat 2 Parts, Oats 1 Part	74.2	.66	390
Lot 9. No. 2 Frozen Wheat with 3 lbs. Skim-Milk daily per. Pig	99.	.86	340
Lot 10. No. 1 Frozen Wheat only	150.4	.94	410
Lot 11. No. 1 Frozen Wheat only	96.3	.79	390
Lot 12. Equal Parts No. 1 Frozen Wheat, No. 2 Frozen Wheat and Corn	124.8	.94	470

It is unsafe to make comparisons of the different rations, but the table fails to show any advantage of the No. 1 frozen wheat over the No. 2.

The most remarkable feature of the experiment is the uniformly good results obtained with all the groups, indicating frozen wheat to be a valuable feed for swine.

The same would probably be found of wheat slightly affected with smut disease and of otherwise shrunken wheat.

Frozen Wheat vs. Barley.—At the Ontario Agricultural College, the writer fed three lots of pigs to compare frozen wheat with barley. The frozen wheat tested only 43½ pounds per bushel.

Lot 1 contained 18 pigs and was fed ground barley and wheat middlings.

Lot 2 contained 20 pigs and was fed ground frozen wheat and wheat middlings.

Lot 3, contained 18 pigs and was fed ground barley and frozen wheat, equal parts, with middlings.

The proportion of middlings varied, being reduced as the experiment progressed, but was the same for all lots.

The pigs in lot 1 averaged 41 pounds in weight at the start, lot 2, 37.7 pounds, and lot 3, 54.5 pounds.

Lot 1 made an average daily gain per pig of 1.08 pounds, lot 2, 1.1 pounds, and lot 3, 1.18 pounds.

The amount of meal consumed per 100 pounds gain was as follows:

Lot 1, 430.9 pounds; lot 2, 431.4 pounds; lot 3, 432.9 pounds.

Both in rate of gain and feed consumed per 100 pounds gain the three rations may be said to have given practically the same results. In this experiment, therefore, frozen wheat proved equal to barley when fed with middlings.

Oats.—Owing to their high percentage of fibre, oats do not possess a high value for fattening hogs. When used at all, they should be used as a comparatively small part only of the ration, and they show to best advantage when used to lighten and give more bulk to a heavy, close-textured meal, such as pea meal, or even corn meal. They are especially useful for making up part of the ration of boars or breeding sows, where the aim is to maintain vigor without unduly fattening.

Rye.—Extensive Danish experiments, summarized by Professor Henry in "Feeds and Feeding," indicate that rye and barley are about equal in value for pig feeding. Very little experimental work with the grain of this cereal has been done in America. Rye meal is best fed in combination with other kinds of meal.

Buckwheat.—The Central Experimental Farm, Canada, reports two trials in which buckwheat was compared with wheat. In the first trial, ground buckwheat was fed against ground wheat, and in this trial 445 pounds of ground buckwheat were required for 100 pounds gain, and 410 pounds ground wheat for 100 pounds gain.

In the second trial, one lot of pigs was fed a mixture of one-half ground buckwheat and one-half mixed meal, and the other lot a mixture of one-half ground wheat and one-half mixed meal. In this trial it required 405 pounds of the buckwheat mixture for 100 pounds of gain, and 380 pounds of the wheat mixture for 100 pounds gain. This is a much better showing for buckwheat than might be expected, since buckwheat has a thick, fibrous hull which the hog cannot digest. Ground wheat showed an advantage of only about 8½ per cent. over ground buckwheat, and the wheat mixture an advantage of 6½ per cent. over the buckwheat mixture.

Emmer.—This grain is commonly known as "spelt" or "speltz." Genuine spelt is a distinct plant, possessing general characters similar to emmer, but is a smaller yielder and possesses about ten per cent. more hull than emmer.

The South Dakota Station reports one experiment with emmer, under the name of "speltz." One lot of pigs was fed whole emmer, one ground emmer, and one emmer and corn. Whole emmer required 771 pounds of feed for 100 pounds gain, ground emmer 826 pounds, and emmer and corn 529 pounds. It will be seen that a marked improvement was effected when corn was added to emmer. Apparently emmer has too much hull or husk (about 21 per cent.) to make a first-class hog feed. Its rational use would be for mixing with concentrated, heavy meals to give more bulk to the ration.

Millet Seed.—The South Dakota Station (Bulletin 83) reports a comparison of millet seed with barley and wheat. The authors of the bulletin state that millet seed can be grown profitably as a fattening ration for swine, but it does not furnish as good a ration as barley or wheat. It is also stated that it required one-fifth more millet than it did barley meal, and a trifle more barley meal than it did wheat, to make a pound of grain, and that a bushel of 56 pounds of millet seed is equal to a bushel of 48 pounds of barley for hog feed. Millet meal produced a softer quality of fat than did either barley or wheat meal.

Beans.—Beans are best thoroughly cooked before they are fed to swine. Bulletin 243 of the Michigan Experimental Station reports results from feeding cull beans to growing pigs and fattening pigs. Without going into details, it may be stated that an exclusive ration of beans is not regarded as satisfactory. For growing pigs, a ration consisting of three parts beans and four parts corn meal did not prove so satisfactory as a mixture of two parts beans, two parts wheat middlings, and three parts corn meal. The last named mixture gave an average daily gain per pig of about one and one-third pounds, which is regarded as satisfactory.

Three trials of beans compared with equal parts beans and corn meal were made with fattening hogs. The results of the three trials are briefly summarized in the following table:

	Fed Beans Alone.	Fed Equal Parts, Beans and Corn
	lbs.	lbs.
Average live weight of hogs	163	159
Average daily gain per hog	1.1	1.52
Average feed consumed per 100 pounds gain	420.9	406.4

The addition of corn meal increased the efficiency of the ration about 3½ per cent.

The relative cost of the two feeds and the cost of cooking would have to be considered by the feeder in coming to a decision regarding the economy of the rations.

Wheat Middlings.—Wheat middlings, frequently called "shorts," is one of the very best feeds for young pigs. It is rich in bone—and muscle—forming constituents, and does not tend to make growing pigs too fat. Its value as a supplement to corn has already been noted, and it combines well with almost any kind of meal. As a single feed for fattening, it is not economical, but it is conducive to thrift and growth when used as a part of a meal ration for fattening pigs. The younger the pig the greater the value derived from feeding middlings.

Wheat Bran.—Bran is too bulky and fibrous to constitute a large part of a pig's ration, but is useful for mature animals, such as stock boars and breeding sows, or where it is desired to give bulk to a ration that is considered too heavy in character. As a rule, however, middlings can be used to better advantage than bran for the purposes mentioned.

Flour.—Various brands of low-grade flour are occasionally put upon the market. Low-grade flour has a higher feeding value than middlings, but is entirely unsuitable for feeding alone, owing to its pasty nature. The writer's experience is that it will cause digestive derangement when fed alone, and must be diluted to a large extent with other feeds. Bulletin 167 of the Virginia Experiment Station reports better results from soaking low-grade flour than from feeding it freshly mixed with water.

Corn-and-Cob-Meal.—The Iowa Experiment Station reports a test of corn-and-cob meal, both dry and soaked, and a summary of the results is given below. The test lasted 140 days.

Kind of Feed.	Average Daily Gain per Pig.	Pounds Corn Required for 100 Pounds Gain.
	lb	lbs.
Dry corn	.74	456
Soaked corn	.63	513
Soaked corn meal	.72	555
Soaked corn-and-cob meal	.56	583
Dry corn meal	.61	595
Dry corn-and-cob meal	.51	604

In the table given above the cob has been deducted from the figures for corn-and-cob meal, so that the actual corn is compared in all cases.

It cost 6 cents per bushel to grind the corn-and-cob meal, and 2 cents per bushel to grind corn meal. The results of the test were regarded as so conclusive against corn-and-cob meal that no further tests were made.

The Missouri Experiment Station also gives a decidedly adverse report upon feeding corn-and-cob meal to hogs, but Kansas and New Hampshire report in its favor.

Gluten Meal.—The Central Experimental Farm, Canada, reports unfavorably upon gluten meal as a feed for swine. J. H. Grisdale says regarding it: "Gluten has been fed in limited quantities, but has not proven very satisfactory for either bacon production, young pigs, or breeding stock. It seems to be rather unpalatable, and produces soft bacon."

The Cornell Station also gives an unfavorable report of this feed as compared with corn when both feeds were fed with skim-milk.

Linseed Meal.—(Oil Meal)—Linseed meal has been referred to under supplementary feeds with corn. It is seldom advisable to feed linseed meal to a greater extent than one-fifth of the total meal ration, and, as a rule, half this quantity will be found more economical. It is highly recommended by some as a feed for nursing sows, and for young pigs after weaning. The writer has had only fair success in its use as a substitute for skim-milk with young pigs.

In experiments with substitutes for skim-milk for young pigs, the Central Experimental Farm, Canada, obtained an average daily gain of six-tenths of a pound per pig with a mixture consisting of four parts wheat middlings and one part linseed meal. It required 280 pounds of the mixture for 100 pounds of gain, which is a very satisfactory showing. The linseed meal was not so satisfactory as skim-milk, but gave better results than other substitutes for skim-milk tested at the same time.

Cottonseed Meal.—This very concentrated feed possesses some property which renders it fatal to hogs when used in considerable quantities. A small allowance per day may be fed without injurious results, but great care is necessary. There does not seem to be any good reason for feeding cottonseed meal to hogs in Canada.

Oat Feed.—This by-product of the oatmeal mill sometimes has a considerable feeding value, but, owing to the fact that it often contains a large proportion of oat hulls, it is not a very satisfactory feed to buy for swine. Experiments with oat feed are not satisfactory, because the product is anything but constant in composition. The same remarks apply to all by-products of the oatmeal mills, under whatever name they may be sold.

Brewers' and Distillers' Grains.—Grisdale, of the Central Experimental Farm, reports economical gains from "spirit grains" when fed in combination with a meal ration. Generally speaking, these products are rather bulky and fibrous for swine, unless used in limited quantity as a supplement to a grain ration, in much the same way as alfalfa hay or roots may be used.

Sugar-Beet Pulp.—In the wet state this product may be regarded as similar in feeding value to roots, and may be employed in exactly the same way. The dried pulp is hardly a satisfactory feed for swine.

Beet-Sugar Molasses.—Beet molasses is unpalatable and generally unsatisfactory for swine. Bulletin 199 of the Cornell Experiment Station reports apparent poisoning of hogs fed beet molasses; and Utah (Bulletin 101) reports scouring, and bad-flavored pork.

Black-Strap Molasses.—Texas Bulletin 131 reports a test with ground corn compared with ground corn and black-strap molasses. Three groups of hogs were used. Lot 1 was fed equal weights of ground corn and molasses. Lot 2 was fed two parts ground corn to one part of molasses by weight. Lot 3 was fed ground corn alone. There were eight hogs in each lot, and the test lasted 91 days. The average weight of the hogs at the commencement of the test was approximately 120 pounds each. Ground corn was valued at $28.20 per ton, and molasses at $16.66 per ton.

The average daily gain per hog and cost of gain were as follows:

		Average Daily Gain.	Cost 100 Pounds Gain.
Lot 1.	Corn and molasses, equal parts	.9 pound	$10.75
Lot 2.	Corn 2 parts, molasses 1 part.............	1.45 pounds	7.53
Lot 3.	Corn alone	1.66 pounds	7.36

In this test molasses proved lower in value than corn. It is pointed out in the bulletin that molasses is poor in protein, and would likely have given better results if fed with a feed richer in protein than corn.

Tankage.—This by-product of the packing house is referred to under supplementary feeds with corn, and also under substitutes for skim-milk. A good brand of tankage contains over 50 per cent. of protein. It is valuable, therefore, to use when the ration is deficient in protein. It costs a high price per ton, but it is necessary to use only a small proportion in the feed, ten per cent. of the total meal ration being sufficient in most cases. When corn constitutes the main ration, or when skim-milk is not available for young pigs, the judicious use of a feed like tankage increases the rate of gain and reduces the cost of each pound of gain.

Weed Seeds.—Professor Henry conducted two trials at the Wisconsin Experiment Station with pigeon-grass seed, cooked and uncooked, for swine. The results are reported in "Feeds and Feeding."

Lot 1 was fed two-thirds cooked pigeon-grass meal and one-third corn meal uncooked.

Lot 2 was fed corn meal only, uncooked.

Lot 3 was fed one-third pigeon-grass meal and two-thirds corn meal, both uncooked.

Lot 1 made the largest gains and required the least feed for 100 pounds of gain, and lot 3 made the smallest gains and required the most feed for 100 pounds of gain.

Professor Henry says: "It is evident that pigeon-grass seed when cooked is a valuable feed for swine . . . To be satisfactory for pig feeding the seed of this grass should be ground and cooked."

At the large elevators, weed seeds and small wheat accumulate in large quantities, and this product can be used to good advantage in feeding swine when judiciously mixed with other meal.

"Stock Feeds"—In Bulletin 151 of the Wisconsin Experiment Station, Prof. F. W. Woll gives a review of the work of experiment stations with so-called "stock feeds," or "condimental stock feeds." In summing up, Professor Woll says, in part: "The feeding experiments include twenty-three different trials, conducted at more than a dozen different experiment stations, with 992 animals in all; viz., with 78 steers, 81 dairy cows, 604 sheep, 112 pigs, and 117 hens.

"In going over the evidence presented, we find that only two out of the twenty-three different trials showed the stock feed to possess any merit; the conclusions drawn from the results of the twenty-one trials is to the effect that nothing was gained by including these feeds in the ration fed; in fact they are shown to be a positive detriment in so far that they rendered the rations more expensive and increased the cost of the product obtained whether this be gain in live weight, milk, butter fat, wool or eggs."

Among the conclusions drawn from investigation work with "stock feeds" are the following:

"They are of no benefit to healthy animals when fed as directed, either as to increasing the digestibility of the feed eaten or rendering it more effective for the production of meat, milk, wool, etc."

"They are of no benefit as a cure-all for diseases of the various classes of live stock; neither do they possess any particular merit in case of specific diseases, or for animals out of condition, off feed, etc., since only a small proportion of ingredients having medicinal value is found therein, the bulk of the feeds consisting of a filler which possesses no medicinal properties whatever."

"Exorbitant prices are charged for these feeds."

"By adopting a liberal system of feeding farm animals and furnishing a variety of feeds, good results may be obtained without resorting to stock feeds of any kind. If a farmer believes it is necessary to feed stock feeds at times, he can purchase the ingredients at a drug store and make his own stock feeds at a fraction of the cost charged for them by the manufacturers."

The following formulas for stock feeds, suggested by two American experiment stations, are given in the bulletin:

"1. Ground gentian, 1 pound; ground ginger, ¼ pound; powdered saltpetre, ¼ pound; powdered iron sulphate, ¼ pound. Mix and give one tablespoonful in feed once daily for ten days, omit for three days, and feed as above for ten days more. Estimated cost, 20 cents per pound. Estimated tonic value, about four times that of most condimental feeds on the market."

"2. Fenugreek, 8 pounds; ginger, 8 pounds; powdered gentian, 8 pounds; powdered sulphur, 8 pounds; potassium nitrate, 8 pounds; resin, 8 pounds; cayenne pepper, 4 pounds; flax-seed meal, 44 pounds; powdered charcoal, 20 pounds; common salt, 20 pounds; wheat bran 100 pounds."

This mixture is said to be "so near the average stock feed that neither the farmer nor his stock could tell the difference." Estimated cost, less than $4.42 per hundred pounds.

"3. Powdered gentian, 1 pound; powdered ginger, 1 pound; fenugreek, 5 pounds; common salt, 10 pounds; bran, 50 pounds; oil meal, 50 pounds. Estimated cost $1.50 per hundred pounds.

Soft Coal, Charcoal, and Tonic Mixture.—Bulletin 150 of the Maryland Experiment Station gives results of a single test with soft coal, charcoal, and tonic mixture, made up as follows: Wood charcoal, 1 pound; sulphur, 1 pound; common salt, 2 pounds; bread soda, 2 pounds; sodium hyposulphite, 2 pounds;

sodium sulphate, 1 pound; black antimony, 1 pound. The ingredients of the tonic were pulverized and thoroughly mixed. The cost of the mixture was 4 cents per pound.

Four groups of pigs eleven weeks old were used in the test, and all groups were fed a meal mixture composed of corn meal, wheat middlings, wheat bran, and linseed meal.

Lots 1 and 2 were given free access to soft coal and charcoal, respectively, lot 3 was fed one ounce of the tonic to every 10 pounds of meal, and lot 4 was fed nothing but the meal ration.

The average daily gain per pig in the four lots was as follows: Soft Coal, .695 pound; charcoal, .738 pound; tonic mixture, .958 pound; no corrective, .614 pound.

The cost of producing 100 pounds gain in weight was as follows:

	Lot 1. Soft Coal.	Lot 2. Charcoal.	Lot 3. Tonic.	Lot 4. Nothing.
Meal	$5.93	$5.42	$4.74	$5.84
Corrective	.20	.14	.11	....
Total Cost	$6.13	$5.56	$4.85	$5.84

It will be noticed that the lot receiving the tonic mixture made the most rapid and most economical gains, the lot receiving the charcoal coming second. The hogs which were allowed access to soft coal made greater gains than those fed meal alone, but the gains were more expensive. It is stated that the hogs fed correctives had a decidedly better appetite than those which received none.

The experiment indicates that correctives or tonics may be used to advantage at times, but that it is easily possible to pay too much for them.

Pasture and Soiling Crops.

Alfalfa.—Bulletin 155 of the Kansas Experiment Station gives a summary of results from feeding alfalfa to hogs at that institution. The following is quoted directly from the bulletin:

"At this station some years ago, a gain of 800 pounds of pork was made from a ton of alfalfa hay, and a little less than that amount of gain was made from an acre of alfalfa pasture. In another test here, an acre of alfalfa produced $20.20 worth of pork, while an acre of rape fed to a similar lot of hogs returned $10.05 worth of pork.

"In a later experiment we found that 100 pounds of alfalfa hay saved 96 pounds of corn. Figuring on the basis of 5 pounds of corn producing one pound of pork, the 96 pounds of alfalfa would produce 19 pounds of pork. Estimating the average of alfalfa to be four tons per acre, on this basis it would mean a production of 1,600 pounds of pork per acre with alfalfa fed in the form of hay in connection with corn. This experiment was conducted during the winter season.

"In an experiment during the summer, we found that 170 pounds of green alfalfa, cut and fed to hogs fresh in a dry yard, was equal to 100 pounds of corn, and in this experiment it took 6 pounds of corn to produce a pound of pork. Therefore, assuming 170 pounds of green alfalfa would produce 16 2-3 pounds of pork, a fraction over ten pounds of green alfalfa woud produce one pound of pork. Estimating that an acre of alfalfa will yield during the season 20,000 pounds of green hay, this experiment would show that such an acre of alfalfa, cut green and fed fresh, would produce something like 2,000 pounds of pork. Of course this is fed in connection with corn, and a statement that an acre of green alfalfa would produce 2,000 pounds of pork would be very misleading. Figuring on the basis of these two experiments, alfalfa hay, yielding four tons per acre (8,000 pounds), would produce 1,600 pounds of pork, and its value at 4 cents per pound would be something like $64.00 per acre; and green alfalfa producing ten tons per acre (20,000 pounds) would produce 2,000 pounds of pork, which, at 4 cents per pound, would be worth $80.00 per acre."

Wyoming Trials.—The Kansas results from feeding alfalfa are about the most favorable of which the writer is aware. Very fair results were obtained at the Wyoming Experiment Station, where alfalfa hay and wheat were fed against wheat alone. In this experiment it required 449 pounds of wheat for 100 pounds of gain where wheat was fed alone; and 319.3 pounds of wheat and 291.3 pounds of alfalfa for 100 pounds of gain where wheat and alfalfa hay were fed. On this basis, a ton of alfalfa hay would give scarcely 200 pounds of pork, which is only one-quarter as much pork as was obtained at Kansas from a ton of alfalfa hay. It is well to remember, however, that alfalfa hay varies very much in quality. Well-cured, fine-stemmed, leafy hay would be best for hog feeding, and coarse-stemmed hay that had been damaged more or less by the weather might have very little value for this purpose. Such a discrepancy as that noted between the Kansas and Wyoming results might easily be accounted for on the basis of different qualities of hay, and in the meantime we may regard the Kansas results as representing the maximum returns from alfalfa. It is also worthy of note that in one Kansas experiment the amount of pork produced by a ton of alfalfa hay was only 235 pounds, an amount only slightly greater than that obtained at Wyoming, so that it would be safer to regard the 800 pounds of pork from a ton of alfalfa hay as a possibility, rather than as something which can be generally depended upon.

The Wyoming Station also tried feeding young pigs, weighing from 60 to 70 pounds, a ration of 1/3 corn meal, or wheat meal, and 2-3 alfalfa hay, but the pigs lost weight, and one died. On the other hand, mature sows were successfully maintained on a ration of alfalfa hay and turnips without other feed, indicating that alfalfa hay is best suited to pigs that are fairly well grown.

Rape.—Rape is a crop which is highly recommended wherever it can be grown successfully. For hog pasture it is best sown in drills about 28 inches apart at the rate of three pounds of seed per acre. It may also be sown broadcast. In most localities, it is safer not to sow until after the first of June. If there is enough moisture in the soil to germinate the seed, it is generally ready for pasture in about six weeks.

Rape Compared with Alfalfa.—The Kansas Experiment Station compared rape with alfalfa for pigs averaging 52 pounds at the commencement of the experiment. Ten pigs were used in each lot. Following are daily gains per head and pounds of grain consumed per 100 pounds of gain:

		Daily Gain.	Grain Consumed per 100 Pounds Gain.
Lot 1.	No pasture	1.04 pounds	371 pounds
Lot 2.	Rape pasture	1.09 pounds	301 pounds
Lot 3.	Alfalfa pasture	1.10 pounds	200 pounds

An acre of rape was required for ten pigs, but half an acre of alfalfa was sufficient for the same number.

An acre of rape pasture produced 202 pounds of pork, and an acre of alfalfa pasture produced 408 pounds of pork.

"This experiment emphasizes the superior value of alfalfa, and likewise emphasizes the value of dwarf Essex rape, which can be seeded in the feed lots that would otherwise go to waste or grow up to weeds, and be made to pay a handsome profit on the investment."

Rape for Pasture.—At the Wisconsin Experiment Station, Craig conducted two experiments with hogs on rape. In the first experiment, 10 hogs, about eight months old, were pastured on one-third of an acre of rape for 76 days, and fed corn and shorts in addition. Another lot was fed in a pen on corn and shorts only. In the second experiment, 19 hogs were pastured seven weeks on six-tenths of an acre of rape, as compared with a similar lot in pens on grain only.

In the first trial one-third of an acre of rape was equivalent to 1,062 pounds of grain, and in the second trial, six-tenths of an acre of rape was equivalent to 1,330.2 pounds of grain. Therefore, in one case an acre of rape was equivalent to 3,186 pounds of grain, and in the other to 2,217 pounds of grain.

Later, Carlyle, of the same institution, repeated the work and states: "With pigs from four to ten months old, representing the various breeds of swine, an acre of rape, when properly grown, has a feeding value when combined with a ration of corn and shorts equivalent to 2,346 pounds of a mixture of these grain feeds."

The Central Experimental Farm, Canada, reports feeding six pigs on three-sixteenths of an acre of rape pasture from August 14th until snow covered the ground. It is estimated that the rape saved 156 pounds of meal, or an acre of rape would save 832 pounds of meal. This is far short of the Wisconsin returns, but the pigs were young at the commencement of the trial, and it is the writer's experience that young pigs do not make as good use of pasture as older ones.

Rape vs. Clover.—The Wisconsin Experiment Station reports two trials with pigs on rape and clover. In the first trial there were twenty pigs in each group, and in the second trial twenty-one in each group. The pigs were from five to six months old at the commencement. The following table shows gains and feed consumed:

	First Trial		Second Trial.	
	Rape.	Clover.	Rape.	Clover.
	lbs.	lbs.	lbs.	lbs.
Average daily gain per pig	.87	.78	1.27	1.22
Amount of grain for 100 lbs. gain	391.	439.	332.	340.

It will be seen that the rape gave somewhat better gains with a smaller meal requirement per 100 pounds gain than the clover, though the difference was not great in the second trial.

Rape vs. Soy Beans.—The Ontario Agricultural College fed soy beans and rape to pigs in pens, the green fodder being cut and carried to the pigs. The pigs were fed meal and skim-milk in addition.

An acre of rape furnished 22 tons of green fodder, and an acre of soy beans 15 tons of green fodder.

Soy beans had a higher feeding value per ton than rape, but when the difference in yield was taken into consideration, the two crops proved about equal in amount of pork produced per acre.

Rape has an advantage over soy beans in that it may be sown on a wider range of dates, and retains its green condition for a longer period.

Rape also makes a better pasture crop than soy beans, as it suffers less from trampling.

Clover and Timothy.—In experiments at the Iowa Experiment Station, hogs were pastured upon both clover and timothy. Without going into details, it may be said that the experiments indicate that clover produced pork at the rate of 400 pounds per acre, and timothy at the rate of 278 pounds per acre. This is probably more than can be expected from these crops as a general rule.

Hairy Vetch or Sand Vetch.—This crop is very much relished by hogs, and if sown in the fall gives an early pasture of high nutritive value. Smooth vetch is sown in the spring, but it is rather late in the season before it is ready for pasture, and does not give the amount of pasture which is desirable. The liability of hairy vetch to winter-kill in some districts when sown in the fall, and the high price of seed, prevent the crop from becoming widely popular.

Various Forage Crops.—Bulletin 95 of the Missouri Experimental Station reports three years' work with several forage crops.

Shelled corn and corn meal were used to supplement the rape and the leguminous forage; and a ration of corn meal 6 parts and oil meal 1 part was used to supplement the sorghum, blue grass, and rye grain forages.

Blue Grass.—"An average of 12.6 head of hogs was pastured for an average of 155.3 days for the seasons of 1908-09-10, and produced on the average 285.2 pounds of pork which could be accredited to each acre of forage eaten. With pork at 6 cents per pound there was returned per acre of blue grass forage an average of $17.12. The average amount of grain per pound gain was 4.49 pounds. Profits from hogs on blue grass forage must be secured early in the season. The blue grass forage became dry and unfit for swine grazing purposes in August."

Alfalfa.—"Under ordinary conditions alfalfa will forage from 10 to 20 shoats per acre. A new seeding should be pastured very slightly the first season. No larger number than ten shoats per acre or one sow and her litter should be used. After the first season as high as 20 head per acre or two sows and their litters may be pastured on it throughout the season." Only one test was conducted with alfalfa and this on newly seeded ground. The test was started with 12 hogs per acre, which number was reduced to 10 at the end of eight weeks. The hogs averaged 58.5 pounds at the commencement of the test. and were turned on the alfalfa when it was six inches high. "The average amount of grain required to produce a pound gain was 3.07 pounds. The amount of pork which could be accredited to the alfalfa forage was 596.8 pounds per acre. With pork at 6 cents the return per acre was $35.71."

Red Clover.—Two tests were conducted with red clover, and it is stated that clover will pasture from 8 to 12 shoats per acre. It is recommended not to pasture clover until it is 10 inches high. The bulletin recommends feeding shoats about a pound of corn per head per day.

"A herd averaging 11 hogs was pastured for an average of 130 days for the seasons of 1908 and 1910, and produced an average of 572.2 pounds of pork that could be accredited to each acre of forage eaten. These experiments indicate that a value of 98 cents may be obtained for each bushel of corn fed to hogs pasturing on clover, when pork is worth 6 cents, and when rent of land, taxes, labor, etc., are valued at $10.00 per acre."

Rape, Oats and Clover.—This mixture was sown at the rate of 5 to 7 pounds of rape, ½ bushel of oats, and 6 to 10 pounds of clover per acre. The results are summarized as follows: "A herd averaging 10 hogs per acre was pastured on rape, oats, and clover forage for an average of 96 days for the seasons of 1909 and 1910, and produced an average of 394 pounds of pork that could be accredited to each acre of forage eaten. A value of 89 cents may be obtained for every bushel of corn fed to hogs on rape, oats, and clover forage when pork is worth 6 cents per pound, and when rent, labor, taxes, etc., are valued at $10.00 per acre."

Hogging Off Rye.—The authors state that when rye is intended for "hogging off" purposes it should be allowed to become thoroughly ripe, so that the heads crinkle down and droop near the ground. In three tests a supplementary ration of corn meal 6 parts and oil meal 1 part was fed at the rate of 1 pound per head per day. In two tests 16 hogs were pastured per acre, and in one test 8 hogs per acre. The amount of pork accredited to an acre of rye in the three tests was 215 pounds, 257 pounds, and 260 pounds respectively. With pork at 6 cents per pound the returns are accounted about equal to the returns when the crop is sold as grain but the fertility is retained under the pasturing system.

General Conclusions.—Of the general conclusions given in the bulletin, the following are of special importance:

1. "The number of hogs which may be kept on each acre of forage will depend upon the abundance of forage, but in general not more than 10 to 12 head should be used."

2. "The greatest returns have been obtained when grain was fed in addition to the forage at the rate of 2 to 3 per cent. of the weight of the hogs per day. The amount fed per head per day should be increased as the hog increases in size."

3. "A very good plan in feeding 80 to 100 pound hogs on forage would be to feed, per head per day during May, 1.75 pounds of grain; during June, 2 pounds grain; during July, 3 pounds grain, and during August, 4 to 5 pounds grain."

4. "Gains made on forage are made at 20 to 30 per cent. less cost than gains produced with grain and dry lot feeding. With pork at 6 cents the average value of a bushel of corn fed to hogs in dry lot was 66 cents; and the average value of a bushel of corn fed to hogs on forage was 80 cents, after a $10.00 charge (per acre) had been paid for rent, taxes, etc."

Fall Rye.—Rye does not make so valuable a pasture as many other crops and its main feature is its early growth. For supplying pasture very early in the spring, a small plot of rye can often be used to good advantage.

Mixtures.—Various mixtures have been used as pasture crops for swine. The writer has used oats and peas, also a mixture of oats, peas, and vetches. These crops do not stand pasturing well, and are better suited for soiling purposes.

The Michigan Experiment Station speaks well of a mixture of corn, peas, oats, rape, and red clover. There is a good deal of waste in pasturing this crop. If, however, the first crop could be cut for soiling purposes, the second growth would furnish a good deal of pasture. (See also Missouri test reported in this chapter.)

Jerusalem Artichokes—The Central Experimental Farm, Canada, reports good results from this crop. One-sixteenth of an acre was planted on May 19th with 70 pounds of tubers. The tubers were planted about four inches deep, in rows 24 inches apart, and in hills about 20 inches apart in the rows. Six pigs, averaging a little over 100 pounds each, were turned into the plot on October 3 and allowed to harvest the crop, which lasted them three weeks. They were fed a light meal ration while eating the tubers. The six pigs gained 197 pounds in three weeks, and consumed only 189 pounds of meal. This is a most extraordinary result, but it must be remembered that the experiment lasted a very short time. The experiment certainly indicates possibilities for this crop. Pigs eat artichokes very greedily.

Pasture vs. Soiling.—Some experiments at the Ontario Agricultural College indicate that more rapid gains with a smaller consumption of feed per pound of gain can be secured by soiling pigs than by pasturing. This is especially true of young pigs, and the writer's experience leads him to believe that pigs should weigh at least 100 pounds before being turned on pasture, to get best results. There is considerable extra labor in cutting green crops and carrying them to the pigs under the soiling system, which brings the two systems fairly close together from the stand-point of economy.

Amount of Grain on Pasture.—Growing or fattening pigs cannot be produced satisfactorily on pasture alone, but a grain ration is necessary. The Montana Experiment Station found that hogs fed a full grain ration on pasture gained, on an average, 1.39 pounds per hog per day, and required 412 pounds of grain for 100 pounds of gain. Hogs fed a half ration of grain gained .98 pounds per hog per day, and required 291 pounds of grain for 100 pounds of gain. Thus, it will be seen that the hogs fed a full ration on pasture made more rapid gains, but consumed much more grain for every 100 pounds of gain.

The Ontario Agricultural College fed two lots of pigs five weeks on clover and ten weeks on rape. One lot received a full meal ration and the other a two-thirds meal ration. As in the Montana experiments, the hogs fed a full meal ration made more rapid gains than the others, but they consumed 421 pounds of meal for 100 pounds of gain, as compared with 353 pounds meal for 100 pounds in the lot fed the two-thirds ration.

It seems to be clearly demonstrated that it is a mistake to feed hogs all the meal they will eat when upon pasture, unless it becomes necessary to do so near the end of the feeding period in order to fit them for market. (See also Missouri recommendations.)

Methods of Feeding Alfalfa.—Bulletin 123 of the Nebraska Experiment Station reports a series of winter tests with varying proportions of corn and alfalfa. The tests covered three years, and they appear to have been carefully conducted.

Summary of Results.—(1) The gains made by the rations containing one-half alfalfa were much slower and more expensive than those obtained from any of the other rations. The tests during two winters showed that a fattening ration should contain less than half alfalfa, but a ration of half alfalfa and half corn was found quite satisfactory for wintering brood sows.

(2) When half the ration consisted of alfalfa, alfalfa meal gave faster gains with less grain than chopped alfalfa, but the difference was not enough to pay for the extra cost of the alfalfa meal.

(3) The average of four tests with 160 pigs showed that rations containing one-fourth alfalfa produced slower gains than a ration of corn alone, or of 9 parts of corn and 1 part of alfalfa. It would seem that a ration containing one-fourth

alfalfa is not as satisfactory for fattening hogs as a ration of corn alone, or a ration containing a larger proportion of corn and a smaller proportion of alfalfa.

(4) Alfalfa meal proved more satisfactory than chopped alfalfa when the ration consisted of one part of alfalfa to three parts of corn.

(5) In three tests with 90 pigs, a ration containing 9 parts of corn to 1 part of alfalfa proved more profitable than corn alone.

(6) When the alfalfa comprised only one-tenth of the ration, chopped alfalfa and alfalfa meal gave almost the same gains, but the chopped alfalfa proved more profitable owing to its lower cost.

(7) In three tests with 90 hogs, the feeding of corn with alfalfa hay in a rack gave very similar returns to feeding 9 parts of corn mixed with 1 part of chopped alfalfa, with the difference in favor of rack feeding.

(8) The results of 5 years' indicate that for fattening hogs the way to feed alfalfa most satisfactorily is to feed it without grinding or chopping.

(9) In these tests, 50 pounds of hay were worth more in the ration than a bushel of corn.

(10) The rations used in these tests are ranked in order of merit as follows:

1st. Corn and alfalfa hay in a rack.
2nd. 9 parts corn and 1 part chopped alfalfa.
3rd. 9 parts corn and 1 part alfalfa meal.
4th. Corn alone.
5th. 3 parts corn and 1 part alfalfa meal.
6th. 3 parts corn and 1 part chopped alfalfa.
7th. 1 part corn and 1 part chopped alfalfa.
8th. 1 part corn and 1 part alfalfa meal.

(11) It is recommended to feed the finest and brightest hay possible. Hogs will not eat the coarse stems.

Roots, Potatoes, Pumpkins, Apples and Dairy By-products.

Roots.—In Henry's "Feeds and Feeding" there is an excellent summary of Danish experiments with roots for swine. The meal equivalent of roots was found to vary in a marked degree in different trials, and 100 pounds of barley were found to be equivalent to 600 to 800 pounds of mangels and 400 to 800 pounds of stock beets. In the United States and Canada, wide variations in the meal equivalent of roots have also occurred in various tests. The following table gives an idea of the range of values found at several stations:

Meal Equivalent of Roots.

Central Experimental Farm	100 pounds meal =	786 pounds roots
Ohio Experiment Station	100 pounds meal =	642.5 pounds roots
Montana Experiment Station	100 pounds meal =	529 pounds roots
Utah Experiment Station	100 pounds meal =	455 pounds roots
Ontario Agricultural College	100 pounds meal =	441.5 pounds roots
Average	100 pounds meal =	570.8 pounds roots

The variations in these trials are similar to the variations in the Danish experiments. Ontario obtained a remarkably high meal equivalent for roots, and it is worthy of note that in the Ontario trials the roots were pulped and mixed with an equal weight of meal, the hogs being fed all they would eat of the mixture.

In the writer's experience, hogs fed roots are thriftier looking and possess better appetites than hogs fed meal alone, and it is no doubt due to their influence upon the general health of the animal that roots are able to make such a favorable showing. The degree to which the general thrift of the animals is injured by exclusive meal feeding will be reflected in the relative feeding value shown by roots and grain, and this fact renders extreme variations quite possible.

Generally speaking, it may be said that sugar beets possess the highest feeding value among ordinary roots, and are most readily eaten by swine. Mangels, Swede turnips, and carrots may be counted practically equal in value, but hogs eat mangels with greater relish than they eat turnips.

Potatoes.—At the Wisconsin Experiment Station, 441 pounds of potatoes, cooked and fed to swine, proved equal to 100 pounds of cornmeal. In "Feeds and Feeding," Henry summarizes experiments, where 400 pounds of potatoes proved equal to 100 pounds of mixed meal. In connection with these investigations, Professor Henry says: "In general, we may say that a bushel of corn is worth four and one-half bushels of potatoes for fattening purposes when cooked and fed with corn meal. Potatoes may have a higher value than the rating here given, in furnishing variety in ration to growing animals."

Potatoes must be cooked for swine, and this item of expense cancels some of the advantage which they possess over roots as a feed for swine.

Pumpkins and Squashes.—Pumpkins belong to the same class of feeds as roots, giving bulk and succulence to the ration and thus promoting thrift. J. H. Grisdale, Central Experimental Farm, has a high opinion of pumpkins for swine. He says: "We cook them and mix meal with them, and I don't think there is anything that will surpass them as a cheap fattening ration." He also states that the pigs like the seeds best, and that no injury comes from feeding the seeds. Excellent results were obtained at the New Hampshire Experiment Station from feeding raw pumpkins, with meal and skim-milk.

The Oregon Experiment Station found that a 200-pound hog consuming 26 pounds of cooked pumpkin and a small amount of shorts gained 1.2 pounds per day. Other investigators have found that 273 pounds of grain and 376 pounds of raw pumpkin produced 100 pounds of pork. Some experiments show that cooking pumpkins does not add to their value.

The squash may be counted as equal to the pumpkin in feeding value.

Apples.—Apples do not appear to possess a high feeding value, but may often be used to good advantage to give variety and succulence to a ration. They are perhaps most suitable for mature breeding stock, but a hog should never be expected to subsist upon apples as the main part of its ration.

Skim-Milk.—The results of nineteen trials with eighty-eight pigs at the Wisconsin Experiment Station are well summarized by Henry in "Feeds and Feeding." It is a well-known fact that when a small proportion of skim-milk is fed with meal, the milk shows a higher meal equivalent than when a large proportion is fed: that is to say, it requires a smaller amount of skim-milk to be equivalent to a given amount of meal when a small proportion of milk to meal is used. Henry summarizes the Wisconsin results as follows:

MEAL EQUIVALENTS OF SKIM-MILK.

Proportion of Milk to Meal	Pounds of Milk Equivalent to 100 Pounds Meal
1 lb. corn meal, 1 to 3 lbs. milk	327 lbs. milk = 100 lbs. meal
1 lb. corn meal, 3 to 5 lbs. milk	446 lbs. milk = 100 lbs. meal
1 lb. corn meal, 5 to 7 lbs. milk	574 lbs. milk = 100 lbs. meal
1 lb. corn meal, 7 to 9 lbs. milk	552 lbs. milk = 100 lbs. meal
Average of 19 trials	475 lbs. milk = 100 lbs. meal

The Ontario Agricultural College reports a trial in which 355.6 pounds of skim-milk proved equal to 100 pounds of meal. The proportion of milk to meal was about 2.5 to 1, and the result is similar to the Wisconsin result with a similar proportion of milk to meal.

The Minnesota Experiment Station reports six trials in which the proportion of milk to meal varied, the highest proportion being about five pounds of milk to one of meal. The average of these trials gives 467 pounds of milk, equivalent to 100 pounds of meal, which is very close to the Wisconsin average.

Utah experiments show 431 pounds of skim-milk equal to 100 pounds of grain, and Tennessee experiments, 476 pounds of skim-milk equal to 100 pounds of grain. The Tennessee results are practically identical with the Wisconsin average, and the Utah results are reasonably close.

These experiments show that, where skim-milk can be obtained conveniently and in suitable quantity, it has a very considerable value in hog-feeding. When meal is worth $20 per ton, skim-milk is easily worth 20 cents per hundred pounds, unless an exceptional amount of labor is involved in procuring it. For young pigs just after weaning, however, its value is very much higher than for older hogs.

Sweet vs. Sour Skim-Milk.—Several experiments with sweet and sour skim-milk indicate that there is little or no difference in the feeding value of the two products,—in fact, the sour milk has, if anything, had the advantage. For very young pigs sweet milk is preferable.

Whey.—At the Ontario Agricultural College, the writer conducted seven trials with a view to ascertaining the value of whey for pig feeding. The average of these seven trials gives 744.5 pounds of whey, equivalent to 100 pounds of meal.

Two trials at the Wisconsin Experiment Station gives an average of 800 pounds of whey, equivalent to 100 pounds of meal.

These trials probably show the maximum value of whey for pig feeding. Under ordinary methods of feeding it would hardly be safe to expect quite as good returns for whey. Where labor is involved in procuring the whey, due allowance must be made in estimating the value of this product.

Sweet vs. Sour Whey. —Five trials made by the writer failed to show any appreciable difference between the feeding value of sweet and sour whey.

Separated vs. Ordinary Whey.—In an experiment conducted by the writer, ordinary whey proved to be worth twenty-five per cent. more than separated whey. The separated whey had been run through the cream separator to remove the fat for making whey butter.

Buttermilk.—Experiments at the Ontario Agricultural College and elsewhere show that buttermilk is practically equal to skim-milk for feeding pigs.

Substitutes for Skim-Milk.—For young pigs, just after weaning, it is difficult to find anything that will take the place of skim-milk. When skim-milk is not available, there is danger of the pigs becoming stunted at this period of their life, especially pigs that are weaned young. The Ontario Agricultural College conducted two trials with Swift's digester tankage and blood meal as substitutes for skim-milk. These two feeds proved nearly equal in value, and, since the tankage costs much less per ton, it was regarded as the more satisfactory.

In the first trial the tankage constituted about one-fourteenth of the total ration, and in the second trial one-tenth of the total ration.

About two pounds of milk to one pound of meal were fed in each trial.

The average of the two trials shows that to produce 100 pounds of gain it required:

375 pounds meal and 34 pounds tankage.

390 pounds meal and 727 pounds skim-milk.

The pigs getting tankage ate their feed quite as eagerly as those getting skim-milk, and continued thrifty throughout the experiment.

Tankage, therefore, proved a very satisfactory substitute, as far as gains in weight were concerned, but, when skim-milk can be obtained at 15 cents per hundredweight, it is cheaper than tankage at prevailing prices, according to this test.

In a second trial, tankage made by the Harris Abattoir Co., of Toronto, was compared with skim-milk for young pigs. The tankage was fed in proportion of one pound of tankage to six pounds of meal. The tankage pigs made an average gain of 1.02 pounds per pig per day, the skim-milk group, 0.93 pounds, and the check group, on meal only, 0.74 pounds. Placing a value of $22 per ton on the meal, we find that in this test the skim-milk was worth 27 cents per 100 pounds, and the tankage, $2.92 per 100 pounds. This test, therefore, like the preceding one, shows that it is economical to furnish young pigs with feed rich in protein, and that it is good practice to use a feed like tankage when skim-milk is not available. It also goes to show that young pigs can be raised economically without skim-milk.

In other experiments by the writer, the results of which have not been published, other substances, such as linseed meal, "black-strap" molasses, and tea from alfalfa hay, have been tried, but none of these approached tankage in efficiency as a substitute for skim-milk for young pigs.

The Michigan Experiment Station also compared tankage with skim-milk for young pigs. The pigs on skim-milk made slightly larger gains, but, when skim-milk was valued at 20 cents per 100 pounds, and tankage at $1.62½ per 100 pounds, the tankage-fed pigs made cheaper gains than the skim-milk pigs.

Preparation of Feed.

Cooking and Steaming.—Years ago there was a popular belief that cooking or steaming feed increased its digestibility, and hence its feeding value. The work of experiment stations and private investigators has thoroughly exploded this idea, and indicates that digestibility may be decreased rather than increased by cooking in the case of many feeds. There are some feeds which are rendered more palatable by cooking, such as potatoes and beans, but in the case of feeds which are eaten readily without cooking, it may be taken as settled that cooking or steaming is poor economy. Instead of being a commendable practice, cooking is something which should be avoided as far as circumstances will permit, and employed only when feeds are not acceptable in the raw state. Where economy is no object, it may be possible to secure larger gains in weight by cooking a certain portion of the feed to make the ration more palatable, thus stimulating the appetite of the animal, but such gains are usually obtained at a comparatively high cost.

Grinding.—The question of grinding was discussed, under corn, and it was shown that, so far as corn is concerned, the gain from grinding is comparatively small. Numerous experiments have been made with other grains to determine the effect of grinding, it being generally supposed that grinding would be more effective in the case of small grains than it would be with corn. It is out of the question to review experimental work in detail in regard to this point, but it may be said that grinding small grains, such as peas, barley, oats, and rye, has almost invariably proved beneficial. Sometimes the advantage of the ground grain has been very slight, and sometimes very marked, but the general evidence indicates that it is advisable, when practicable, to grind such grains. When the cost of grinding is excessively high, the practice may not be advisable, but, under ordinary circumstances, it is the safe course. According to a compilation of experiment station results, made by G. M. Rommel (Bulletin 47, U. S. Dept. of Agr.), the average saving effected by grinding small grains is 12.26 per cent.

Wet vs. Dry Feed.—Considerable experimental work has been done with wet and dry feed, and results are very contradictory. On an average, the two methods of feeding show practically equal results. The writer's experience is that when hogs can be fed dry meal in such a manner that they cannot waste it, they make as good use of it as when it is wet. There is more tendency to waste feed when it is fed dry, especially when a considerable number of hogs are fed out of the same trough. Troughs arranged so as to prevent crowding will tend to lessen the waste. In cold pens, dry meal feeding has some advantages, and mixing dry meal with an equal weight of pulped roots makes a good ration. Under ordinary conditions, it is difficult to see much advantage from dry feeding.

Soaking.—Soaking feed is another practice which seems to give variable results, according to experimental data. There seems little doubt, however, that, in the case of dry hard grain fed whole, soaking is to be commended. In the case of meal, freshly mixed feed will likely give as good results as soaked feed.

Fermenting.—The practice of fermenting feed for swine was formerly much more common than it is at present. In the case of cotton-seed meal, the Texas station recommends mixing the cotton-seed meal with other meal, and allow the whole mass to sour. The New Hampshire Station obtained better results from fermented bran than from unfermented bran. With feeds well adapted to pig feeding, it is not likely that fermentation would be of any benefit.

Methods of Feeding.

"Hog Motor Grinder" vs. "Hopper."—The Maryland Experiment Station (Bulletin 150) reports tests with the "hog motor grinder," a contrivance by means of which hogs grind their own grains as they require it. The grinder was compared with a self-feed hopper. In the first test whole corn was used in the hopper, and in the second test ground corn was used. The pigs were from four to five months old at the commencement of the experiment.

In the first test the hopper-fed pigs made an average daily gain per pig of 1.85 pounds, and the grinder-fed pigs 1.65 pounds.

The feed consumed per 100 pounds gain was as follows: Hopper pigs.—Corn, 256 pounds; middlings, 68 pounds; milk, 339 pounds. Grinder pigs.—Corn, 224 pounds; middlings, 76 pounds; milk, 385 pounds.

In the second test the hopper-fed pigs made an average daily gain per pig of 2.11 pounds, and the grinder-fed pigs, 1.86 pounds.

The feed consumed per 100 pounds gain in the second test was: Hopper pigs.—Corn, 287 pounds; middlings, 71 pounds. Grinder pigs.—Corn, 273 pounds; middlings, 80 pounds.

The author of the bulletin states: "The hog motor grinder and feeder gave good results in two tests. However, when used in comparison with hopper feeding of both shelled corn and cornmeal, the margin of profit was in favor of the hopper-fed pigs."

Hopper Feeding vs. Trough Feeding.—The bulletin referred to above also reports two tests in which the self-feed hopper was compared with trough feeding. In the first test 10 five-months-old pigs were used, and in the second test 10 pigs about three and one-half months old were used.

In the first test all the pigs were fed a mixture of ground corn, wheat middlings, and bran; and in the second test, hominy chop and middlings. In each test dry meal was fed in the hoppers, and wet meal in the troughs.

The results of the two tests were as follows:—

First Test: Hopper fed.—Average daily gain per pig, .71 pound. Meal consumed per 100 pounds gain, 520 pounds. Trough fed.—Average daily gain per pig, 1.36 pounds. Meal consumed per 100 pounds gain, 348 pounds.

Second Test: Hopper fed.—Average daily gain per pig, 1.26 pounds. Meal consumed per 100 pounds gain, 387 pounds. Trough fed.—Average daily gain per pig, 1.36 pounds. Meal consumed per 100 pounds gain, 348 pounds.

It will be seen that in both tests the trough-fed pigs made more rapid and cheaper gains than those fed from hoppers, though there is less labor when hoppers are used.

PART IV.

SELECTION, FEEDING AND MANAGEMENT.

The Boar.

Selection.—In these days, when pure-bred males are plentiful and reasonable in price, there is practically no excuse for using anything but a pure-bred boar, even though the sows be merely grades. The pure-bred male will transmit his own qualities to his progeny with greater certainty than a grade or cross-bred, and will get pigs of more uniform quality and excellence, so that it pays to use a pure-bred boar even for producing market hogs. It is true that many pure-bred boars should not be used for breeding, but this affords no reason for using a grade boar. The "scrub" pure-bred should be rejected along with the grade and cross-bred, and there are reasonably good pure-bred boars always available to the man who will make an effort to get one.

When selecting a boar to head a pure-bred herd, it will not do to be too economical regarding price. This does not mean that we are to pay fancy prices, running into the thousands, such as we sometimes read about: but it is well to bear in mind that a boar which is not good enough to command a fair price is seldom good enough to put at the head of a pure-bred herd. The importance of the herd will determine the price which the owner can afford to pay for a boar, but a few extra dollars on the price of a boar is a small matter when it is the means of securing something that the breeder really needs. The mere size of the price, however, is not a safe criterion of the merit of the boar, but it rests with the man who makes the selection to see that he gets value for his money. It is right here that a wide experience and a seasoned judgment count for so much in stock breeding. Sometimes aged boars, which have proved their excellence as stock getters, are to be had at a very reasonable price, and if they are still active they are much safer to buy than young, untried boars. There is much unreasonable prejudice against aged boars, and many an excellent aged boar is sent to the butcher long before his usefulness is past merely because no person would buy him for breeding purposes; and young boars, many of which should have gone to the butcher before being used at all, are taken in preference. These things are matters of judgment, and to select wisely the breeder must know what he requires.

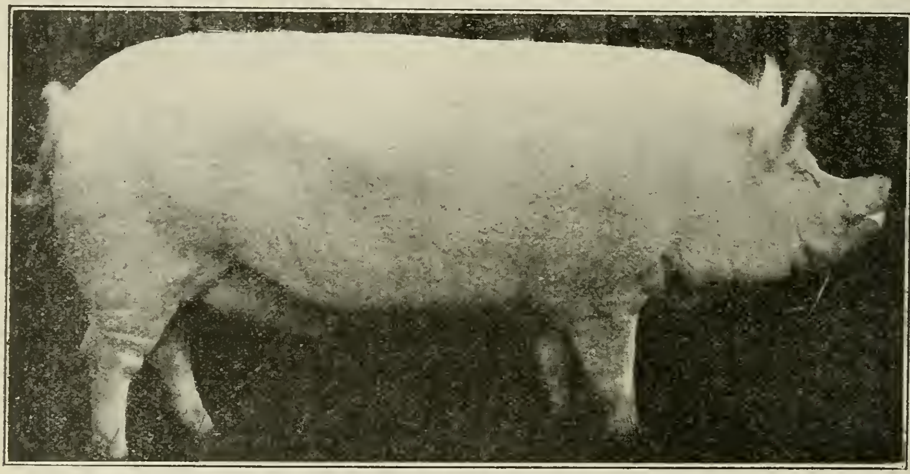


Fig. 6.—Large Yorkshire boar; an English Royal Show winner.

When buying a young boar, it will be found safer to buy one from eight to twelve months old than a pig two or three months old. The reason for this recommendation is plain, it being impossible to foretell just how the very young pig is going to develop. Highly-fitted show boars had better be avoided. It is more satisfactory to select by personal inspection than to buy through correspondence. A visit to the herd which produced the boar enables one to judge the general quality of the hogs produced in the herd, and one can pick up information regarding the sire and dam that could not otherwise be obtained.

If the boar is shipped some distance and arrives excited and tired, he should be fed very lightly at first, and not used for several weeks after his arrival.

The desirable conformation of the boar will depend upon whether he belongs to the fat type or the bacon type, and will also be influenced, more or less, by the breed to which he belongs. The general type of the fat hog and the bacon hog is discussed in another place, but it may be said that we expect a boar to be stronger in the head and to possess a more muscular neck, more massive shoulders, and heavier bone, than a sow or barrow. He should conform to the best type of the breed to which he belongs, and should have a bold, impressive carriage and general appearance. There should be nothing effeminate about his appearance and general make-up. Coarseness and roughness are not desirable, but if it came to a choice between two boars, one of which was fine and effeminate and the other inclining to coarseness, but strongly masculine, the writer's experience would lead him to choose the latter, other things being equal.

Use.—The age at which a young boar may be first used depends largely upon his development. Some boars may be used to a few sows when not more than seven months old without apparent injury. As a rule, it is safer not to use a boar before he is eight months old, and to use him as sparingly as possible until he is a year old. No hard and fast rule can be laid down, and the owner must use his judgment in the matter. Excessive use when young is likely to shorten the period of a boar's usefulness, and, since a boar will usually leave the best pigs after he reaches maturity, the importance of saving him while he is young will be readily

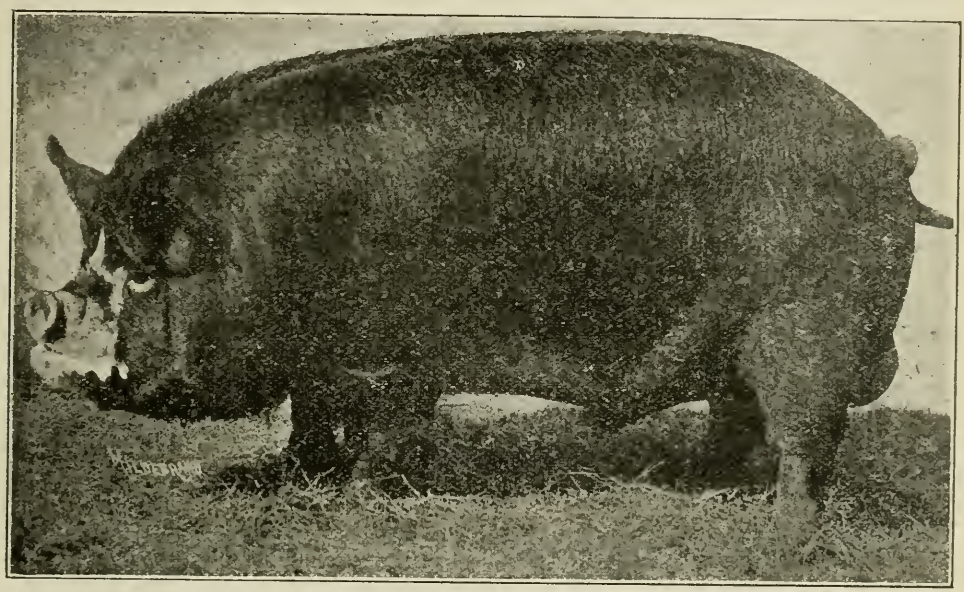


Fig. 7.—Berkshire boar, championship winner at the Iowa State Fair.

appreciated. Some good breeders will not allow more than one service a day, with intervals of one or two days a week without being used in the case of valuable boars. This is a matter which can be regulated better in large herds, where several stock boars are kept, than it can where only one boar is kept and where outside sows are admitted. The owner of a boar under the last named conditions will require to exercise all his ingenuity to prevent his boar from being used too freely during certain seasons of the year. In no case should more than one service to a sow be permitted, and the boar should not be allowed to run with sows to which he is to be bred. Excessive use is likely to result in small, weak litters, and the aim should be to save the boar as much as possible. It is not good to use a boar immediately after he has been fed.

Exercise.—Probably nothing is more essential to the health and vigor of an animal than exercise. In summer it is usually a comparatively simple matter to provide exercise in a paddock or pasture lot, but in winter it is more difficult. A roomy pen should be provided, with a sheltered outside yard. When practicable, it is a good plan to feed the boar outdoors at some distance from his sleeping quarters, thus compelling him to take exercise in walking back and forth between his pen and the feeding place. Icy ground is the greatest drawback to this method, but this can be overcome by littering the walk with some strawy horse manure Sometimes the boar can be fed in a well-littered barnyard, which makes a very good arrangement when practicable.

When several boars are kept, it is difficult to provide separate runs for each boar, and it simplifies matters if they are taught to run together. The tusks should be removed, and a cool day should be selected for turning them together for the first time. It takes a very short time, as a rule, to settle the question of supremacy, and when once settled no further disputes arise. The writer has had considerable experience with this method, and has never known bad results to follow. The two mentioned conditions are necessary—namely, the tusks must be broken off and a cool day selected for the tournament. After the first struggle the boars will live together as peaceably as sows.

Removing Tusks.—Armed with long, sharp tusks, the boar is capable of inflicting serious injury upon man or beast should he take the notion, but deprived of his tusks he becomes comparatively harmless. It is the part of wisdom, therefore, to remove these tusks before any damage is done, because we never know what the quietest boar may do under provocation. Several methods may be employed, and the following one will answer very well: The boar is first made fast to a post by means of a rope noosed about his upper jaw back of the upper tusks. Then one man takes a crowbar and another a sharp cold chisel and a hammer. The sharp edge of the crowbar is placed against the tusk near its base and held firmly in position, and the edge of the cold chisel is placed on the opposite side of the tusk directly opposite to the edge of the crowbar. A sharp blow with the hammer on the cold chisel does the job.

Feeding.—It requires good judgment to keep a boar in the best possible condition. Extremes are to be avoided. The over-fat boar does not make a satisfactory sire, as a rule, and a half-starved boar cannot transmit vigor and constitution to his progeny to the same degree that he would if properly managed. To get the best results the boar should be in fair flesh. A reasonable amount of fat on his bones will do him no harm if he gets sufficient exercise.

An exclusive meal ration will not give good results, especially if the ration is made up of corn. It is true that corn can be fed to a boar without injuring him, but it must be fed in the right way. Corn is fattening, but its exclusive use is debilitating, and the feeder must combine something with it to get good results. Equal parts ground oats and wheat middlings make a first-class meal ration when corn is not used. It gives sufficient bulk, and is nutritious without being heating or too fattening. Ground oats, middlings, or bran may be used singly to dilute corn or other heavy meal; in fact a very great variety of grains may be fed so long as the feeder uses judgment.

Supplemental Feeds.—But a boar needs something besides grain and meal to be in his best condition. Skim-milk and buttermilk are excellent, and will give good results with meal even if nothing else is used. In winter roots of any kind are much relished. They have a cooling, laxative effect, preventing constipation and keeping the animal thrifty and vigorous. If roots are not available, alfalfa hay of fine quality or even red clover may be used to give bulk to the ration. Some feed the alfalfa hay dry in racks, and others prefer to cut it and soak it with the meal ration or scald it with boiling water before mixing with the meal. As a substitute for roots, the soaked or steeped alfalfa would be preferable to the dry hay. Alfalfa or clover hay may be fed along with roots, and will be found to give good results if the feeder takes care to supply a reasonable amount of concentrated feed to make the ration sufficiently nourishing.

Summer management is usually simpler than winter. A pasture lot provided with shade is one of the best places to keep a boar. The grass or clover, or whatever the pasture may consist of, will furnish the bulky, succulent feed necessary for health, and gathering part of his food from pasture compels the boar to take exercise. If it is not possible to provide the pasture, he should be liberally supplied with green feed in his pen.

The quantity of meal to feed a boar will vary with circumstances. During the season when he is used most, he will require liberal treatment, but at no time should he be fed more than he will eat up clean before leaving the trough. During

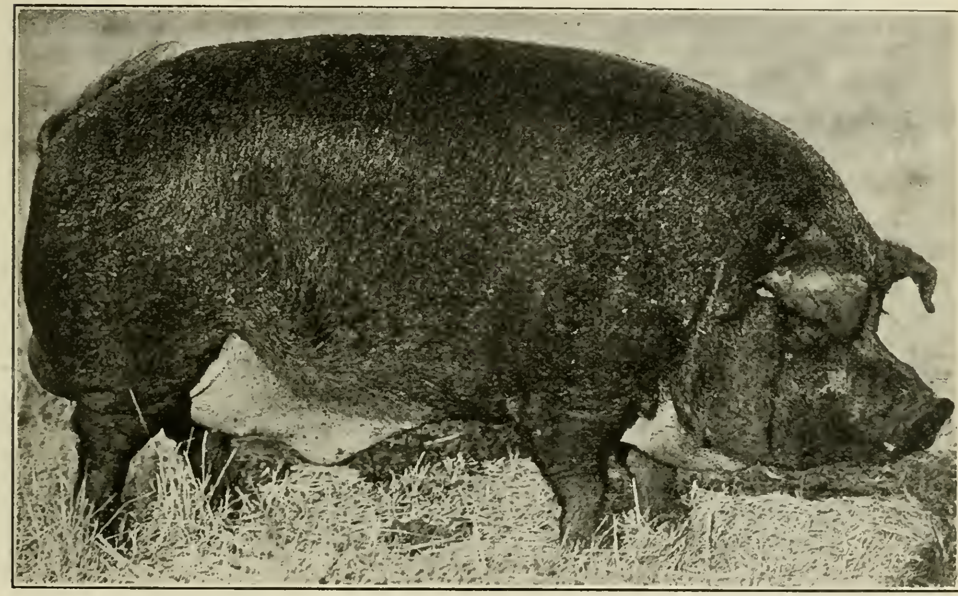


Fig. 8.—Duroc-Jersey boar, championship winner at Iowa State Fair.

comparatively idle seasons a very light meal ration will be sufficient, and if on good pasture he will require but little feed in addition. It is entirely a matter of judgment, and the feeder must be guided by the condition of the boar. It is never wise to make sudden changes in the ration—that is, to change suddenly from a light ration to a heavy one, or from a heavy ration to a light one. Changes should be made gradually, and the feeder, knowing about when the heaviest season commences, should start in plenty of time to prepare the boar for it.

Breeding Crate.—When it is necessary to breed heavy boars to rather small sows, a breeding crate often can be used to advantage. There are many types of breeding crates, but the one shown in the illustration is easily made, and will answer the purpose very well.

The dimensions of the crate are: Length, 5′ 6″; width, 2′, and height, 3′ 6″. The uprights at the corners are made of 2″ x 4″ scantling, and the sides may be made of 4″ strips of inch lumber, with a 10″ board at the bottom on each side. The supports for the feet of the boar (AA) are hinged at the front end of the crate, and can be raised or lowered by means of the chains (B). On the outside of the crate are hooks for holding the chains. "C" is an iron rod which slips through holes (D) bored in the bottom side boards of the crate. The rod should come just above the hocks of the sow, and there should be enough holes to permit adjusting the rod to the size of the sow. If it is desired to use a small boar on a large sow, the crate may be made to answer the purpose by simply placing a cleated sloping platform at the rear of the crate.

The Sow.

Selection.—For the production of market hogs it is not essential that a sow should be pure-bred. A grade sow of good type and parentage will usually produce very satisfactory pigs for market purposes, if mated with a boar of good breeding and quality, but, of course, none of her boar pigs should be kept for breeding purposes.

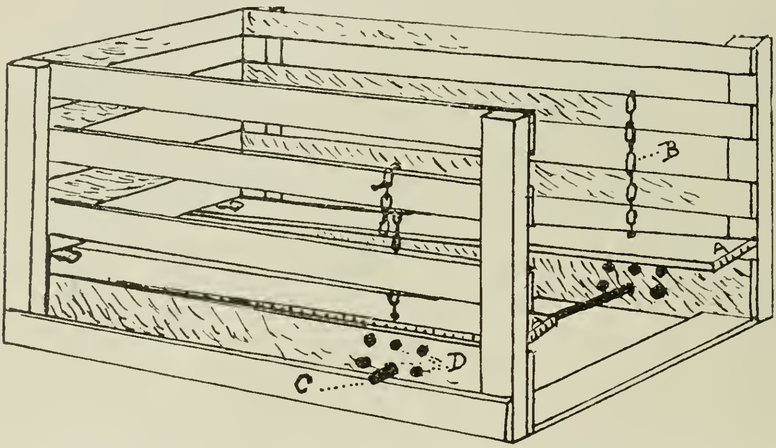


Fig. 9.—Breeding crate.

Whether pure-bred or grade, a sow selected for breeding should be from a prolific mother, and by a boar that comes of a prolific family, because fecundity is hereditary to a very high degree. It is safest to select a sow from a matured mother who has had a chance to demonstrate her usefulness. In making a selection, the number and character of the teats should be noted. A sow is more likely to make a good mother if she has at least twelve well-developed teats, set well apart, and the front ones well forward on the body.

In character, the sow is directly the opposite of the boar, and there is a femininity about her general appearance and bearing which indicates the prolific and indulgent mother.

When a really good sow is once obtained, she should be kept in the herd as long as she retains her usefulness. A really first-class sow is not too easily obtained, and when once acquired it will be found the part of wisdom to keep her as long as she continues to produce satisfactory litters.

Age of Breeding.—The age at which a young sow is first bred will depend upon her development, but it is very seldom that it is advisable to breed her before she is eight months old. Many good breeders prefer not to breed sows before they are ten or even twelve months old, and if they are intended for show purposes it is scarcely advisable to breed them earlier. One of the great objections to breeding sows very early is the fact that the very young sow is seldom able to raise a fair-sized litter of pigs, and if she raises only a few pigs in her first litter her mammary glands do not develop properly, and she rarely makes as good a nurse with subsequent litters as the sow which raises a good-sized first litter. Another objection to early breeding is the fact that the very young sow has not the strength to stand the strain of nursing a litter of pigs, and her vitality is sapped to such a degree that she never develops as she should. As a result, she will not retain her usefulness for so long a period, nor is she so likely to give strong, vigorous litters as though she had possessed more maturity before being bred.

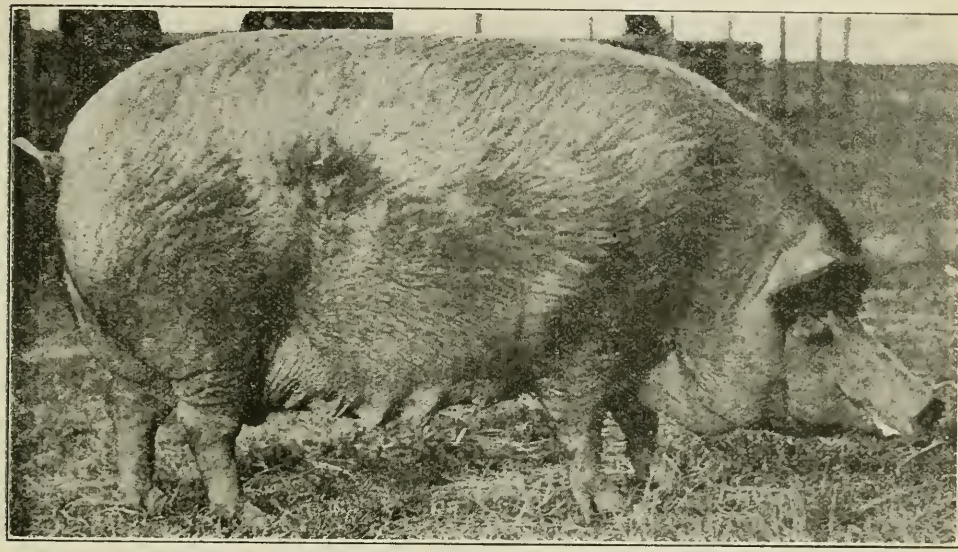


Fig. 10.—Tamworth sow, winner of championship at the English Royal Show.

Breeding Mature Sows.—Many sows will accept service a few days after farrowing, but it is hardly necessary to say that to breed a sow at this time is bad practice. No sow can do justice to herself and two litters of pigs at the same time, and the man who attempts to gain time by following such a practice will surely lose by it in the end.

Usually the sow may be bred again a few days after her pigs are weaned, if not too much pulled down in condition by nursing. If she has raised a large litter and is very much emaciated, the chances are that she will produce a small litter the next time if she is bred immediately after the pigs are weaned. In such cases she should be given three weeks or a month of liberal feeding to enable her to regain something of her lost strength and vitality before she is bred.

Though the sow need not be fat, she should be in good heart and thriving at the time she is bred. Many a man has been puzzled to know why his sow, which had raised a large litter, should drop down to four or five pigs the next time. The reason is not difficult to find, because a sow must be strong and full of vitality at the time of service in order to produce a large, vigorous litter.

Period of Gestation.—The period of gestation in sows is usually placed at 112 days. Often, young sows will farrow a few days sooner than the stated time, and old sows will frequently go a few days over it. It is not a good sign when a sow goes much over the sixteen weeks, as the litters are often lacking in vitality when carried much over time. If a sow has been properly handled, she will seldom go more than a few days over sixteen weeks, though there are exceptions to all rules.

Best Times for Farrowing.—Where winters are at all severe, it requires exceptional skill and equipment to make a success of winter litters. Most farmers will find it safer to have their sows farrow in April and October. It is generally possible to give April pigs a little outdoor exercise at an early stage of their growth, which will be found a great help in keeping them healthy and thrifty. The October pigs will also be able to get outdoor exercise for a time, which will enable them to

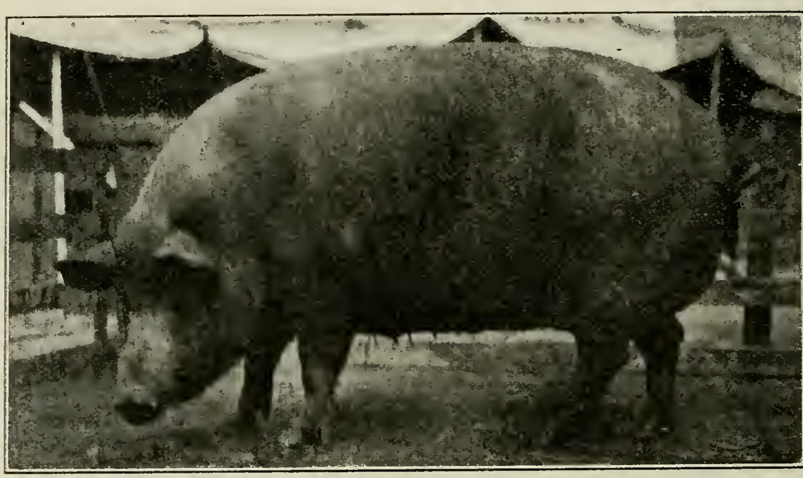


Fig. 11.—Tamworth sow, a prize winner at leading Canadian shows.

get a good start and make them better able to endure the closer confinement necessary during winter.

One or Two Litters.—The man who is breeding for show purposes, and who wishes to have his pigs with the sow as long as possible, as well as get his sows into high condition between litters, will find it necessary to breed his sows only once a year; but the general practice of farmers is to require their sows to do more than this. There is no good reason why a sow should not produce two litters a year when properly handled, provided that the sow is not to be fitted for the show ring.

Exercise.—Though exercise is important in the case of the boar, it is doubly important with sows during the period of gestation. Without considerable exercise during this time, sows cannot be made to give satisfactory results. In summer, pasture should be provided in which there is plenty of shade. A good pasture affords ideal conditions for sows, the green feed and the exercise keeping the sows in the best possible condition.

Winter Exercise and Quarters.—The greatest difficulty will be encountered in giving the sows sufficient exercise during the winter. Where only a few sows are kept, it is often possible to give them the run of a barnyard, where they will take exercise rooting in the manure, or working in scattered straw or chaff to find what little grain it may contain. If a dry, well-bedded sleeping-place is provided, which is free from draughts, the conditions are about as good as can be obtained.

When it is impossible to use the barnyard, a roomy shed with earth floor, and a sleeping-place arranged in one corner, can be made to answer the purpose very well. By littering the shed with cut straw or chaff and sprinkling a very little whole grain in the chaff every day, the attendant can-induce the sows to take considerable exercise. Another method is to use portable pens set in outside lots. The pens should be placed facing the south, and fifty yards or more from the feeding-

Fig. 12.—Large Yorkshire sow, championship winner at the English Royal Show.

place. If kept well bedded, and banked about the bottom with strawy horse manure, they make comfortable sleeping quarters. The sows are forced to take exercise in walking backwards and forwards between the pen and the feeding place.

It is better to keep not more than five or six sows in a pen of this kind, and care should be taken to provide plenty of trough room. The troughs should be placed on dry ground, or on a platform, and it is preferable to have them in a place that is sheltered from the wind. (See under "Portable Pens," Part VI.)

Feeding and Management during Gestation.—During the period of gestation the sow should be kept in good, strong condition, but not overloaded with fat. Extremes in condition are to be avoided. The very fat sow is apt to be clumsy with her pigs, and sometimes her pigs are few in number or lacking in vitality. On the other hand, the very thin sow will either not do justice to her pigs, or will become a mere wreck herself during the time she is nursing her litter. and the chances are that both these things will happen. A sow may be kept in fairly high condition and will produce satisfactory litters, provided she takes plenty of exercise.

In districts where corn is plentiful, there is a temptation to feed almost exclusively upon corn. Such a method of feeding cannot give the best results, because corn does not furnish enough bone and muscle-forming constituents to properly develop the unborn pigs. It is also rather too fattening and heating to feed in large quantities to a sow at this stage. It is true that corn may be fed, but, as in the case of the boar, it must be fed with judgment. The ration recommended for the boar—namely, equal parts ground oats, and wheat middlings—will answer very nicely for the sow. The proportion of corn, if fed, should not be over one-third of the meal ration, and wheat middlings or bran may be used to dilute the corn meal without oats. In cold weather, if sows have a good deal of outdoor exercise, they may be fed more corn with safety than when they are kept pretty closely confined.

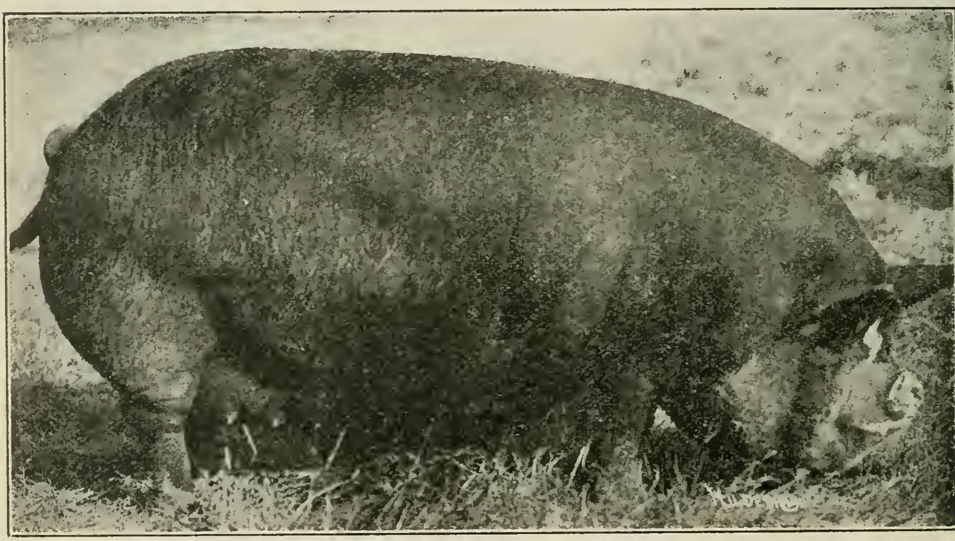


Fig. 13.—Champion Berkshire sow at the Iowa State Fair.

A meal ration which is preferred by the writer to all others is equal parts ground oats and middlings, leaving out corn altogether. It is possible, however, to use a wide variety of feeds, so long as the feeder realizes the importance of furnishing considerable bulk and of restricting the proportion of heating or highly fattening feeds.

As in the case of the boar, the sow requires something besides meal, and the furnishing of some such feeds as roots, or alfalfa, or red clover hay, is even more important than in feeding the boar. Skim-milk is also excellent but is not always available for sows.

In summer, a pasture field will furnish the bulky part of the ration, and, if sows are in good condition to start with and are given a good pasture, they will get along very well without other feed for two or three months. They should be given a little meal for several weeks before farrowing, to accustom them to its use, and render the change less violent when they are taken into the pens. With regard to the quantity of meal, the feeder must be guided entirely by the condition of the sows.

Meal may be fed either wet or dry. When roots are fed, a good plan is to mix the dry meal with pulped roots, though the feeder has wide latitude in regard to the methods he may see fit to follow.

In Cold Weather, when sows are fed out-doors, very little water shoud be used in mixing their feed. It will be found better to furnish them with water separately, should they require it. If they are fed roots, they will take very little water in cold weather. It should be seen to, however, that they have water when they need it, and in hot weather an abundant supply of fresh water is very important.

A record should be kept of the date of service of each sow, so that the date of farrowing will be known in advance, and due precaution taken. A week or two

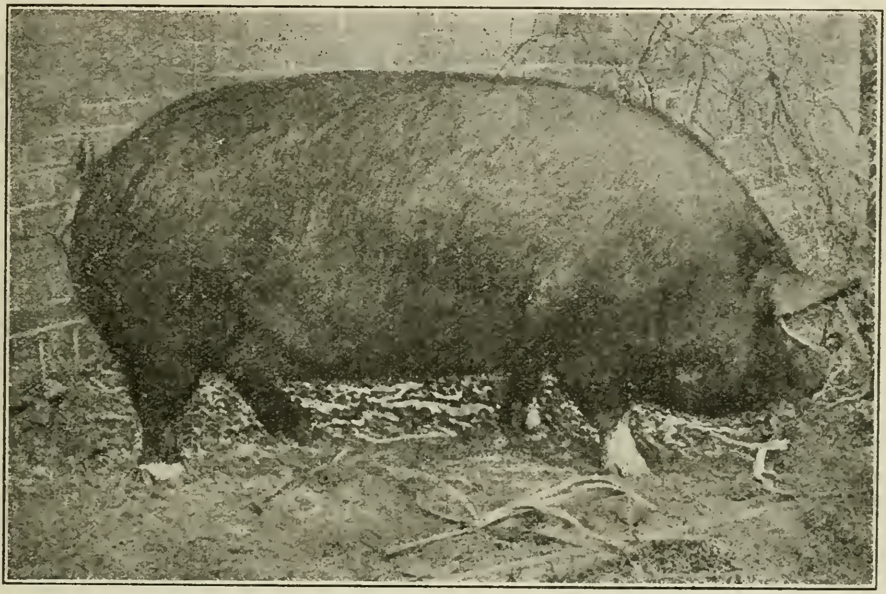


Fig. 14.—Large type Berkshire sow, representing the type popular in Canada.

before farrowing, the sow should be placed in the farrowing pen, so as to become accustomed to her surroundings and changed conditions before the pigs are born.

Constipation is the bane of the swine breeder, and if the sow becomes constipated before she farrows, the chances are that she will lose her pigs, and possibly her own life. Constipation, therefore, is one of the main things to be guarded against at this time. When it once occurs, very little can be done to overcome it and save the pigs, so that it is almost altogether a matter of prevention. If a sow is taken directly from a pasture field, shut up in a pen, and fed upon an exclusive meal ration, trouble is almost sure to occur. Radical changes in feeding are to be avoided, and the ration should be kept practically the same after taking the sow into the pen as it was before. If anything, the feed should be made rather more sloppy, and the green feed or roots should be supplied the same as they were before the sow was taken in. A small amount of linseed meal (oil meal) or ground flaxseed added to the ration is also helpful in preventing constipation. The wisdom of feeding meal to sows while on pasture for a time before they farrow can be readily appreciated, as it prevents a violent change in their ration. The sow should also be given a chance and encouraged to take exercise.

Farrowing.—The farrowing pen should be dry, well ventilated, and free from draughts. It is a good plan to provide the pen with a guard rail made of two by eight inch planks fastened with their edges against the sides of the pen a little above the bed. These prevent the sow from lying against the partition, and lessen the danger of injury to the little pigs, which often find the space under the guard a very convenient refuge.

There is a difference of opinion as to the amount of bedding which should be used, some maintaining that the sow should be liberally supplied with bedding, and others that the bedding should be limited. The writer's experience is that active sows in comparatively light condition can generally be trusted with a liberal

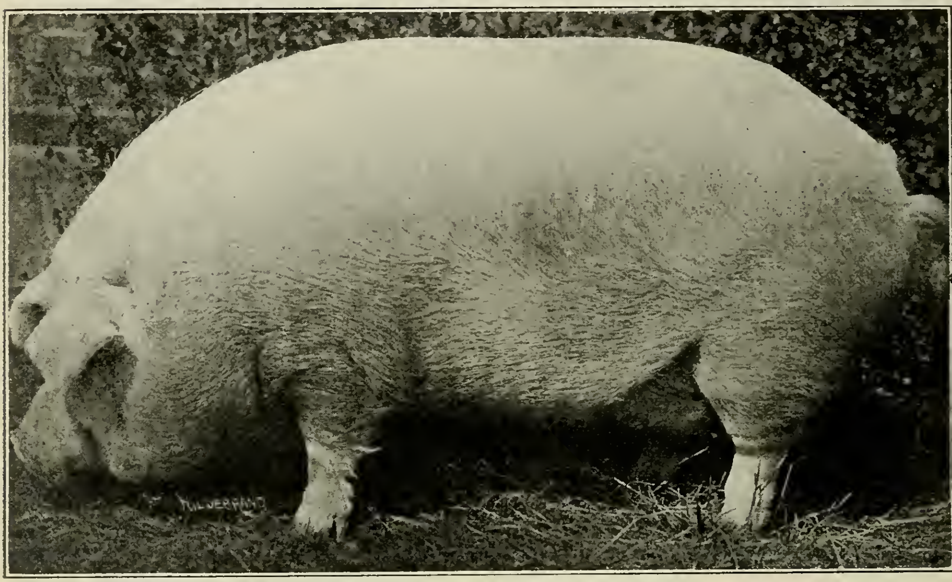


Fig. 15.—Chester White sow, a prize winner at American shows.

amount of bedding, but sows which are in high condition, or which are at all clumsy, had better be given only a moderate amount of cut straw.

Sows should not be allowed to farrow in a large piggery where many other pigs are kept, unless it is warm weather and windows and doors can be left open. The air of a piggery where many pigs are kept seems to be poisonous to little pigs, when the weather is cold and the doors and windows have to be kept closed, in spite of ordinarily good methods of ventilation.

The writer has had good results from sows farrowing in portable single pens placed in a sheltered yard, even in zero weather. Tarred paper was put on the studding, and the pen tightly boarded outside and inside. A ceiling of slats was put in the pen, and the space above the ceiling stuffed with straw. A window in the side, a small ventilator running from the ceiling out through the roof, and a lighted lantern hung in the pen on the coldest days when the pigs were very small, completed the equipment. The air in this pen always felt dry and comfortable, and the pigs all kept healthy and thrifty. (See under "Portable Pens," Part VI.)

It pays to treat sows kindly and to have them quiet. If they are on good terms with the attendant and regard him as a friend, there is much less danger of trouble from nervous, excited sows when the critical time of farrowing arrives.

Feeding and Management after Farrowing.—After farrowing, the sow should not be disturbed, and if she lies quietly for ten or twelve hours, or even more, so much the better. When she wants anything she will go to the trough for it. At first she should have little more than a drink. A very thin slop of middlings and water will answer very well. If the weather is cold, tepid water should be used. During the first three days, great care must be exercised not to over feed, and the ration should be kept very light. After this, the feed may be gradually increased, taking a week or ten days to reach full feed. A good mother with a large litter requires very liberal feeding, but if the litter is small, it may be necessary to reduce the feed.

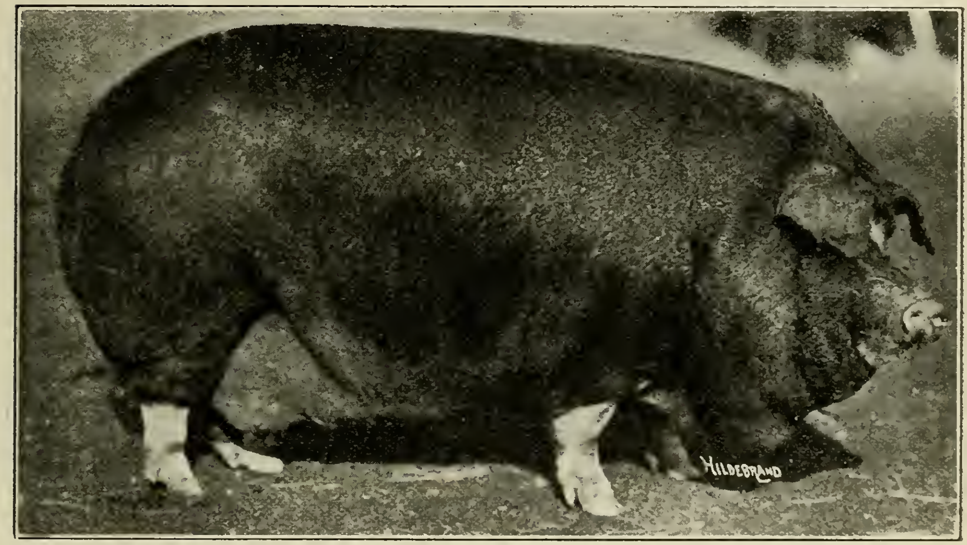


Fig. 16.—Champion Poland-China sow at the Illinois State Fair.

Many different rations are used for nursing sows. Equal parts of finely ground oats and wheat middlings, allowed to soak between feeds, makes a most excellent ration. If sweet skim-milk can be added to the mixture, it makes an almost ideal ration. Corn may be used as recommended for sows before farrowing, and in larger quantities if skim-milk is available. A certain amount of roots and green feed are always in order, but the sow should not be expected to subsist upon such feeds at this time. A limited amount of bulky, succulent feed helps to keep the sow healthy.

The sow's udder may become hard and inflamed. If so, it is a good plan to bathe thoroughly with hot water and apply equal parts of lard and turpentine.

When the pigs are weaned, the feed should be cut down to check the secretion of milk. Dry oats make a safe feed for the sow for a few days after the pigs are weaned. If the udder gets very full, it is a good plan to turn the sow in with the pigs once a day for a few days.

Sows which Eat their Pigs.—Occasionally a sow will be found which will eat her pigs. It is claimed by some that the tendency to eat their young is sometimes caused by allowing sows to eat their afterbirth. As a precautionary measure, the afterbirth should be promptly removed from the pen. There is little doubt that the trouble is generally caused by a fevered condition in the sow, often induced by injudicious feeding before farrowing, or even after farrowing. A remedy that has been suggested is to feed the sow salt pork, but the danger is that once the sow has eaten her pigs she acquires the habit and is likely to do it again. Unless she is a very valuable sow, it is safer not to give her a second opportunity, but to turn her into the feed lot and fatten her for the butcher.

The Young Pigs.

Feeding and Management before Weaning.—When the pigs are born, the attendant should be on hand to see that everything goes well. If the pigs

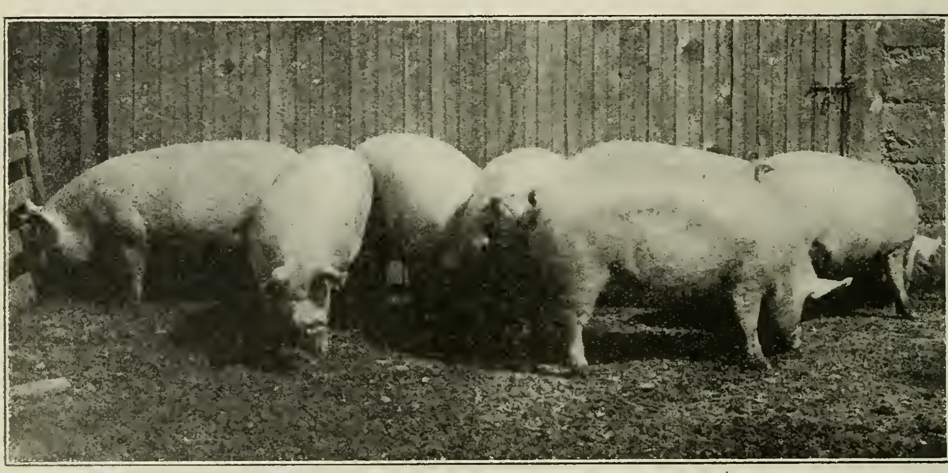


Fig. 17.—Group of young Large Yorkshire sows. Note the uniformity of type and the excellent quality throughout.

are strong and the sow lies quiet, it is better not to interfere. Sows that have been properly fed and given sufficient exercise seldom have difficulty in farrowing.

If the pigs seem somewhat weak, or if the sow is very restless, it is safer to place the pigs in a well-bedded box or basket to keep them out of the way until all are born. If the pen is chilly, a bottle of hot water placed in the bottom of the basket and covered with a blanket, with another blanket over the top of the basket, will help keep up the vitality of the pigs.

The pigs should be placed to the teat to suck as soon as possible. The weaker the pigs, or the colder the pen, the more important an early drink of the mother's milk becomes. If parturition is not unduly protracted, and if the pigs are strong, lively, and comfortable, they may wait for their first drink until all are born, but in such matters the attendant must use his judgment.

In cases of difficult parturition, a pig that is apparently lifeless can often be revived by opening its mouth and blowing into it. To be successful, this operation must be performed as soon as it is born. A chilled pig can sometimes be revived by immersing up to the neck in water heated to a temperature of about 98 degrees.

When removed from the water, it should be rubbed dry, and induced to suck if possible.

As soon as the sow appears to have settled down quietly, it is best to put the little pigs with her and leave them together. It is well not to interfere except when it is absolutely necessary.

By the time the pigs are about three weeks old they will have learned to eat. If at all possible, it is a good plan to give them access to another pen in which is kept a small trough. Here they can be fed a little skim-milk with a very little middlings stirred into it. The quantity of middlings can be increased gradually as the pigs grow older. If they can be taught to nibble at sugar-beets or mangels during this time, so much the better. A small amount of soaked whole corn, or almost any other grain, scattered on the floor of the pen, will cause them to take exercise while hunting for it. If it is not possible to provide an extra pen, the sow may be shut out of the pen while the pigs are being fed. Many people simply allow the young pigs to eat with the sow, and many good pigs are raised in this way, but better results will be obtained if the pigs can be fed separately.

☞ **Exercise** is very important for young pigs, and every possible means of securing it must be adopted. If they are kept in a small pen with the mother, some of the best of them will likely become too fat, and probably sicken and die. Outdoor exercise is especially beneficial, but pigs should be protected from cold winds or from a very hot sun. If the sow is turned out with her pigs, it is not well to give her a very large range at first, as she is likely to travel too far and unduly tire the pigs.

Boar Pigs not intended for breeding purposes should be castrated before weaning, to get the best results, though there is not much danger from castrating at a later date, provided care is exercised in connection with the operation. Clean hands, a clean knife, and the use of a disinfectant upon the wound will obviate practically all danger.

Ruptured Pigs. —Pigs ruptured in the scrotum may be easily castrated as follows: Have an assistant hold the pig up by the hind legs. In making the incision, cut only through the skin of the scrotum, being careful not to cut the membrane or sac which envelops the testicle. Then draw out the testicle enclosed in its membrane, and, at the same time, work the intestine back into the body of the pig. With the pig held as described, the intestine will go back to its place with little or no assistance. Having drawn out the testicle far enough, tie a strong string firmly around the cord of the testicle (including the membrane), and then cut away the testicle (enclosed in its membrane) just outside of where the string is tied. Leave the ends of the string three or four inches long, so that they hang outside the wound. If the string does not come away in a couple of weeks, it may be pulled out.

If the rupture is only on one side, the remaining testicle may be removed in the ordinary way. The scrotum should be washed with disinfectant before any incision is made. The hands of the operator and the knife should also be washed with disinfectant, and the string should be soaked in disinfectant before it is used. The incision in the scrotum should extend well downwards to facilitate drainage from the wound. These simple precautions assure success.

The writer has employed this method successfully, and when the wound heals no person could tell that the pig had been ruptured.

Feeding and Management after Weaning.—There is considerable difference of opinion as to the best age at which to wean pigs. Some advocate leaving the pigs with the sow for ten or twelve weeks—in fact, the sows is allowed practically to wean her own pigs. For producing show pigs this method may answer very well, but it means only one litter a year; at any rate, it does not admit of two litters a year. The average farmer will find it more profitable to wean his pigs early enough to permit two litters a year to be raised. If the young pigs have been taught to eat as described, and skim-milk is available, they may be weaned successfully when six weeks old. It is true that many pigs are weaned before they are six weeks old, but it is seldom advisable to do so if they appear to be thriving with the sow. If skim-milk is not available, it is generally advisable to defer weaning for two weeks more, and special pains should be taken to have the pigs well accustomed to their new feed, and eating heartily before they are weaned. (See Part III, "Substitutes for Skim Milk").

Skim-milk and middlings make about the best feed for young pigs after weaning. If the middlings are fine and floury, which is not very likely to occur under present-day methods of milling, they will sometimes cause indigestion, which may show itself either in the form of diarrhoea or constipation. Diluting the middlings with a little bran or finely ground oats will help prevent the trouble. Soaking or scalding the middlings will also tend to prevent digestive troubles. Scalding the middlings is especially useful when no skim-milk is to be had, as it makes the pigs like the feed better. To scald the middlings, it is best to pour boiling water on them, cover the vessel, and allow to stand several hours, or from one time of feeding until the next. When the pigs are first weaned, it is better to feed four times a day, giving only a small quantity of feed each time, and taking care to keep the trough clean. When well started, they may be changed to three feeds a day.

It is not well to be in a hurry to commence feeding grain. Generally speaking, when pigs are about three months old a little grain may be introduced into their ration. Two parts of middlings and one part of corn meal or ground barley, mixed with skim-milk to form a slop, make an excellent ration for growing pigs. As the pigs grow older the proportion of grain to middlings may be increased, but at no time should they be fed exclusively or almost exclusively upon corn, because corn is a poor bone and muscle-former. The importance of feeding supplementary feeds with corn has been pretty fully discussed under the work of experiment stations. The need of such feeds is most important during the early life. A few roots will be found most helpful in keeping young pigs healthy during the winter, and green feed of almost any kind will answer the purpose during the summer. The feeder has a wide range of feeds to choose from, and if he understood something of their nature he should have no difficulty in compounding a ration which will give satisfaction.

The aim should be to develop bone and muscle during the early stages of growth, and, while the pigs should be thrifty and sleek in the hair, they should not be fed in such a way as to overload them with fat. This is especially true of pigs which are intended for breeding purposes, and which should be carried right through to breeding age upon feeds which stimulate growth and general vigor rather than fat. A reasonable amount of fat is not objectionable, but the development of the frame, the muscular system, and the vital organs must not be neglected, if a satisfactory breeding animal is to be produced. Variety in feeds and plenty of exercise are very essential features in raising an animal that will possess all-round development.

Cost of Raising Pigs.—The Ontario Agricultural College obtained some interesting figures relative to the cost of raising young pigs until six weeks old, at which age they are commonly weaned.

Feeds were valued as follows: Meal of all kinds, including bran and middlings, $20.00 per ton; roots, $2.00 per ton; skim-milk, 15 cents per 100 pounds.

It is assumed that the sow raises two litters a year, and that she nurses each litter six weeks. This would leave about nine and one-quarter months during the year that the sow would not be nursing pigs, and the cost of maintaining the sow during the time she is dry is estimated at 75 cents a month, it being assumed that the sow is fed as economically as possible during that time. The maintenance during the nine and one-quarter months at 75 cents per month amounts to $6.94, or, in round numbers, $7.00. Half of this amount, $3.50, is charged against each litter, in addition to the cost of feed consumed by the sow and pigs before the pigs are weaned.

Risk, interest on investment, labor, and manure are left out of the calculation.

Twelve litters of pigs were used, which were weaned at six weeks old in each case.

The following table gives particulars of each litter:

Sow and Litter.	No. of Pigs in Litter.	How Bred.	Cost of Feeding Sow and Litter for Six Weeks.
No. 1	4	Pure Yorkshire	$3 20
" 2	9	Berkshire sire, Tamworth dam	3 08
" 3	6	Pure Yorkshire	3 87
" 4	5	Yorkshire sire, Tamworth dam	3 70
" 5	8	Yorkshire sire, Tamworth dam	3 04
" 6	3	Yorkshire sire, Berkshire dam	5 85
" 7	9	Berkshire sire, Yorkshire dam	4 31
" 8	8	Pure Yorkshire	4 33
" 9	8	Pure Tamworth	3 88
" 10	8	Yorkshire sire, Tamworth dam	3 94
" 11	6	Tamworth sire, Berkshire dam	3 33
" 12	4	Tamworth sire, Berkshire dam	2 37
Average	6½		3 74

Total and Average Costs.—To arrive at the total cost of the pigs at six weeks old, the service fee and half the cost of maintaining the sow when dry are charged against the average cost of maintaining the sow and litter for six weeks, making the total cost as follows:

Service fee	$1 00
Half cost of maintaining dry sow (½ of $7.00)	3 50
Average cost of feed for sow and litter	3 74
Total	$8 24

Average number of pigs in litter, 6½.
Average cost per pig six weeks old, $1.27.

Variations in Cost.—If the cost of maintaining the dry sow were placed at $1.00 per month, it would bring the cost of the young pigs to $1.44 each at six weeks old. It is probably a safe statement, therefore, that young pigs can be raised to the age of six weeks at $1.50 each, making some allowance for items not considered in the experiment described.

J. H. Grisdale, Central Experimental Farm, Canada, estimates that a breeding sow can be maintained during a whole year at from $12.00 to $15.00, under careful management, and produce two litters during the year. This approximates, very closely, the Ontario results, which, omitting service fee, make the cost of maintaining a sow half a year, and one litter of pigs for six weeks, $7.24.

Since the above calculations were made, there has been a very material increase in the cost of feeds, but if we add 50 per cent. to the cost of maintenance all round, the cost of a pig six weeks old is about $1.85, which is a very moderate cost.

FATTENING.

Many of the problems connected with the fattening of hogs have already been discussed under experiment station work. Corn may be used much more freely for fattening hogs than for those intended for breeding, but experiments show conclusively that corn has its limitations, even for fattening, and that it is greatly improved by having some feed richer in protein combined with it. The importance of using some sort of supplementary feed with almost any meal ration in order to give bulk and variety has also been demonstrated, and the important place which pasture may play in the fattening of hogs has been quite fully dealt with. There are a few general facts of more or less importance remaining to be given under this heading.

Winter Feeding.—Generally speaking, winter feeding is more expensive than summer feeding. Part of the extra feed required in winter is probably due to the fact that more feed is required to keep up the heat of the body during cold weather. There is little doubt, however, that much of the advantage of summer feeding is due to more sanitary surroundings—that is, more fresh air and outdoor exercise, coupled with more succulent feed, which seems to aid digestion. The man who feeds hogs in winter, therefore, should aim to approach summer conditions as nearly as possible. He cannot get summer temperature, it is true, but he can provide a fair amount of fresh air, and feeds that will keep the digestive organs in good condition. It is just here that a man who grows a few roots for winter feeding has a great advantage over the man who does not. Skim-milk, buttermilk, and alfalfa may also be made to perform a useful part in giving variety and aiding the digestive organs to perform their functions properly.

Quantity of Feed—The test of the skill of the feeder is his ability to keep just slightly within the appetite of the animals under his charge. He must watch the animals closely and see that they clean up with apparent relish all that he gives them. Feed left in the trough is a sign that something is wrong with the methods employed, and to have to cut back in the quantity of feed means a loss of time. The quantity should be so gauged that there is a gradual increase as fattening advances, and radical changes, either in quantity or kind, should be avoided. To be successful, the feeder must learn the lesson that all changes should be made gradually, and that undue haste in fattening may mean serious delay in the process, together with a waste of feed.

Regularity and Comfort.—Regularity in time of feeding is necessary to regularity in the appetite of the animal. The animal which is fed at the same hours every day will take more feed with less danger of surfeiting than the one fed at any time to suit the convenience of the feeder.

Dry, comfortable quarters, and sanitary conditions generally in pen or feed lot, are important factors in securing satisfactory gains, and in avoiding disastrous loss through disease.

Cost Increases with Age.—Prof. Henry, in "Feeds and Feeding," gives a very instructive table, compiled from results from numerous experiment stations, showing the feed consumed per 100 pounds gain by hogs of different weights. Following is an abbreviation of the table as given in Prof. Henry's book:

Weight of Animals in Pounds.	Total Number of Animals Fed	Average Feed Eaten Per Day.	Feed Eaten Daily per 100 lbs. Live Weight.	Average Gain Per Day.	Feed for 100 lbs. Gain.
		lbs.	lbs.	lbs.	lbs.
15 to 50....................	174	2.23	5.95	.76	293
50 to 100....................	417	3.35	4.32	.83	400
100 to 150....................	495	4.79	3.75	1.10	437
150 to 200....................	489	5.91	3.43	1.24	482
200 to 250....................	300	6.57	2.91	1.33	498
250 to 300....................	223	7.40	2.74	1.46	511
300 to 350....................	105	7.50	2.35	1.40	535

The table shows that the heavier hogs made more rapid gains and consumed less feed per 100 pounds of their live weight, but there was a steady increase in the amount of feed required for 100 pounds gain as fattening advanced.

A similar result was obtained at the Ontario Agricultural College with 36 pure-bred pigs of different breeds, as shown by the following table:

Live Weight of Hogs.	Meal Required for 100 pounds Increase in Weight.
54 to 82 pounds....................	310 pounds.
85 to 115 pounds....................	375 pounds.
115 to 148 pounds....................	438 pounds.
148 to 170 pounds....................	455 pounds.

These figures, together with others that might be given, show very clearly that the cost of production steadily increases as the hogs become older.

Correctives.—Swine appear to have a craving for what might be called "unnatural" substances. This is especially true of hogs which are kept in confinement, which will eat greedily such substances as charcoal, ashes, mortar, soft coal, and rotten wood. It is probable that some of these substances are not good for hogs, but there is no doubt that charcoal and wood ashes have a beneficial effect. Charcoal made from corn cobs answers very well. It is a good practice to supply hogs with charcoal, especially during the winter months, but, if the hogs have not had any charcoal for a considerable time and are then given a liberal supply, there is danger that they may take too much for their own good. The same caution must be observed in regard to salt.

Theodore Louis, a veteran American swine breeder, recommends the following:

"Take 3 bushels of charcoal, 8 lbs. salt, 2 quarts of air-slaked lime, and 1 bushel of wood ashes. Break the charcoal well down, and thoroughly mix with other ingredients. Then take 1¼ lbs. copperas, dissolve in hot water, and with a watering pot sprinkle over the whole mass, and mix thoroughly again. Put this mixture in boxes and place where hogs of all ages can eat it at pleasure."

This mixture is spoken of very highly by many who have used it.

Another very good mixture can be made up of one part salt, one part sulphur, and about ten parts of wood ashes. This is placed in boxes where pigs have free access to it.

Prof. Dietrich recommends keeping salt, charcoal, air-slaked lime, bone meal, and wood ashes in separate compartments of a trough, so that the pigs can take what they desire of any one of the substances. Sods make a good corrective for swine. A wagon-load or two of sods placed conveniently near the piggery so that the feeder can throw one or two into each pen occasionally will be found very beneficial during the winter.

Hogs that are out-doors during the summer and have access to earth and vegetable matter have little need of other correctives.

Money Returns for Feed Consumed by Hogs.—Some interesting results have been obtained by the Ontario Agricultural College relating to the value it is possible to obtain for feed consumed by hogs, when the hogs are sold at varying prices per pound live weight. The investigation includes hogs fed by the College, as well as a large number fed by farmers throughout the Province. The following summary shows the scope of the investigation:

Number of hogs	297
Weight when marketed	56,718 pounds.
Average weight per hog	190.9 "
Total meal consumed, which included barley, peas, oats, corn, middlings, and bran.....	165,911 "
Total skim-milk consumed	112,500 "
Total roots consumed	64,600 "
Miscellaneous feeds, such as pasture, green feeds, etc., valued by experimenters at...	$77 00

The pigs are valued at $1.50 each at weaning time. This amount, together with the value of the skim-milk at 20 cents per cwt., roots at 10 cents per bushel, and the miscellaneous feeds valued at $77.00, is first deducted from the gross proceeds derived from the assumed sale of the hogs at each of the different prices per pound, and the remainder represents the cash received for the meal consumed by the hogs. The following table shows the prices obtained for feed, under each valuation of the hogs when sold:

Prices Realized for Feeds Consumed by 297 Hogs.

Assumed Selling Prices of Hogs, Live Weight.	Meal, including Mixed Grain, Middlings and Bran.	Milk.	Roots.
	Per ton.	Per cwt.	Per Bush.
If sold at 4½ cents per pound	$20 45	$0.20	$0.10
If sold at 5 cents per pound	23 87	.20	.10
If sold at 5½ cents per pound.......................	27 29	.20	.10
If sold at 6 cents per pound.......................	30 71	.20	.10
If sold at 6½ cents per pound	34 13	.20	.10

Figures such as the above, obtained from a large number of hogs fed under varying conditions, carry considerable weight. They show that the hog is able to give a good account of the feed he consumes, provided he is handled with intelligence. Of course, the figures in the table are averages. Some tests showed larger returns and some did not show as large, but it is worthy of note that two tests which showed exceptionally good results were omitted from the computation in order to make the results as conservative as possible.

PART V.

CURING PORK

Farmers' Bulletin 183 of the U. S. Department of Agriculture, by Professor Andrew Boss, gives much useful information regarding the curing of meats, and has been liberally drawn upon in the preparation of material for this section.

Cooling.—"Meat must be properly and thoroughly cooled to insure good keeping qualities when cured. If salted before the animal heat is out, the shrinkage of the muscles causes the retention of injurious gases, giving an offensive odor to the meat. Neither should meat be frozen when salted, as the action of the frost will prevent the proper penetration of the salt, and uneven curing will result. While the temperature cannot well be controlled on the farm, it is possible to slaughter when the weather is favorable to cooling the carcass before the surface freezes. The most desirable temperature for cooling meat is 34 to 40 degrees Fahrenheit. It is important, also, that meat be cured as soon as cooled, and while still fresh. Ordinarily, twenty-four to thirty-six hours after slaughtering will allow sufficient time for cooling."

Vessels for Curing.—"A clean, hard-wood barrel is a suitable vessel in which to cure meat. A barrel made for the purpose is best, but where it cannot be had, a molasses or syrup barrel will answer. The important point is to have it clean and tight enough to prevent leakage. A large stone jar is the best vessel that can be had. A barrel or a jar that has once held meat may be used again and again, unless meat has been spoiled in it. If used repeatedly, it will be necessary to scald it out thoroughly each time before packing with fresh meat."

Brine Curing and Dry Curing.—"Brine-cured meats are best for farm use, for the reason that a suitable place for dry curing is not usually obtainable. It is also less trouble to pack the meat in a barrel and pour on a brine than to go over it three or four times to rub in the salt. The brining method also gives better protection from insects and vermin. Trouble is sometimes experienced in keeping brine, but if pure water is used and directions followed in making the brine (see next paragraph), there should be no difficulty in keeping it for a reasonable length of time. During warm weather, brine should be closely watched. If it becomes 'ropy,' like syrup, it should be boiled, or a new brine made. A cool, moist cellar is the best place for brine curing. Dry curing may be done successfully in a cellar also, though even more moisture is needed to effect a thorough cure. The cellar should be dark and tight enough to prevent flies and vermin from damaging the meat."

Plain Salt Pork.—"Rub each piece of meat with fine, common salt and pack closely in a barrel. Let stand over night. The next day weigh out ten pounds of salt and two ounces of saltpetre to each 100 pounds of meat and dissolve in four gallons of boiling water. When cold pour this brine over the meat, cover, and weight down to keep it under the brine. Meat will pack best if cut into pieces about six inches square. The pork should be kept in the brine until used."

To keep the meat under the brine use a loose-fitting wooden cover, and weight with a heavy stone or several vitrified bricks. The cover should be made of some hard wood, oak preferred. Such woods as pine or cedar will taint the brine.

Sugar-cured Hams and Bacon.—"When the meat is cooled, rub each piece with salt and allow it to drain over night. Then pack it in a barrel with the hams and shoulders in the bottom, using the strips of bacon to fill in between or to put on the top. Weigh out for each 100 pounds of meat 8 pounds of salt, 2 pounds of brown sugar and 2 ounces of saltpetre. Dissolve all in four gallons of water, and cover the meat with the brine. For summer use it will be safer to boil the brine before using. In that case it should be thoroughly cooled before it is used. For winter curing it is not necessary to boil the brine. Bacon strips should remain in this brine four to six weeks; hams, six to eight weeks. This is a standard recipe, and has given the best of satisfaction. Hams and bacon cured in the spring will keep right through the summer after they are smoked."

The length of time the meat is kept in the brine depends upon the size of the pieces. A large ham takes more time to cure than a small one.

Dry-cured Pork.—"For each 100 pounds of meat weigh out 5 pounds of salt, 2 pounds of granulated sugar, and 2 ounces of saltpetre, and mix them thoroughly. Rub the meat once every three days with a third of the mixture. While the meat is curing it is best to have it packed in a barrel or a tight box. For the sake of convenience, it is advisable to have two barrels, and to transfer the meat from one to the other each time it is rubbed. After the last rubbing the meat should lie in the barrel for a week or ten days, when it will be cured and ready to smoke. To cure nicely it is desirable to have a cool and rather moist place in which to keep it. This recipe should not be used where the meat must be kept in a warm and dry place, as the preservatives will not penetrate evenly and uniformly."

Smoking.—"The smoke-house should be eight or ten feet high to give the best results, and of a size suited to the amount of meat likely to be smoked. One 6 by 8 feet will be large enough for ordinary farm use. Ample ventilation should be provided to carry off the warm air in order to prevent overheating the meat. Small openings under the eaves or a chimney in the roof will be sufficient if arranged so as to be easily controlled. A fire-pot outside of the house with a flue through which the smoke may be conducted to the meat chamber gives the best conditions for smoking. When this cannot well be arranged, a fire may be built on the floor of the house and the meat shielded by a sheet of metal. Where the meat can be hung six or seven feet above the fire, this precaution need not be taken. The construction should be such as to allow the smoke to pass up freely over the meat and out of the house, though rapid circulation is at the expense of the fuel.

"Brick or stone houses are best, though the first cost is greater than if they are built of lumber. Large dry goods boxes, and even barrels, may be made to serve as smoke-houses where only small amounts of meat are to be smoked, but a permanent place is much more satisfactory.

"The best fuel for smoking meats is green hickory or maple wood smothered with sawdust of the same material. Hard wood of any kind is preferable to soft wood. Corn-cobs are the best substitute for hardwood, and may be used if desired.

"Meat that is to be smoked should be removed from the brine two or three days before being put in the smoke-house. Washing the meat in tepid water and scrubbing clean with a brush is a good practice. The pieces should then be hung up to drain for a day or two. When drained they may be hung in the smoke-house. All should be suspended below the ventilators, and should hang so that no two pieces come in contact.

"A slow fire may then be started, warming up the meat gradually. During the winter months in cold climates it is best to keep the fire going continually until the smoking is complete, holding the temperature at about the same point. During the spring months and in the summer, a light fire may be started every second or third day for a couple of weeks, the meat being allowed to hang in the smoke-house until sufficiently colored. When the fire is kept going steadily, twenty-four to thirty-six hours will be required to finish one lot of meat. Smoke will not penetrate frozen meat. As soon as smoked sufficiently the meat should be cooled by opening the ventilators or doors. When hard and firm it may be packed away."

Keeping Smoked Meats.—"A dry, cool cellar, or an attic with free circulation, will be a satisfactory place for smoked meats at all seasons, if it is kept dark and flies are excluded."

"If to be held only a short time, hams and bacon will need only to be hung out separately without covering. For longer keeping it will be necessary to wrap them first in paper, and then in burlaps, canvas, or muslin, and bury them in a grain bin (or in wood ashes) or other suitable place, the object being to gain a uniform temperature and to keep away insects. For absolute safekeeping for an indefinite period of time, it is essential that the meat be thoroughly cured. After it is smoked and has become dry on the surface, it should be wrapped in parchment paper or old newspapers. Then inclose in heavy muslin or canvas, and cover with yellow wash or ordinary lime whitewash, glue being added to the whitewash. Hang each piece out so that it does not come in contact with other pieces. Do not stack in piles."

Trying Out Lard.—"Only the best of fat should be used for choice lard. Leaf fat is the best. The back strip of the side also makes nice lard, as do the ham, shoulder, and neck trimmings. Gut fat should never be mixed with the leaf and back fat. It makes a strong-smelling lard and should be kept separate. All scraps of lean meat should be cut out of the fat before trying out, as they are very likely to stick to the kettle and get scorched, giving an unpleasant flavor to the lard. When preparing the fat for trying, cut it into pieces from 1 to 1½ inches square. They should be nearly equal in size, so that they will try out in about the same time. Fill a clean kettle about three-fourths full, and put in a quart of water, or, if convenient, a quart of hot lard. One or the other is necessary to prevent the fat from burning before the heat is sufficient to bring out the grease. Keep the kettle over a moderate fire until the cracklings are brown and light enough to float. Frequent stirring is necessary to prevent burning. When done, remove from the stove and allow to cool slightly, and then strain through a muslin cloth into a suitable jar or crock. Stirring while the lard is cooling tends to whiten it and make it smoother. A quarter of a pound of saleratus (baking soda) added to each 100 pounds of fat has a like effect."

PART VI.

BUILDINGS

The question of buildings for swine is such a complicated one that it seems almost a hopeless task to attempt a discussion of the subject. Almost every piggery that is built possesses certain features peculiar to itself and rendered necessary by the circumstances which it is intended to meet. All that can be attempted is to discuss the most desirable features of a piggery, for the general guidance of those who wish to build, but every man will have to adapt his building to his own peculiar requirements.

The most important qualities of a piggery are dryness, ventilation, light, freedom from draughts, reasonable warmth, and convenience.

Dryness.—Dryness is closely associated with ventilation, but is also influenced by the material of which the building is constructed. Good results cannot be obtained in a damp pen, and dripping walls are a pretty sure indication of impending disaster. Stone and cement walls are very cold in winter and chill the air of the pen, causing it to deposit its moisture upon their surface. In a short time the wall becomes quite wet, and trouble is stored up for the pigs. A hollow cement or hollow tile wall is much less objectionable than a solid one, but there is little doubt that wooden walls, constructed in such a way as to form a complete dead-air space inside are the best.

The floors and foundation may be constructed of cement concrete, and the foundation may rise about two feet above the surface of the floor. This will preserve the wood of which the walls are constructed and it is not likely to prove at all injurious to the pigs.

A very good wall can be made by setting two-by-four scantlings on end, and first boarding inside and out with rough lumber. This rough lumber should then be covered with tarred paper, and then the walls should be tightly boarded up with matched lumber. If preferred, the outside of the pen may be clapboarded. Smooth, matched lumber is best for the inside of the pen. Patent building paper may be used outside.

If it is thought desirable to have a loft over the pen, the ceiling can be made of poles, placed a few inches apart, and well covered with straw. The straw absorbs moisture and helps to keep the pen dry. Where this is done, the straw should be renewed at least every year, otherwise it becomes a harbor for dust and disease germs.

Ventilation.—Thorough ventilation is a great help in preserving dryness, but it is a difficult thing to secure in a piggery without unduly lowering the temperature. It is an aid to ventilation to provide a large air space; in other words, to have a high ceiling. Some breeders have no loft over the piggery, but have the space above the pigs extend to the roof. This gives more air space and makes ventilation a simpler problem, but it necessitates lining the under side of the rafters with matched lumber in order to prevent the pen from becoming too cold.

There are two well-known methods of ventilation. One of these is the King system. In this system, fresh air is admitted by constructing shafts in the walls at intervals of about fifteen feet. The shafts may be about four by six inches, inside measurement, and open outside near the ground, and inside at the ceiling. Provision should be made for closing, or partially closing, these intakes when cold air is admitted too rapidly. The shafts for carrying out the foul air should be about eight inches square, starting near the floor and running out through the roof. It is usually more convenient to place these outlet shafts beside the walls, in which case, after passing through the ceiling, they may follow the slope of the roof to the peak, where they can be given outlet. In any case, the top of the shaft should be higher than the peak of the roof. The inside of the

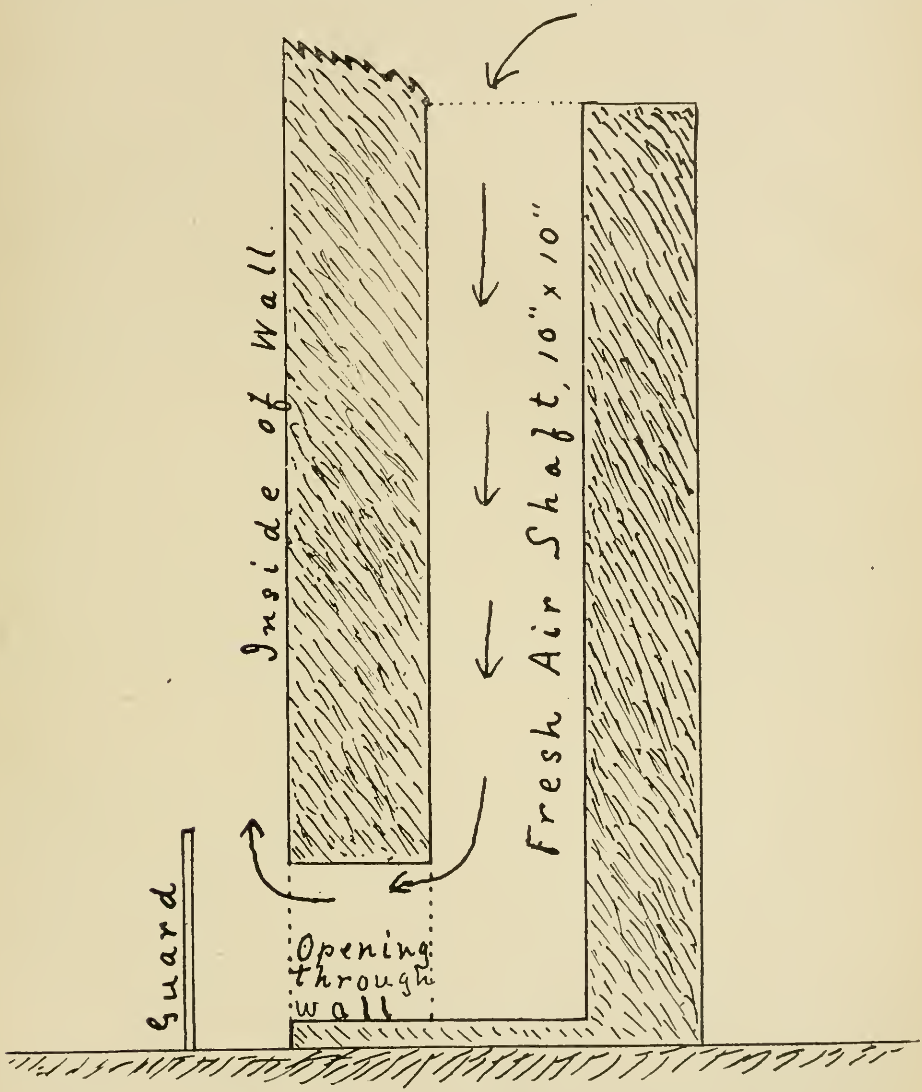


Fig. 18.—Method of admitting fresh air.

shaft should be perfectly smooth, and there should be no sudden turns in its course. A right-angled turn will render an outlet shaft practically useless.

The second method takes in the fresh air at, or near, the floor, and the foul air escapes through shafts which open at the ceiling, and run straight up through the roof. As in the other case, the top of the shaft should be higher than the peak of the roof. Fig. 18 shows how the inlet is constructed. The drawing shows the outside structure made of concrete, but it may be made of wood if desired.

Both inlets and outlets should be fitted with slides on the inside of the pen, so that the inflow and outflow of air may be regulated to suit circumstances. There should also be a guard placed in front of the opening, several inches from the wall, to turn the current of cold air upwards, and thus prevent a direct draught into the pen.

If a feed cooker is used, it could be utilized to great advantage in assisting ventilation. If the building is not a very long one, the chimney may be constructed at the opposite end of the building from the feed cooker, and the pipe from the feed cooker run the whole length of the building before it enters the chimney. In a long building the chimney may be placed about the centre, so as not to have too great length of stove-pipe. The heat from the stove-pipe has a wonderful influence in aiding the circulation of air in the pen, as well as modifying the temperature and helping to keep the air dry.

In fact, where winter litters are raised in large pens, some helpful device like this is absolutely necessary.

Light.—Light, especially sunlight, has a wonderful influence in promoting health. So far as possible, the windows should be on the south side of the building, because the south side gets the most sun and is least exposed to cold winds.

Draughts.—While ventilation is necessary, draughts are extremely injurious, and their prevention should be kept in view when building.

Warmth.—Warmth is a good thing, but it should not be secured at the expense of ventilation. A somewhat cold pen, well ventilated, but free from draughts, is preferable to a warm pen where the air is damp and foul, and the pigs will suffer less discomfort in the former than in the latter. Very young pigs require warmer quarters than older ones, and when a sow farrows in winter special pains should be taken to secure warmth and freedom from draughts. If she is in a large piggery it is often a help to lay poles across the tops of the partitions over the bed and then cover these poles with straw.

Plan of Piggery.

A feature of this piggery is the placing of the pens and out-door yards on the south side of the building. The main windows are placed on the south side also, thus letting the sunlight freely into the pens. The main objection to the plan is the fact that it is not economical of space, because the same passage could be made to serve another row of pens on the opposite side. By making the building about twelve feet wider, a row of pens could be put on each side of the passage, in which case it would be necessary to provide for a feed-room, because it would not be practicable to have the feed-bins in the passage. The feed passage could be made narrower if the feed-bins were removed.

Troughs.—Better made of cement. Eight inches high next to the passage, four inches high next to the feeding pen, and ten inches wide, inside measurement, are suitable dimensions.

The dotted line running along the back of the feeding floor indicates the drain, which may be given a fall towards either end of the pen, to suit circumstances.

The beds should be raised several inches above the feeding floor, and given a slight fall towards the drain. The feeding floor should be given a fall from the trough to the drain.

Floors are cement. Cement makes a durable, clean, sanitary floor. A cement floor may be made as dry and practically as warm as a wooden floor by putting

Explanation

"w"—Windows, which should be large, especially on the south side.

"d"—Doors leading from pens to outdoor yards.

"d1"—Doors which constitute part of partitions when closed, but which can be swung back, confining the pigs to the apartment containing the bed, and leaving a continuous passage for cleaning out the pens, taking pigs to the loading chute, etc.

"d2"—Doors leading from pen to passage. Note how the partitions are set back to economize trough room. These doors should be at least eighteen inches wide.

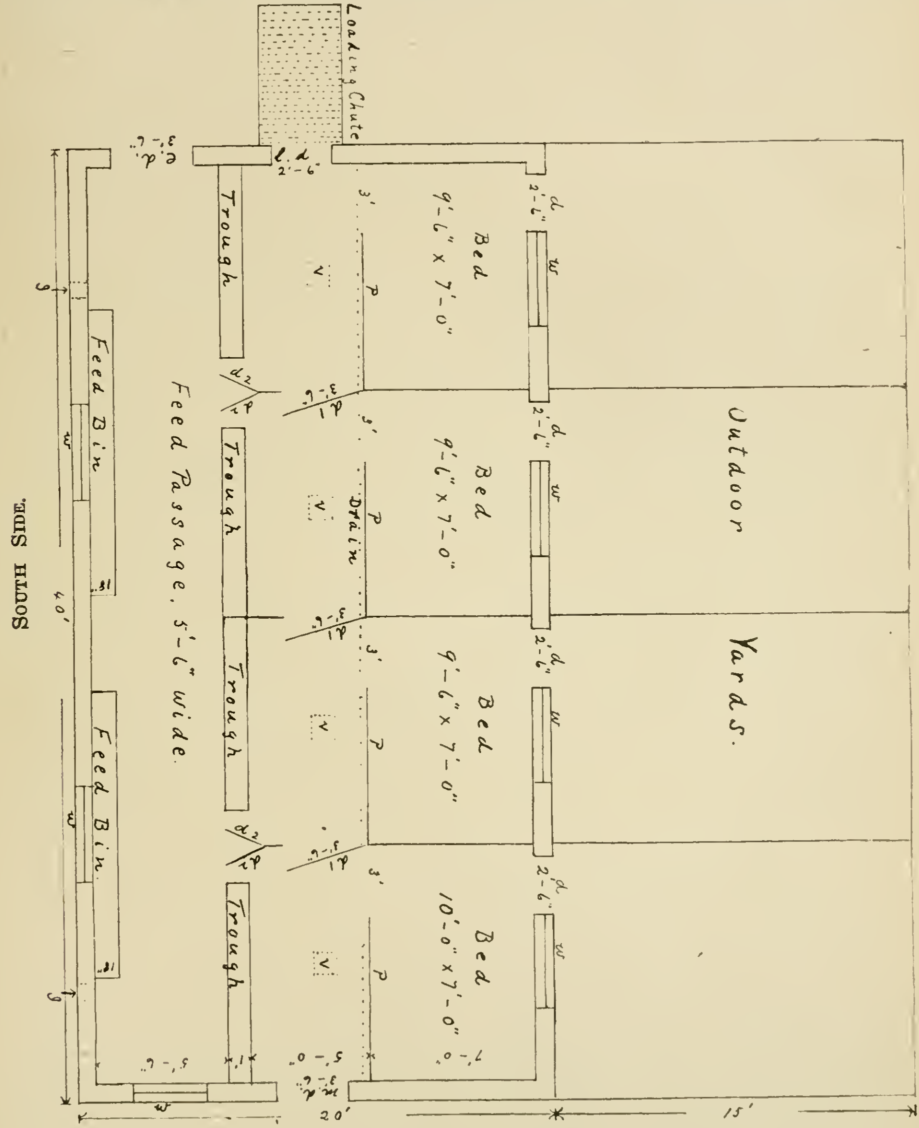


Fig. 19.—Plan of piggery.

"m.d."—Door through which manure is carried when cleaning the pen.

"l.d."—Door leading to loading chute.

"P"—Partitions, three feet six inches high. These keep the bedding in place and help protect from draughts.

V.—Ventilating shafts opening at the ceiling and running up through the roof.

I.—Fresh air inlets. (See under ventilation.) If pens were made on each side of the passage, the inlets would have to be made at the ends of the passage.

a coat of pitch on top of the grouting before the facing, or finishing layer, of sand and cement is put down. For this purpose, a mixture of about eight parts of pitch to one part of coal tar, applied hot, is very effective. Coal tar alone may be used, and is cheaper than the mixture just mentioned, as well as more easily applied. It is not so effective as pitch, but makes a very marked improvement in the warmth and dryness of the floor. If a person does not feel inclined to go to the expense of treating the whole floor with pitch or coal tar, he will find it well worth the extra cost to treat at least the portion occupied by the beds. If the pens are used for farrowing, it is usually safer to put a plank over-lay on

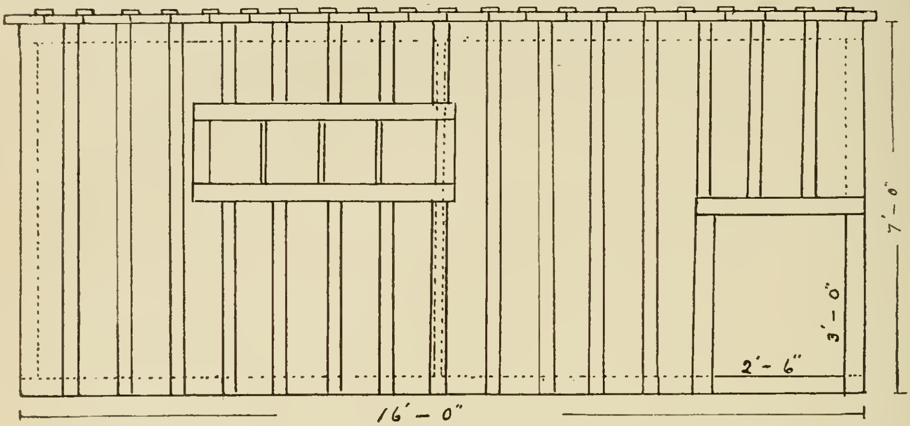


Fig. 20.—Front view of portable pen for wintering sows.

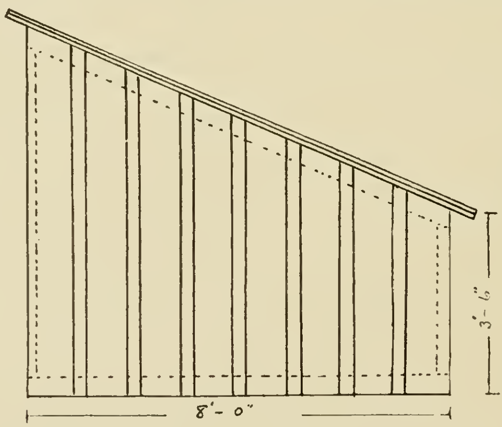


Fig. 21.—End view of pen shown in Fig. 20.

the floor of the part occupied by the bed. This over-lay, or platform, is better to be made so that it can be lifted up when it is necessary to clean and disinfect the pens.

The surface of the floors should be finished by using only a wooden float. If trowelled down smooth, they are too slippery, and are dangerous to the pigs.

Portable Pens.

The accompanying sketches (Figs. 20 and 21) show a very cheap and easily-constructed pen, suitable for winter quarters for breeding sows. The pen is sixteen feet long by eight feet wide. It is seven feet high in front and three and a half feet high at the rear. It is boarded with cheap lumber, but all cracks are securely battened. It should be practically wind and rain proof. The opening is at one corner, and the pen should be set with the opening towards the south. A door is not necessary. Plenty of bedding should be supplied and the pen should be banked up outside with fresh horse manure to a depth of about two feet, in order to prevent draughts about the floor. This method of housing sows is better than close confinement in warm pens, and will be found to answer very well when other means to provide shelter and exercise are not available.

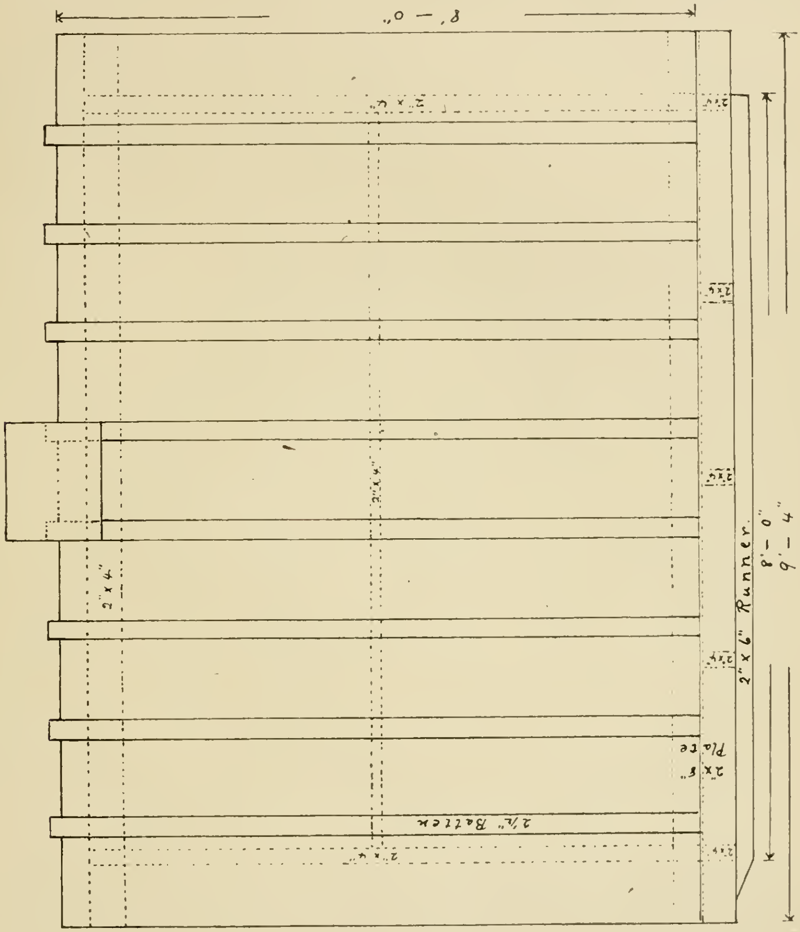


Fig. 22.—Side view of A-shaped pen.

The A-shaped Pen.—The accompanying sketches (Figs 22 and 23) show a convenient portable pen, which may be used for a sow and her litter, or as a shelter for two or three sows. The description is taken from Bulletin 153 of the Wisconsin Experiment Station. The pen is constructed by nailing inch boards on six joists, each 2 by 4 inches, and 7 feet 8 inches long, for the floor. Beneath the joists are nailed three stringers, each 2 by 6 inches, and 8 feet long, which serve as runners for moving the house. Next, a plate piece 2 by 8 inches, and 9 feet 4 inches long, is spiked to the ends of the joists, having the bottom of the 2 inch by 8 inch even with the bottom of the joists, which will allow it to project 3 inches above the floor. It will also extend out 7 inches at each end.

This 2 inch by 8 inch forms a plate to which the rafters and roof boards are nailed. The 7-inch extensions of the plate at the ends support the cornice, and protect the lower corners of the roof, which otherwise would be easily split off. The 2-inch by 8-inch planks, besides strengthening the house, raise the rafters and the roof boards nailed to them at least three inches off the floor, and thereby increase the floor space and capacity of the house.

If the house is to be used in cold weather, a door will be necessary, which may be hung on hinges or made to slide up out of the way. The doorway is shown in the drawing, 20 inches by 30 inches. In the case of very large sows, it would be better to make the door three feet high.

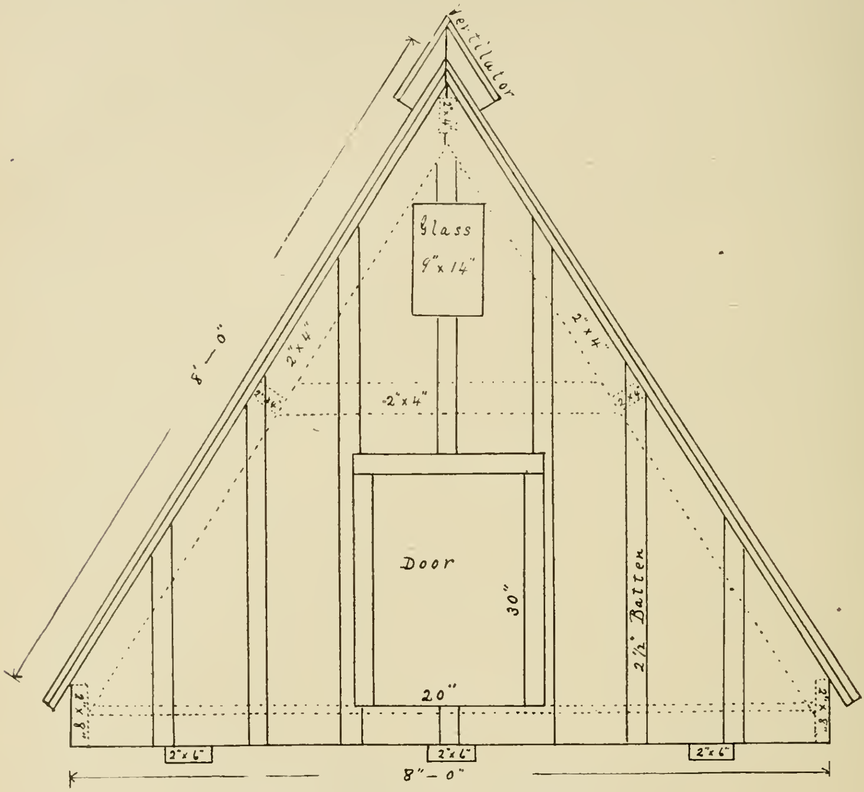


Fig. 23.—End view of A-shaped pen.

The dotted lines in the drawings indicate the scantlings which constitute the framework of the pen.

The ventilator is made by cutting the upper ends from two roof boards, opposite one another. Then 2-inch by 2-inch pieces are nailed on top of the battens on each side of the opening, meeting at the top, and boards are nailed on top of these strips on each side of the roof. The upper ends of these boards meet at the top, and the lower ends come an inch or two past the lower sides of the opening.

It is recommended to have a door at the back of the building similar to the one in front, for purposes of ventilation in hot weather; also a small opening near the peak at the rear of the building, which could be covered with a slide, and used to assist ventilation under some circumstances.

Owing to the fact that the runners are likely to decay, some prefer to have them not fastened to the building, so that they can be renewed conveniently. In the plan shown, the runners are fastened to the structure, but they could be attached by means of bolts, so that it would not be difficult to renew them. An application of tar would save them many years.

Portable Cold Weather Farrowing Pen.—The farrowing pen shown in the illustrations (Figs. 24 and 25) is the one referred to when discussing the management of the sow. The pen is 8 feet square and five feet from the ground to the eaves. The base, the corner posts, and the two plates are made of 4-inch by 4-inch scantling, and the remainder of the frame is made of 2-inch by 4-inch

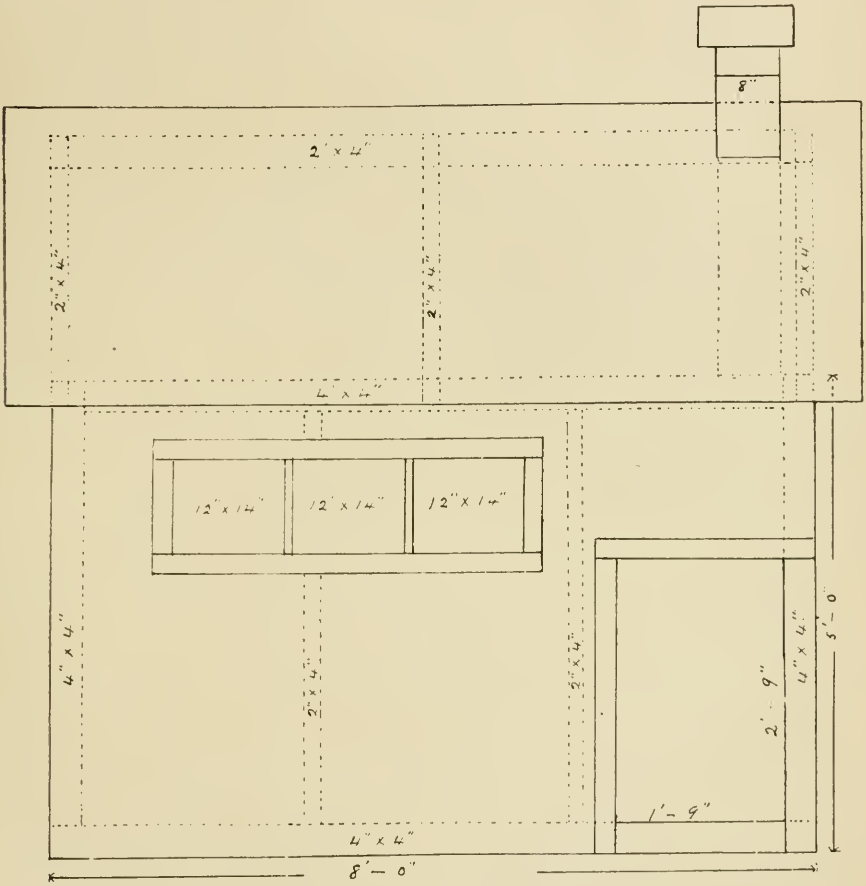


Fig. 24.—Side view of portable farrowing pen.

scantling. The dotted lines in the drawings show the position of the scantlings comprising the frame.

An opening should be made in the gable at the end farthest from the ventilator. Then, if a few strips are laid across the plates, straw can be shoved in through the opening, filling the peak of the roof, and making the building warmer. As shown by the dotted lines, the ventilator shaft is run down to the ceiling.

The roof may be shingled, or made of boards with battens over the cracks. The battens are not shown in the drawing except in the end view of the roof. Outside, the pen is single boarded, with battens over the cracks. Inside, tarred paper may be put on the studding and then tightly boarded, but a better job will be made by first covering the studding with rough lumber, covering this with tarred paper, and then tightly boarding on the inside.

The window comprises three 12-inch by 14-inch panes set in a sash, which should be hinged at the top so that it will swing inwards. In hot weather it can be swung up to the ceiling and fastened there, allowing a good circulation of air.

The pen may be built on runners, or temporary skids may be provided when it is necessary to move the pen. In very cold weather, a lighted lantern hung in the pen will make it quite comfortable for new-born pigs. By the time the pigs

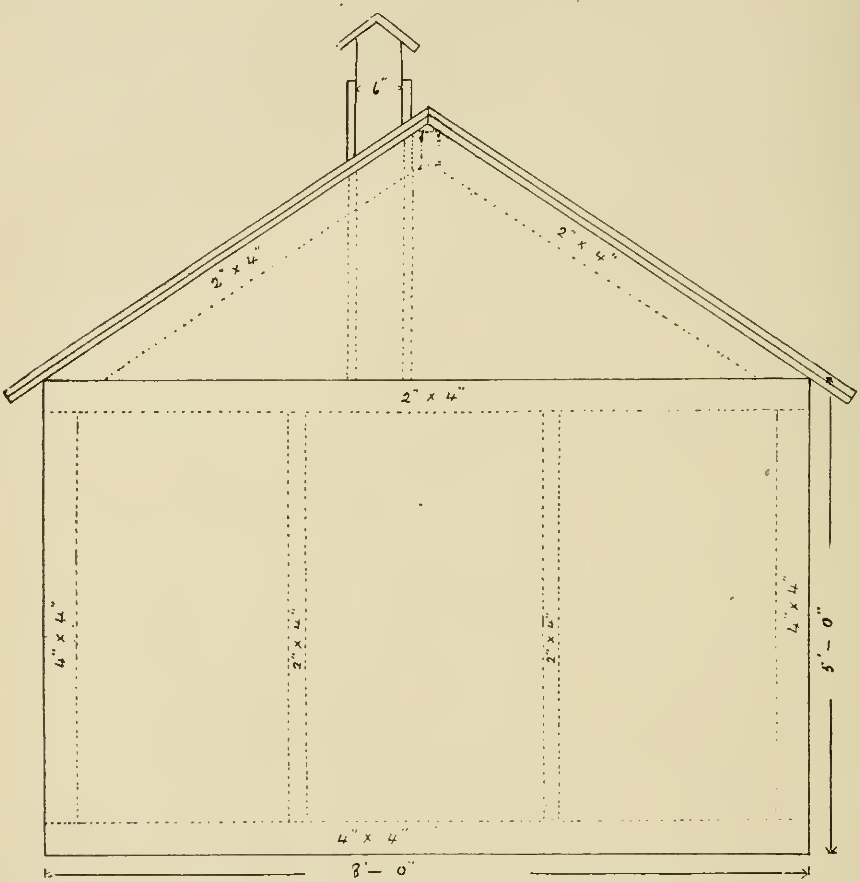


Fig. 25.—End view of portable farrowing pen.

are twenty-four hours old, the pen will need no artificial heat. A pen such as this will be found much safer for winter litters than a large building where other pigs are kept.

The various plans which have been submitted are capable of many modifications, and the man gifted with a little ingenuity may be able to improve upon them so far as his conditions are concerned. They are presented in the hope that they may prove suggestive of ideas to the man who intends to build, and each man must decide for himself what modifications would render them most suitable to his circumstances.

PART VII.

SANITATION

The hog is a difficult animal to treat when attacked by disease, and hence the breeder must adopt every means within his power to prevent disease from entering the herd. One can never be too careful in this matter, and the proverb: "An ounce of prevention is worth a pound of cure," is especially applicable in the management of swine.

Cleanliness.—Filth is an excellent harbor and breeding ground for disease germs. Care should be taken to have the pens cleaned frequently, and the pens should be so constructed that there are no places for filth to accumulate where it cannot be cleaned out. Water-tight floors with as few cracks and corners as possible, together with adequate drainage, are important in a piggery.

Disinfection.—Every swine breeder or feeder should acquire the habit of using disinfectants freely. There are numerous proprietary or patent disinfectants upon the market, and, so far as the writer is aware, the well-known ones are quite effective if used according to directions accompanying them. Crude carbolic acid and creolin are excellent disinfectants. A five per cent. solution of either, or five parts of the disinfectant to one hundred parts of water, will be found effective for disinfecting pens. Chloride of lime is also good, and is especially recommended by some for pens where cholera has existed. Five or six ounces of chloride of lime to a gallon of water makes an effective disinfectant.

In case of disease, all bedding and manure should be removed and burned. Loose boards or planks should also be removed, and all adhering filth scraped off the floors, partitions and troughs. It is of little use applying a disinfectant on top of a coating of filth which may conceal and protect millions of disease germs. A good spray pump is best for applying the disinfectant, so as to force the liquid into every crack and cranny, and it is not wise to be economical in the use of the disinfectant. Every part of the pen should be thoroughly saturated with the solution.

If there are small outside yards attached to the piggery, they should be floored with concrete, and then they can be disinfected in the same way as the interior of the building. If they are not floored it is almost impossible to disinfect them thoroughly, and they are a constant menace to the health of the animals.

Pasture lots and large paddocks or feed lots are more difficult to deal with. Liberal liming and plowing up is about all that can be done. In case of some diseases, such as cholera, it is safer to remove the hogs to other feed lots or pastures for at least several months. Of course, the lots could be disinfected by saturating the surface soil with a good disinfectant, but it would be an expensive operation.

Systematic disinfection of the premises should not be neglected even if there is no disease. A small spray pump and a constant supply of disinfectant to be used at frequent intervals about the buildings constitute an important part of the equipment of a piggery. At least once a year, a general house-cleaning is advisable, and whitewashing the walls, ceiling, and partitions with lime and crude carbolic acid will go a long way towards keeping the building sanitary. A good pint of crude carbolic acid to three gallons of whitewash will answer the purpose.

Quarantine.—Provision should be made in large herds for quarters where hogs that have been purchased, or brought home from shows, can be kept entirely separate from the rest of the herd for at least three weeks. The plan of using portable pens and dividing the herd up into small groups has a marked advantage over keeping the hogs in a large piggery, in case a contagious disease breaks out. With the portable pens, all hogs are not exposed, and it is a simpler matter to effect a quarantine.

Hog cholera is the most dangerous contagious disease that the swine breeder has to contend with. In case of an outbreak of either cholera or swine plague in the neighborhood, a most rigid quarantine should be put into force. There should be no visiting back and forth by either man or beast between infected farms and those which are clear, because the virus which causes the disease may be easily carried on the boots of the persons or the feet of animals. Even dogs have been known to carry the disease from one farm to another. Dogs should be tied up until an outbreak of this disease is under control. Carcasses of hogs which die should be burned or buried so deeply that they are not likely to be dug up by dogs or other animals, and disinfection should be systematic and thorough.

Feeding for Health.—Feeding has been dealt with in another place, but the importance of feeding in such a way as to maintain vigor cannot be too deeply impressed. Hogs which are fed in an injudicious manner have their vitality weakened and are more likely to contract disease than those which have been furnished a suitable ration.

Light.—Sunlight is a good disinfectant, and an effort should be made to admit plenty of direct sunlight into all pens. It must be remembered that disease germs flourish best in the dark.

Ventilation and Dryness.—To the difficulty of securing adequate ventilation in the piggery, may be traced a great many troubles which affect pigs. Rheumatism, bronchitis, pneumonia, and scours, the last mentioned being most common in young pigs, are among the commonest winter troubles of swine, and are generally caused by lack of ventilation and consequent dampness in the building. Unless ventilation is provided and the pens kept reasonably dry, good results cannot be expected.

Lice.—When lice once become well established in a herd, it requires a good deal of painstaking effort to eradicate them. They may be the cause of serious loss, and lousy pigs cannot give as good returns for feed consumed as those which are kept clean. It is also claimed by good authorities that lice weaken the vitality of hogs and render them more susceptible to disease.

Almost any of the better known dips will prove effective if used according to directions. A two per cent. solution of creolin (2 parts creolin to 100 parts water) makes a good dip for lice. Coal oil is very effective, but is apt to blister, and should be applied lightly. Crude petroleum is excellent. It is inexpensive, does not blister, and is more lasting in its effects than some patent preparations.

In applying a dip, care must be taken to wet thoroughly all parts of the animal's body. Lice are commonly found on the inside of the legs, about the ears, or in the folds of the skin on any part of the body, and, unless the application of dip is thoroughly made, many of them will escape. Dipping is one of the most effective methods, and, when large numbers are to be treated, it is necessary to have a special dipping vat through which the hogs are compelled to swim. The dip may be applied also by means of a good spray pump, which forces the dip through the hair, and into all crevices. It may also be applied by means of a broom, using a pail to hold the dip. By brushing the dip into the hair the job can be done thoroughly.

When lice have been in a building for some time, it will be necessary to treat the building in practically the same way as recommended for disinfection, the disinfectants being also good insecticides.

In treating for lice, one application of insecticide is seldom sufficient, because there will be many eggs to hatch out to give a new brood. A second treatment, about a week after the first, should always be given, and a third treatment would not be out of place.

PART VIII.

COMMON DISEASES OF SWINE

Hog Cholera, (Swine Fever).

This highly infectious disease is due to a germ, and causes a loss of many millions of dollars annually in the United States. In Canada it is not so prevalent, thanks, mainly, to the very vigorous measures adopted for its eradication. In spite, however, of all efforts, it continues to inflict considerable loss upon Canadian swine growers. It causes an inflammation and ulceration of the stomach and intestines, enlargement and inflammation of the lymphatic glands, and various other disturbances. The most characteristic lesions of the disease are inflamed areas on the lining membrane of the intestines and stomach, which eventually change into raised ulcers, circular in outline.

Symptoms.—The hog usually goes off by itself and lies in a cool place. The back is arched, the hind parts appear stiff, causing the hog to stagger and cross the hind legs as it walks. There is a watery secretion from the eyelids, which later becomes thicker in character, causing the lids to adhere. Owing to increased secretions from the skin, dirt adheres to it, giving the animal a dirty appearance. Alternate diarrhoea and constipation is common, and the diarrhoeal discharge is thin and watery, and some times mixed with blood.

Acute cases usually terminate in death in from two days to two weeks, but sometimes death occurs before the symptoms become well marked.

In the subacute or mild form, the symptoms may escape notice, but there is usually a slight fever, with loss of appetite, constipation, and diarrhoea. The pig generally recovers in a few days.

The disease is said to be chronic when it lasts for a considerable time, possibly several weeks or even two or three months. Often the pig becomes a complete wreck, and death at last occurs.

Treatment.—When a hog once contracts the disease, little can be done in the way of treatment. Preventive measures are the only effective means for fighting this disease. In Canada, treatment for hog cholera is not allowed, it being compulsory to slaughter affected herds. Full particulars regarding this law may be obtained by writing the Veterinary Director-General, Department of Agriculture, Ottawa, Ontario.

Swine Plague.

Swine plague is sometimes mistaken for hog cholera, and often accompanies the latter disease. It is an infectious disease caused by a germ, and the symptoms are similar to those of cholera. As a rule, the lungs and pleural membrane are inflamed, but the button-like ulcers on the lining membrane of the intestines and stomach, which are characteristic of cholera, are absent. The lining membrane of the stomach and intestines is commonly inflamed, and sometimes ulcers are present, but the ulcers differ from those of cholera, being more hollowed out and less button-like in appearance.

The germs which cause swine plague are more easily destroyed and are less readily carried from one farm to another than those of cholera. Up to the present, medicinal treatment has not been successful, and the farmer must rely upon preventive measures. (See under Sanitation.) This disease comes under the same law as cholera.

Bronchitis.

Bronchitis commonly attacks young, growing pigs, and may be caused by dust, lung-worms, or damp, chilly quarters. A distressing cough, especially when disturbed from their bed, is one of the most prominent symptoms. Many of the pigs become unthrifty, and, if the disease attacks very young pigs, it is likely to cause death.

Dry, comfortable quarters and nourishing feed will often pull the pigs through, and care should be taken in making the pens and yards sanitary before any more young pigs are put in them.

Pneumonia.

Pneumonia is more serious than bronchitis and frequently causes death in a very short time. It often results from a severe cold, and may also be brought on by over-exertion, such as being chased, or driven at too rapid a rate. Damp and unsanitary conditions in the pen may also be a cause. A cough, fever, and hurried or labored respiration are among the symptoms.

About all the farmer can do is to aim to prevent the disease. If he has a case to deal with, careful nursing is the main thing. Comfortable, well-ventilated quarters, and a light, sloppy diet, are important. Daily doses of castor oil will help keep the bowels active, and if the weather is cold the animal should be kept covered with a blanket. Treatment is not very satisfactory, as it is difficult to nurse a very sick pig.

Tuberculosis.

The following extracts are quoted from a report issued by the United States Bureau of Animal Industry:

"Reports gathered from the various meat-packing centres of the United States show tuberculosis of hogs to be on the increase, and causing heavier loss to raiser and packer alike than any other disease."

"Statistics show that when there were over 56,000,000 hogs in this country their value at that time was over $339,000,000. Federal inspection at the abattoirs of the country show two per cent. of the hogs slaughtered to be affected with tuberculosis. Reports from Europe show a far more widespread infection, that runs from 5.5 to 7.5 per cent."

"Hogs from Arkansas, Oklahoma, and Texas are remarkably free from tuberculosis, due to the methods of caring for them, or rather the lack of care. They are not restricted to feed-lots, where disease is commonly found, but roam over large areas to shift for themselves. No prolonged feeding is practised in narrow limits, but from birth to maturity they are pastured on alfalfa, oats, corn, rape, and peanuts . . . In striking contrast are the hogs slaughtered at three cities in one of the leading dairy states, where there are a large number of co-operative creameries and the raw skim-milk is fed."

"Buyers for packing-houses are learning from bitter experience to avoid sections of certain states, and two firms will not buy hogs from one state known to be badly infected. In fact, many of the smaller packers in the Central West buy subject to post-mortem inspection, as a measure of self-protection."

"It is known beyond all doubt that the majority of tuberculous hogs are produced by the following causes:

"1. Feeding raw milk and slime from creameries."

"2. Feeding hand-separated milk from tuberculous cows."

"3. Feeding behind tuberculous cattle."

"4. Feeding tuberculous carcasses."

"5. Feeding slaughter-house offal."

"The danger of feeding hogs behind tuberculous cattle lies in the fact that such cattle discharge enormous numbers of tuberculosis germs in their faeces."

Symptoms Obscure.—The quotations given show the importance of this disease, and the need for the farmer to be on his guard. It is a contagious disease and must be treated as such. The symptoms are not well marked, and a hog may be badly diseased and show practically no clinical symptoms. If the lungs are affected, the hog usually has a cough, and, if the digestive organs are badly affected, there is generally indigestion, and general lack of thrift; but similar symptoms may show themselves with other diseases, and it requires a great deal of experience to diagnose the disease with certainty.

Treatment.—Entirely preventive. Since the disease is usually communicated to hogs through their feed, it is necessary to make certain that their feed contains no germs. In dairy districts, the practice of sterilizing skim-milk, buttermilk and whey is to be commended, because dairy by-products constitute the main medium for transmitting the disease to hogs. Sanitary surroundings, pure feed, and fresh air are the feeder's main safeguards in connection with this dangerous disease.

Indigestion.

Indigestion in various forms is caused by mistakes in feeding. Over-feeding and lack of exercise will sometimes bring on the trouble, or the feeding of swill containing injurious substances, such as washing powders, is apt to cause derangement. In the acute form it causes the animal a good deal of pain, causing it to arch its back and give general evidences of suffering. In such cases it is well to have a veterinarian prescribe for the trouble.

The chronic form sometimes follows an attack of acute indigestion, causing an unthrifty, stunted condition of the animal. Perhaps the best home remedy is a dose of castor oil, followed by careful feeding upon easily digested feeds. If the trouble is not relieved, a veterinarian should be consulted.

Constipation.

As mentioned in another place, constipation is most disastrous in the case of pregnant sows, and is the result of too little exercise and too much concentrated feed. In cases of constipation, perhaps the simplest remedy is to give them from two to four ounces of raw linseed oil once daily in the slop of a mature animal. If this is not effective, give four ounces of Epsom salts. Give exercise and supply laxative feeds, such as bran, oil meal, or ground flax-seed, roots or alfalfa.

Scours.

Dr. Alexander (Wisconsin Bulletin 184) writes as follows: "When young nursing pigs begin to scour, it is evident that the milk of the sow is disagreeing with them, and immediate attention, therefore, should be directed towards improving her ration. Most often the trouble comes from overfeeding on corn, or other rich feed, just after farrowing, and pigs of fat, flabby, pampered, cross, nervous, constipated sows are most apt to suffer. Sudden changes of feed, or feeding sour or decomposing slop, or feed from dirty troughs or sour swill-barrels, also tend to cause diarrhoea either in nursing pigs or those that have been weaned, and all such causes should be prevented or removed.

"To correct scouring in nursing pigs, give the sow 15 to 20 grains sulphate of iron (copperas) in her slop night and morning, and if necessary, slightly increase the dose until effective. Lime water may, with advantage, be freely mixed with the slop as a preventive when there is a tendency to derangement, or after the trouble has been checked, and it is also an excellent corrective for weaned pigs showing a tendency to scour on slop or skim-milk. Where little pigs are scouring severely, each may with advantage be given a raw egg and 5 to 10 grains of subnitrate of bismuth twice daily, in addition to changing the feed of the sow and mixing copperas in her slop. In cases which do not promptly respond to treatment, success may follow the administration of a dose of castor oil shaken up in the milk. In all cases it is important to set right all errors in diet and sanitation, and to provide the pigs with dry, sunny, well-ventilated quarters. The derangement is always most apt to occur, and sure to prove disastrous, among pigs kept in unsanitary conditions."

Infectious Sore Mouth.

This disease is quite common in small pigs from a few days to several weeks old. It is caused by a germ. Filthy quarters and damp, muddy yards favor the development of the disease.

One of the first symptoms is a disinclination to suck on the part of nursing pigs, or a falling off in appetite in older pigs. The lining membrane of the mouth becomes inflamed, and sometimes the snout and lips become swollen. Later, ulcers form, often involving the lips and snout.

Dr. Craig recommends the following treatment:

"As soon as the disease breaks out in a litter, both the mother and pigs should be removed from the herd. The affected pigs can be treated by dipping head foremost into a four per cent. water solution of some reliable disinfectant; or permanganate of potassium, one ounce to a gallon of water, can be used. A more thorough way to treat them is to wash out the mouth by injecting the solution directly into it with a syringe. It is advisable to use this method wherever practicable, and especially in advanced cases. It is also advisable to clean the ulcerated parts by scraping away the dead tissue and rubbing the surface of the ulcer with lunar caustic. The above treatment should be repeated twice a day in advanced cases, and in mild ones once a day. It should be kept up for as long a time as necessary. It is usually more economical to kill the badly diseased pigs than it is to treat them, as they are apt to scatter the disease and become badly stunted and deformed."

If treatment is adopted from the first appearance of trouble, the disease is not too difficult to cure.

Thumps.

This disease is caused by a disordered digestion which irritates the nerves connected with the diaphragm, causing sudden contractions of the diaphragm at irregular intervals. The contractions or spasms of the diaphragm cause a jerking movement of the flank, which is a characteristic symptom of the disease. The pig becomes unthrifty and stunted, and very young pigs are likely to succumb or to become practically worthless.

Too liberal a supply of feed and too little exercise will often bring on the trouble. Young pigs often contract the disease before they are weaned if they have a good mother and are not given much exercise, and it is usually the finest and fattest pig in the litter which is the first to go wrong.

Treatment is mainly preventive, and hence the necessity for providing exercise for young pigs, especially if their mother is a liberal milker and the pigs become very fat. Judicious feeding and exercise will entirely prevent the disease. If a case occurs, it is a signal that a change in methods should be made at once. Sometimes it is difficult to obtain exercise for young pigs in cold weather, and some recommend shutting them in a pen away from the mother for an hour or so twice a day. As a rule, this plan will stimulate the laziest of them to take considerable exercise.

Inflammation of the Udder.

Heavy milkers are most liable to have this trouble. Whatever the cause, the disease calls for prompt treatment. Dr. R. A. Craig, in his excellent book, "Diseases of Swine," recommends the following treatment:

"Milking the sow's udder two or three times a day will usually relieve its congested condition. A physic of Epsom salts should be given every other day, and a sloppy diet fed.

"In case the udder becomes inflamed, it should be kneaded gently with the fingers, and the following ointment applied daily: Extract of belladonna and gum camphor (one drachm of each), and vaseline, (three ounces). Hot fomentations may also be used.

"Sore teats should be bathed daily with white lotion (one part zinc sulphate. three-fourths of a part lead acetate, and thirty parts water) until healed."

Eczema.

Eczema, and similar skin troubles, can usually be successfully treated by washing or spraying with a one per cent. solution of creolin, or some of the well-known tar disinfectants. The hog should be kept in a clean, dry place, and out of the sun until cured. It sometimes requires time to effect a cure, and the treatment should be given every day until the disease is conquered.

Rheumatism.

In northern latitudes, rheumatism often occurs among swine, especially during cold, damp weather. Damp, ill-ventilated pens are a common cause, and it may sometimes be caused by over-feeding. Piggeries built with stone or concrete walls and floors are generally more dangerous than those built of wood. When such walls are hollow and the floors insulated with a tar layer, they are much safer.

The hog becomes very lame and stiff and moves about with difficulty. Sometimes the joints become swollen and very painful, and the animal becomes practically helpless. In such cases it is seldom that the hog makes a recovery.

The feeder must be on his guard against this disease. Dry, well-ventilated pens and careful feeding will generally enable him to avoid disaster. Animals which become affected should be kept in dry, warm quarters. Dr. Craig ("Diseases of Swine") says: "Salicylate of soda is the most useful drug to give in this disease. The dose is twenty or thirty grains in the feed, or as a drench, three times a day. Larger doses, and at more frequent intervals, may be given in acute cases for a short time. Quinine and bitter tonics can also be given. Blistering ointments and liniments should be applied to the inflamed articulations."

Rickets.

In this disease, which is commonly found among young pigs, there is enlargement, bending, and distortion of the bones of the joints and limbs, and fractures of leg bones are not uncommon. The bones do not contain their normal proportion of mineral matter, and hence lack strength. It is claimed that the disease is most common among closely in-bred hogs. The excessive feeding of corn throughout generations of swine is believed to be an exciting cause, or any conditions which interfere with proper nutrition, such as disease or unsanitary surroundings, may predispose towards the disease in question.

Dr. Alexander of Wisconsin says: "Pigs affected with rickets can seldom be profitably treated. Prevention is to be sought by avoiding the causes mentioned, maintaining sanitary conditions about the hogs, providing adequate supplies of various feeds, rich in all the requisites of a perfectly nourished animal, and obviating degeneracy by careful selection of robust sows and timely infusion of new blood."

Plenty of mineral matter should be provided at all times during the life of the pig. Methods and forms of supplying mineral matter have already been given in this bulletin.

Paralysis.

In Virginia Bulletin 189, Dr. Mayo writes: "The disease first appears as a slight loss of control of the hind legs, as shown by a weaving of the body, knuckling of the fetlocks, and finally a paralysis more or less complete. The animal is unable to raise itself on its hind legs, and often drags the hind quarters as it moves about. The disease occurs in swine of all ages. This disease is popularly supposed to be caused by "kidney worm," but there is no evidence to support this belief. The disease seems to be located in the spinal cord at the lumbar region, but the actual cause is unknown at present.

"Some cases recover without treatment, but a majority of the cases prove fatal. Generally the treatment is to give a purgative of from one-half to two ounces of castor oil, depending upon the size of the animal, followed by nourishing, easily digested feed. Rubbing the back vigorously with a good veterinary liniment once daily is also beneficial."

Mange.

Mange is caused by very small animal parasites called mange mites, which burrow in the outer layer of the skin.

The disease is most troublesome in young pigs, causing great irritation, indicated by the little pigs scratching and rubbing themselves. Later, the hair stands erect, and thick scabs form at the roots of the hair on the neck and shoulder top and about the ears and face. Often the scabs extend along the back to the root of the tail.

Dr. Mayo, of the Virginia Experiment Station, strongly recommends the lime and sulphur dip, which is made as follows: Take 8 pounds of fresh lime and slake with enough water to form a thick paste. Sift into this paste 24 pounds of flowers of sulphur and mix thoroughly with a hoe. Place in a kettle with 25 or 30 gallons of water and boil for at least one hour, then add enough water to make 100 gallons of dip. The dip should be used warm, about 100 or 110 degrees Fahrenheit.

The coal-tar dips, such as chloro naphtholeum, zenoleum, and others of this class, give good results, and are more convenient when a small number of animals are to be treated.

It is very important that the animals be kept wet with the solution until all the scabs are thoroughly soaked through, and it is a good plan to scrub off with a stiff brush to remove as much as possible of the scabs. Two thorough treatments, ten days apart, are necessary.

Pens should be thoroughly cleaned and disinfected. Sows should be treated as well as the young pigs, though the disease may not show to any great extent in the older pigs. The disease is transmitted by contact, and the young pigs almost invariably become infected through coming in contact with a diseased mother.

Intestinal Worms.

Common Round Worm.—The most common intestinal worm affecting swine is the round worm, which is found mainly in the small intestine. If a post-mortem examination is made some time after death, the worms may be found in the stomach, having made their way there after the death of the animal. The worms vary from six to seven inches in length, and taper somewhat towards the extremities. In color they are usually a yellowish white. The eggs of the female pass out with the excrement and become scattered over the premises. Eventually, some of them are taken up by other hogs along with their food.

They do not seem to cause the hog any inconvenience unless they are present in large numbers, when they may cause digestive troubles, and the writer has known death to result. There can be little doubt, however, that a pig affected with worms cannot make the best use of its feed, even though it may appear quite thrifty.

Thorn-headed Worm.—This parasite is much less common than the round worm. It is usually found attached to the wall of the intestines by its hooked proboscis, from which it derives the name "thorn-headed." In length it is similar to the round worm, but its surface is somewhat wrinkled, and the posterior extremity is blunt. Though only a few are usually found in an animal, they do much more damage than the round worm, irritating the lining of the intestine, and sometimes causing severe inflammation. It would be difficult to distinguish the symptoms from other intestinal derangements, but a post-mortem examination would readily reveal the presence of the worm.

Pin-Worm.—The pin-worm is very small and might be easily overlooked in a careless post-mortem. It is usually found near the beginning of the large intestine, often hidden in the folds of the lining membrane. It is a very common parasite of swine, and does not seem to cause much inconvenience to the animal.

Whip-Worm.—This is also a small worm, being about one and one-half inches long. It attaches its head to the lining of the intestine, and is usually found in the beginning of the large intestine. The anterior portion is very thin and hairlike, and the posterior portion is thick and cylindrical in shape. Like the pin-worm, it does not seem to create much disturbance, but must be more or less injurious.

Treatment for Intestinal Worms.—Preventive treatment consists in keeping buildings and surroundings clean and sanitary. Feeding in filthy yards and allowing to drink stagnant water are practices which favor the spread of parasites.

As to medicinal treatment, the writer has found that allowing hogs to have access to a mixture of charcoal and salt, or charcoal, wood ashes, and salt, seems to be quite effective in driving out round worms.

Turpentine is commonly recommended for worms, especially the thorn-headed worm. The dose is a teaspoonful for every eighty or one-hundred pounds live weight of the hogs to be treated. It can be given in the feed, and the hogs should be fasted at least twelve hours before treatment. A dose each day for three days will generally prove effective.

Another remedy which is recommended is five grains of calomel and eight grains of santonin for every hundred pounds live weight of the hogs. This remedy can also be given in the feed. It is generally advisable to give a physic after treatment for worms.

Lung Worms.

The lung worm is a small, thread-like, whitish worm, sometimes found in large numbers in the air passages of the lungs. Ordinarily, about the only symptom is a spasmodic cough, which is somewhat similar to the cough which accompanies bronchitis. Sometimes the irritation caused by the worms produces inflammation and consolidation of the lung tissue, in which case the animal dies, but in many cases no bad effect is apparent. In a post-mortem examination, the worms can be detected by cutting the lung near the apex and then squeezing the tissue next to the cut. The pressure forces the thread-like worms out upon the cut surface.

There is practically no effective treatment for this parasite. Clean pens, in which disinfectants are liberally used, and clean, well-drained yards, will help keep the worm in check. Filthy yards and wallows favor its development. Ploughing up old hog lots and re-seeding them is also a preventive measure.

Other Diseases.

The diseases which have been mentioned represent only a few of the troubles which may affect the hog, and no attempt has been made to treat the subject from a veterinarian's standpoint. There are other diseases. The aim has been to note only a few simple remedies for common ailments, rather than the cure of disease. The hog is not easy to treat for disease, and the main effort of the farmer should be towards maintaining health and preventing the entrance of disease into his herd. In regard to the long list of diseases which have not been mentioned, together with many of those included in the list, it will generally be advisable to consult a skilled veterinarian, but the services of a veterinarian can often be rendered unnecessary if the farmer makes the best use of the means at his disposal.

Examine Carcasses. —Every man who has to deal with stock should make a practice of holding a post-mortem upon every animal that dies upon the farm. He will soon learn what healthy organs should look like, and will be able to locate the seat of the trouble. If he cannot determine the nature of the disease, he can take the diseased organ or organs to a veterinarian, or send them immediately to the nearest experiment station, and have the disease identified. Experiment stations exist for the purpose of helping the farmer, and the officers of the stations will be glad to send any information they can to help him overcome his difficulties.

Administration of Medicine.

Medicines which are not distasteful can be given with the feed, provided the hog has not completely lost its appetite. Wherever possible the administration of medicine in the feed is preferable to drenching.

Dr. Craig ("Diseases of Swine") recommends the following method of drenching hogs:

"To hold the animal while drenching it, a noose of sash-cord or quarter-inch rope can be placed around the upper jaw well back toward the angles of the lips, and the medicine thrown into the back part of the mouth with a dose syringe. As there is a danger of the hog breaking the syringe, it is best to use a metal one. Sometimes, when the drench is bulky and the hog hard to hold, it is necessary to elevate the head and raise the fore-feet off the ground. For this purpose a pulley and rope wire stretcher is recommended. It is best to wait until the hog has become quiet and well under control before giving it the drench, as there is some danger of the medicine getting into the air-passages and doing harm."

The writer has seen more than one hog killed in the operation of drenching. If the drench is poured too rapidly into the throat, it is almost sure to be drawn into the lungs, and the hog will probably die in a few minutes. The medicine should be poured very slowly, and it is best to pour it just inside the cheek instead of into the throat.

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Ontario Department of Agriculture

FRUIT BRANCH

BULLETIN 226

Plum Culture

IN

Ontario

By

F. M. CLEMENT, B.S.A.

Director of Horticultural Experiment Station,

Vineland Sta., Ont.

TORONTO, ONTARIO, DEC. 1914

BULLETIN 226] [DECEMBER, 1914

Ontario Department of Agriculture

FRUIT BRANCH

Plum Culture in Ontario

F. M. Clement.

Of the important tree fruits plums and pears have received least attention at fruit meetings, and in the agricultural press during the last few years. Apples are worth a great deal more money to the Province, and as a consequence are more generally popular, and take the leading place in the discussions. Peaches, though adapted commercially to limited areas in the Province, have through the energy and organization of the growers been boosted excessively in tender fruit sections. Even in cherries, of late, a few are quoting the large profits that have been made and are to be made from them, and the plantings are rapidly increasing. 1914 crop and low prices will, however, check this advance for a time. Pears have begun to grow in popularity because of the more gradual upward trend of prices and the more successful control of blight, but plums at date of writing are not holding their own in the Province, and except for a few growers who are making a success of them the interest is dead. Prices are from medium to low, few trees are being planted, their care is incidental, or secondary, and they are almost everywhere considered a side line, not a specialty. The purposes of this Bulletin, therefore, are:

1. To sum up the status of the industry as a whole.
2. To study causes of the lack of interest.
3. To study the cultural methods of the most successful growers.
4. To describe a few varieties that are important commercially.
5. And to offer suggestions for future development.

(1) PRESENT STATUS OF THE INDUSTRY.

The census returns for 1911 show a decrease in the number of trees in the Province. In 1901 Ontario was credited with 1,685,719 trees. Of this number 999,091 were bearing and 686,628 were non-bearing. In 1911, the last year for which the census figures are available, Ontario was credited with 1,124,022 trees, 767,827 of which were bearing and 356,195 were non-bearing. The number of bearing trees had decreased by 330,433, or 48.1 per cent., while the total decrease was 561,697 trees, or 33.3 per cent. The greatest decrease is in the non-bearing

Block showing 130 varieties planted in 1908 and later at the Experimental Farm, Vineland.

stock, for during the last decade conditions do not seem to have been such that growers cared to take a chance on future markets. The yields in the census years above mentioned were 337,108 bushels and 331,278 bushels, or approximately a million baskets each year. The latter figure is, however, no indication of the decay or growth of the industry, as the two seasons may have been very variable. They indicate, however, a fair average yield.

Compared with this, pears have decreased by 105,253 trees, or 12.4 per cent.; apples have decreased by 1,775,362 trees, or 18.6 per cent.; vineyards have increased by 3,629 acres, or 66.7 per cent.; small fruits have increased by 5,824 acres, or 71.7 per cent.; cherries have increased by 151,389 trees, or 22.1 per cent.; and peaches have increased 399,356 trees, or 31.1 per cent. The total number of fruit trees in the Province has decreased by 1,835,118, or 13 per cent., or about 2-5 the per cent. decrease in the plums.

The question now arises as to whether the consumption of plums has fallen off, or if the consumption has not fallen off, since the amount produced has not decreased to any great extent, who has supplied the plums for the ever-increasing number of persons in Canada who desire this fruit.

Prunes should in part be considered plums, and in the following table prunes and plums are considered one fruit, because as the consumption of dried plums and prunes increases the consumption of fresh plums must decrease.

Following are the imports of "prunes and plums, dried unpitted" for consumption in Canada as furnished by the Customs Department at Ottawa:

Year.	Quantity.	Value.
1895	2,798,256 lbs.	$75,232.00
1900	4,013,089 "	156,178.00
1905	6,034,815 "	147,637.00
1910	10,145,969 "	384,127.00
1913	8,942,599 "	466,868.00
1914	10,592,068 "	550,175.00

The marked increase in the consumption of dried plums or prunes to me indicates quite clearly that some other fruit has suffered a decrease in consumption, and that the consuming public is willing to pay for a good article that may be had at a reasonable price at such times of the year as desired.

During the same period of years the imports into Canada of "fresh plums" for consumption, as furnished by the Customs Department, were as follows:

Year.	Bushels.	Value.
1895	25,417	$22,688.00
1900	38,854	38,849.00
1905	53,593	66,473.00
1910	69,529	158,756.00
1913	151,650	267,563.00

These figures show a steady increase and seem to indicate that the plum growers of this country have not been awake to their opportunities. Or, as mentioned previously, it may be that the consumer prefers the imported product because of the uniformity and neat packing of the fruit.

For the years 1911, 1912 and 1913 the importations by months of fresh plums for consumption in Canada are as follows:

Months.	Bushels.	Value.
April, 1911	....	....
May	....	....
June	2	$22.00
July	11,014	41,816.00
August	28,957	78,193.00
September	38,254	85,006.00
October	17,988	32,866.00
November	1,006	1,905.00
December	22	22.00
January 1912	....	....
February	1	6.00
March	2	20.00
	97,246	$239,856.00
April, 1912	10	$10.00
May	....	....
June	33	151.00
July	20,073	46,636.00
August	43,808	89,711.00
September	74,452	111,332.00
October	11,799	17,521.00
November	825	1,178.00
December	301	435.00
January, 1913	....	....
February	....	....
March	349	606.00
	151,650	$267,580.00
April, 1913	3	$22.00
May	....	....
June	1,430	6,330.00
July	25,519	91,435.00
August	30,017	95,446.00
September	50,407	99,142.00
October	14,403	21,019.00
November	1,739	3,100.00
December	2	7.00
January, 1914	....	....
February	3	24.00
March	8	35.00
	123,531	$316,560.00

Our heaviest shipping months, or when Ontario growers are putting most plums on the market, are August, September and October. At the same time the imports into Canada are heaviest during these months, and this in the face of a duty of thirty cents a bushel.

From the foregoing figures and statements it is possible to draw certain conclusions.

(1) Plums and prunes grown in Canada show a marked decrease in number of trees, value and interest during the last few years.

(2) The imports of fresh plums into Canada show a steady increase during the same period of time.

(3) The imports of dried plums and prunes into Canada show a marked increase during the same period of time.

Therefore (1) either plums are produced under more favorable natural conditions elsewhere and the imported product is of a higher quality than ours.

(2) Or the fruit can be produced cheaper elsewhere than we can produce it.

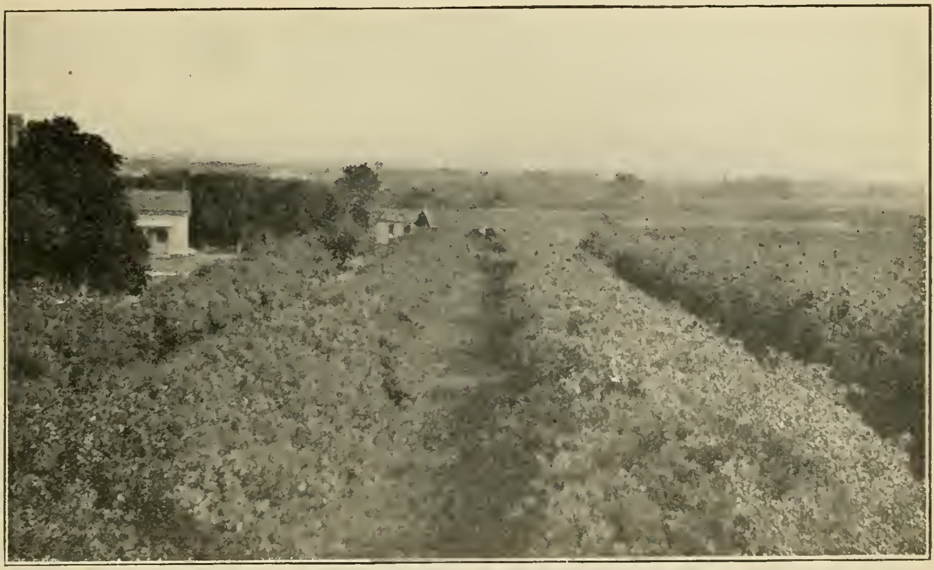
(3) Or the organizations of our competitors are more complete than ours and their methods of packing and sale are superior.

In the opinion of the writer the last two reasons are the main causes, namely:

(1) Cheaper production.

(2) Better organizations, including packing and selling.

Before discussing directly the two factors mentioned, I wish first to draw attention to conditions in two adjoining counties, both fairly heavy producers of plums, one in Ontario, Canada, and the other in the State of New York. Niagara County, N.Y., has approximately 180,000 plum trees, or about 1-5 of the total number in the State. The orchards are large, a great many of them ranging from six acres up. In some cases the varieties, or perhaps I should say the rows of the different varieties, are badly mixed, but a large number of orchards contain quite large blocks of one variety. Niagara or Bradshaw is the favorite. The land on which



Plum orchard at Lockport, N.Y.

they are growing is valued at about 50 to 60 per cent., or less, than that in the adjoining county mentioned. The cultivation methods are *extensive* and *thorough;* less money is spent on fertilizers, and the aim of the grower is to make his money from a large quantity grown cheaply, and marketed as cheaply as possible.

Notice, again, *large orchards, large blocks of one variety; cheaper land, extensive cultivation methods; marketed quickly.* In Lincoln County (and a part of Wentworth County, included in the Niagara Peninsula) we have *very few large orchards, many varieties badly mixed, intensive cultivation methods, high-priced lands,* and an attempt to market the fruit over a long season no matter what the rush of other fruits. A few growers can take exception to this, as they have large orchards of good varieties and are making money from them, but the general condition is as stated.

The men immediately across the border—and these men have the largest orchards—prefer, at present prices, to sell in Canadian markets, and on the statements of the growers themselves I have it that with a minimum of a cent and a quarter to a cent and a half a pound—with now and then a good year—the fruit is a very profitable one to grow. Quantity and quick handling at a fair average price is the motto.

The imports at Queenston Bridge for the season of 1911 were 6,740 bushels; for 1912, 3,789 bushels; and for 1913, 362 bushels. This is one port only, and represents largely the quantity that was drawn across the bridge in wagons for canning purposes. Queenston is the port between the two counties before mentioned through which the largest share of the trade passes, but the figures do not take into consideration any that may have entered at Niagara-on-the-Lake or Niagara Falls.

This one port is mentioned only as an example, and to still further emphasize the fact that there is an opportunity in plums where conditions for production are similar to those of our neighbors.

The question of cheaper production is covered largely in the comparison drawn above, but that of methods of packing and sale is not included, as the trade there is local—the large cities of the middle and eastern States—whereas the greater part of the fruit of our competitors is sold either in our Prairie Provinces or the large cities of the East.

Nearly all Ontario plums are sold in the two sizes of fruit baskets, eights and elevens, so well known to all growers. The baskets are also known to the trade and are an indication of their origin. This fruit is sold largely for cooking or canning purposes. The American product is largely in smaller baskets packed in cases, all fruit carefully placed and the packages faced. These are to be seen in our fruit stores at all times during the plum season; and it is this trade—the fancy trade that seems to have been neglected by our growers. Trade in fancy packages is necessarily not as extensive as the general trade, but still it is profitable.

It cannot be developed in a year, but if it is given "careful consideration" by our fruit men in the same manner that box-packed pears and apples have been in the last few years a certain amount of the trade at least will fall to the Ontario shipper.

In order that at least a fair idea might be obtained of the present commercial plum areas of the Province a list of questions was sent each of the District Representatives. The replies were for the most part very general, but gave some idea of the industry in the particular county. From the replies the Province might be divided into three parts:

(1) The colder Northern parts where plums are grown only in the home garden as a hobby or not at all.

(2) The western part of Eastern Ontario and all of Central and Western Ontario, except a few locations where they are grown locally and marketed in the nearby towns and villages; where local production supplies, or almost supplies, the local demand.

(3) The centres where the commercial orchards are situated; Lincoln, Wentworth, some favored spots on Lake Huron in Grey County, on Lake Erie in Elgin, Kent and Essex, and on Lake Ontario in Prince Edward County.

It is with these latter districts that we are mostly concerned at present, so far as production is concerned, and also the first division in which are situated many small towns that would take regular shipments during the season from the commercial districts.

It must not be supposed from the above remarks that every man in the State of New York is an expert plum grower, or that every man in Ontario is making a failure, because such is not the case, and that is not the idea that the writer intends to convey. The percentage of men in New York who are making money from plums is probably a little higher than in Ontario, but not all are specialists. Plum specialists are scarce, and the idea that the writer means to convey is that certain phases of the methods and plans of our American friends could be profitably adopted by us. Those particulars have been enumerated, and it is hoped that the suggestions thrown out will be of some interest and value to Ontario plum-growers.

The question might rightly be asked, how do successful plum-growers consider plums compared with other fruits as a profitable line to follow? The general idea is that plums are a secondary consideration, and one prominent grower remarked to me that he believed the last dollar had been made in plums, and that he would not take the trees as a gift if he had to set them out and wait for them to bear. It was the exception rather than the rule to find a man who gives his plums the same attention as he gives other fruits, but still they yield fair returns.

The situation is summed up quite well in a letter from a prominent grower in the State so often mentioned, which is here quoted in part: "Plums were very low here also, but I got better prices than I expected, from 8 to 10 cents per 7 lb. basket loaded on the car here; prunes 15 cents a basket. My plums and prunes were never better and more perfect than this year, and the largest crop I ever had. Plums and prunes pay fairly well, as they come into market when one is not very busy, and they generally bear abundantly."

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(2) THE CAUSES OF THE LACK OF INTEREST.

Many causes or reasons might be assigned for this lack of interest in the plum industry of the Province, but I believe the principal ones may be found in the following:

(1) The prevailing prices have been low.

(2) A large number of poor varieties were planted in the decade previous to 1901 and the few years following.

(3) Low prices did not seem to warrant the adoption of careful cultivation, pruning and spraying methods, and as a result much fruit has been of low quality, and large quantities were in a state of over-ripeness or decay before they reached the consumer.

(4) The other fruits are more popular with both producer and consumer, and the plums are crowded out in favor of the more highly praised and advertised fruits. Plums and the culture of plums have scarcely been discussed at fruit conventions during the last few years.

Low Prices.—Prices and net returns are the key-note of growth or decay in any business, and around this hang the other reasons for lack of interest.

The following returns, worked out by L. B. Henry, B.S.A., of Winona, and by whose courtesy I am permitted to use them, are of great interest and value in that they show the variation in price from year to year and the variation in price of the different varieties. They represent the gross returns of five good growers—not average or poor growers—in the Winona district, per eleven quart basket for a period of ten years. These figures I consider very reliable, and represent what a man who understands his business might expect.

	Bradshaw.	MediumBlue and Burbank.	Lombard.	Fancy Blue and Red.	Reine Claude
1903	21.1	21.2	11.9	19.6	19.5
1904	44.8	38.3	35.0	45.2	52.5
1905	31.6	19.3	14.0	24.0	35.3
1906	42.0	42.0	41.9	43.4	41.1
1907	78.3	63.7	60.0	77.9	95.6
1908	25.3	29.2	15.9	29.4	32.4
1909	26.5	27.3	15.0	33.0	36.4
1910	28.0	27.3	25.0	33.2	47.0
1911	35.3	32.7	35.1	42.5	42.9
1912	33.7	26.9	26.3	38.0	36.5
Average	36.6	32.8	28.0	38.4	44.2

In "Medium Blue" are included Gueii and Quackenboss. In "Fancy Blue" are included Glass Seedling, Monarch and Grand Duke.

The year of lowest prices was 1903, when the average of all varieties was only 18.6 cents per eleven quart basket gross. The year of highest prices was 1907 when the average for all varieties was 75.1 cents gross; certainly an exceptional price for plums.

Again the average for all varieties for the ten years was 36 cents per eleven quart. This price, though low to many, I consider fair, and consequently it does not warrant the present partially neglected state of the industry. If five good growers received this for all varieties for a period of ten years does not the increasing demand warrant more careful methods of culture and sale and the planting of selected varieties?

Carrying yields and returns still further we have in New York State (1909 census) 919,017 bearing plum and prune trees, with a yield of 553,552 bushels. Ontario (1911 census) has 767,827 bearing plum and prune trees with a yield of 331,278 bushels. The New York product was valued at $519,192. The Ontario product, at the average rate quoted previously in the table for that year (37.7 cents, average of all varieties), and considering three baskets to the bushel, would be worth $374,675.48.

Estimating thus, the product of Ontario was worth 48.8 cents per tree on an average, while that of New York was worth 56.5 cents per tree on the average. The figures are admitted to be only approximate averages, but still they are fairly correct. The figures are even for different years, but they illustrate comparative values, and the fact that plums as a whole are worth as much, or more, in the open markets of the neighboring republic as they are in our open markets. In Ontario the average price per bushel was lower in 1909—the year of the last New York census—than in the year quoted (from figures quoted previously), but the yield was higher, so the comparative values per tree will still be the same. The total yield for Ontario is not available for 1909, so we must use the census year. This again, to me, at least, illustrates that the production and marketing methods of our competitors are cheaper than ours, and that the industry could be made a profitable one, if given the same attention as the other branches of the fruit industry.

Poor Varieties.—Scarcely had the old and tried domestica varieties of plums become widely distributed and well known when the much lauded, much advertised, over praised Japanese varieties were put on the market. A word as to their history will make clear their standing. The first trees were imported in 1870 (Bailey) and fruited in 1876. Commercial propagation began in 1883, or really only thirty-one years ago. For twenty or more years they were heralded as the best possible, and it is only within the last few years that they have found their level. But they were planted promiscuously and over-planted, and the whole industry has suffered as a result. Most of the varieties are not equal to the domesticas, and though the tide has found its ocean level it will be some years yet before the results of the mistake are completely obliterated. I do not mean to infer that the Japanese varieties have no place, but that their place is not above the best domestica varieties. It might be said, too, that early ripening domesticas (with the exception of Bradshaw or Niagara) have to a certain extent been over-planted. Some are making money from them in a limited way, but the majority are not. The best growers have of late been watching the expanding markets, and the varieties now being planted are being more carefully selected and for the markets of the near and distant future.

SPRAYING, CULTIVATION, ETC.—The percentage of growers who spray and care for their plum orchards as carefully as they spray and care for their other fruits is very small indeed. The interest in their care is such that as a general rule the trees are given such care and attention as time will permit after the other fruits have received their special treatments. In very many cases the orchards are not given any spray treatment after the dormant spray. Other applications would necessitate special effort, and consequently the trees are left untreated. A small per centage are more thorough and produce good fruits. The former and larger percentage are as a consequence not getting the highest returns. The latter are receiving returns commensurate with their efforts. The returns of the more careful growers are quoted previously.

POPULARITY OF OTHER FRUITS.—Plums are common property. They grow almost everywhere and nearly all are familiar with their habits. They have not been favored with heavy yields at high prices. When yields are heavy prices are low. We have no big returns to quote for them as we have for the strawberry, the peach, and the apple. At least we have not been quoting them. Their quality, flavor and character is such that they do not appeal to the taste in sufficient degree to be desired in the largest quantities. The production and consumption of prunes, dried, is increasing yearly and making inroads on the fresh plum industry. The former can be purchased from the provision merchant in any quantity, large or small, at any time, whereas fresh plums must be canned or preserved at once or they will spoil.

The plum must be of first-class quality and marketed in an attractive manner if it is to hold its own with its natural competitors.

(3) PLUM CULTURE OR CULTURAL METHODS.

The history of plums and plum culture dates back to many years before Christ. Plums were cultivated by the Greeks and Romans, and the pits or seeds were scattered from this centre throughout Western Europe. Nor are all our common best varieties products of modern civilization. Our best varieties are European importations or offshoots from them, and we have not a single variety evolved from our native American species that is equal to them. The Japanese varieties are importations, or have been produced from imported stock, and as yet not a single variety has been produced that has maintained a permanent hold on the public—a hold equal to that of the Reine Claudes, Prunes, and Damsons.

In order to more thoroughly understand the discussion later it might be well to outline a classification that covers the common varieties. Each class requires somewhat special treatment or care, and it is well at the outset to make mention of them. We have in all twenty-four distinct species of plums (Hedrick), and more than two thousand varieties, but we are directly concerned with only four species and about thirty varieties, or even less.

Prunus Americana includes nearly all our best native varieties. These are not grown largely in commercial orchards, but are found in many gardens throughout the Province. The principal varieties are De Soto, Hawkeye, Stoddard, Wolf, Wyant and New Ulm. One other variety that is very similar to the above is Cheney, but is a distinct species (*Prunus nigra*).

Prunus domestica includes nearly all our best varieties, those that have been imported direct from Europe or developed from the importations. Some of our best varieties are Monarch, Grand Duke, Smith Orleans, German Prune, Italian Prune, Pond Seedling, Quackenboss, Shipper's Pride, Reine Claude, Green Gage, Washington, Yellow Egg, Lombard, General Hand, Gueii, Bradshaw, Moore's Arctic, Glass Seedling.

Prunus Triflora includes the Japanese varieties, those that have been imported from Japan or developed here from the importations. Abundance, Burbank, Red June, Willard are the best known varieties.

Prunus insititia includes the Damsons, the most important of which are the Sweet Damson, Common Damson and Shropshire Damson. Besides the four above mentioned species we have a number of common and important hybrids, plums that have been produced by crossing. The most important of these are Climax and Shiro.

Soils.

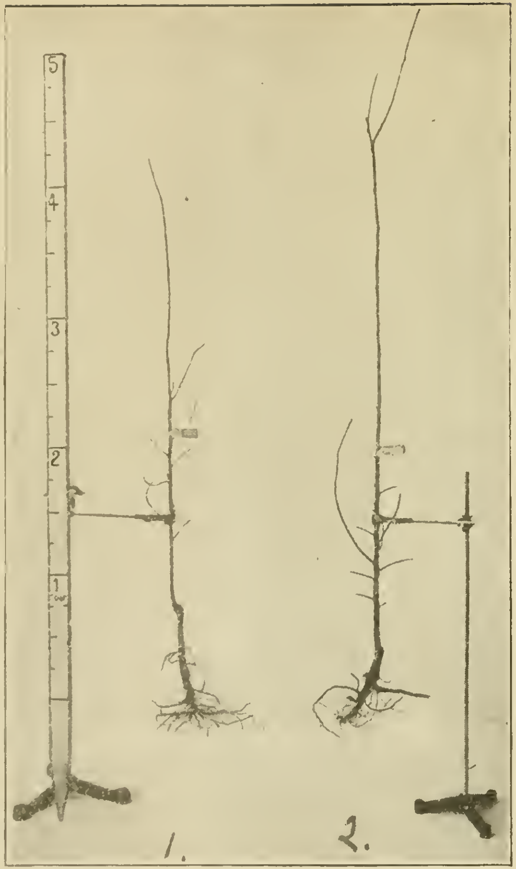
Plums are adapted to a wide range of soils, but like most other fruits have a preference. The domestica or European plums are best suited to clays and clay loams. They will thrive on sands and heavy clays, but the largest and most regular yields of the highest quality fruit seem to be found on the clays and clay loams. It is sometimes written that plums will thrive on wet soils, but in the main the statement is incorrect. They will thrive under damper soil conditions than the peach or cherry, but it does not follow that such a soil is wet. Warm bottomed lands are as much preferred by plums as by any other fruit, but they will maintain their vigor under more adverse conditions.

The Damsons are well adapted to a little greater variations and will thrive to the fullest degree on the heavy clays. Japanese plums, on the other hand, though also adapted to a wide range of soils, may be expected to yield highest returns on the lighter soils. Many of these species are worked on peach roots—especially in the South, and in such cases are adapted to soils that favor that particular fruit.

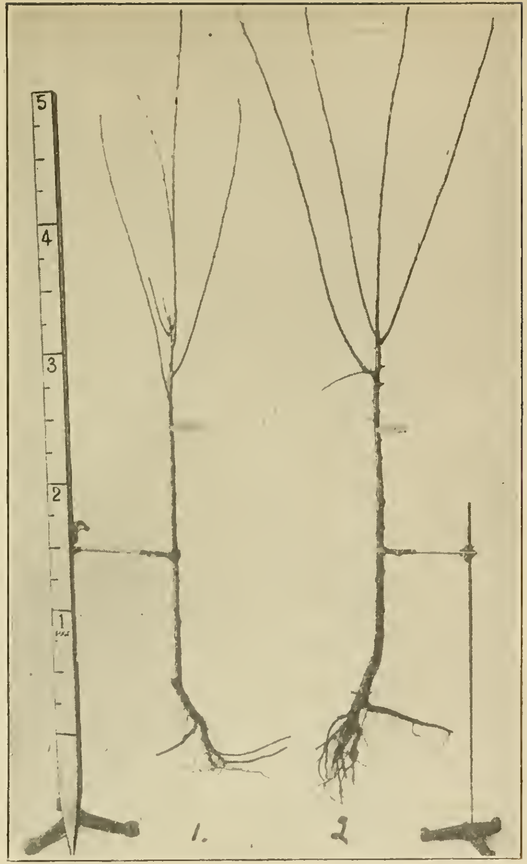
Soils, generally speaking, are not as important as the drainage of the soil. If the subsoil is sufficiently open to permit of an extensive development of the root system, if it dries off readily in the spring or after a heavy rain, if it is sufficiently open to permit of easy drainage and at the same time holds moisture well under judicious management, be it sand or heavy clay, it is adapted to fruit trees, and plums will thrive on it. It is a mistake to put plums where no other fruit would grow.

There is no objection to a large number of stones in the soil provided they do not interfere with cultivation, as such a soil is usually open and quite fertile.

The above statements will arouse this question: If plums are only a fair investment, and do not pay as well as some other fruit, why should we not reserve the good soil for the better paying fruit? By all means put the plum orchard on the heavier and cheaper land, but only if that cheaper land is adapted to them.



Niagara (1), Burbank (2), as usually sold from the nursery—1 yr. The Burbank is large and vigorous, but the Niagara is a small grower. The Niagara is a poor specimen.



Niagara (1), Burbank (2), as sold from the Nursery. The former is a first-class specimen tree of the variety, but the latter is too large. The Burbank is a thrifty tree at one year.

Drain it, and fertilize and cultivate it and the plums will respond as readily as any other fruit. Plant them under the best conditions possible in your particular circumstances.

Propagation.

Plum trees used in the commercial orchards of Ontario are grown almost entirely by the local nursery firms. A few are imported from the United States, but a large percentage are home-grown.

Seedling stocks (Myrobolan) are obtained from France in the winter and planted in the nursery rows the following spring. At one time St. Julien stocks (*prunus insititia*) a species of Damson were used almost entirely by the nurserymen of the Eastern United States, but they have given way for the Myrobolan. It is generally admitted, however, that domestica and Damson plums make better trees, thrive better and live longer on St. Julien than Myrobolan, and there are to-day many orchards on this stock in the State of New York.

The nurserymen, however, prefer the Myrobolan stock, because it gives a larger and thriftier tree in one year, and is easier to bud successfully. Also it is less subject to disease, and it costs less than St. Julien. Naturally, then, under these conditions the nurseryman is going to use the stock that gives the best growth while in the nursery and makes the most money for him.

The seedling stocks planted in spring are budded the summer immediately following (August), and sold a year from the following spring as yearling trees, or sold two years from the spring following the bud, as first or second class trees of standard sizes according to grade.

The stock may either be dug from the nursery row in the fall and heeled in a dry place near the buildings, or what is more generally the practice, and is the best practice, tied in bundles and piled in the storage houses, where they are held at a low temperature to prevent any starting of the bulbs. Heeling in is also practiced sometimes in the storage cellars, but requires a vast amount of space. In a few cases trees are left all winter in the nursery row, but such a practice cannot be recommended for spring delivery.

In winter the trees in the storage are sorted into sizes or grades and with the opening of spring are packed for delivery.

The larger trees are in greatest demand, but smaller sizes, and especially the good grades of clean straight stock of one and two year old trees are to be preferred. One year old stock of the rapid growing Japanese varieties is recommended. The Reine Claudes and similar types are slower growers, and are much smaller than the Japanese varieties at one year. Two years are required for them to attain their size.

Site.

The site for the plum orchard is generally largely determined by the soil factor. Two other factors are, however, worthy of consideration. Plums when hanging heavily on the trees rot very easily if the weather is at all warm and damp. Brown Rot is especially adapted to warm, humid conditions, and the application of spray materials is much more effective when aided by air circulation and sunlight. The rot spores cannot thrive under dry conditions, and the freer the air circulation the less rot there will be. Do not hide the trees behind a woods or thick hedge where air currents cannot reach them.

The other factor, that of sunlight, is controlled largely by pruning, but proximity to a high hill, or part enclosure by woods, is of considerable importance. The orchard should be as much in the open as possible without undue exposure to heavy winds. Proximity to woods, old fences, etc., is also conducive to rot and insects because of the nearness of the breeding grounds of the curculio. Curculio stings admit rot spores.

Orchard showing the result of too close planting. 18 ft. x 18 ft. is a good average distance.

To get most sunlight and air circulation keep away from the hollows, and unless the soil is too valuable select as good a site as for the peach or the apple.

Another factor of some importance is the freezing of the blossoms in the spring. The Japanese varieties open comparatively early, and if there is any preference they should have it. Japanese varieties cannot be raised in many sections of Ontario because of this. They blossom freely, but fail to set any fruit, or if any does set it turns yellow and falls off soon after. For these varieties a northern slope or one near the water is preferred in all sections subject to late spring frosts.

Planting.

The planting of the nursery stock may be done either in the fall or spring. Spring planting is the most popular time at present, but there is no reason why they should not be set in the fall, if well matured trees can be obtained in late September or in October, or even later. The trees must be well matured for transplanting, and unless good well-ripened individuals can be obtained it is better to wait till spring. Ordinarily they can be obtained. Experiments conducted here with one variety, Reine Claude, over a period of three years, indicate that something is gained by fall planting. Six trees were planted in the falls of each of the years of 1911, 1912, 1913, and in the springs of 1912, 1913, 1914. In every case the fall planted trees show a greater growth; are more vigorous and thrifty. One tree planted in the spring of 1913 died, but all others are still under observation. Some discussion has also taken place with regard to the merits of dynamiting holes for trees. The experiments have not been conducted sufficiently long to report definitely, but the results to date are included in the following table. The wood growth per tree and the diameter of the trunk of each tree, with averages for spring and fall planting, are also included in the table. No fruit has been produced.

	Dynamited Holes 1912		Spring Planted 1912		Autumn Planted, Fall of 1911	
	Diameter of Trunk	New Growth 1914	Diameter of Trunk	New Growth 1914	Diameter of Trunk	New Growth 1914
Tree 1	1.11	188½	1.58	299	1.66	266¾
" 2	1.11	164	1.75	278	1.66	338
" 3	1.43	317½	1.41	138½	1.58	255
" 4	1.27	222	1.34	216½	1.66	274½
" 5	1.34	216	1.43	161¾	1.75	237
" 6	1.27	209	1.58	274	1.75	266½
Total	7.53	1317	9.09	1367¾	10.06	1637¾
Average	1.255	219.5	1.515	227.9	1.676	272.9

There is possibly a labor advantage in fall planting sometimes, but not always. The rush of fruit picking is often more trying than spring cultivation and planting.

If the soil can be put into first class shape and the trees obtained when ready it will pay to plant; otherwise wait till spring.

The distance apart to plant varies a great deal with the different varieties. Some are quick, vigorous growers and make large trees; others are small trees even when matured. Seventeen feet square is a good average, or on rich loam twenty feet square is not too great a distance. The Abundance is a small grower and will adapt itself to a square fifteen feet each way. Burbanks are more spreading and should have at least seventeen feet; eighteen are better. Where it is desired to plant a number of varieties the rows may be kept in straight lines and the trees an equal distance apart in the row, but the rows brought closer together. For instance, the trees in the rows may be eighteen feet apart and the rows eighteen feet apart for the large growing domesticas, but when the rows of Abundance or Lombard are planted they may be planted the same distance apart in the row but fifteen feet between the rows.

Don't make the mistake of planting too closely. Just as much and better fruit will be produced at the greater distance, and it will not all be in the tops of the trees.

Reine Claude in midsummer of the third year.

Reine Claude in midsummer of the third year.

Pollination.

The question of pollination is important where large quantities of Japanese and Americana varieties are grown, but not so important where the domesticas are in evidence. Most varieties of Japanese and Americana are self-sterile; that is, the varieties will not pollinate or fertilize themselves. Cross fertilization is much stronger. Damson and Domestica varieties are not self-sterile, as far as the present evidence will permit of a final judgment, but they are stronger and more likely to produce abundantly when cross pollinated. Japanese varieties are readily pollinated by Americana varieties that blossom at the same time.

Reine Claude in midsummer of the third year.

A large block of Burbank or a large block of Abundance will not pollinate freely if isolated, but if the blocks are near each other or the rows mixed through, pollination will be almost certain. The same might be added with regard to Red June. The popular American varieties, De Soto and Hawkeye, are self-sterile, as is also the popular Nigra variety Cheney, but they all cross pollinate readily. On the other hand, a large block of domesticas, say Bradshaws, will produce well even when isolated from other varieties.

The question of the "June Drop" might be taken up here. By this I mean the falling of a large number of fruits soon after the blossoms fall or even when the fruits are the size of beans, and in a few cases very much larger. The fruit turns yellow, shrivels up and falls off.

There are two main causes of this drop—weak pollination and attacks of Plum curculio.

No plum can produce seed unless it is pollinated, and fruit cannot form unless the seed is strong and vigorous. Those plums that are not fertilized will drop almost with the blossoms; those that are partly or weakly pollinated will fall later, and only those that are vigorous will grow to maturity.

An examination of the fallen specimens will show that the curculio is also responsible for a large share of the damage. This can only be remedied by careful spraying and general tidy methods.

PRUNING.

The pruning of plums as generally practised is a haphazard operation, and I feel that I can safely prophesy that the plum growers fifty years hence will smile at the methods of to-day. For no fruit has pruning received the scientific study that spraying or even fertilizing has. Plums are no exception to the rule, and

A good low-headed Reine Claude, two years planted; was cut back to a whip and headed very low when planted in the spring of 1911.

when we consider the various tree types even in the different species we have a magnitude in variations and habits of growth.

Americanas at best are generally a tangled, crooked, thorny bunch of limbs that it is very difficult to work amongst. The cross and broken limbs must be cut away, but the head left fairly thick to protect the trunk and main limbs. It may be necessary to thin out a little, but sections to which this species is adapted are cold and severe, and heavy pruning is not to be recommended. Low heading is, however, strongly recommended. Even where the snowfall is heavy it is not necessary to have a three or more foot trunk to protect the trees from the rabbits, etc. A trunk of thirty inches as a maximum, and perhaps I should have said twenty-four inches, is less liable to sunscald and winter injury.

Japanese plums are also varied in their habits of growth. We have the extremes in Burbank and Wickson. Burbank is a broad, low growing, flat-topped tree, while Wickson is narrow and upright. Abundance is intermediate, in shape vasiform, and may be taken as a type. Burbank must be thinned out and headed in as much as from one-half to three-fourths of the new wood. Its heavy bearing qualities make it necessary often to thin very heavily. Burbank also bears some fruit on the new or one-year wood. Besides thinning out and heading in, as mentioned, the tree must be pruned upward.

With Wickson the dense top must be thinned, but the pruning must be to induce growth downward, not upward. This variety, as far as growth and pruning are concerned, resembles somewhat the Yellow Transparent apple and requires much the same treatment.

The domestica plums vary as much as the Japanese, and with a few rules they must be left. The illustrations will be somewhat of a guide, but only a guide, as the requirements of each variety are very varied.

(1) Cut out all cross and tangled limbs.

(2) Let some sunlight in at the top, but not as much as with the apple.

(3) But little heading in is necessary.

(4) Thin out so the sunlight is fairly evenly distributed throughout the tree.

(5) Prune horizontal trees upward and upright trees downward.

(6) Study the fruiting habit; that is, examine all buds and spurs and find out how the buds are borne and which ones bear blossoms and fruit. Are they on one, two or three-year wood, lateral, terminal or on spurs. Pruning can be done intelligently only when these things are observed.

The illustration on page 17 is a good type of a spreading tree and that on page 19 of an upright tree.

The fruit buds are for the most part borne on spurs, on wood older than one year. Some Japanese varieties bear on one-year wood—Burbanks partly—and in such cases the cutting back of new growth thins the fruit. This will not apply to Domesticas and Americanas. Fruit buds are generally in clusters of from two to six or seven and sometimes more on a spur. Their size and form is very similar to leaf buds and their denomination is more to be determined from position than any other characteristic. The central bud may be considered a leaf bud and the near lateral buds fruit buds.

The general opinion is that plums do not require as severe pruning as some other fruits, but nevertheless we sometimes see pruning carried to the extreme with no harmful results. The writer has visited orchards where the trees (Bradshaw), were as open headed as any Baldwin apple in Ontario, headed in severely at the top and all growth forced downward. In one orchard of this type the trees were set about 20 by 30 feet, diagonally, and were good yielders of fruit of good quality. The writer has also visited orchards where the other extreme was practised. On one orchard in particular the trees were planted 10 by 12, pruned high, all the lower limbs and ground were shaded, and yet for the first foot or two in the tops the trees promised well and the owner claimed a profitable orchard.

What then are we to do in the face of the greatest extremes. Individual tastes only can answer. The habits of the varieties must be studied and the trees pruned accordingly.

Cultivation, Fertilizing, and Cover-Cropping.

The three above headings are each in themselves worthy of discussion and scientific investigation, but at present it seems that as far as practical results are concerned they are best discussed together. Thorough cultivation is the cheapest fertilizer obtainable. Cover crops add the humus that breaks down, and makes not only its own substance available, but also the locked up plant food in the soil.

Cultivation destroys the weeds that would absorb plant food at the critical season of the year; it conserves the moisture that dissolves the fertilizer, it prepares the soil for the covercrop, the seed of which is to be sown in what is usually a dry season of the year.

We talk covercrops, fertilizer and soil moisture and I repeat, each is important, but the lion's share of their possible values is dependent on thorough cultivation. Cultivate repeatedly during the season for cultivation and the moisture problem will partly be solved; cultivate repeatedly to break down the cover crop you have plowed under, and it will work for you; cultivate to incorporate the humus with the soil, to make it sufficiently open to admit air freely and plant food will be liberated from the clay and made available to the plant. Cultivate to make available the fertilizer you have applied.

Niagara or Bradshaw at the end of the third summer, showing what is possible from a one-year whip very low headed.

The cover crop should be placed second in importance. Just as it is important that the trees be given all opportunity in the spring and early summer to grow, so is it important that in late summer and fall that they ripen their wood and buds for the following season. Sow the cover-crop in July or August depending on moisture and the quantity of fruit on the tree. Crimson Clover, 18 lbs. per acre, Rye, $1\frac{1}{2}$ bushels per acre, Buckwheat, 40 lbs. per acre, Red Clover, 15 lbs. per acre, Vetch, 30 lbs. per acre or oats 51 lbs. per acre, may be used. Or if chickweed (so popular with many growers) is plentiful and wants to grow there is no objection to it in the orchard. There is objection if it spreads to other fields—especially strawberry plantations.

Little attention has been paid to scientific fertilization of plums. Even the best growers do not fertilize regularly. Some have tried commercial fertilizers, but because of inadequate returns they have not come to be used generally. Farmyard manure is most used and even with this the other fruits seem to have the preference and if any is left the plums may get it. A light application, eight or ten tons once every two years is the exception rather than the rule. A few apply light dressings annually, and the returns seem to warrant the expenditure; but these are only the few, and the best, but it indicates that plums under skilful management are a paying crop.

Two serious objections might be raised to the foregoing statements *re* cultivation and cover crops. The extreme of cultivation produces heavy tender growth, but thorough spring, not late cultivation, only is advocated. And covercrops tend to harbor curculio and rot. This is the sound objection in some instances, but where the best pruning and spraying methods are followed the danger of infection is reduced to a minimum.

Picking and Packing.

Is there anything to be said about the picking of plums? Very little, I am afraid, except to repeat the oft-quoted rules with regard to other fruits.

Because of the lack of confidence in the plum trade, and prices generally, the fruit is often picked roughly—"shelled" so to speak in baskets without any particular care being exercised. This applies more particularly to such varieties as Burbank and Lombard. Baskets containing plums of various sizes in various degrees of maturity, sometimes also some leaves, can be purchased on the large markets during the rush of the season. To some extent at least this is the cause of low prices. The grower has had a large quantity and received a medium price which has paid him well enough, but it has hurt the sale of plums as a whole.

A single decayed plum in a basket soon plays havoc with the fruit nearest it, and the infection soon spreads. Much care should be exercised to prevent such waste. The writer has seen baskets of plums—and other fruits also—spoiling on the hands of the retailer. This may seem to be far from the producer, but when the loss from decay is heavy the good fruit must be sold at a correspondingly high price to protect the retailer from financial loss. This is one of the reasons of high cost to the consumer that the producer does not always consider. A large share of the apparently large retail price is due to loss caused by careless picking and packing methods.

At no time should plums be placed in baskets when they are at all damp. This only hastens the decay. All plums are not ripe when they begin to turn blue; German Prunes, for instance, are not ripe till many days later and should be left till in a better state for shipment. They are better picked a little green than over-ripe though, especially for long-distance shipment. Most of the early Japanese varieties should be picked a little green as they quickly "go down" if over-ripe. The above are the conditions generally. A few men are more careful, and are paving the way. Their plums are graded into "extra fancy," "fancy," "medium," and "Lombard" grades, and as such their fruit is known to the trade. Their baskets of plums carry the same guarantee as their baskets of other fruits and the returns are commensurate with the extra trouble and expense of picking and packing. Wet or damp weather conditions during the ripening and picking season are in some measure responsible for heavy loss from decay in transit and when in the hands of the retailer. Loss at this time can not be avoided except by careful pruning to admit an abundance of air and sunlight into the tree and by the use of fungicides to prevent scab development.

To the Western markets only the best varieties and the best grades should be sent and the fruit must be picked a little greener than for the nearby markets. As soon as the fruit is partly colored and has attained nearly full size it should be picked and shipped at once. The week or more in transit will give them some time to reach maturity. For fancy shipments the fruit should be picked with the stems on the same as cherries are always picked for shipment.

The cost of picking will vary a great deal depending on the quantity of fruit on the tree, the variety and the care that is exercised. On an average it should not cost more than three and one-half cents or four cents per eleven-quart basket.

The packing generally consists in putting the plums into the eight or eleven-quart baskets and tacking on the cover. No special packing methods are followed. A few attempts have been made to market in small baskets, four in a case (the western plumcase), but at present the market does not seem to be ready for Ontario fruit in this case. It might be developed in the same steady, progressive manner the box trade in apples has been developed. Eleven-quart baskets are used almost entirely, but the demand for the smaller basket seems to be increasing. At any rate the fruit carries better in them—the smaller quantity—and it is a much more convenient quantity for the consumer to handle. A very large quantity of the product in New York State is marketed in seven-pound baskets and they seem to give satisfaction.

Cost of Production.

Cost of production is as important a factor as the selling price. Following are given two estimates that are intended to be a guide only. They represent average costs and average returns. They might be exceeded by a great many growers and a large number will come much under them when they balance their books at the end of the year.

As worked out by L. B. Henry, of Winona, and based on the results obtained through experience in that district and from figures quoted previously:—

For buying 10 acres of orchard, 7 years old, at $500.00 per acre	$5,000.00
Interest on $5,000.00 at 6 per cent	300.00
Taxes	20.00
Pruning, 40 days at $1.50	60.00
Gathering Brush	10.00
First spraying, 40 barrels Lime-Sulphur	40.00
Second spraying, 40 barrels Lime-Sulphur and Arsenate	40.00
Third spraying, 40 barrels Lime-Sulphur and Arsenate	40.00
Cultivation, 10 acres at $5.00 per acre	50.00
Picking 6,075 baskets at 3 cents	182.25
Fertilizer	200.00
Delivery to station	80.00
Depreciation, 5 per cent for 20 years	250.00
Management	300.00
Total	$1,572.25

Receipts.

6,075 baskets at 29.7 cents	$1,804.25
Cost	1,572.25
Profit	$232.00

The above estimates are based on the figures quoted previously: average crop 4.5 baskets per tree; trees planted 18 by 18 feet or 135 to the acre; rate per basket 33.5 cents gross or 29.7 net to the grower for the fruit. (In the latter figure, the cost of the basket is deducted).

The following is worked out by the writer and is based on general conditions where land prices, etc., are not so high as in the Winona district:

Cost of land, 10 acres at $200.00 an acre	$2,000.00
Planting and cultivating, fertilizing, pruning, spraying, etc., 8 years at $22.50 per acre	2,250.00
	$4,250.00

Estimates based on an average crop of three baskets per tree, the trees planted 135 to the acre at a net to grower price of thirty cents a basket for the fruit.

Interest on investment, $4,250.00 at 6 per cent.	$255.00
Taxes, 10 acres at $1.50	15.00
Pruning and picking brush at $7.00 per acre	70.00
Spraying three times, labor and including 150 barrels of diluted spray with arsenate when needed	150.00
Cultivation, 10 acres at $4.00 per acre	40.00
Fertilizer, 10 acres at $15.00	150.00
Picking 4,050 baskets at 3½ cents	141.75
Delivery at 1 cent a basket	40.50
Depreciation, 5 per cent. for 20 years	212.50
	$1,074.75

4,050 baskets at 30 cents	$1,215.00
Cost	1,074.75
Profit	$140.25

Or in other words after paying interest at six per cent. on the investment the returns from the above estimates would be $140.25 or $14.03 per acre for the management.

It is said that figures won't lie, but they sometimes are misleading. Nevertheless, if the intending planter will use these only for the purpose for which they are intended, using them for a guide only, he may find them helpful.

The personal factor is one that can not be estimated in dollars and cents, and on it depends the whole proposition. What the grower receives in profits is really a dividend on his ability as a managing fruit grower.

Diseases Affecting Fruit and Tree.

Brown Rot, *Sclerotina fruitigena.*—This is the most serious disease affecting the fruit of the plum and requires very thorough measures to control. The fruit becomes a soft, rotten mass and quickly spreads the infection to other fruit, and particularly those in contact with it. The diseased fruit, if allowed to hang on the tree, shrivels up and dries and will remain hanging all winter.

The disease is a fungus that rapidly develops during warm, moist weather.

Control: If the disease is established pick off all the dried or mummied fruits and bury or plow under.

Pruning the tree and thinning the fruit so that plenty of air and sun can find its way to all the leaves and fruits will make conditions that are adverse to its development.

The regular spraying, as outlined under spraying, should keep it under control. Sometimes, however, rot will develop as the fruit is ripening and sprays that mark the fruit can not be used. At this time use ammoniacal copper carbonate.

Copper carbonate, 5 ounces. Ammonia, (20° Baume) three pints. Water, forty-five gallons.

Refer to Bulletin 195, Ontario Department of Agriculture, page 36, for full instructions in making.

BLACK KNOT, *Plowrightia morbosa.*—This is the most serious disease affecting the tree. It is a fungus that works in the inner tissues of the limbs and twigs and cannot be controlled by spraying. It shows itself quite plainly by making rough looking knots in various places.

Control: All diseased parts must be cut out and destroyed in late fall or winter. Don't wait till late spring or early summer. If the trunk or main limbs are affected the diseased parts may be cut out as thoroughly as possible and the wound painted with red lead. It is recommended, however, that when the trunk is badly affected, to remove the tree entirely to prevent the spread of infection. If a large limb is badly affected it is safer to cut out and destroy than to attempt a remedy. The orchardist can not be too careful about the removal of all infested parts as fast as they appear. Control will not be complete unless the methods are thorough.

LEAF SPOT OR SHOT-HOLE FUNGUS, *Cylindrosporium padi,* is a fungus which shows itself by making somewhat cylindrical holes in the leaves. It is not comparatively serious and is controlled by good orchard methods and the regular sprays applied thoroughly.

PLUM POCKETS, *Exoascus pruni,* is not common in Ontario, but is worthy of mention. The small green plums become enlarged, soft and spongy. The nutrition of the stone seems to be interfered with, as it does not develop. It also causes a curling of the leaves similar to peach leaf curl.

Control: Remove or cut out all signs of disease. The first spray should keep it under control if applied just as the buds are beginning to swell.

SUN-SCALD is injury caused by the rays of the sun blistering and destroying the exposed trees and limbs. It might be considered a form of winter injury. The bark cracks and shells; breaking away from the wood beneath, exposing the tissues. When once the bark is broken disease spores are likely to get in and start decay.

Control: Prevention is the only remedy. Bank up the tree with earth to a height of about eight or ten inches. Cut ordinary rolls of building paper into about four lengths with a saw and use this to wrap the trunks from the top of the bank to the lower limbs. Put on the paper much the same as a bandage or legging and tie at the top with twine. Wrap loosely but tie tightly.

If the tree is already damaged cut away the loose bark and all decayed and dead parts, if possible, and paint with white or red lead. Or if you prefer it, cover the whole of the exposed tissues with grating wax. Low heading lessens the liability to the trouble. Gummosis or gumming of the wood, is somewhat common and where common is serious. It apparently is the result of mechanical injuries, though it is not proven. Hedrick in "Plums of New York" says, "The disease is least common in species and varieties having hard wood; on trees on soils favoring the maturity of wood; under conditions where sun and frost are not injurious; and obviously, in orchards where by good care the primary causes of gumming are kept out.

Insects.

San José Scale, *Aspidiotus perniciosus.*—The most serious insect pest of the plum tree is undoubtedly the San José. It is to be found in most of the commercial plum districts. Here it needs no description, but unless kept well under control the damage will be similar to that on peaches and apples. The trees will become weakened and the fruit will be unsaleable.

Control: Spray thoroughly with lime-sulphur just before growth starts. If scale is quite plentiful use the spray as strong as the 1.032 specific gravity hydrometer test. The work must be done thoroughly.

Plum Curculio, *conotrachelus nenuphar*, is the most serious pest on the fruit. It is a rough looking grayish snout-beetle about one-fifth inch in length, the female of which lays eggs in the green plums. The eggs hatch and the larvæ develop in the fruit. The adult beetles also sometimes do damage by eating the leaves, though this is not serious. The larvæ in the plum destroys it and causes it to drop prematurely.

Control: All old brush piles, weeds, rail-fences, etc., that are the hiding places of the insects should first be cleaned up or burned. Jarring the trees, causing the insects to fall in nets held below, was once practised, but has now given way to spraying methods. The regular sprays as outlined under spraying will keep this pest under control. In case the regular sprays are not applied three pounds of lead arsenate in forty gallons of water applied as soon as the blossoms fall and again ten days later, will keep them under control. It is much better to use the summer strength lime sulphur than the water as it tends to control Brown-Rot as well.

Shot-Hole Borers of various species attack the trunks and main limbs of plums. Their work can be recognized by small gum exudations which, if removed, expose an opening in the bark about the size of a small shot. If a few trees are more attacked than others it is almost a sure sign that those trees are weak or unhealthy.

Control: Control measures are not very effective. Remove any brush piles or piles of wood that may be near and clean up all waste. This destroys the breeding grounds. Increase the health and vigor of the tree by heavy applications of barnyard manure. The insects cannot thrive where there is a good sap flow.

Aphids, attack the twigs and foliage of plums very seriously at times. They might be recognized in the spring as tiny green or black "bugs" on the buds just before they burst. In the summer and fall, if plentiful, they give the tree a dark, dirty appearance. They do damage by sucking sap from the leaves and twigs.

Control: When once they get established they are very difficult to control, as they live on the under side of the leaf which appears to curl around and protect them. Examine the buds just when they are beginning to burst and if present in quite large numbers spray at once with Kerosene emulsion or whale oil soap. At this time they have not the means of protection that is afforded them later.

Other insects attacking the plum are Tent Caterpillars, Tussock Moth, Spring and Fall Canker Worms, and Green Fruit Worm. These sometimes become serious, but not generally, and all should be controlled by the regular spray application. It is always best to spray while the larvæ is small and it can not be too strongly urged to apply the regular applications thoroughly rather than make any special applications later. There are, I believe, about thirty other species of insects listed as attacking the plum or becoming occasional parasites, but the most serious ones, with the treatment for each, is given above.

Spray Calendar for Plums.

First Spray: Before growth starts and as near the bursting of the buds as possible use home-boiled lime-sulphur or commercial lime-sulphur or home-made concentrated lime-sulphur, winter strength. It is well to use a hydrometer and test the mixture that is being used before applying. 1.032 or 1.030 specific gravity is an average strength, that is, dilute about one to ten. This controls the Scale insects, some Black-Knot and Black-Rot spores and cleans up the tree generally.

Second Spray: This is applied just after the fruit is set. The blossoms will be off but all the fruits will not yet be free from their calyces. Use commercial lime-sulphur about one to fifty or home-made concentrated lime-sulphur about 1.007 test (this would have to be tested in the concentrated form and diluted accordingly), or Bordeaux mixture. To whichever mixture is used add two and one-half pounds of arsenate of lead to each forty gallons of the mixture.

This further tends to control the disease spores and at the same time the curculio.

Third Spray: About two weeks after the second spray repeat the application and use the same material at the same strength as for the second spray. This will tend to check any insects or disease spores that may have escaped the former applications.

Fourth Spray: This spray is optional and is applied only if disease or insects appear about ten days or two weeks later.

(4) THE LEADING COMMON AND COMMERCIAL VARIETIES DESCRIBED.

The following list of varieties is by no means complete, but it is hoped that it will be of some assistance to intending planters. Only those varieties that are most common in Ontario are mentioned and in each case where the variety is of special merit, mention is made of it. They are roughly arranged alphabetically, and in most cases season of ripening is mentioned.

Abundance.—This is one of the over-planted Japanese varieties, and perhaps the best known of them all. As the name implies it bears regularly and heavily, but the fruit is soft, rots easily and is a poor shipper. The tree is medium to large and adapted to a large range of soils. Its medium to large fruit of a handsome red color makes it rather attractive to the average amateur, but its commercial qualities do not bear out its appearance. Season early and short, about the second and third week in August. Not recommended for commercial planting on a large scale.

Burbank.—This is another one of the over-planted Japanese varieties. as almost every person who grows plums has a tree or two. It bears annually and abundantly; but blossoms early and is consequently sometimes injured by frost. The tree makes rank wood growth and is characteristic in its branching habit of growth. The fruit ripens the latter part of August, and when of fair size brings a fair price. It should be thinned to get size. A few trees will add to the returns if they are properly cared for, but the variety is not recommended for extensive commercial planting.

Bradshaw.—This variety also goes by the name of Niagara, and is the earliest good commercial blue plum that we have, ripening about the third week in August. It is the heaviest planted plum in many sections and is a favorite, largely blue in color and of good quality. The tree is vigorous and upright, medium to heavy bearer, but sometimes comes into bearing late. The fruit is a favorite with the consuming public, and also with the canners, as it comes in at a season that is comparatively slack. One of the best plums for commercial planting, but must be marketed quickly as it does not stand long shipment as well as some other varieties.

Bixby is one of the midseason American varieties of medium quality, skin thick, flesh tender. It is a good variety to plant only in the colder sections where domesticas will not grow. It is adapted to local trade only.

Cheney is the leading native plum. It is the wild plum of Canada and the United States. The quality is fair and the tree productive, but it is recommended only for planting in the parts for home consumption and local trade. It is extremely hardy. Ripens first week in September.

Climax is a hybrid plum, but to the grower it is Japanese, as it shows distinctly characteristics of this species. It is quite largely planted in the leading plum section but has not proved a marked success. Its color and beauty make it an attractive plum to grow, but because of irregular bearing habits and comparatively tenderness of tree it is not to be recommended for large commercial planting. The demand for all such varieties is limited. Ripens the second and third weeks in August.

Damsons.—There are a large number of varieties of Damson plums, but the one that is of most interest to us is the Shropshire. Damsons have been grown ever since before Christ, but the variety mentioned above originated in England about 150 years ago. The trees are vigorous, adapted to a wide range of territory and very productive. The small blue fruit is a little tedious to pick, but it grows in such abundance and such clusters that the trees produce large quantities. It is much favored as a canning and preserving plum and as such is, at the present time in much demand on the Western markets. The flavor is tart but pleasant, and is well worthy of more consideration than it has received of late. Damsons are well known to the trade everywhere and are in demand. Season of ripening is late.

De Soto is one of the best if not the best American plum for commercial purposes ripening at midseason. The tree has more the habit of the domesticas, bears well and regularly and is extremely hardy. It might be planted for local trade in the colder districts. Fruit is medium size, red in color and as firm and good a quality as the other varieties of the species.

Emerald.—This variety is highly recommended by some leading growers. Fruit and commercial value is unknown to the writer.

German Prune.—This is in many respects the most popular plum on the market to-day. It is well known to the trade and in great demand. Its large size, blue color, free stone and good eating and cooking qualities as well as its good keeping qualities put it in the foremost rank. The trees are hardy, fairly regular bearers, but are slow coming into bearing. The fruit changes color before it is really ripe and because of this it is sometimes put on the market before it is ready. Season of ripening is late September and early October. The trade in this plum might easily be developed still further and it is worthy of favorable consideration by intending planters.

General Hand is a large dessert plum belonging to the Reine Claude Group. It ripens in September and is quite popular in the garden but not commercially.

Glass Seedling. This is a large blue plum of medium quality, fair dessert and a good cooker, ripening in September. The tree is hardy and very productive and as such is recommended for the section of Ontario just beyond the good commercial districts.

Golden Drop (*Coe's*) is of doubtful value commercially. The tree is only fairly productive; the fruit, not as disease-resistant as most domesticas, is sometimes badly affected by Brown Rot. It is more adapted to its English home and to the American Pacific coast than to Ontario. It might be recommended for the home garden; season is second and third weeks in September.

Grand Duke. This is in many respects one of our leading market plums. Its large size, blue color, firm flesh and handsome appearance generally, commend it

A good type of Monarch top-worked on Lombard.

to the consuming public. The tree is fairly vigorous and fairly productive and the fruit ripens the third and fourth weeks in September. It is highly recommended for commercial planting.

Gueii holds a doubtful place. It is considered by many to be one of the best varieties because of its early bearing and heavy bearing qualities. As such it is undoubtedly a money maker. The tree is vigorous and thrifty. The fruit is medium size and poor quality. The fruit is, however, firm, and it is a fair shipper. Many growers condemn it because it is somewhat subject to Brown Rot. It ripens the last week in August and the first week in September. Though it is a large favorite with many I would hesitate to recommend it for commercial planting except in limited quantities.

Hawkeye is another of the midseason American varieties of good quality either as dessert or cooked. It is quite popular but is recommended only for local planting and in home gardens. It is worthy of a place in the orchards of Eastern and Northern Ontario.

Italian Prune or Fellenberg has been largely planted in the last few years. It is the leading variety for prune making in the Western States, but in Ontario has not been tried out in large orchards. The fruit ripens in mid-September, is large, blue in color and an excellent cooker. When fully ripe it is first-class for dessert. The tree is medium hardy and medium thrifty and does not seem to be so well adapted to the varied soil conditions as some other domesticas. It does not always bear as heavily as might be expected. Given good soil conditions, and then well cared for, it should prove a leading variety in the commercial districts of Ontario, but I would not care to plant it as a "sure crop" until I had seen it more thoroughly tested. The fruit is in big demand on the leading markets.

Lombard. Some growers claim that Lombard has made them more money than any other variety. At the same time there are often years when large quantities are not picked. It is a heavy regular bearer and the fruit unless thinned is likely to run small. It is in demand for canning purposes and is well known to the trade. The money is made from large quantities quickly handled at low prices. It is largely planted all over Ontario and well known to all, but in the light of present prices and developments except where the grower is prepared to spray thoroughly and then when needed thin it, I would not recommend planting it. It rots badly during the ripening season if the weather is at all warm and damp. Spraying and thinning will remedy this and increase the size.

Monarch. This is one of the most popular market varieties at the present time. The fruit is large, blue, medium to good quality for both cooking and dessert; it ships well and will keep for some time in the basket without waste if picked before too ripe. The tree is hardy, vigorous and an early and abundant bearer. Though it has been introduced but a short time it is largely planted and well known to the trade. It ripens in late September. It is highly recommended for planting in the commercial orchard.

Moore's Arctic is recommended only because of its hardiness. The fruit is medium in size and quality and the tree dwarfish in its nature. The trees in the Experimental orchard at Macdonald College have produced but a few fruits and are not entirely hardy. For sections warmer than this and colder than the commercial plum districts it is recommended. It is a profitable local variety where the less hardy domesticas cannot be grown.

Pond Seedling. A large blue plum. that is planted to some extent commercially, but not very productive and somewhat subject to rot. A favorite with some but not recommended for extensive commercial planting; ripens the second and third weeks in September.

Quackenboss. This variety is a favorite with many growers because of its large size, handsome blue color and good shipping qualities. The tree is large, hardy and vigorous and usually bears well. It ripens about the last week in September and brings a fair price for home canning purposes. It has a place in the commercial orchard.

Quaker is an American variety of some merit and has a place in the home gardens and local markets of the colder sections.

Red June is one of the heavily planted Japanese varieties that is not gaining in popularity. It has, however, some points in its favor. It is an early and fairly abundant bearer, blossoms quiet late for a Triflora and the fruit ripens very early, the last of July or first of August. As such it should have some value when well grown. It must be cross pollinated to produce well. It is worth planting in small numbers.

Reine Claude has of late years been planted quite heavily because of the demand for canning purposes. It also sells well in the open market. Its yellow color when ripe, and high quality will always give it a place in the plum kingdom. It is considered by many the standard of quality in plums. The tree, however, is tender and not as thrifty as most domesticas, but it bears fair crops regularly. The nursery tree is small compared to other varieties and it is a little more difficult to grow. The price for the last ten years has averaged as high or higher than for any other variety. It is well worthy of a place in the commercial orchard. With this variety might also be classed the plums that go under the name of Green Gage. The fruit ripens from mid to late August.

Shipper's Pride. This variety is grown in small numbers in all the plum districts, but has never come into prominence, because it is only a medium bearer and is susceptible to rot. It is a large blue plum of fair quality, good for canning and a good shipper. It is being planted to some extent and is perhaps worthy of the attention it is receiving. It ripens about the first or second week in September.

Smith Orleans is planted quite largely but is losing ground. It is medium to large sized blue plum but ripens in late August at a time when plums are plentiful. Scarcely worthy of a place in the commercial orchard with such a large list to choose from.

Stoddard is one of the best American varieties, ripening in late September. It is worthy of a place in the garden because of its large size and flavor.

Shiro is a comparatively new variety that gives fair promise of becoming a favorite. It ripens early and is fairly large, of a yellow color with flesh so clear that it is semi-transparent. It bears heavily and early and is worthy of a trial in Ontario orchards.

Washington is a large plum of the Reine Claude type, of the highest quality but the tree is generally a poor bearer and the fruit bruises easily and rots readily in transit. When marketed in good condition it commands a high price. A few growers, however, consider it a profitable variety and the writer this past season (1913), saw as fine a crop on trees top-worked on Pond Seedling as could be desired. The trees had borne heavily for three successive years.

Wolf is another of the popular American varieties that has long held a place and is worthy of consideration in sections where the domesticas are not hardy. Does well at Macdonald College.

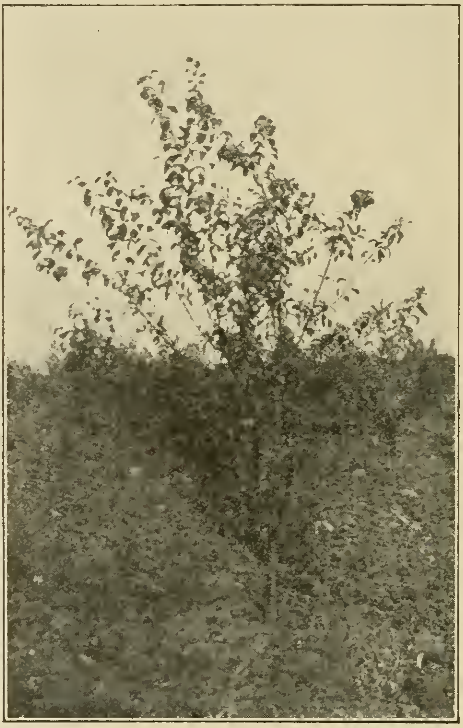
Wyant is also a good American variety and is worthy of a place along with the varieties before mentioned.

Willard, a very early ripening Japanese variety that is raised quite extensively but the fruit is of too poor a quality and the tree too light a bearer to win and hold a place.

Wickson is one of the largest plums grown and because of this and much advertising it was quite heavily planted. It has, however, not proven a success commercially and is deserving only of a place in the garden. The tree is tender and it blossoms too early to always escape frost. It is largely grown in California where conditions are more adapted to its requirements.

Yellow Egg. This variety is widely distributed and well-known, but is losing favor because of its susceptibility to rot. Its large size and yellow color make it attractive to the purchasing consumer, but its quality is only fair. It has not won a leading place in years of test in Ontario.

At present plum breeding or variety improvement is not receiving as much attention as some of the other fruits at the Experimental Farm, Vineland, but they are not being neglected and some attempts were made at hand pollination this year. Few plums set, but the results are far from being discouraging. A few seedlings are growing in the nursery plots.



A Shiro plum that gave 7 quarts of good fruit the third year.

The following varieties are under test:—Rockford, Improved Lombard, Arch Duke, Victoria, Gideon, Reine Claude, Moore's Arctic, Fellenberg, Smith's Orleans, Yellow Egg, Pearl, Field, Gueii, Cullin's Golden Gage, Tennant Prune, Early Prolific, King of the Damsons, Duane's Purple, Early Transparent, Blue Permain, German Prune, Moyer, Pond Seedling, Shipper's Pride, Coe's Golden Drop, Mary, Early Rivers, Mallard, Washington, Shropshire Damson, Beauty of Naples, Togo, General Hand, Monarch, Quackenboss, Lombard, Ancaster, Latchford, Warner's Late, Staunton, Monroe, Imperial Gage, Bleaker's Gage, Emerald, Lowry's Gage, Maynard, Formosa, Vesuvius, Santa Rosa, Gaviota, Red Egg, Huling's Superb, McLaughlin, Canada Orleans, Grand Duke, Satsuma, Kelsey, Shiro, Oriental, Bartlett, Diamond, French Damson, Purple Egg, Kingston, America, Prunus Simoni, Burbank, Willard, Chabot, Earliest of All, Waugh, Czar, Saunders, Columbia, Bradshaw, Glass Seedling, York State Prune, Lucy Gray, Peter's Yellow Gage, Klondyke, Large Golden Prolific, Riley Damson, Apple, Mathews, Sutton, Imperial Peach, October Purple, Climax, Clyman, Ickworth, Raynes, Thanksgiving, Sultan, Stella, World Beater, Poole Pride, Hawkeye, Daisy, Omaha, Belle de Louvain, Hunt Hybrid, Wolf, Darwin Peach, Goliath, Femmonzi, Wyedale, Belle, Gisborne, Splendor, Improved French Prune, Silver, Uncle Ben, Sergent, Cox's Emperor, Belgian, Curlew, Sugar Prune, Pacific Prune, Belle de Paris, Saratoga, Reine-Claude, Gabriel Combes. Also we have twelve trees of each of eight leading varieties planted in rows side by side. These are used for the thinning and spraying experiments.

For discussion of the industry we divided the Province into three divisions:—

(1) The colder parts where plums are at present grown only in home gardens —a large part of Eastern Ontario and Northern Ontario.

(2) The Western part of Eastern Ontario and a large share of Western Ontario where plums are grown locally to supply the trade.

(3) The commercial districts, including Lincoln, Wentworth, some favored spots on Lake Huron and Georgian Bay and along the shores of Lake Erie and Ontario in various places.

For district number one, the following varieties are recommended: American and Nigra varieties: Cheney, Wolf, Stoddard, Hawkeye, De Soto, Quaker. The domestica varieties are a doubtful proposition, but the following are worthy of trial: Mount Royal, Perdrigon, Glass and Early Red.

For district number two, the following are recommended: Glass, Lombard, Bradshaw, Mount Royal and Shipper's Pride. For district number three, the following are recommended: Reine Claude, Bradshaw, Damsons, Monarch, Grand Duke, German Prunes and Italian Prunes. To this list might be added: Shiro, Burbank, Quackenboss, Lombard, Coe's Golden Drop and Smith Orleans, and for deep, dry, warm peach soils, Washington.

It is suggested to the intending planter that he read the short description here given and pick from the list the varieties that seem best adapted to his particular conditions and markets. It is recommended also that the planter limit the number of his varieties to about from four to seven rather than plant a few trees of each of a large number of varieties.

The following is the writer's choice of seven varieties for an orchard of seven hundred trees: Shropshire Damson 125, Monarch 125, Grand Duke 125, German Prune 125, Reine Claude 100, Bradshaw 75, and Shiro 25.

If I desired to experiment I would add a few trees each of Fellenburg and Emerald, and if I had the proper soil some Washington.

Any of the varieties given in the descriptive list may be experimented with in the home garden.

(5) SOME GLEANINGS AND SUGGESTIONS.

(1) But little attempt has been made to improve our native varieties, and still less attempt has been made to introduce the best that we now have into the gardens and home plantings of the Northern parts of the province. A few trees would add to the interest of the garden, and would in no way interfere with the commercial side of the business.

(2) The tendency is to drop the once greatly lauded Japanese varieties and the poorest of the earlier domestica varieties for heavier planting of Reine Claude, Bradshaw, Monarch, Grand Duke, Italian Prunes, German Prunes and Damsons.

(3) Plums at present prices seem adapted to large scale production; that is in blocks of from about five acres up rather than in small lots of one or two hundred trees or less.

(4) The tendency is to plant larger blocks of one variety that can be harvested quickly and not interfere with the gathering of other fruits. The idea seems to be to gather quickly as cheaply as possible and get them out of the way to make room for something else.

(5) Plums thrive and produce just as well on the heavier and cheaper lands as on the valuable peach and cherry soils.

(6) Plums have few large yields at high prices to their credit but they give a moderate return regularly for the money expended.

(7) Orchards that have been given reasonable care have repaid the owners well for their labor—and a little besides. If plums are worthy of a place on the fruit farm they are worthy of attention.

(8) The time is ripe for planting selected varieties of plums. The demand will have increased very materially by the time they come into bearing.

(9) Plums are worthy of further study and of more attention at our fruit meetings. Interest in better varieties and better quality marketed in a more attractive manner can only be awakened in this way.

(10) This last suggestion I put in brackets because it is the work of organizations not the work of the producers.

[How many consumers know the best varieties of plums and what season they may expect to find them on the market?

How many dealers allow fruit to spoil on their hands, because of direct exposure to sunlight, rough handling, deep piling of baskets, no refrigeration? What percentage of the great difference between the wholesale and retailers prices is due waste caused by:—

(1) Carelessness on the part of the producer.

(2) Carelessness on the part of the transportation companies.

(3) Carelessness on the part of the retailer.

What percentage of waste is due to exposure to dust, dirt and winds when exposed on the fruit stands?

It is a very easy matter to put all blame for certain unsatisfactory conditions on the fruit-grower—he can stand it because he is accustomed to it, but in the humble opinion of the writer as vigorous an educational campaign is needed among the retailers and consumers as among the growers. They are a large part of the business and also require instruction.

Acknowledgments.

The writer desires to thank the many fruit growers in Ontario and especially in the Niagara Peninsula for their assistance and for the kindness and courtesy extended to him in his visits to their orchards and homes. He desires especially to thank Mr. J. E. Henry and Mr. L. B. Henry for their assistance and permission to use the figures on returns previously quoted.

Thanks are due many growers in New York State who willingly and cheerfully guided me through their orchards and explained their methods, and to the state inspectors who directed me to the leading men in their respective districts.

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