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Nos. 416 to 443

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Statistics and Publications Branch

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INSECTS TROUBLESOME IN THE HOME

BY

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Guelph, Ontario

May 1941—50M—A685.

INSECTS TROUBLESOME IN THE HOME

BY

LAWSON CAESAR

INTRODUCTION

The purpose of this bulletin is to enable housewives and others to identify the various insects which may infest homes, restaurants, hotels or other dwelling places; to describe briefly the habits and life history of each insect; and to outline the best methods of control known at present.

As bulletins are costly to publish and the supply is limited, the reader should keep his or her copy where it will not be lost but will be available whenever needed.

In dealing with insects it is important to bear in mind that some insects, as bedbugs, cockroaches and crickets, pass through three stages in the course of their life—egg, nymph or larva, and adult. In these insects the nymphs resemble the adults except in size and absence of wings. Other insects, as beetles, flies and moths, pass through four stages—egg, larva, pupa, and adult. The larvae of these insects do not resemble the adults but are quite different in appearance. For instance, the larva of a beetle is a grub; of a fly, a maggot; and of a moth, a caterpillar. The pupa is a resting stage in which great changes are taking place internally, preparatory to the insect's becoming an adult. Pupae, except of mosquitoes, do not move about and never feed.

INSECTICIDES

As some readers will not be familiar with certain of the insecticides recommended, a little information on these is given here.

Sodium fluoride. This is a fine, white powder and can be purchased in most drug stores. It is a good poison for several troublesome house insects but not for all. It acts both as a stomach and a contact poison. It is soluble in water and must not be used on plants because it burns foliage. As lime neutralizes its killing properties, it should never be mixed with lime or anything containing lime. It may, however, be mixed with flour, talc, sulphur or pyrethrum.

Caution. Sodium fluoride is poisonous to man and live stock, hence the need of care in using and of keeping it in a properly labelled container and marked **POISON.**

Pyrethrum. This is a brown powder made by grinding finely the dried flowers of certain species of plants of the genus Chrysanthemum. The powder contains poisons which are fatal to many, but by no means all, insects. It is not injurious to man nor to plants. It kills insects by contact and may be applied either as a dust or a spray. To make a spray use it at the rate of 1 ounce of standard strength pyrethrum powder to 1 gallon of water.

Most of the commercial mosquito or fly sprays in common use are composed chiefly of pyrethrum and a water-white kerosene. In making them, 10 to 16 ounces of pyrethrum are added to every gallon of kerosene and the mixture then allowed to stand, with occasional shaking, for twenty hours or longer. By the end of this time the kerosene will have extracted nearly all of the poisonous material out of the pyrethrum. The clear liquid is then siphoned off or the mixture filtered through a double ply of cheesecloth or a filter paper. It is then ready for use. Methyl salicylate is sometimes added at the rate of 3 fluid ounces to each gallon to remove the odour of kerosene. The spray is usually applied by means of an atomizer. Instead, however, of going to the trouble of buying the ingredients separately and making the spray themselves, most persons prefer to use one of the well-tested commercial sprays.

It should be kept in mind that pyrethrum deteriorates quickly if exposed to light and air, and therefore should be stored in an air-tight, dark container. Moreover, it should never be used with lime as this also deteriorates it.

Derris. This, like pyrethrum, is a brown powder and is made from the ground roots of certain tropical plants of the Deguelia, Lonchocarpus, and Cracca genera. These all contain a number of poisons of which rotenone is the most important. Good grades of derris, or of cubé, which is practically the same thing, are standardized to contain 4 to 5 per cent of rotenone.

Derris acts both as a stomach and a contact poison and is almost harmless to man and plants. It is a valuable insecticide for several house insects and also for certain domestic animal pests. There are, however, many insects against which it is not effective. It may be used either as a dust or as a spray. As the former it should be diluted with three or four times its own bulk of talc, flour or sulphur, but not of lime, for lime deteriorates it just as it does pyrethrum. As a spray 1 ounce should be used to 1 gallon of water.

Like pyrethrum, derris should always be stored in an air-tight, opaque container because light and air gradually deteriorate it.

There are several commercial dusts and also sprays which have derris as their main toxic ingredient. Most of these are reliable, though some may have to be used more heavily than recommended. Cubor dust is practically the same as derris dust. When either of these dusts is purchased already diluted, it should, for household insects, be guaranteed to contain 1 per cent of rotenone. Weaker than this it is not likely to be effective.

Thiocyanates. These are synthetic, organic insecticides of which two, known as Lethane and Loro, have come into considerable prominence in recent years, especially for use against bedbugs. They are clear, odourless liquids, kill all stages of the insects quickly, and do not stain garments or other fabrics. The directions are given on the containers. They come in two forms, one being used for insects on plants and the other for insects in homes or other places.

FUMIGATION

There are times when the most satisfactory method of dealing with a severe outbreak of some particular household insect is by fumigating with one of the deadly gases used for this purpose; as hydrocyanic acid gas, chloropicrin, methyl bromide, and ethylene oxide-carbon dioxide gas. Fumigation with any of these gases requires a mask, is dangerous, costly, and likely to be a failure unless done by an experienced person; hence the writer is of the opinion that the best policy is for the householder not to attempt it himself but to engage a reliable, licensed, commercial fumigator to do the work under guarantee of satisfaction. In the case of hydrocyanic acid gas, it is illegal in the Province of Ontario for any person to fumigate a building with it unless he has a license from the Provincial Department of Health.

Sulphur Fumigation. Sulphur, when burned, gives off a gas that, with care, may be used safely by almost any person and will kill all stages of most insects. Its use, however, should generally be limited to unfurnished or poorly furnished houses such as those of the poor, because the gas bleaches all bright-coloured fabrics and wallpaper, and tarnishes metals and silver or gilt on picture frames or elsewhere.

Directions for Fumigating with Sulphur

1. Never fumigate when the temperature of the house is below 60° F., because it is almost impossible to get satisfactory results below that figure.

2. Since a strong wind interferes with the uniform distribution of the gas in the house and since moisture increases the bleaching and tarnishing by the fumes, choose, if possible, a calm, dry day for the work.

3. The sulphur to be used may be either flowers of sulphur or ground sulphur. The strength required is 4 pounds to every 1,000 cubic feet of space; hence to find the number of pounds required for a house, find first the number of cubic feet of space in it, divide this by 1,000, and multiply by 4. The sulphur should be ordered up well ahead of the time it is to be used. It usually costs from 3 to 8 cents per pound.

4. Sulphur alone often fails to continue to burn until all is consumed, hence it is wise to have on hand a few pounds of coarsely powdered charcoal and to mix a handful of this with each dish of sulphur.

5. It is better to burn a dish or pan of sulphur in each room or one at each end of a large room than to burn all in one or two large vessels. An old washbasin or any wide-mouthed, shallow metal vessel—2 to 4 inches deep—is satisfactory. Procure as many of these as there are rooms to be fumigated.

6. Procure also the same number of larger metal vessels and place in the bottom of each about 3 inches of sand or ashes on which to set the sulphur container to avoid danger of fire from the sulphur boiling over or sputtering out upon the floor. Washtubs with 2 inches of water and two bricks or stones in the centre of each to hold the sulphur containers may be used as substitutes, if handier to secure.

7. Make the house or room to be fumigated as nearly air-tight as possible, otherwise so much of the gas will escape that the fumigation will be a failure. Hence cover tightly all fireplaces, chimney openings, ventilators and other large openings, also cracks or leaks in windows, doors and around their casings, and in the walls or other places. For this purpose crack filler, putty, tow, or fairly wide strips of paper carefully pasted on are convenient.

8. Remove, as far as possible, all bright-coloured fabrics, silver, gold or other bright metals, and anything that is gilded or silvered, as picture frames. Before replacing these, examine to see that there are no insects in them.

9. Open all drawers, cupboards, trunks, boxes and closets and spread out bed clothes and other bulky materials so that the gas may readily penetrate everywhere.

10. Divide up the sulphur into the containers to be used for this purpose, add a handful of the crushed charcoal to each, mix, and then mould the whole into the form of a cone, because the sulphur burns better in this form. Next place each sulphur vessel in the larger container or washtub, mentioned above, to guard against fire and distribute them among the rooms to be fumigated.

11. When all is ready, make a depression in the top of each sulphur cone, pour in a tablespoonful or two of denatured alcohol (methylated spirits) and drop a lighted match on it. If there is more than one story in the house, light those in the upper story first, then in the lower, so that the fumes will not interfere with the operator getting out of the house.

12. When all are burning, close the door and lock it, and allow the fumigation to continue for 24 hours. Then open up the house and ventilate.

One fumigation often is sufficient, but sometimes a second ten days later is necessary.

SUPERHEATING

If the temperature of a house or room is raised to 120° to 130° F. and kept at this heat for eight hours, it will kill all stages of the insects present. The most convenient time to do this superheating is on a hot, calm day in summer, for under these conditions it is easy by stoves, hot-air or hot-water furnace, or by steam to raise the temperature to the required figure and maintain it there.

Before beginning the heating, all very inflammable materials, such as gasoline or benzine, and anything that heat is likely to injure, should be removed. It is probably wise to remove also musical instruments for fear the heat may injure them.

In addition to the above precautions the house should be made as nearly air-tight as possible and all drawers, closets, trunks and boxes opened up, and clothing and other packed materials spread out as described under **Sulphur Fumigation**, page 5, so that the heat may penetrate quickly everywhere.

When this has been done, a thermometer should be suspended in each room on a side away from the source of the heat and about 2 feet above the floor. These thermometers should be inspected every hour to keep careful track of the temperature, and when this has reached 120° F. the furnace should be regulated to maintain this figure, or to keep the heat between 120° and 130° F. and not allow it to go at the most more than a few degrees above 130° F. lest damage result. At the end of eight hours of temperatures of 120° F. or higher, the house should be ventilated and allowed to cool off.

ANTS

More requests are received for information on the control of ants than of any other kind of household insect. There is scarcely a home that is not troubled by these active, inquisitive, persistent and pugnacious little creatures. Fortunately, in this Province all species except a tiny, reddish-yellow one, known as Pharaoh's ant, usually disappear during the winter season and are active only in warm weather.

Common Species of Ants Infesting Homes. There are about a dozen species of ants which can be found at times in houses in this Province. Of these the most common are two very tiny, reddish yellow species, known as Pharaoh's ant, *Monomorium pharaonis* L., and the tiny thief ant, *Solenopsis molesta* Say. These two look much alike and are only 1/15 to 1/10 of an inch in length. A third species is the black carpenter ant, *Camponotus herculeanus*

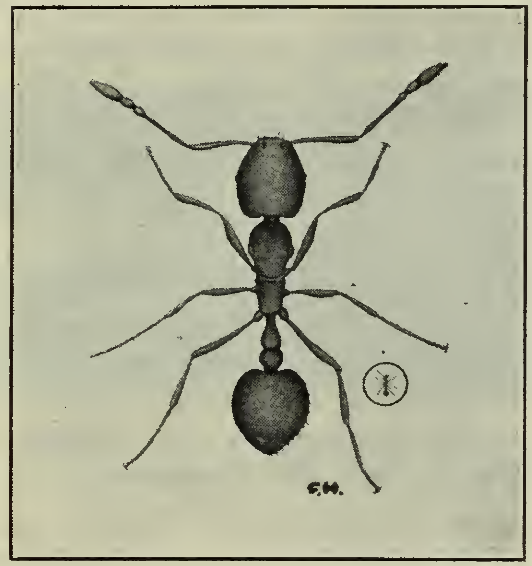


FIG. 1. Pharaoh's ant, enlarged and natural size. (After Gibson and Twinn, Publication 642, Can. Dept. Agr.)

pennsylvanicus DeGeer. This is the largest species commonly found in homes and is usually about 1/3 of an inch in length and black in colour. The name "carpenter ant" comes from its habit of carving out nests for itself in logs, posts, trees and house timbers. A fourth species is known as the cornfield or field ant, *Lasius niger americanus* Em. This is brown in colour and about 1/8 of an inch in length. It is very common in lawns and fields. There are also two or three small black species of ants that are at times quite troublesome in homes, especially in towns.

Food. Ants feed upon almost every kind of food eaten by man and also upon many other things. Most of them are very fond of sweet substances of almost any kind. A few, like the tiny thief ant, are particularly fond of fats. Ants also often attack other insects and feed upon them. In this last way they are beneficial.

Life History. Ants are probably the most intelligent and industrious of all insects. Like honey-bees they live in colonies. Each colony is composed of one or more queens, a number of males, numerous workers, and many eggs, larvae and pupae. The queens are much larger, as a rule, than the workers or the males. At first they have wings but lose them soon after mating. The queen's task is to lay eggs, which she does in large numbers over a long period. The males are usually larger than the workers but, apart from fertilizing the queens, play little part in the economy of the colony. The workers are by far the most numerous and are the ants we find moving about everywhere and causing trouble in our homes. Their chief duty is to find food for the other members of the colony, to tend the queens, to care for the eggs, larvae and pupae, and to defend the colony from attack. The eggs are very small and white. The larvae are white, legless and helpless. The pupae are also white, legless and helpless. As the queens are very prolific, a colony may become very large before the end of the season.

Control

1. By Destroying the Nests. Wherever practicable, the best method of control is to find the nest and destroy the queen or queens and all the occupants. The method used to find the nest is to observe the direction in which the ants are coming and going and then follow along the trail until the nest is reached. Sometimes, if small crumbs of bread or cake are placed where the ants are wont to feed and other food kept away, they will carry these off and thus guide the observer to the nest.

If the nests are in the ground or in mounds, holes 3 to 5 inches deep may be made with a stout cane at intervals of about 8 inches all over the infested area and 2 tablespoonfuls of carbon bisulphide poured into each. Then the holes should be closed by pressing with the foot. It is advisable, if the soil is covered with grass, to make the holes a little deeper than the roots of the grass to prevent injury to it from the fumigant.

The writer has also destroyed ants in mounds and in level areas about 14 inches in diameter in the grass by dusting pyrethrum powder all over the area, applying an extra quantity directly over the entrance and exit holes, and then covering the hill or grass area with a heavy burlap sack or a newspaper weighted with stones or bricks to keep it in place.

If the nests are beneath cement or bricks or stones, pour 3 or 4 tablespoonfuls of carbon bisulphide down through each crack or opening and then, if possible, close these entrances.

If the nests are in posts, trees or other wooden structures, enlarge the openings if necessary with a brace and bit or a chisel and, with a machinist's oil-can or funnel, pour in carbon bisulphide and close the entrance with putty or any plastic material or tow.

Sometimes boiling water alone will destroy the nests or kerosene may be used, but neither is safe on living tissues of any kind.

Caution. The gas from carbon bisulphide mixed with air is very inflammable and so it should never be used in a house except in small quantities and when there is no fire near. Carbon tetrachloride may be substituted for it, but about three times the amount is necessary. Its gas is not inflammable and has a rather pleasant odour versus the foul odour of carbon bisulphide.

In using any kind of gas, best results are obtainable on a warm, calm day.

2. The Use of Poison Baits. Wherever it is difficult to find the nest or to reach it with a fumigant or other material, ants can almost always be killed readily by a poison bait. The bait which the writer uses most and which in the great majority of cases gives good control is a mixture of tartar emetic and honey in the proportions of 1/5 of a level teaspoonful of the former to 1 tablespoonful of honey. Before setting out this or any other bait, sweep the floor well and leave as little food as possible for the ants to eat. A few drops or not more than ¼ teaspoonful of the bait is then put on each of a number of small pieces of glass or chinaware and these placed out of the way on pantry shelves, in corners of the kitchen, or any place where the ants are abundant. A neater way and one that keeps the bait fresher is to put a little in a cardboard or tin pill-box with three holes cut near the bottom to allow the ants to enter and depart. The cardboard boxes should first be paraffined on the inside by dipping them into melted paraffin. A large nail may be used to make the holes in the tin boxes.

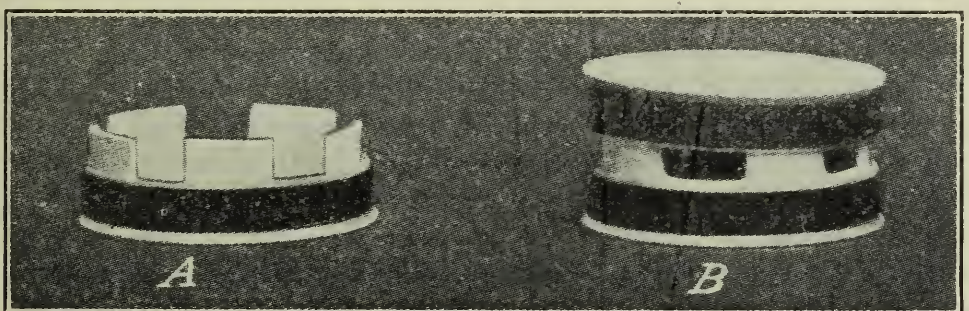


FIG. 2. Pill boxes for ant baits: (A) with lid off, (B) with lid in place after putting in the bait. (After Back, Leaflet 147, U.S.D.A.)

Sometimes the ants may refuse to eat the bait. In that case try mixing the tartar emetic with maple syrup, jam, marmalade, or any other substance that these insects seem to like; and at the same time change the baits to new locations, because the ants otherwise are almost sure to shun the old locations.

The little thief ant is fonder of greasy substances or fats than of sweets, hence for it mix the tartar emetic with peanut butter instead of honey, or work it into bacon rind or a slice of cooked, fat lamb.

A thallium bait made from thallium sulphate, granulated sugar and water has given us even better results than tartar emetic and honey, but thallium is such a dangerous poison that the writer thinks it wise not to give the directions for making the bait in a bulletin. The Department of Entomology at the Ontario Agricultural College, Guelph, will, however, give them to anyone who writes for them and can guarantee that all the necessary precautions will be taken in making and using the bait. Thallium baits costing about 25 cents per pill-box may be purchased in drug stores and probably other stores. These should be effective and the risk of danger is less than when made at home.

Both of the above baits have the merit that they do not kill the workers quickly but permit them to carry the poison home and feed it to the queens and larvae and thus destroy the whole colony.

3. Other Insecticides for Ants. Two other insecticides are helpful against ants; namely, pyrethrum powder and sodium fluoride. The writer knows an apiculturist who has kept his bee-house free from ants for several years by merely dusting pyrethrum powder heavily on the floor all around the base of the walls and just inside the doors and windows. The ants on coming to this are either repelled or killed. Other persons have likewise found pyrethrum helpful, but it is not as reliable on the whole as a poison bait and, unlike the poison bait, only destroys the ants that come into close contact with it without affecting those in the nest itself. Pyrethrum loses its strength quickly if exposed to sunlight.

Sodium fluoride is used in much the same way as pyrethrum, but does not lose its strength from exposure to light. It is a strong repellent for some ants, notably the black carpenter ants, but against some others has little value. It is poisonous to man and due care should therefore be taken to keep it in a container properly labelled and marked **POISON.**

4. General Control of Ants in Lawns. We have already stated that ant nests, whether in large mounds or in a concentrated area in the grass, may be destroyed by carbon bisulphide or pyrethrum powder, but ants are often to be found all over the lawn, sometimes in large numbers. Usually they are much worse in light sand where the grass is poor. This suggests that if such lawns were given a good dressing of fine manure in late winter or early spring, followed about the middle of April by an application of sulphate of ammonia at the rate of about 4 pounds to every 500 square feet of surface, the grass would be greatly improved and the ant infestation probably lessened. Frequent waterings of the lawn in dry weather should also help.

The most common control for ants in lawns is a mixture of Paris green and brown sugar in the proportions of 1 ounce of the former to 1 pound of the latter. Mix very thoroughly and, on a dry day, scatter thinly over the lawn. The above amount is sufficient for one treatment of a lawn about 100 feet long by 40 or 50 feet wide. A little of the mixture is also often placed under boards or stones. As rain seems to destroy its effectiveness, repeat as soon as the grass has become dry again.

Ants will, of course, come in from neighbouring lawns, hence the co-operation of neighbours will help.

BEDBUGS

There is no household insect so much dreaded by good housekeepers as the bedbug, *Cimex lectularius* L. To them it is a terrible shock to find even a single specimen in the house.

Description. Bedbugs are very flat-bodied, reddish-brown, wingless insects with piercing and sucking mouth parts. When full-grown they are approximately ¼ inch in length and at the widest part about half as broad as long. The young or nymphs resemble closely the adults except for being smaller. The flatness of body enables these insects to enter cracks or narrow openings to hide, rest, or lay eggs.

Life History. The adults lay their white, oval eggs singly or in batches in the various places where they hide. The eggs hatch in six to ten days in warm weather but more slowly in cool weather. The young, like the adults, feed on blood, and under favourable conditions are full-grown in nine to ten weeks, but under unfavourable conditions require much longer. As a rule there are probably three to four generations a year; hence the rate of increase is high.

Food, Habits, and Injury. The food of bedbugs is blood, chiefly human blood. In the absence of man they can live on the blood of mice, rats or almost any other warm-blooded animal to which they can get access. Strange to say,

Fig. 3. Bedbugs, natural size. (Photo by T. Armstrong.)

they can live for several months or nearly a year without any food. This helps to explain the presence of living bedbugs in houses that have been vacant for half a year or longer.

In infested buildings the bugs lie concealed by day in almost any good hiding place, as the joints of bedsteads, especially wooden bedsteads, under the tufts or seams of mattresses or inside the mattress itself if there are any openings, in dresser drawers, among clothing or bedding, in crevices almost anywhere in the room, behind pictures or torn wallpaper, in cracks in the walls, ceilings or floors, and beneath and behind wainscotting, baseboards and mouldings. At night they come forth, if hungry, and attack man. The favourite places of attack are the forehead, arms and legs, but almost any part may be attacked.

The bite itself is not so painful as that of a mosquito, but painful enough, if there are several bugs, to interfere with sleep. The mere suspicion of the presence of bedbugs is sufficient to keep some persons awake for hours. Bites are often followed by itching and inflammation. A person who has been severely bitten will often show numerous red, inflamed, hive-like spots on arms, legs, forehead and sometimes other parts of the body. Some persons, however, are almost or quite immune to bedbugs; in fact about one out of every five seems to be so.

Another unpleasant result from bedbugs is the presence of a foul, characteristic odour. This heavy, offensive odour in a room should be a warning to the traveller to seek another lodging place.

One would expect from their habits that bedbugs would carry venereal or other human diseases, but this does not seem to be so in Canada.

Sources and Methods of Spread. Bedbugs are found most commonly where there is disregard of cleanliness and tidiness, such as low-class hotels, cheap boarding houses and homes in congested areas. Nevertheless any hotel, home or other dwelling may at times become infested. This is because of the ease with which the insects may be brought into a building in grips, trunks or other luggage by a visitor or a member of the family who happens to have spent some time where the bugs were present. Other common means of spread are through the luggage of servants from poor homes, through parcels from the laundry, and through the purchase of second-hand furniture. They also migrate at times from one house to another where the houses are semi-detached or near each other.

Control

1. Where the Infestation is Heavy or of Long Standing. Under these conditions the best method is fumigation. If cost does not stand in the way, the wisest policy is to engage a licensed commercial fumigator to do the work under guarantee of satisfaction. If cost is an important factor, do your own fumigating, using sulphur as described on page 5. Read carefully and follow closely the directions given there. Or you may use superheating (page 6).

2. Where the Infestation is Light or Recent, or Confined to One or Two Rooms. In such cases control may be obtained, without fumigation, in the following ways, though they involve a good deal of care, labour and patient perseverance. Each day when making the beds watch for bugs and, if any are found, kill them by hand or with a swatter. Examine two or three days in succession the seams and tufts or buttons of the mattresses and kill any bugs found concealed under them. Then dust the surface of the mattresses heavily with a mixture of equal parts of derris dust (containing 1 per cent rotenone) and fresh pyrethrum, and leave it there until the bugs have all disappeared from the building. The dust can then be removed easily by a vacuum cleaner.

Dust the above mixture also over the bottom of all dresser drawers, trunks and boxes, behind loose wallpaper, beneath the backs of pictures, and both behind and beneath the baseboards and mouldings on the wall. Leave it in all these places until all bugs have gone.

In addition to the above, once a week for three or four weeks, until all the eggs will have hatched, use kerosene alone, or a homemade or commercial pyrethrum-kerosene fly spray, or a thiocyanate spray (see page 4) and, with a feather or machinist's oil-can or hand sprayer, wet thoroughly all the joints in the bedsteads and any other good hiding place for the insects in these or the bed springs. It is also well to supplement the dusting behind and beneath the baseboards with a heavy spraying. To get the dust or spray behind these pry out the top of the baseboard with a screwdriver.

Bedbugs may hide in the cracks of the floor, so these should either be filled with a crack filler to keep them out, or a machinist's oil-can used and any of the above sprays run into them to kill those present. Do this once a week until all the bugs are gone.

In the homes of the poor the wallpaper is often torn or loose, thus giving a good hiding place for bedbugs and their eggs. Such paper, if possible, should be removed, any cracks in the walls plastered, and the walls either repapered or painted. If this cannot be done, paste the loose paper in place as well as possible.

If there is a carpet in the room reaching to the walls, dust the derris (1 per cent rotenone) and fresh pyrethrum mixture beneath the outer 4 to 6 inches all around the margin to kill any of the insects that may hide there.

BOOK LICE or PSOCIDS

Book lice, often called psocids, are very small insects, so small that their presence is usually overlooked except when they are very abundant and almost swarming over everything in the room. They are yellowish white or grayish white in colour, soft-bodied, wingless, and have chewing mouth parts. The young resemble closely the adults in appearance and habits. The name "book lice" was apparently given to them because they are very often found in or among books, magazines and other papers, sometimes in great numbers. In such case the books, etc., have usually been left for a long time undisturbed in a dark, poorly ventilated room.

Importance. Book lice are not of importance because of any damage they do to books and other things in the home or other buildings, but only because of the large numbers in which they occur at times. This causes great

Fig. 4. Book louse or psocid, enlarged and natural size. (After Gibson and Twinn, Publication 642, Can. Dept. Agr.)

annoyance and humiliation to tidy housewives who do not know how to destroy them, and may lead tenants to vacate the premises and landlords to be unable to find new tenants. In storage buildings they sometimes occur in such swarms on the goods that purchasers refuse to accept them. The writer knows of a case where a flax mill became so heavily infested that the owner could not sell the tow.

Food and Conditions Favouring the Insects. Very little is known about the food of book lice. They seem to feed at least to some extent upon starch, glue and a number of other substances, including the eggs of some insects, but an eminent entomologist thinks it probable that their main source of food is a microscopic fungus which grows on almost everything in damp, warm rooms or buildings. The evidence in favour of this appears to be strong, because observation shows that they are abundant only in such buildings and that dry, well-ventilated and well-lighted buildings are exempt.

Control

Temporary control may be obtained by the use of fumigants or by spraying with a pyrethrum-kerosene mixture, kerosene alone, a thiocyanate spray, or some other insecticide. But none of these is satisfactory, because the building soon becomes reinfested from outside sources. The only really satisfactory and the most logical control is to remove the main condition which favours the insect; namely, dampness. Much can be done to accomplish this by putting in more windows, taking greater care to give good ventilation, and by seeing to it that there is good drainage for the cellar and foundations. It will be well before making these alterations to consult a good contractor or an architect.

CLOTHES MOTHS

There are two species of clothes moths in Ontario: the webbing clothes moth, *Tineola biselliella* Hum., and the case-making clothes moth, *Tinea pellionella* L. The former is by far the more common, the latter being rather

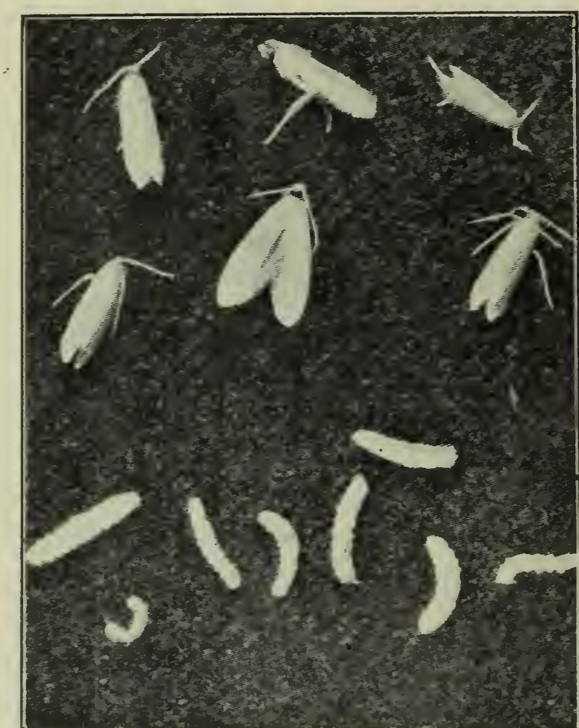


Fig. 5. Clothes moths, adults and larvae, about twice natural size. (After Back, Leaflet 145, U.S.D.A.)

rare. These two species resemble each other so closely in their adult and larval stages, and in the nature of the damage they do, that we shall discuss them as if they were one.

Description. The adults are small, yellowish or buff-coloured moths with a wing expanse of about ½ inch. They are the little moths often seen flying around in homes at night, especially in May and June. The moths themselves do no harm except that they lay the eggs from which the larvae come. The larvae do all the damage. They are small, slender, white worms with brown heads, and when full-grown are about ½ inch long.

Food. The larvae feed upon all kinds of woollens, furs and feathers; hence they attack woollen garments, blankets, carpets, rugs, upholstered furniture, fur coats, capes, museum specimens of fur-bearing animals and birds, unless the skins are poisoned, and insect collections. In addition they feed upon a number of animal products such as fish meal, dried milk and casein. It will be noted that all the above foods are of animal origin. Things of vegetable origin, as linens, cottons and rayon goods, are immune.

Injury. When we consider the fact that there is scarcely a home in this Province that is free from moths, and think of the enormous number of furs and woollen garments, blankets, carpets, rugs and upholstered goods attacked and in many cases ruined by the moths, we may safely say that the total loss in this Province alone runs up into hundreds of thousands of dollars annually.

Life History and Habits. The insects normally winter in either the larval or pupal stage wherever they happen to have been feeding. On account of the low temperature they rarely do any feeding or damage during the cold months; nevertheless if the building is kept at temperatures above 70° F., feeding and breeding may continue even in the coldest months. In April, as soon as the weather has warmed up, the larvae renew active feeding, and when full-grown pupate in little cylindrical cases made of particles from the materials fed upon. In May the moths from these pupae and from those that wintered over begin emerging and continue to do so all through June. A few belated moths will also be found in July and August, but only a few. Soon after emerging the moths begin laying their pearly-white, little eggs on the various food materials mentioned above. The small, round, hard pellets about the size of the head of a pin, often seen where larvae have been feeding and mistaken for eggs, are not eggs but merely the excrement of the larvae. The eggs are much smaller and are pearly-white in colour. They usually hatch in four to eight days. The larvae require a long time to mature, many of them not doing so until fall and some not until the next season or later. In the ordinary home there is only one regular generation a year, but, as mentioned above, in very warm houses feeding may continue all winter and so, if moisture conditions are right, may lead to two broods. The larvae shun bright light and therefore do most damage to goods stored in dark places. They also do more damage to things that are left undisturbed for a long time than to those that are moved from time to time. Garments that are in constant use are not injured; therefore homes that are shut up in summer and the blinds drawn suffer more injury than homes that are occupied all summer. Larvae seem also to prefer worn and soiled garments to fresh and unsoiled.

Control

1. Fumigation. For anyone who can afford it, fumigation with one of the more deadly gases, as hydrocyanic acid, chloropicrin or methyl bromide, is the quickest and most effective way, but in the case of any of these a licensed, commercial fumigator should be engaged to do the work. (See under **Fumigation,** page 4.) Superheating may also be used. (For directions see under **Superheating,** page 6.) Sulphur fumes, though effective, would cause too much bleaching and tarnishing in the average home to justify their use.

2. Good Housecleaning. This, next to fumigation, is the most important method of control but should be supplemented by other measures described below. Housecleaning to destroy the moths should be done in April and, if the house is heavily infested, repeated in July. The great thing accomplished by the April cleaning is the destruction of the vast majority of the larvae and pupae before they can mature, change into moths, and lay eggs for a new brood. To be most effective it should be done on a bright, sunny day. All woollens, furs and feathers should be taken outside and spread over the grass or hung on the clothes line where the sun's rays will beat on them. The light and heat drive the larvae out of their hiding places, kill some of them, and cause the rest to seek dark quarters.

When bringing out the various materials it is very necessary not to overlook anything in which the insects may be feeding or hiding, such as patch bags, goloshes, spats, mittens, caps, discarded socks, woollens, or furs and bags of feathers. If any of these are not going to be used, they should be given away or burned at once. Cottons, linens and rayon materials, being exempt from attack, need not be taken outside.

After an hour or so in the open, all the materials should be taken up, shaken well, turned upside down, and left for another hour or until convenient to bring them into the house. Before bringing them in they must again be shaken well or brushed or both to knock off all stages of the insects.

In the meantime each room should be swept carefully or better, gone over with a vacuum cleaner and then kerosene or a pyrethrum-kerosene mixture (see page 3) sprayed heavily or poured from a machinist's oil-can with a long spout into all cracks in the floor and beneath and behind the baseboards in all the rooms and closets. The object of this is to kill the insects which often are present in large numbers in such places and feed upon the accumulated lint and dust. To get the spray behind the baseboards it may be necessary to pry them away from the wall at the top with a screwdriver.

In addition to the above the lint and dust which accumulates in the cold-air passages to the furnace should be removed and burned, because these afford another good breeding ground both for clothes moths and carpet beetles.

3. Summer Protection for Valuable Woollens, etc. Although good housecleaning does a great deal to control moths, yet there are always some that escape destruction and are likely to damage valuable materials. Hence the need of protection against these during the danger months. There are several ways of giving this protection:

The materials may be sent to a cold storage where their safety will be guaranteed for a fee.

Moth bags may be purchased and the materials put into them, but before this is done it is necessary to make sure that the latter are free from all stages of the insects by taking them outside, sunning, shaking and brushing them. The best time to put them into the bags is just as early in spring as they are no longer needed for use. The bags must be securely fastened and have no openings. If 3 ounces of paradichlorobenzine in a muslin or cheesecloth bag is hung at the top of each moth bag along with the woollens or other things, this will help to insure safety.

Instead of using a moth bag, one may place the fur or woollen material between two large sheets of wrapping paper or between the pages of a newspaper, and then with a sewing machine stitch these all around about 2 inches from the margin, then fold the margin over on itself and restitch.

Red cedar chests may be used and if made largely of heartwood are quite valuable. They do not kill the adults, eggs, half-grown or larger larvae, or pupae, but do kill the small larvae. Therefore if the goods are free from the insects when put in, the chest will keep them free.

Another method which affords protection on a larger scale is to put the furs, woollens and feathers into an air-tight trunk or box with a close-fitting top. When this is half full, put on them about ½ pound of paradichlorobenzine spread between two clean sheets of paper. Then fill the trunk and put another ½ pound of the same material on the surface between two more sheets of paper. The top should then be firmly fastened in place. If the trunk or box is not airtight on the sides and bottom, it can easily be made so by lining with good wrapping paper lapped and glued at the seams. One pound of paradichlorobenzine is sufficient for a trunk (3 ft. x 2 ft. x 1½ ft.).

If a still larger amount of woollens or other goods is to be protected during the summer months, especially when the occupants are all away, a clothes closet may be used. Clean the closet first. Fill all cracks in the walls and floor with plaster, crack filler, or other plastic substance. Then after sunning, shaking and brushing the woollens and other materials, pile them in the closet and scatter about ½ pound of paradichlorobenzine all around between the walls and the woollens or other goods and suspend in a muslin or cheesecloth bag from a hook or nail near the ceiling paradichlorobenzine at the rate of 3 pounds to every 100 cubic feet of space. The fumes of this material are 5.1 times heavier than air and so sink down into the goods beneath. They are not poisonous to man but are poisonous to insects. When the above has been done, fasten the door and seal it with strips of sticky paper all along the top, sides and bottom. Do this carefully, for, if there are leaks, the gas will escape and leave the woollens and other materials unprotected.

4. The Vacuum Cleaner a Great Help. A good vacuum cleaner is a great help against clothes moths. It should be run once a week over all carpets, rugs, upholstered furniture, especially that covered with mohair, and also over floors with cracks between the boards. It aids by sucking up the eggs and many of the young larvae before they can become established and do any appreciable damage. It also removes the lint out of the cracks and thereby lessens the breeding places. It is one of the main factors in keeping moths under control in hotels. If, however, one cannot afford a vacuum cleaner, much good can be done by using a broom and brush.

5. Shaking and Brushing Suits and Clothing. In spite of the spring cleaning mentioned above, all valuable suits and other garments not being used are very likely to become reinfested in warm weather unless stored in one of the ways described above. They should therefore be taken out into the sun and brushed and shaken well from time to time to prevent injury.

6. Special Treatment for Carpets. Carpets are difficult to keep free from moths and carpet beetles. The fact that they usually extend right up to the walls gives these insects a great opportunity to establish themselves and do much damage along the margins where it is very difficult to reach them with a brush or vacuum cleaner. It is therefore advisable for every person who can do so to substitute rugs for carpets. Rugs are also more hygienic. If, however, this cannot be done, it is important to lift the carpet at least in spring, take it outside and sun, brush and beat it well. Before bringing it in, give the floor and cracks the treatment recommended above under Good Housecleaning. When putting the carpet in place again, it is advisable to saturate the margin for 4 or 5 inches back with a solution of 1½ ounces of sodium fluoride or sodium fluosilicate dissolved in 1 gallon of hot water. This may be done by holding the nozzle of the sprayer about 4 inches away from the material and spraying very heavily until it is all wet. When the water evaporates the poison remains in the treated area and kills any larvae trying to feed upon it.

Caution. The above substances are poisonous to humans, so keep them in a safe place properly labelled and marked **POISON.** Bury any liquid not used.

Another method of freeing a badly infested carpet from moths is to spread uniformly over it paradichlorobenzine at the rate of 1½ pounds to 150 square feet, then roll it up tightly and leave it in a room for four days at a temperature of 70° F. or higher.

7. Special Treatment for Upholstered Goods. Moths in all stages may be killed by exposing them to zero or sub-zero weather for 48 hours. Hence upholstered furniture or other materials can be freed from moths in such weather by simply leaving them outside on a veranda or other exposure for two successive nights and days or, better, leaving them out for 24 hours, then bringing them in for 24 hours and again putting them out for 24 hours.

When this cannot be done, another method of treatment is to turn the couch or chair on its face, open the lining in three or four places, dust in a liberal supply of paradichlorobenzine, and close the openings. Then set the piece upright and cover it completely until white with the crystals, using nearly ½ pound for a large chair and 1½ pounds for a couch. When this has been done, place the piece in the centre of a quilt or blanket and cover it with another blanket or other heavy material, allowing the bottom of the cover to fall well onto the floor. Then roll together the surplus of the floor blanket and the covering blanket, thus sealing the goods within and preventing the fumes from escaping rapidly. Leave for four days at a temperature of 70° F.

8. Treating the Piano for Moths. Moths sometimes feed upon the felts of a piano and do much damage. They can be destroyed by suspending a muslin bag containing 3 to 6 ounces of paradichlorobenzine inside above the felts and leaving the piano closed for four days at a temperature of at least 70° F.

9. Mothproofing Materials. These are now coming on the market and are likely to play an important part, especially in protecting upholstered goods. The proper place, however, to apply them is in the factory during the course of manufacture. We have not had sufficient experience yet to know what kinds are reliable or to make definite recommendations for home use.

CARPET BEETLES

In this Province there are three common carpet beetles: the black carpet beetle, *Attagenus piceus* Oliv., the buffalo carpet beetle, *Anthrenus scrophulariae* L., and the varied carpet beetle, *Anthrenus verbasci* L.

Description of Adults and Larvae. The black carpet beetle is the largest. The adult is black, oval, and from 1/8 to 1/5 of an inch in length. The larva when full-grown is nearly ½ inch long, tapers from head to tail, is densely covered with short golden-brown to dark-brown hair, and has a tail of brown hairs one-half or more as long as the body. This long tail of hairs easily distinguishes it from the other two species.

The buffalo carpet beetle adult is scarcely half the size of the black carpet beetle, looks like a small ladybird beetle except for its colour, and is 1/10 to 1/8 of an inch in length. The colour is a mixture of black, white and red. The red or reddish colour is located chiefly down the middle of the back. Its larva differs greatly in appearance from that of the black carpet beetle and is, when full-grown, about ⅕ inch long, rather stout, and covered with tufts of dark-brown hairs which give it a bushy or hedgehog appearance.

The varied carpet beetle adult looks much like the buffalo carpet beetle, but is a little smaller and paler in colour with yellow instead of red markings.

Fig. 6. Black carpet beetle, enlarged and natural size. (After Gibson and Twinn, Publication 642, Can. Dept. Agr.)

Fig. 8. Buffalo carpet beetle, enlarged and natural size. (After Gibson and Twinn, Publication 642, Can. Dept. Agr.)

Fig. 7. Black carpet beetle larva, about natural size. (Adapted from Gibson and Twinn, Publication 642, Can. Dept. Agr.)

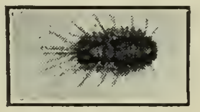


Fig. 9. Buffalo carpet beetle larva, slightly enlarged. (Adapted from Gibson and Twinn, Publication 642, Can. Dept. Agr.)

The larva also resembles that of the buffalo carpet beetle but is a little smaller, not quite so hairy, and lighter brown in colour.

Food. Carpet beetles do not, as the name would imply, feed solely on carpets and rugs but attack also other woollens and, in addition, furs, feathers, hair and materials containing any of these. They therefore feed on practically the same things as the clothes moths. The black carpet beetle larva is also an important pest of flour, meal, middlings, seeds, fish meal and powdered milk.

It should be remembered that the adults of these three beetles do no harm except by laying eggs. It is the larvae that do the harm.

Life History and Habits. The winter is usually passed by all three in the larval stage. In the average home the larvae in the winter are either dormant or nearly so, and consequently do very little damage. If, however, the house is very warm, feeding may continue all winter and all stages of the insect be found. In the spring the over-wintered larvae become full-grown, pupate, and change into adults in May when spiraeas and hawthorns are in bloom. At this time it is often easy to find scores of adult buffalo and varied carpet beetles feeding upon the bloom of the above and other plants, but black carpet beetles are seldom found on plants. It is believed, however, that it is not essential for any species to feed upon bloom or anything else before laying eggs. The eggs usually hatch in favourable weather in about a week. The larvae require several months to a year or even two years to mature. Pupation of all three species takes place in the last larval skin where the pupae escape notice. In two or three weeks they change into adults and emerge. There is usually only one generation in a year, although under favourable food and weather conditions there may be a partial second brood.

The larvae, unlike clothes moth larvae, are quite active and if disturbed run to shelter. They shun the light and therefore work in dark places, though they move around freely from place to place. Favourite locations for them are beneath the margins of carpet along the walls of the room, underneath base-boards, in cracks in floors, in cold-air passages to the furnace, and any place where lint and dust accumulate. They are not, however, solely limited to such places but may attack food materials wherever they find them.

The injury done consists chiefly in eating out areas in woollens, furs or other materials containing these, and in feathers. In some homes they may cause more destruction than clothes moths, but on the average appear to cause less. They are, nevertheless, very important pests.

Control

Fortunately the same measures control these insects as described already for the control of clothes moths (see pages 15 to 18). Hence in fighting the latter one has the satisfaction of knowing that he is taking the best measures to control carpet beetles also.

COCKROACHES

Cockroaches are large, brown or sometimes nearly black insects which hide by day and run around very actively at night. Their size, filthy habits, foul odour and often large numbers make them very objectionable pests in homes or other buildings.

Species and Description. In Ontario there are five species, but of these only four are important, namely the German cockroach, *Blatella germanica* L., the Oriental cockroach, *Blatta orientalis* L., the wood cockroach, *Parcoblatta pennsylvanica* DeGeer, and the American cockroach, *Periplaneta americana* L.

Of these species the German cockroach is much the most common and important, more than 90 per cent of all inquiries being about it. It is the smallest of all our cockroaches, being only ½ inch or a little more in length and about 1/5 of an inch in width, and is light brown in colour with two conspicuous blackish stripes on the thorax. Both sexes have long wings which cover the entire abdomen.

FIG. 10. German cockroach: (at top) two adults, (in middle) two egg capsules and a female with egg capsule attached to her body, (below) from right to left, nymphs in different stages of development. (Photo by G. G. Dustan.)

The Oriental cockroach, though next in importance, is very much less common than the German cockroach. Nevertheless, at times it causes a good deal of annoyance, especially in a damp environment. It may be identified easily by its size—1 inch in length and about 1/3 of an inch in breadth—its dark, almost black colour, and by the females being practically wingless, while the males have wings which cover only about three-quarters of the abdomen.

The wood cockroach is of importance only in buildings situated in or alongside woods; hence it is sometimes annoying in summer cottages. It is brown in colour and about 1 inch in length. The wings of the males are long, extending beyond the tip of the abdomen; those of the females are shorter, covering only about three-quarters of the abdomen.

The American cockroach is the largest of all our species, being about 2 inches long and ½ inch or more in width. It is brown in colour. This species is troublesome occasionally in a few of our cities.

Favourite Haunts. Cockroaches are pests chiefly of cities and towns and only rarely of rural districts. In the former they are most common and numerous in kitchens of hotels, restaurants and other institutions, and least common and numerous in private homes. In addition they are often a nuisance in bakeries, laundries, grocery stores, engine rooms and various other places where there is a liberal supply of grease, moisture and heat, or of moisture and heat alone.

Food. They feed upon almost all kinds of human food and also upon greasy substances and decaying vegetable and animal matter; for instance they often occur in hundreds of thousands in garbage dumps.

Methods of Distribution. They may spread readily from one locality to another by flight at night, or may crawl from one house to another, or may be brought from wherever they happen to be in luggage or parcels of various kinds, for instance in parcels from the laundry or in grocery parcels.

Injury. The injury is not that they eat any appreciable amount of our food, but rather that, being accustomed to feeding on filthy as well as clean materials, they pollute any of our food to which they gain access. Moreover the sight of them running over the walls, tables and floor at night is exceedingly worrying and humiliating to tidy housekeepers. The foul odour is also objectionable. When very abundant they often drop unnoticed into food.

Life History. This varies somewhat with the species and is roughly as follows: Breeding takes place wherever the insect happens to be living. The eggs, unlike those of other common insects, are laid in large brown capsules or sacs, each containing from about 12 to 40 eggs. The female may carry this capsule around with her attached to the anal end of her body until the eggs hatch, or she may soon deposit it on the ground or floor and leave it there to hatch. Each female may produce several capsules a year. The young, soon after hatching, become nearly the colour of the adults and resemble them in shape, but of course are smaller and never have wings. Their feeding habits are the same as those of the adults. Breeding may go on all through the year in heated buildings, but in unheated buildings all stages die from the cold with the exception that the wood cockroach, which breeds chiefly in wood outside, is hardy enough to withstand very low temperatures. The German cockroach may have two or even three generations a year, but the other species are nearly all limited to one generation.

Control

It is usually easy to control cockroaches in private homes, but much more difficult to do so in large buildings. The trouble in the latter is that there are so many hiding places for the insects that some of these are almost sure to be overlooked. However, if a thoughtful person is assigned to the work, almost any building can, at a low cost, be either totally or almost totally freed.

Another factor that sometimes has to be considered is migration from nearby buildings. In such cases an extra treatment about once a month may be necessary.

The best remedy is sodium fluoride—a fine white powder which can be purchased from almost any druggist and costs from 25 to 50 cents a pound. Often half a pound is sufficient for an ordinary house. This powder is commonly used alone, but the writer has several times mixed it with equal parts of flour or cornstarch and obtained excellent results.

Sodium fluoride kills cockroaches not only when it is dusted on them, but also whenever they walk over it or get it into their mouth when feeding or when cleaning their legs and antennae. Moreover, it possesses the very desirable property of remaining effective long after it has been applied.

The method most commonly used in applying sodium fluoride is first to sweep the floor well and then, by means of a small powder gun with a flattened or small spout, blow the powder liberally into every crack or opening in which the cockroaches hide. If a larger gun or one with a coarser outlet were used, a good deal of dust would be spread in the air and the operator might be made ill by inhaling it. After all hiding places, such as the openings behind sinks, wainscotting, baseboards, cupboards and bookcases and large cracks have been well dusted, the next step is to use a perforated can with a firmly attached lid and with this make a dust band about 3 inches wide on the floor all along the walls of the infested rooms. Shake some dust also over the top of bookcases, cupboards, and any other places where you have observed that the cockroaches hide. Be sure also not to forget to dust along the water pipes, as this is a favourite haunt. If the dusting is well done almost every cockroach will come in contact with the powder within a few days and die. The dust should be left on the floor for several days, then swept up and a second application made, but it will not be necessary this time to treat the hiding places that cannot be reached with a broom, because the dust already in them is sufficient. Two treatments are often all that are necessary for a private home, but in large buildings more are almost always needed, though often it will be only the places that have been overlooked which will require the extra treatment.

A number of householders have reported excellent results from first treating the hiding places with the blow gun as described above and then using baits surrounded by a band of the powder 1 inch or more in width. To reach the bait the cockroaches have to walk over the poison. The baits may be composed of small amounts of human food, such as a little section of a banana, a piece of cake, and a little rolled oats. These should be placed in out-of-the-way places where the cockroaches most commonly are seen. Two to four baits should be sufficient for a room 15 feet square. If there are children or dogs or cats present, it will be wise to place the materials under a large dish, or piece of linoleum, or even a board raised up on one side just high enough to allow the cockroaches to enter freely. The baits themselves should be renewed about every third or fourth day and fresh materials substituted until all the cockroaches have disappeared.

Caution. Sodium fluoride is poisonous to humans and most other animals. Care should therefore be taken to see that it is not mistaken for flour or any other white powder and that it is kept always in a container properly labelled and marked **SODIUM FLUORIDE—POISON.**

A second but much less satisfactory control is the use of a liquid spray such as one of the pyrethrum-kerosene fly sprays or a thiocyanate spray.

These kill only by hitting the insects; there is no residual action such as in the case of sodium fluoride. Therefore the spraying will have to be repeated several times and even then often fails to exterminate the pest.

Of these two methods we strongly prefer the first as the cheaper and more satisfactory.

CRICKETS

Two crickets—the common black field cricket, *Gryllus assimilis* Fab., and the house cricket, *Gryllus domesticus* L.—are found at times in houses. These two are nearly the same size and look very much alike except that the first is black in colour while the second is brown. As both may be controlled in the same way and as the first is seldom important as a house pest, we shall confine our attention to the house cricket which sometimes is a very great pest.

Description. The adults, as said, are brown, usually a light brown, about an inch in length, have long, powerful hind legs adapted for leaping and, in the case of the females, a long spear-shaped ovipositor. The mouth parts

Fig. 11. House cricket, natural size. (Photo by A. Wilkes.)

are of the chewing type. The underwings are large, thus enabling the insect to fly long distances. The nymphs or young are very similar to the adults except in size and have similar feeding habits.

Food. House crickets feed upon almost all kinds of table foods; as cereals, meats, vegetables and fruit, whether these be cooked, fresh or in a decaying condition. They also attack clothing and other fabrics. Their favourite feeding and breeding places are active garbage dumps where there is an abundance of food remnants and other decaying organic matter. The fermentation which goes on in such places attracts rather than repels them.

Habits and Methods of Spread. During the day the crickets remain in hiding in the dump at or near where they have been feeding; in late evening and at night they come out to feed, mate and wander about. In their wanderings on foot they often, sometimes in swarms, travel several hundred yards, and many of them find their way into houses nearby. They also spread by flight widely over a town or city. Having reached a house they have an almost uncanny power of finding their way inside through windows, doors and unsuspected cracks or openings. Most of them, however, enter through cellar windows or other cellar openings. Once in a house they usually remain there even over winter unless killed or starved to death.

Injury. In houses they sometimes become very abundant; for instance, the writer once saw more than a thousand in a living-room. In such cases they are a great pest, especially at night, for they run all over the place, get into the pantry and feed upon the food there, attack clothing and other fabrics of various kinds, and eat holes out of them, work their way into the beds, crawl over the sleeper's face, and make such a loud noise by chirping and singing that sleep is almost impossible.

Fortunately, outbreaks like this are scarce and come only when there is a garbage dump or other very favourable breeding place nearby, and when the season has been warm and moist so that they have favourable conditions for thriving and reproducing rapidly. In the average year there is usually little trouble from them, and in any case heavy infestations are nearly always limited to buildings not more than one-quarter of a mile distant from an active dump.

Life History. The females lay their eggs wherever they happen to be feeding. The eggs hatch into tiny nymphs which, if they get nourishing food, grow rapidly to maturity. There are several broods which overlap, for egg-laying in garbage dumps seems to be going on all summer, and young in all stages as well as adults can be found at the same time. Breeding continues up into October in the warm areas of the garbage dump, and apparently there is usually sufficient heat present there to enable a number, both of the adults and nymphs, to winter over safely. In houses it is common for some to come through the winter alive, especially in cellars.

Control

The main step in control for a city or town is to prevent the breeding of crickets in garbage dumps, because it is from these that the houses become infested. Prevention may be obtained as follows:

1. Purchase an incinerator and run all the garbage through this. A number of cities use this method and, though the initial cost is high, have made it pay.

2. If the incinerator cannot be purchased, make a practice of separating each day all the coarse, combustible materials, as paper or wooden boxes, shavings, brush, newspapers and oily substances, and burning them. Also practise putting all of one week's garbage in one definite place and the next week's in another place some distance away. As soon as the first week's garbage is all dumped, level the rough spots and cover the surface 6 inches deep with earth, lime, cinders, soot or other similar material. This covering, if well done, will soon kill all the crickets beneath or prevent their breeding. The next week cover the second week's garbage. Keep this rotation going all summer after the crickets are once seen to be at all numerous.

Another good method which the writer saw work well was where there were two separate dumps several hundred yards apart. One was used until the crickets became numerous, then the other was used and the first levelled off, the coarse materials burned, and the whole dump covered well. The result was that at the end of about two weeks only a few crickets here and there could be found.

3. A poison bait may be used to hasten control. The formula is: Bran 25 pounds, sodium fluoride 1 pound, molasses 2 quarts, and water 2½ gallons. Dissolve the sodium fluoride in the water by stirring; add the molasses; stir again; and then pour the poisoned water over the bran and stir until all the bran is thoroughly moistened. Do the mixing on a concrete floor with a shovel or hoe, not with the hands. Apply the bait late in the evening by carrying in a pail and scattering by hand heavily over every infested part of the dump and also for several yards on each side of it; because at night the crickets, as said, wander around. It is a good plan, too, in the worst places to lift loose refuse such as hay or weeds or brush and throw the bait beneath it. Repeat the application in about four days. The bait kills large numbers of the crickets, old and young.

4. To destroy crickets in the house, sweep carefully and leave no food where they can reach it. Then place a sheet of newspaper in one or two corners of the room. In the centre of this put 1 tablespoonful of rolled oats and around it run a ring about 1 inch wide and 1/8 of an inch deep of a mixture of equal parts fresh pyrethrum powder and sodium fluoride. The crickets are fond of rolled oats and to reach it will walk through the powder and thus be killed. Death does not take place, however, sometimes for a day or more. Leave the bait undisturbed for several days or until all the crickets are dead.

It is a good plan to cover the bait and ring with a large pan or a board raised up enough at the one end to allow the crickets to enter easily. This will help to keep children, dogs or cats from finding it. Moreover, the crickets are fond of running under a protection like this.

Caution. Sodium fluoride is a poison. Take the necessary precautions to burn the material when no longer needed and to store any left in a bottle properly labelled and marked **POISON.**

EUROPEAN EARWIG

The European earwig, *Forficula auriculariae* L., is a new insect to Ontario, discovered for the first time in the summer of 1938 in a small village in the County of Grey. The insect evidently had been present for several years, for the infestation in the village was heavy. There is little doubt that the earwig is now here to stay and that it gradually will spread through the Province.

Description. The European earwig is reddish-brown to almost black in colour, is 2/3 to ¾ inch in length; has wing covers which meet in a straight line down the back and are so short that they do not cover quite half the abdomen. At the end of the body is a conspicuous pair of pincers. These and the short wing-covers distinguish it from other insects of the same size and colour. The mouth parts are adapted for chewing.

Life History and Habits. In late fall all the earwigs seem to desert the houses to winter outside in the soil or under other good shelter. In the spring the females lay their eggs in nests made in the ground and also beneath the shelter of stones. The eggs hatched in Grey County in 1939 a little before June 1st. The young, though white at first, soon turn dark and resemble the adults closely in form. For a time they feed on vegetable matter but later upon animal. About July 1st they are full-grown and change to adults. These feed both upon vegetable and animal matter, often eating the bodies of their dead comrades. Feeding in all cases is done at night. During the day both adults and young remain hidden under any good nearby shelter on the ground, or among the foliage of plants, or in the crotches of trees. They are especially fond of hiding under woodpiles, among stones and under old bags, papers, boards and dense rubbish.

Houses, as a rule, are not entered in spring but only after the young have matured and become adults, which, as said above, is around the first week in July.

Fig. 12. European earwig: (a) nymphs, (b) male adult, (c) female adult—all natural size. (Photo by G. G. Dustan.)

Nature of the Damage. Very few complaints were received of damage to any kind of plant, though a little could be seen on cabbage and a few other plants. The one great grievance was the annoyance, worry and humiliation caused by the presence, often in scores, of the insects in the house where at night they ran around over everything, including even the food on the table and the beds. In the morning, when the members of the family went to dress, they had to shake everything—shoes, stockings and underwear—to make sure there were no earwigs in them. Throughout the day they could scarcely move a paper, rug, dish-towel or book without one or more earwigs running out from beneath and hurrying to shelter. Some of the women became so worried that they said they would have left the village had the control measures mentioned below not reduced the insects to a very small percentage of what they had been.

Control

In infested areas in Oregon and in British Columbia a favourite control measure is the use of a poison bran bait. A test of this was made in the aforesaid village, the population of which was about 400, and gave remarkably good results. The formula used was: Wheat bran 12 pounds, sodium fluoride 12 ounces, molasses 2 quarts (wine measure), and water enough to moisten the bran—a little more than 1 gallon. In making this the sodium fluoride is first dissolved by stirring in the water; the molasses then added and stirred a little; then the poisoned liquid poured gradually over the bran and stirred until all the bran is moist and will fall through the fingers like sawdust. If too sticky to do this, add a little more bran.

The bait should be applied twice: first, just before the insects begin to enter the house, which is usually about July 1st; and second, about three days or a week later.

For success in treating a village or town it is necessary that all the householders co-operate so that the whole village and also the surrounding open areas for a hundred yards or more on all sides may be treated. Some capable leader should always be appointed to take charge and see that the work is done systematically and well. The Department of Entomology, Ontario Agricultural College, Guelph, if requested, will gladly send one of its staff to advise and help. The bait should be applied always shortly before dark so that it will remain fresh and attractive all night.

The method of application is to carry a supply of the mixture in pails or other vessels and scatter it broadcast over all the lawns, gardens, roadsides and other places. The application should be heaviest around the foundations of houses and other buildings, the borders of flower or vegetable beds, the base of trunks of trees, and wherever there is rubbish. It is wise, also, to lift boards, papers and dense rubbish and throw some bait beneath these. If any earwigs have entered the house before the second application, place a little of the bait in one or two corners of each infested room beneath a piece of board or linoleum or other cover.

FLEAS

Fleas are tiny, brown or black, wingless, hard-skinned insects. The body is very narrow when viewed from above, but much broader when viewed from the side. The hind legs are long, powerful and well adapted for leaping, and there are many stout spines on the body all pointing backward. The narrow body, backward-pointing spines and long hind legs enable the insects to move readily through the hair of the animals on which they are most commonly found. The mouth parts are of the piercing and sucking type.

Food and Injury. All our common fleas feed in the adult stage upon the blood of warm-blooded animals, as dogs, cats, foxes, man, hogs, chickens, rats and mice. In the case of man the feeding is done chiefly on the ankles and the lower part of the legs. The bite of a flea is as painful as that of a mosquito and the itching and inflammation which follow are often worse. Where a house is heavily infested, the life of the occupants is not enviable.

Fleas and Bubonic Plague. Although Canada is free from bubonic plague, it is interesting to know that in countries such as India, where this dread disease occurs, its chief carrier is the rat flea. This flea feeds upon rats infested with the disease and then upon humans and in doing so infects the latter.

Method of Distribution. Although unable to fly, fleas can move about from place to place readily by leaping and crawling. The main way, however, by which they are distributed is by being carried on dogs and cats. This is the way, too, in which they nearly always get into homes.

Species. In Ontario four species are more or less common: the dog flea, *Ctenocephalus canis* Curtis; the cat flea, *Ctenocephalus felis* Bouche; the human flea, *Pulex irritans* L.; and the hen flea, *Ceratophyllus gallinae* Schrank. None of these is restricted, as their names would suggest, to a single host, but all will attack man and several other hosts.

Life History. All our fleas have a similar life history. The eggs are dropped singly either on the hair of the dog or cat or on the ground, chiefly where these rest. Those laid on the hair drop or are shaken off to the ground or floor. The eggs are white and hatch in from two days to two weeks, depending upon the temperature and moisture. The larvae are tiny, worm-like creatures with a brown head and whitish, legless bodies. When full-grown

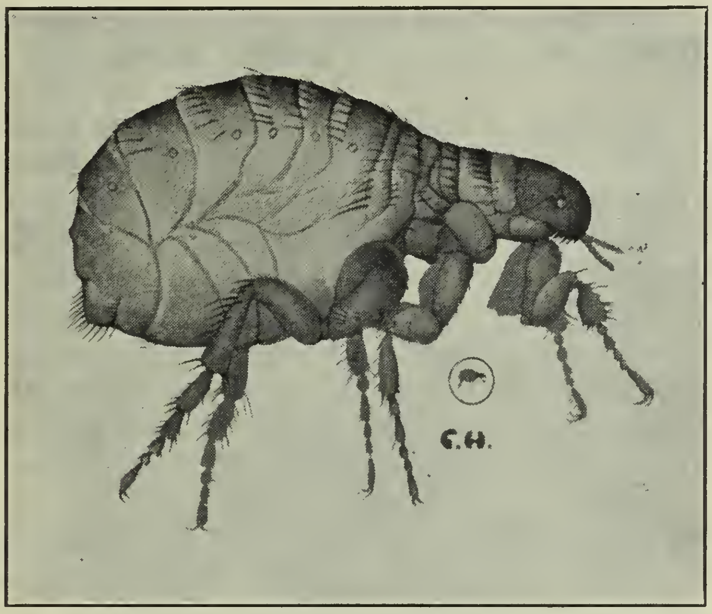


FIG. 13. Dog flea, enlarged and natural size. (After Gibson and Twinn, Publication 642, Can. Dept. Agr.)

they are scarcely ¼ inch in length. The mouth parts, unlike those of the adults, are adapted for chewing. Their food does not consist of blood but of tiny particles of organic matter, of which they find a sufficient supply in the soil in dog kennels or other favourite resting places of dogs or cats, and in the lint and dust that accumulates in cracks and beneath baseboards in houses or other infested buildings. The larvae, under favourable conditions, may become full-grown in a week, or under unfavourable conditions not until three months or more. Pupation takes place in little silken cocoons wherever the larvae feed. The pupal stage, like the larval, may require as short a time as a week or as long as three months or more. It is, of course, followed by the adult stage. There are usually several generations a year, and from a few adults in spring there may come great numbers of fleas by late autumn.

Control

To control fleas in the home we have to deal first with the carriers; namely, the dog and cat; then with the infested rooms in the house itself, and after these with the various breeding places outside the house.

The best way to deal with the dog and cat is to dust these with a derris or cubor dust containing 1 per cent of rotenone. Such dusts may be purchased in most drug stores. Another dust often used is a mixture of equal parts of either of the above and pyrethrum powder. In applying the dust shove the hair back with one hand and with a salt shaker shake a little of the dust into the opened area. The dust to be effective must not be merely on the surface but must be worked down to or near the skin, and should be applied here and there in about a dozen places over the body, including the head. Repeat every fourth or fifth day until fleas can no longer be found.

Instead of using the dust on dogs and cats, some persons use a flea soap containing derris. Others use other kinds of insecticides. The writer, however, favours the derris or derris-pyrethrum dust method advocated above, as this is easy to apply, does not harm the skin of the animal, and is not poisonous to humans. It is the common substance used to kill fleas on foxes.

As soon as the dog and cat have received their first treatment the house should be treated. The cheapest and quickest way to do this is to scatter naphthalene flakes uniformly over the floor and right up to the walls at the rate of 5 pounds to every 300 square feet of space. Then close all the doors and windows and leave them closed for 24 hours at a temperature of not less than 66° F. or better 70° F. or higher. The naphthalene volatilizes faster at the higher temperatures. All the infested rooms may be done at the same time, or the flakes from one room may be swept up at the end of 24 hours and used again in another room, adding, of course, more to them if there are not sufficient to keep the proportion of 5 pounds to 300 square feet of floor.

Instead of naphthalene flakes, the derris or derris-pyrethrum dust used to treat the dog or cat may be scattered over the floor at the rate of about 3 pounds to 300 square feet and left for at least four days, but is much more expensive and slower in action.

The next step in control is to treat the outside breeding places. These are chiefly the dog kennel and the places where the dog or cat rest, especially in the heat of the day. Make sure where these places are and spray them heavily, until the ground is wet to a depth of ½ inch or more, with kerosene or fuel oil or with a homemade lubricating oil emulsion containing 5 or 6 per cent of cheap lubricating oil. Waste crankcase oil may be used in making the emulsion if not considered too dirty. A barrel sprayer or any orchard sprayer, if in good working condition, should be used in making and applying the emulsion. For directions for making lubricating oil emulsion, write to the Department of Entomology, Ontario Agricultural College, Guelph, Ont.

If the pig-pen or hen-house is infested, clean out all manure and other rubbish, haul it several hundred yards away, and then spray heavily the whole of the infested area with the 5 per cent lubricating oil emulsion and repeat in a week.

'It has been reported that sulphur dust applied at the rate of 100 pounds to 75 square feet of surface will destroy fleas on the ground, but the writer has not tested this method or had any means of verifying the claim.

HOUSE FLY

The house fly, *Musca domestica* L., is a very important insect because of its annoying habit of getting into our homes; alighting on our hands, hair and faces time after time; crawling over cakes, sugar and other foods; sipping the milk and cream; polluting everything it touches; and leaving dirty, brown specks on lamp shades, paint and other resting places. But more important than all these is the well-known fact that it is a great agent in the spread of several dangerous diseases; for example, typhoid fever.

How to Distinguish It from Other Flies. There are several other flies which get into the house, some of which closely resemble the house fly. From these it may be distinguished readily by the following characteristics:

1. It has soft, fleshy mouth parts adapted solely for rasping and sucking, and not for piercing. Any fly that bites is not a house fly, no matter how much it looks like one.

Fig. 14. House fly, much enlarged. (After Guyton, Gen. Bul. 432, Penn. Dept. Agr.)

2. There are four parallel, usually distinct, black stripes down the back of the thorax.

3. The lowest full-length wing vein bends upward near the apex at a distinct angle, not in a curve, until it nearly meets at the margin of the wing the vein above it.

Several species of flies have one or two of the above three characteristics, but the house fly is the only one in the house that has all three.

Life History and Rate of Reproduction. Like most insects the house fly passes through four stages in its life cycle—adult, egg, larva, and pupa. The female adult lays little white, elongate eggs in large batches in fresh manure of almost any kind, but preferably in horse or pig manure. She also lays in garbage and other fermenting organic matter. Eggs are not laid in dry or old manure.

The eggs in warm weather hatch within twenty-four hours. The young larvae feed upon the juices of the manure or other materials and become full-grown in five or six days. When full-grown they are white, a little more than 1/3 of an inch long, blunt at one end and tapering towards the other. There are no legs and no distinct head, but a black hook at the small end of the body takes the place of mouth parts and is used to tear apart the manure or other materials and free the juices. The larvae cannot feed on solids, but only on liquids. When the larvae are full-grown they change into pupae. These are reddish brown and, roughly speaking, about the shape of a very large grain of wheat. After four or five days the pupae transform into adults and in a few days begin laying eggs for a new generation.

Fig. 15. House fly eggs in horse manure, natural size. (After Gibson and Twinn, Publication 642, Can. Dept. Agr.)

The total time required for a full life cycle is only about two weeks; hence there may be at least six generations in a season. Since a single female can lay 300 eggs or more, the total offspring from one male and one female by the middle of October may amount to several millions. In spite of the enormous numbers in the fall, only a very few flies are present in May to begin the new season. All the adults, except a rare one, which happens to find a warm building with sufficient moist, waste substances in which to keep reproduction going, perish soon after cold weather sets in. Apart from such exceptions the winter seems to be passed only as larvae or pupae in or beneath manure or other accumulated breeding materials.

House Flies and Disease. The chief diseases carried by house flies are typhoid fever, certain types of dysentery, infantile diarrhoea, and apparently to some extent tuberculosis. How the flies transmit these diseases can be understood readily when we consider the following facts: (1) that the flies frequent, either for feeding or for breeding, manure of almost all kinds, decaying vegetable and animal materials, sputum in spittoons, waste from sickrooms, and other filthy substance; (2) that as a result they get their fleshy mouth parts, hairy bodies and sticky pads on their feet contaminated with the disease germs which the above things often contain; (3) that thus contaminated they come into our homes, crawl over our food, chinaware, drinking vessels and milk containers, leaving germs wherever they go, even the little brown specks of excrement they leave behind them often containing germs which passed through their bodies without being killed; and (4) that in consequence we often, without knowing the danger, eat the food and drink the milk thus polluted and so take the germs into our bodies.

Fig. 16. House fly larvae in manure, full-grown, natural size. (Photo by G. G. Dustan.)

Control

House flies are difficult to control satisfactorily because of the large number of breeding places, the amazing power of reproduction, the ability to fly long distances, and the strong sense of smell which enables them to find their way to human food as well as to filthy breeding places. Control consists in the following measures:

1. Destroy Breeding Places. This is the most important fundamental step. In cities it is not nearly so difficult as in the days when there were many horses instead of automobiles and when there was no sanitary practice of disposing of garbage.

Wherever there is a horse or a cow, the manure should be carefully cleaned up once, or better twice, a day, placed in a box with a flyproof cover, hauled out from time to time, and scattered thinly over a garden or field. By scattering it thinly it will dry out and thereby be unsuitable for food or breeding purposes.

Garbage should always be well wrapped in paper and put into tightly covered cans, and no waste organic matter of any kind allowed to accumulate on any property.

The city or town garbage dump should have all paper and combustible matter in it burned each day and the soft or fermentable matter quickly covered with earth, ashes, lime or similar material to protect it from flies; otherwise millions of flies will breed in it. This fact is too often overlooked by health departments. A city incinerator would, of course, solve this problem.

On farms it is much more difficult to prevent breeding, but here too cleanliness in regard to garbage and decaying vegetable matter will help. Outdoor toilets should, where possible, be replaced by indoor toilets and septic tanks, or by chemical toilets. Where neither can be substituted the outdoor toilet should be made as nearly flyproof as possible by keeping it dark and the pit covered. In addition chloride of lime should be dusted liberally over the contents promptly after using and the latter emptied and buried several times during the summer months.

Horse manure and also pig manure are difficult to deal with without going to a good deal of expense. They should, however, after the middle of May be gathered up cleanly, hauled out and scattered thinly over the field as often as possible.

In the State of Illinois a method* of handling manure piles throughout the summer months has been devised which could be adopted on a number of Ontario farms. The manure is hauled out daily and piled in ricks to a height of 8 or 9 feet. The sides of each rick must be kept perpendicular and tidy, and close along the bottom of each side a ditch dug to catch any liquid which runs off the rick. The surface of the rick should be kept level and covered by full-length strips of heavy tarpaper about 3 feet wide, lapped 3 or 4 inches on each other, and kept in place by bricks on top. The paper should always be replaced after each day's manure is added, and left on for five days after the rick has reached its final height. Then it may be removed, as all the larvae beneath will by that time be dead and flies no longer be attracted to lay eggs. The paper has the effect of raising the temperature beneath it to a degree that kills all larvae in the manure. The furrow alongside results in the death of any larvae which work their way out of the sides of the rick. Ricks should not be very long or very wide, otherwise the handling of the tarpaper will be too difficult.

2. Keep Flies Out of the Home and Also the Home Dairy. Houses and other buildings where food or milk is kept should have all windows well screened, preferably by full-length screens which will enable the owner to open the windows both at the top and bottom for ventilation. Likewise all doors leading outside should have close-fitting, self-closing screen doors and care taken to see that there are no holes in the screens. Darkening rooms helps to keep out flies; so it is a good plan on the farm dairy and on the kitchen to have a closed porch in front of the entrance. Awnings over windows also help.

*Jour. Econ. Ent., Vol. 32, No. 6, pp. 851-854, 1939.

3. Use Swatters, Tanglefoot and Poisons. If flies, in spite of the above, find entrance, they should be killed by swatters, tanglefoot and fly poisons. A cheap fly poison can be made by adding 1 dessertspoonful of formalin to an ordinary glass of water. A teaspoonful of sugar may be stirred into this to sweeten it but is not absolutely necessary. Place a piece of blotting paper about 4 inches square on a saucer or small plate. Then invert the paper and saucer or plate on top of the glass and, holding all together firmly to prevent spilling, turn them upside down. The water will not run out but will gradually moisten the blotting paper and keep it moist. If the blinds are then closed on all the windows in the room except one, preferably the south one, and the saucer and glass placed on the sill, the flies will come to it for moisture and quickly be killed. The mixture should be made up fresh every three days to keep it attractive.

Spraying the room or rooms with a well-tested commercial fly spray or a homemade pyrethrum and water-white kerosene spray (see page 3) will stupefy all the flies and cause them to fall to the floor. They should then be swept up after a few minutes and burned, otherwise some of them will recover.

4. Be Careful Where There Is Sickness. If there is sickness in the home, great care should be taken to keep all flies out of the sickroom and to dispose of all slops from the patient in such a way that there will be no danger of flies getting access to them.

BLOW FLIES

There are several species of flies called blow flies. These are usually either blue or green in colour and are often spoken of as bluebottle and greenbottle flies respectively. They are all larger than the house fly, some of the bluebottles being ½ inch in length and quite stout. All of them seem to make a characteristic loud buzzing noise when flying, which helps to reveal their presence.

The injury done comes from their habit of entering homes and laying numerous white eggs on meat, fish and, to a lesser extent, on cheese. From these hatch little white maggots which work their way into the meat or whatever the eggs were laid upon, and in a few days utterly ruin it for food. It only requires four or five days for the maggots to become full-grown and ½ inch or more in length. A full-grown maggot is white, blunt at one end and tapered to a point at the other.

Out-of-doors the flies lay their eggs on meat, dead animals of almost any kind, including fish and snakes, on many kinds of excrement, and sometimes on garbage.

Control

The control measures outlined for house flies (see pages 33 to 35) will also largely control blow flies. The main steps are to bury all dead animals as soon as seen and before any eggs can be laid on them; bury or burn all offal and all meat and fish remnants; take the necessary precaution in connection with outdoor toilets to keep them fly-free; screen well all doors and windows; keep meat and other materials subject to attack in refrigerators or covered with flyproof screens; and swat or destroy in other ways all flies that enter the home.

LARDER BEETLE

The larder beetle, *Dermestes lardarius* L., is a stout, dark-brown or almost black beetle about 1/3 of an inch long, with a broad, pale-yellow band across the middle of the body. This band makes identification easy. The larvae are stout, brown grubs about ½ inch long when full-grown and covered with long brown hairs. At the tail end of the body on the last segment are two smooth, stiff, brown spines pointing obliquely outwards.

Food and Injury. Both the beetles and their larvae feed upon various kinds of animal products, such as meats—especially dried hams—cheese, skins, feathers, dried blood, hair and occasionally woollens. In the average home an occasional adult may be found from time to time, but little damage is done unless dried meat or some other favoured food has been left undisturbed for several weeks. In such case the beetles may find this, eat holes in it, lay their eggs, and produce large numbers of larvae which bore into and sometimes ruin the infested material before their presence is discovered. When meat is cured and stored in granaries or other buildings the insects sometimes attack it and do much damage, especially by destroying the surface area. Both adults and larvae are often found in or beneath poultry killing-boxes, apparently feeding upon a mixture of blood and feathers but doing no real harm.

Fig. 17. Larder beetles, natural size. (Photo by G. G. Dustan.)

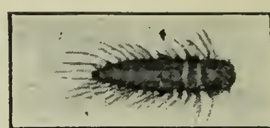


Fig. 18. Larder beetle larvae, about natural size. (Adapted from Gibson and Twinn, Publication 642, Can. Dept. Agr.)

Life History. This does not seem to have been fully worked out, but out-of-doors the winter is passed in the beetle stage in various sheltered places; indoors, if the building is heated, the beetles remain active all winter and a few larvae, but apparently only a few, are found along with them. Egg-laying commences soon after the warm weather begins in spring. It seems to be generally accepted that there are at least two full generations a year.

Control

Usually all that is necessary for control in the home is, whenever adults or larvae are seen, to search carefully until you find what they are feeding upon, then kill all the insects you can find, burn the material attacked or, if very valuable, pare off the injured area and burn this, and use the remainder as soon as possible; also scrub with hot water and soap the shelves where the insects were feeding to destroy any eggs or young that may have escaped. It is a good plan, moreover, to spray the cracks or openings nearby with a good fly spray to kill any stage of the insects that may be concealed in them. When this is done a small piece of dried ham or beef or cheese may be left for a week as a bait to attract any beetles or larvae not destroyed. Examine this from time to time and kill any insects present.

Where ham or dried meat is kept during warm weather in granaries or other storage places, examine this occasionally and, if any is attacked, kill the insects present, pare off the injured areas and burn these, wet the cut surface with a saturated solution of borax and water, and when dry cover each parcel of meat with a paper, cheesecloth or cotton bag and tie so carefully that no insect can enter.

ITCH MITE

Itch is a contagious disease of the skin caused by a mite *Sarcoptes scabiei* Hering. This mite is very closely related to the mites which cause mange on horses, cattle, hogs, sheep, dogs and some other animals.

Description. The itch mite is a very small creature, so small that it can scarcely be seen without the aid of a hand lens. The colour is whitish, and the body is almost round and has four pairs of short legs.

Habits and Life History. The females make small burrows in the skin, especially where it is tender and thin, as between the fingers, between the toes, on the underside of the wrists, beneath the knees, and on many other delicate parts of the body. The burrows vary in length from less than 1/8 of an inch to a little more than 1 inch, and are often visible as grayish, winding, thread-like lines just below the surface of the skin. Here and there along these lines are little hard pustules about the size of the head of a pin. As the female moves along in making her burrow she deposits her eggs. The eggs hatch in two or three days. The young mites remain in the burrow for four to six days and then come out and soon begin making their own burrows, and in about another week are full-grown. Thus there is a short life cycle and many generations in a year. Breeding continues all the year.

Nature of the Injury. As a result of the activity and feeding both of the mother mites and the young in the burrows, and of the irritating secretions given off, an intense itching is caused. This leads to scratching and rupturing of the little pustules. When this happens they send out a yellowish exudate characteristic of the disease. The injury from scratching causes the area to become inflamed and scabs to form. Red areas of this nature may occur on many parts of the body, though seldom if ever on the head.

Method of Distribution. The only way by which the itch disease can be distributed is by the mites themselves passing from one person to another. This can easily take place, because the mites in the course of their life spend some time moving about over the patient's body and clothing. Thus they may be spread readily by close contact with an infected person; for example, they may pass from one person to another in a bed, or from a mother to a child, or from one individual to another when sitting close together. They may also be distributed by using gloves, towels, bed clothing or other things used by a diseased person. If no precautions are taken, a single person may infect every other person in a house.

Control

Fortunately the disease, no matter how severe, is easy to control, but it is always wise to treat it at once as soon as identified and thereby prevent its spreading. The method commonly practised is to massage thoroughly the whole body from the base of the head to the feet with green soap and hot water. As the object of massaging is to soften and remove the scabs and open up all the burrows, it should be continued for at least half an hour and, if the case is a severe one, for an hour. Use the soap liberally enough to make a good lather and rub well. At the end of the above period, cover the whole body thoroughly with a mixture of ½ ounce of fine sulphur and 10 ounces of lard and rub this in repeatedly so that it will enter every burrow and reach the mites there. The patient should then be given a complete change of clothing, and all the old clothing, bed clothes, towels, socks, gloves or other things used by him either washed in scalding hot water for ten minutes or hung up outside and left there for twelve days to starve to death any mites that are on them at the time or that may hatch from eggs.

A second massaging and treatment with the sulphur and lard a week later is necessary to kill mites that may hatch from eggs not destroyed in the burrows.

It is, of course, necessary to treat every person in the house who shows any signs of the disease.

Prevention consists chiefly in avoiding contact with suspected persons and in not using public towels or sleeping on soiled sheets or pillows.

LICE ATTACKING MAN

There are three species of lice which attack man: the head louse, *Pediculus capitis* DeGeer; the body louse, *Pediculus humanus corporis* DeGeer; and the crab or pubic louse, *Phthirius pubis* L.

None of these lice is found in the average well-kept home except when brought in temporarily from some outside source. The regular source of all three species is the slum districts, where no real effort is made to combat them.

HEAD LOUSE

This species is grayish, somewhat oval in outline, about 1/16 of an inch in length, and about half as wide as long. The legs are stout and each has a large curved claw which helps it to work its way through hair. The mouth parts of this and also of the other two species are adapted for piercing and sucking.

Food and Life History. The head louse lives almost entirely on the head and its food is blood. By crawling around and feeding it causes irritation and itching with consequent scratching.

The eggs are whitish, are glued to hairs, and are commonly spoken of as "nits." They hatch in about a week and the young, which closely resemble the adults, become full-grown in about three weeks. Adults, under favourable conditions, usually live about a month. Breeding continues all year through and there are several generations, which overlap one another.

Methods of Spread. Head lice may readily be spread from one person to another in any of the following or other ways: by close proximity to an infested person or persons; by using the same seats after them; by using an infested brush or comb; and by trying on hats or coats after other persons in low-grade stores or at bargain sales. Little children, especially little girls, readily contract them by close association with other children in schools and by interchanging caps or hats.

Control

As prevention is better than control, care should be taken to be on one's guard against becoming infected in any of the ways mentioned above.

Control of head lice is simple and easy. A very common method is, before retiring at night, to bathe the head thoroughly with a 2 per cent solution of carbolic in water and then at once wrap a large towel closely about it and fasten this securely in place. Leave the towel on for a couple of hours or even

FIG. 19. Head louse, enlarged and natural size. (After Gibson and Twinn, Publication 642, Can. Dept. Agr.)

until morning, then wash the head with soap and water and with a fine-toothed comb remove all the dead lice. Nits that fail to come off by combing should be loosened by washing the hair with vinegar after which they can be removed easily. One careful treatment in the above way is usually sufficient.

Instead of the carbolic solution some use a mixture of equal parts of kerosene and olive oil well shaken together. Kerosene alone may be used, but is likely to irritate tender scalps unless washed out with soapy water about half an hour after it is applied. A derris extract solution has recently been found to give good control without any injury. It should be used at the strength recommended on the container. Light infestations may be controlled by using a fine-toothed comb kept moistened by dipping it often into kerosene. Hats or caps should also be treated by spraying the interior with the carbolic solution and dusting a little derris powder behind the inner band.

BODY LOUSE

This louse is usually a little larger than the head louse, but otherwise the two are almost identical in appearance. The easiest way to distinguish them is by where they are found: if a louse lives on the head, it is almost sure to be a head louse; if it lives on the body clothing or body itself it is almost sure to be a body louse. When hungry, body lice move from the clothing to the body, pierce through the skin and suck the blood. The irritation caused by the insects crawling around and feeding leads to scratching, inflammation and sometimes sores. Their presence also causes great worry and annoyance to the host.

Body lice are liable to become very numerous wherever human beings live together in close association without good sanitation and hygiene, such as in slums, camps of various kinds and billets and trenches in times of war.

Not only do lice cause worry and annoyance, but what is much more important, they are the chief agents in war in spreading typhus fever and trench fever. During the Great War many hundreds of thousands of Russians, Serbians and other nationalities, whose sanitary methods were backward, died of typhus fever. In Canada, however, there is very little danger of typhus.

The body louse differs from the head louse in its egg-laying habits; instead of gluing its eggs to the hair it lays them on the body clothing, especially along or under the seams at the waist. Reproduction continues all through the year and the rate of increase is very rapid.

Control

Body lice under civil life conditions are little, if any, harder to control than head lice, but in war control in the army is sometimes very difficult. The control given below is meant chiefly for civil life, but some of it is applicable also to war conditions.

The first thing to keep in mind when dealing with control is that the lice, when not feeding, are mostly on the infested individual's clothes, especially the underwear, and that the eggs are also on them, and therefore control cannot be secured without treating the clothes, including the bed clothes. There will, however, be a few lice on the patient's body itself either feeding or wandering about. Hence the patient must also be treated.

The common method of treatment is to bathe the individual in as hot water as is safe and to lather the whole body with a good soft soap or green soap from head to foot. The bathing, soaping and scrubbing should be continued for about twenty minutes, then he should be given a complete change of clothing. In addition, any of the body clothes which can be spared should be burned at once and the rest washed for ten to twenty minutes in soapy water at a temperature of 170° F. or higher. Many persons claim that the water has to be boiling to kill, but experiments have shown that 170° F. will kill all stages, if all parts of the clothes are heated that high. The trouble is that tests are often made without a thermometer and the temperature is lower than the operator thinks. To maintain 170° F. add boiling water as needed.

Soaking clothes in gasoline for a few minutes will also kill all stages of the lice, but because of the fire hazard the soaking must be done in the open at some distance from any building and no smoking permitted nor fire brought near.

During the last few years another method of control has been tested by several entomologists and other persons and found effective. This is the use of derris dust as a poison. The dust kills all the lice which come in contact with it and at the same time is practically harmless to the human body, though occasionally it does, when used heavily, cause a slight rash where it comes into contact with the skin. The method of using is to dust the derris over both the outer and inner garments of the infested person, taking special care to apply it heavily to all seams, especially in the underwear, forcing it directly down into the seams themselves and also beneath the flaps on each side of the seams. The dust used should be guaranteed to contain 1 per cent of rotenone and must have been kept where sunlight did not reach it. Two applications may be necessary and in war more, because of reinfestations in billets, trenches or elsewhere.

CRAB OR PUBIC LOUSE

This species is approximately the same size and colour as the body louse, but may easily be distinguished from it and the head louse by its crab-like appearance, caused by the legs sticking out nearly straight from the sides,

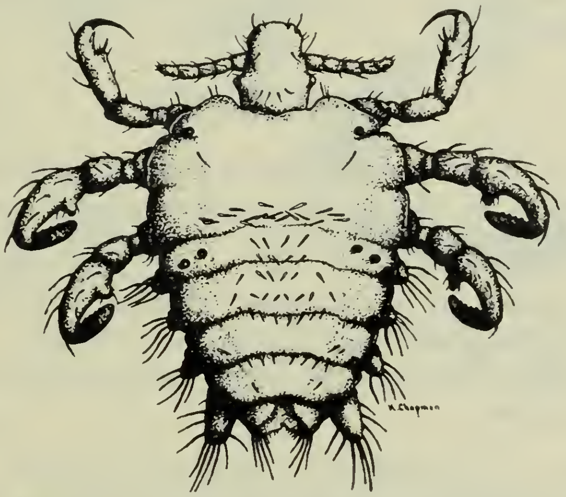


Fig. 20. Crab or pubic louse, greatly enlarged. (From drawing by K. Chapman.)

and by the presence of a thumb-like projection a short distance below the claw on each of the hind two pairs of legs. Another distinguishing characteristic is that it lives almost exclusively in the pubic area, while the head louse lives on the head, and the body louse chiefly on the body clothing.

The crab or pubic louse is usually to be found wherever the body louse is present, the same conditions of crowding and poor sanitary conditions favouring both species.

Its spread is brought about largely by sleeping with infested persons or in the same bed after them. Public toilets, too, sometimes act as a factor in its spread.

Like the other two species, it feeds upon the blood of its host and thereby causes itching, scratching and often inflammation of the affected areas.

Though a loathsome creature, it is apparently not a disease carrier.

Control

Like the head and the body louse this species is not difficult to control. Care should, of course, be taken to avoid contamination. If, however, this has taken place the person should use one of the following:

1. A derris ointment well rubbed into the affected parts. This ointment may, however, not be easy to obtain in some localities. In that case a home-made ointment of 1 level teaspoonful of derris well mixed with a heaping tablespoonful of vaseline may be substituted for the commercial product.

2. A mixture of equal parts of olive oil and kerosene used as in 1 above.

3. Mercuric ointment very lightly rubbed over the infested area. If applied heavily this ointment will burn. In any case it is wise to wash it off with soap and water about an hour after applying. The fingers should also be washed directly after the application.

4. The mosquito repellent, Sta-way, is recommended by Prof. G. J. Spencer*.

One application with any of these is often sufficient, but sometimes a second is necessary.

MOSQUITOES

Mosquitoes may be distinguished from other flies closely resembling them by the presence of scales on the veins and margins of the wings. These may readily be seen by means of a hand lens.

There are many kinds of mosquitoes. These differ more or less in size, markings, life history and habits. We shall, however, limit our discussion of them almost entirely to the so-called house mosquitoes and the most common field and woodland species.

Breeding Places. All mosquitoes breed in water. The so-called house mosquito species breed chiefly in rain barrels and water that has collected in puddles, open cans, pots or any other containers in and around houses in cities and towns or on the farm. The adults are believed not to travel more than a few hundred yards from their breeding places. The field and woodland species breed chiefly in ponds and ditches that are flooded in spring but dry up in summer. These often travel several miles, and are great pests to fishermen, canoeists and tourists in spring and early summer.

Life History. Female mosquitoes have sharp, piercing and sucking mouth parts and feed chiefly on the blood of man and other warm-blooded animals, including birds, but also to a considerable extent on the juices of plants. Male mosquitoes lack the piercing mouth parts and feed only on plant juices such as the nectar of flowers. Hence the males do no harm.

All species pass through four stages—egg, larva, pupa, and adult. The so-called house mosquitoes winter in the adult stage in houses, barns, caves, hollow trees and other good shelters. In spring they come out and lay their eggs in boat-shaped clusters or rafts on the surface of the water in the breeding

*Can. Ent., Jan. 1941, p. 20.

places mentioned above. The field and woodland species winter in the egg, not adult, stage. Their eggs are laid singly in late spring or early summer on the ground in places which were flooded in spring but dried up later. Such eggs do not hatch until the next spring.

The larvae of all mosquitoes live only in water and are known as wrigglers. Good examples of them are the little dark, worm-like creatures often seen swimming or wriggling about in the water in rain barrels or floating at its surface. Their food consists of bacteria and other microscopic vegetable or

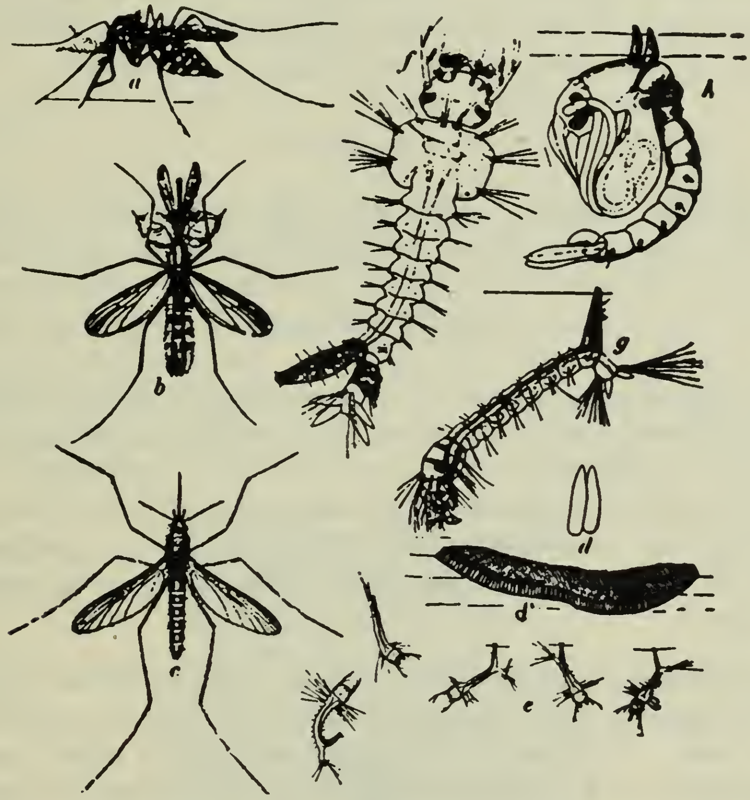


FIG. 21. A so-called house mosquito (*Culex sp.*): (a, c) adult females, (b) male, all enlarged about three times; (d) eggs, enlarged; (d[1]) raft of eggs, natural size; (e) larvae or "wrigglers," about natural size; (f) larva, much enlarged; (g) enlarged larva suspended at surface of water, showing breathing tube protruding above the surface; (h) pupa, much enlarged, with breathing tubes protruding above surface of the water. (After Howard, U.S.D.A., as adapted by Herrick and Griswold, Extension Bul. 202, N.Y. Sta. Col. Agr.)

animal organisms. They usually become full-grown in a week or a little longer and then change into pupae.

The pupa is a strange-looking creature with head and thorax forming a large, somewhat globular mass, and the much more slender abdomen extended close along it in a curve. Pupae do not feed at all but can move about freely in the water. They are, however, most commonly seen floating at the surface with their two horn-like breathing tubes projecting into the air. After a few days they change into adults. (See figure 21h.)

Number of Generations a Year. The species which winter as adults have several generations a year, the number depending largely upon whether the season is wet or dry. A wet spring and early summer means more broods and more trouble from mosquitoes. The species which winter in the egg stage usually have only one generation a year.

Mosquitoes and Disease. In the warmer countries mosquitoes cause a great deal of suffering and loss through acting as carriers of diseases, especially malaria and yellow fever. Not all mosquitoes, however, but only a few can carry either of these diseases. Fortunately for us the yellow fever carrier cannot live in our climate and, though at least one species of the genus *Anopheles* which carries malaria is present, this Province seems to be free from malaria. It is believed, however, that if persons suffering from the disease were present, and were bitten by this species, an outbreak might occur.

Control

Control in the Home. This may be obtained by using close-fitting screen doors, by screening windows, and by blocking up or covering all openings in the wall, roof or other parts of the house where the insects enter. The wire screen on doors and windows should have 16 or 18 meshes to the inch; 14-mesh will not keep out the smaller mosquitoes. On windows the screens should cover the entire window and may be tacked directly to the casing. All screens should first be painted well, otherwise they will rust, unless made of copper, bronze or brass. If painted every two or three years they will last almost indefinitely. If unable to afford wire screens for all the doors and windows, mosquito netting may be substituted. To find all the openings in the walls or other parts of some houses and close them requires a great deal of time and patient effort.

If the mosquitoes are numerous outside, some of them will at times enter the house when opening and closing the doors, or will be carried in on persons or on dogs and cats. To destroy these use one of the more popular brands of commercial mosquito or fly sprays according to the directions on the container. The spray should be applied about ½ hour before bedtime. These sprays are also excellent for freeing tents from mosquitoes.

In a house that for any reason cannot be made mosquito-proof, protection at night may be secured by making a frame over the bed high enough to allow plenty of air and covering this carefully with mosquito netting, which must be long enough to reach the floor on all sides so that no mosquitoes may enter from beneath. Before retiring a mosquito spray should be used to kill any mosquitoes that might be under the net.

Mosquito repellents are sometimes used to protect persons at night. One of the most popular of these is a mixture of 3 ounces of oil of citronella, 2 ounces of spirits of camphor, and 1 ounce of oil of cedar. A few drops of this on a bath towel hung at the head of the bed and a drop or two on the cheeks and forehead will usually keep the mosquitoes away for several hours.

Control by Destruction of Breeding Places. We should keep in mind that thousands of mosquitoes may breed in a single barrel of water and thousands more in a single backyard in rain water that has collected in such places as open cans, pots, cast-off rubber tires, little puddles or other containers. In a city or town a score of nearby houses may, therefore, become infested from such a place. This shows that cities and towns can often do a great deal to control the mosquito nuisance by making it compulsory for every householder to see that no rain water is left standing on his premises. If he wishes to keep a rain barrel, he may be allowed to do so on condition that he cover it tightly to keep out mosquitoes, or pour a spoonful or a little more fuel oil over it to kill any larvae or pupae present, or add 1 pound of fresh hydrated lime to every 40 gallons of water.

As mosquitoes breed also in the surrounding territory in standing water in pools and ditches, these should be filled in or drained for a distance of at least a mile on all sides of the city or town, or, when this is not practicable, should be kept covered with a film of fuel oil from a little while before the mosquitoes begin to be troublesome—usually early in May—until their season is over. It would be wise, however, for a city or town before entering on this work to ask the Department of Entomology at the Ontario Agricultural College, Guelph, or the Entomological Branch, Ottawa, to send a man to look the situation over and outline in detail the steps necessary for success.

SILVERFISH

Silverfish may be identified easily by their silvery colour, long antennae and three long, thread-like appendages at the posterior end. When full-grown

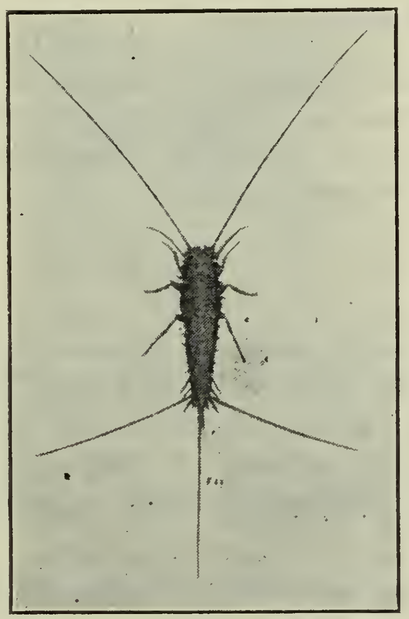


Fig. 22. Silverfish, about natural size. (Adapted from Gibson and Twinn, Publication 642, Can. Dept. Agr.)

they are 1/3 to ½ inch in length, have no wings, run swiftly when frightened, and are difficult to capture. The name "silverfish" has been given to them because the shape of their body and the silvery scales which cover it cause them to resemble somewhat certain tiny fish.

Species. There are three species in Ontario: *Lepisma saccharina* L., *Thermobia domestica* Pack., and *Ctenolepisma quadriseriata* Pack. These three resemble one another so closely in appearance and have so similar life histories that for our purpose we may consider them as one. It is interesting, however, to note that each species seems to have its own favourite range. The first prefers the main floors in general and basements; the second warm or hot places such as furnace rooms and the vicinity of ovens in bakeries; and the third attics and roofs.

Food and Injury. Most of the persons who have sent the writer specimens of silverfish stated that the insects were injuring wallpaper, curtains or books. In such cases they were evidently feeding upon the starch, glue or sizing present in these. Experiments, however, have shown that they are much fonder of oatmeal, flour and some other materials than of starch, glue or sizing, and that apparently it is extreme hunger which drives them to attack the latter things.

Though silverfish are fairly common throughout the Province, the damage done is, as a rule, not great. The greatest so far reported has been to books or documents stored in vaults or rooms and seldom moved.

Life History. The eggs are white and oval, and are laid loosely in the places where the insects hide. A single female lays about 100 eggs. These hatch into nymphs which, even in their early stages, resemble closely the adults in appearance and habits. The nymphs grow very slowly and require several months to a year to reach maturity; hence the rate of increase is not nearly so rapid as that of most insects.

Methods of Spread. Apparently the chief ways in which silverfish spread from one place to another is on foot, and by being carried in trunks, parcels or other containers in which they happened to conceal themselves. Having no wings they of course cannot fly.

Control

Fairly good control may often be obtained by dusting sodium fluoride alone or a mixture of equal parts of it and fresh pyrethrum over the places where the insects are most commonly seen and blowing it into the cracks or openings in which they take refuge. In doing the latter, take care not to inhale the dust. Doubled cheesecloth may be used over the nose as a mask during the dusting.

A cheaper and on the whole more satisfactory method is the use of a poisoned bait. The one most highly recommended at present is made from the following formula*:

Oatmeal or rolled oats	1 imperial pint
Sodium fluoride	2 level tablespoonfuls
Icing sugar	2 level tablespoonfuls
Table salt	1 teaspoonful

As the bait is most effective in the form of a powder, the oatmeal or rolled oats should first be run through a hand mill or a close-set meat chopper. After

*Adapted from the formula given by Snipes, Hutchins and Adams in Jour. Econ. Ent., 29 : 3 : 423 : 1936.

this has been done, put all four ingredients into a half-gallon or a gallon can with a tight-fitting cover and shake vigorously for a few minutes to mix thoroughly. Then put about a teaspoonful of the bait on a piece of paper in each of the various places where the insects are most commonly seen. A neater and cleaner method is to put a teaspoonful into each of several shallow, uncovered pasteboard boxes, such as necktie boxes, and cover these with crumpled paper cut to fit. Then distribute them in the places where the insects are most likely to find them. The bait does not kill quickly, and so should be left undisturbed until all the insects have been killed. This may be three or four weeks.

Before putting out the bait or the dust, it is always wise to sweep the infested rooms well and so far as possible keep all food in tightly covered containers where the insects cannot get access to it.

SOWBUGS

Sowbugs, though not insects, are included here because they are often present in cellars and occasionally in flower pots.

They seldom do much harm, though their presence is of course undesirable. There are times, however, when they become a great nuisance; namely, when they migrate at night from a garbage dump or other breeding places to nearby

Fig. 23. Sowbug, normal position and coiled into so-called pill bug shape, natural size. (After Gibson and Twinn, Publication 695, Can. Dept. Agr.)

houses. In such cases hundreds of them may enter through cellar windows, doors or other openings and cause great worry to the inmates, especially as the migration may take place night after night for several weeks. The writer saw a case of this at Brantford, Ont., in 1931.

Description, Food, and Life History. Adult sowbugs are flattish, gray creatures about 1/3 to ½ inch long and ¼ inch broad. They have seven pairs of legs and when disturbed often coil up into a ball. From this habit the name "pill bugs" is sometimes given to them. The young resemble the adults. Both adults and young require a good deal of moisture to thrive. Hence they are found chiefly on the ground under boards, logs, stones or other covers, and in cellars in houses. They are quite common also in greenhouses in the beds and decaying boards.

In greenhouses they feed upon decaying wood, manure and the roots and tender parts of plants, especially young plants. In garbage dumps they find an abundance of food in the decaying and fermenting organic matter present. In cellars they feed upon any decaying vegetable matter they can find.

The eggs are not laid openly but are carried around by the mother in her pouch (marsupium) until they hatch. The young also are thus carried for a few weeks and then set free to fend for themselves. It requires about one year for the young to mature into adults.

Control

The most common method of control in homes and greenhouses is a poison bran bait made according to the following formula:

	FOR A LARGE AMOUNT	FOR A SMALL AMOUNT
Dry bran	2 gals.	1 qt.
Paris green	¼ lb.	½ oz. (1 level tablespoonful)
Molasses	1 qt.	½ cup
Water	4 qts.	1 pt.

Mix thoroughly the bran and Paris green dry; pour the molasses into the water and stir a little; add the liquid to the poisoned bran; and mix until all is moistened.

A dessertspoonful of this bait should then be placed under each of several pieces of board or other covers in the places where the sowbugs are most common. If this dries out, it should be moistened with a little water or replaced with fresh bait.

Another popular bait is made by mixing together 1 level teaspoonful of Paris green and 20 level teaspoonfuls of icing sugar, and scattering a little of this dry in the infested places.

The migration of sowbugs from garbage dumps to nearby houses can be stopped by levelling off the surface of the dump and then covering it uniformly to a depth of 6 inches with slag or earth. This destroys the sowbugs. At the same time a new place at considerable distance from the old should be used for dumping the garbage. Slag was used to cover the dump in the Brantford outbreak with complete success.

INSECTS ATTACKING FLOUR, BREAKFAST CEREALS, MEAL, NUTS AND BEANS

There are a dozen or more beetles and several moths which attack flour, breakfast cereals, meal, nuts or beans. Of these the most important are two little beetles and two moths.

The beetles are known as the confused flour beetle, *Tribolium confusum* Jacq. and Dur., and the saw-toothed grain beetle, *Oryzaephilus surinamensis* L. The former is glossy, reddish-brown, and about 1/7 of an inch long. Its larva is a little, brownish-white grub about 1/5 of an inch in length. The saw-toothed grain beetle is a little duller reddish-brown, flat, and only about half the size of the confused flour beetle. Its larva is white and about 1/7 of an inch long. Both the adults and the larvae attack the materials mentioned above.

Beans are often attacked by a small, stout, olive-coloured beetle which makes holes in them and, if not checked, reduces them to powder. This insect is known as the bean weevil, *Mylabris obtectus* Say.

The two moths are known as the Indian meal moth, *Plodia interpunctella* Hbn., and the Mediterranean flour moth, *Ephestia kühniella* Zel.

Fig. 24. Confused flour beetle, enlarged and natural size. (After Gibson and Twinn, Publication 642. Can. Dept. Agr.)

Fig. 25. Saw-toothed grain beetle, enlarged and natural size. (After Gibson and Twinn, Publication 642, Can. Dept. Agr.)

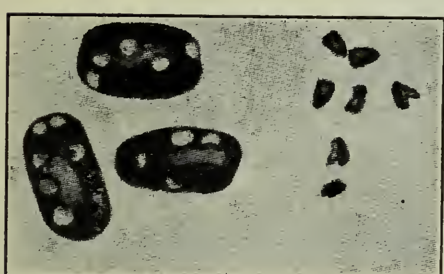


Fig. 26. Bean weevils and their work, natural size.

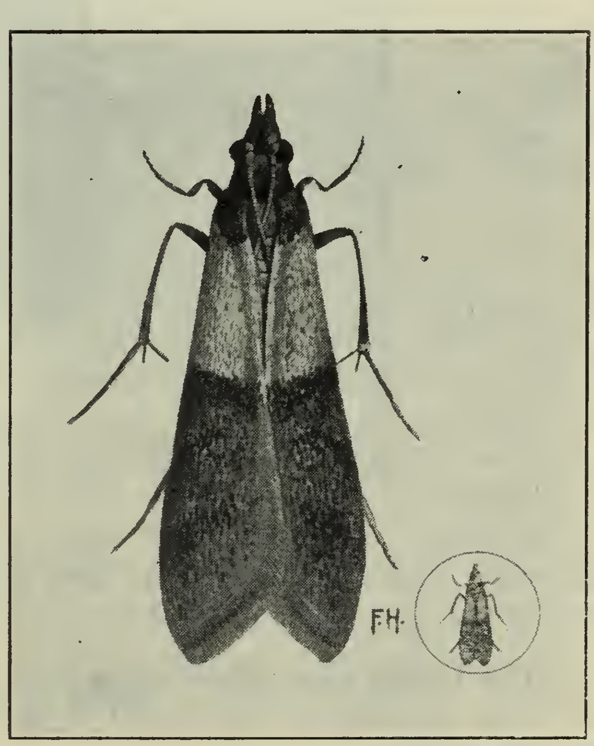


Fig. 27. Indian meal moth, enlarged and natural size. (After Gibson and Twinn Publication 642, Can. Dept. Agr.)

The Indian meal moth is sometimes seen flying around in kitchens and is often mistaken for the clothes moth, but may be distinguished from it easily by its being a little larger and by the upper wings not being buff or yellowish, but reddish-brown on the outer two-thirds and whitish gray on the inner third. The larvae when full-grown are white, often with a tinge of green or pink, and are about ½ inch in length.

The Mediterranean flour moth is about half as large again as the Indian meal moth, having a wing expanse of 1 inch. The colour of the front wings is leaden gray. Its larvae look very much like those of the Indian meal moth but are a little larger and never have a green tint.

Fig. 28. Mediterranean flour moth, enlarged and natural size. (After Gibson and Twinn, Publication 642, Can. Dept. Agr.)

It is not the moths but only the larvae which damage flour or other materials. Both of these larvae have a characteristic habit of weaving together with silken threads masses of the materials upon which they feed.

The Indian meal moth has a very wide range of food materials, including all those mentioned above and in addition such things as raisins, figs and nut chocolates.

The Mediterranean flour moth restricts itself almost exclusively to flour, meal and breakfast cereals.

General Control

1. Make a practice of not buying large quantities of the food materials at one time, because some of these may be infested when purchased and the insects spread from them to the rest, and also because the longer flour or other materials are stored the greater the danger of infestation. The best plan is to buy only sufficient at a time to do for a few weeks or a month. Cereals put up in sealed paper boxes are regularly superheated to kill all stages of insects present and are on the average safer to buy.

2. Do not allow dust or waste from flour, meal or other similar substances to accumulate in the bottom and sides of flour bins or storage places, because insects often breed in such accumulations. Hence clean thoroughly all bins or storage places from time to time and, if there are any crevices in them, spray these heavily with a good fly or mosquito spray or treat with boiling water.

3. Any material seen to be infested should be returned at once to the merchant. If kept for a week or two you may not be able to prove that it did not become infested after being purchased.

4. Keeping food materials in tightly covered tin containers helps to prevent infection.

5. Any finely powdered material such as flour or meal may, unless in too large a quantity, be freed from insects by placing it in shallow pans, not more than 2 inches deep, in the oven and raising the temperature gradually to 150° F. and keeping it there for twenty minutes or long enough to heat the interior to 150° F. The material should then be run through a screen to remove all the insects and their larvae. The heating does not injure the baking or eating properties.

6. Low temperatures may be used to kill the insects. If the infested materials are put out in the cold at a temperature of zero or near it and left there for a week, the insects present will perish. In summer a house refrigerator may be used in a small way for this purpose.

7. Where there is too large a quantity of flour or other material to be treated by any of the methods suggested above, fumigation may be resorted to. When the temperature is 70° F. or higher, or never lower than 66° F., place the materials in an airtight, 40-gallon wooden or metal barrel and fill to about 2 inches from the top. Then pour nearly a pint of carbon tetrachloride into a small, flat dish placed on the material. Cover the barrel tightly with good heavy wrapping paper fastened down by a hoop driven over it or by tight cords, and leave for forty-eight hours. Carbon tetrachloride is not inflammable or poisonous to humans. The work may be done in a cellar with the windows open.

The bean weevil attacks only beans and only if they are stored in a warmed room. Hence to avoid danger store them for winter in an unheated room. Infested beans may also be fumigated as above.

INDEX

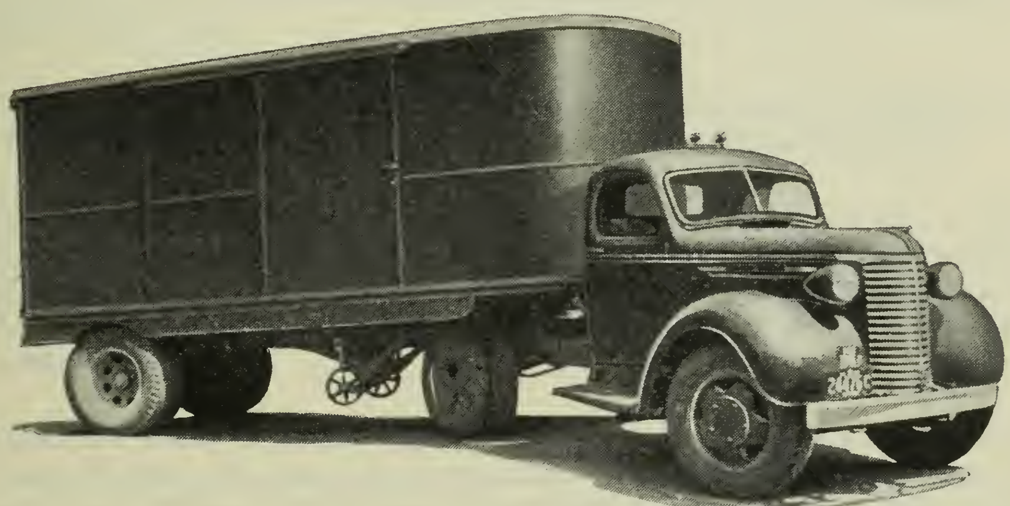
BULLETIN 417 JUNE, 1941

Ontario Department of Agriculture
Statistics and Publications Branch
TORONTO, ONTARIO

MILK TRANSPORTATION

in the

TORONTO MILK SHED



By

Economics Department, Ontario Agricultural College, Guelph,

and the

Milk Control Board of Ontario

SUMMARY OF MAJOR FINDINGS

1. Motor trucks have replaced other agencies almost entirely as a method of transporting milk from the farms of producers to the dairy plants in the Toronto milk shed, and, in 1938, 178 motor trucks gave a daily service to 3,127 milk producers and hauled 3,275,000 cans of milk worth $5,253,000.00 at a total cost to the producers of approximately $768,000.00.

2. Rates varying from 18c to over 30c per can, according to a definite schedule of distances from Toronto, were charged for this service. The weighted average charge on the entire amount was approximately 24c per can and on the 89 routes studied in detail this average cost was 22.5c per can.

3. An analysis of the operating statements shows that, on the average, the margin for interest on investment and profit on the 89 routes was about 4c per can.

4. Variation in volume of load is three times as important as variation in truck operation costs in influencing the cost of milk transportation.

5. Unnecessary overlapping of service is quite evident. If the whole business were operated on the basis of efficiency attained by the most efficient 25% of the operators, 33 trucks could be eliminated, and a theoretical saving of 3,324 miles per day or 22% of the total mileage obtained.

6. From the study it would appear that any substantial savings in milk transportation costs that are to be secured must come largely from the improved efficiency which results from larger average loads. This would necessitate a general reorganization of the routes to eliminate unnecessary trucks and unnecessary mileage.

FOREWORD

During the year 1939, the Milk Control Board of Ontario, in the course of its investigations into the fluid milk business in the Province, secured detailed information relative to the transport of milk by motor truck within the Toronto milk shed. After studying this information from the point of view of immediate milk transport problems, the Board requested the Economics Department of the Ontario Agricultural College to analyse the material further with the purpose of preparing some conclusions which might be of general and permanent interest to the industry.

The basic material for this study was therefore included in the reports made to the Board which reports covered the physical and business factors in connection with the various milk trucking routes for the year ending December 31, 1938. For some purposes the entire 161 reports were used but for the purposes of cost analysis it was necessary to use only the 89 reports which were evidently more complete and accurate than the others.

The analysis of the information was completed by Mr. Alex Stewart of the Economics Department of the O.A.C., and the report prepared with the co-operation of Mr. J. B. Nelson, Secretary of the Milk Control Board of Ontario.

MILK TRANSPORT AS A FACTOR IN MILK COSTS

The costs to the producer for transporting his milk from the farm to the plant of the distributor in Toronto amounts on the average to approximately 15% of the delivered value of that milk and to about three-quarters of a cent per quart on all milk sold to consumers.

As a preliminary to this study some estimated total figures for the Toronto market for the year 1938 are of interest:

Delivered value to producers of all milk......	$5,253,000	
Cost of Milk Transport................................	$ 768,000	
Total mileage travelled by milk trucks......	5,493,830	miles
Mileage per day	15,052	”
Total number of cans of milk hauled........	3,275,020	80 pound cans
Cans hauled per day.....................................	8,972	80 pound cans
Number of farms served..............................	3,127	
Number of trucks in daily use....................	178	
Number of routes operated..........................	161	
Number of operators in business................	111	

From this information it will be seen that milk transport costs are an important factor in the cost of milk supply and so, are of interest not only to the trucker who provides the service and to the milk producer who pays directly for it but also to the distributor whose total costs are affected and to the consumer who ultimately pays all costs.

MAP NO. 1

County	No. Shippers
York	1272
Peel	550
Ontario	375
Halton	256
Wentworth	128
Durham	121
Northumberland	71
Victoria	46
Oxford	45
Waterloo	42
Peterboro	36
Brant	30
Simcoe	26
Middlesex	25
Wellington	24
Dufferin	21
Lincoln	15
Norfolk	18
Perth	12
Huron	6
Haldimand	5
	3127

EXTENT OF THE TORONTO MILK SHED

The 3,127 farmers who supplied about 9,000 cans of milk daily during the year 1938 are located in twenty-one counties of the Province. Map number one shows the general location of the farms and the relative importance of the various counties as sources of whole milk for the Toronto market. This map also indicates the size of the problem of transporting milk to Toronto.

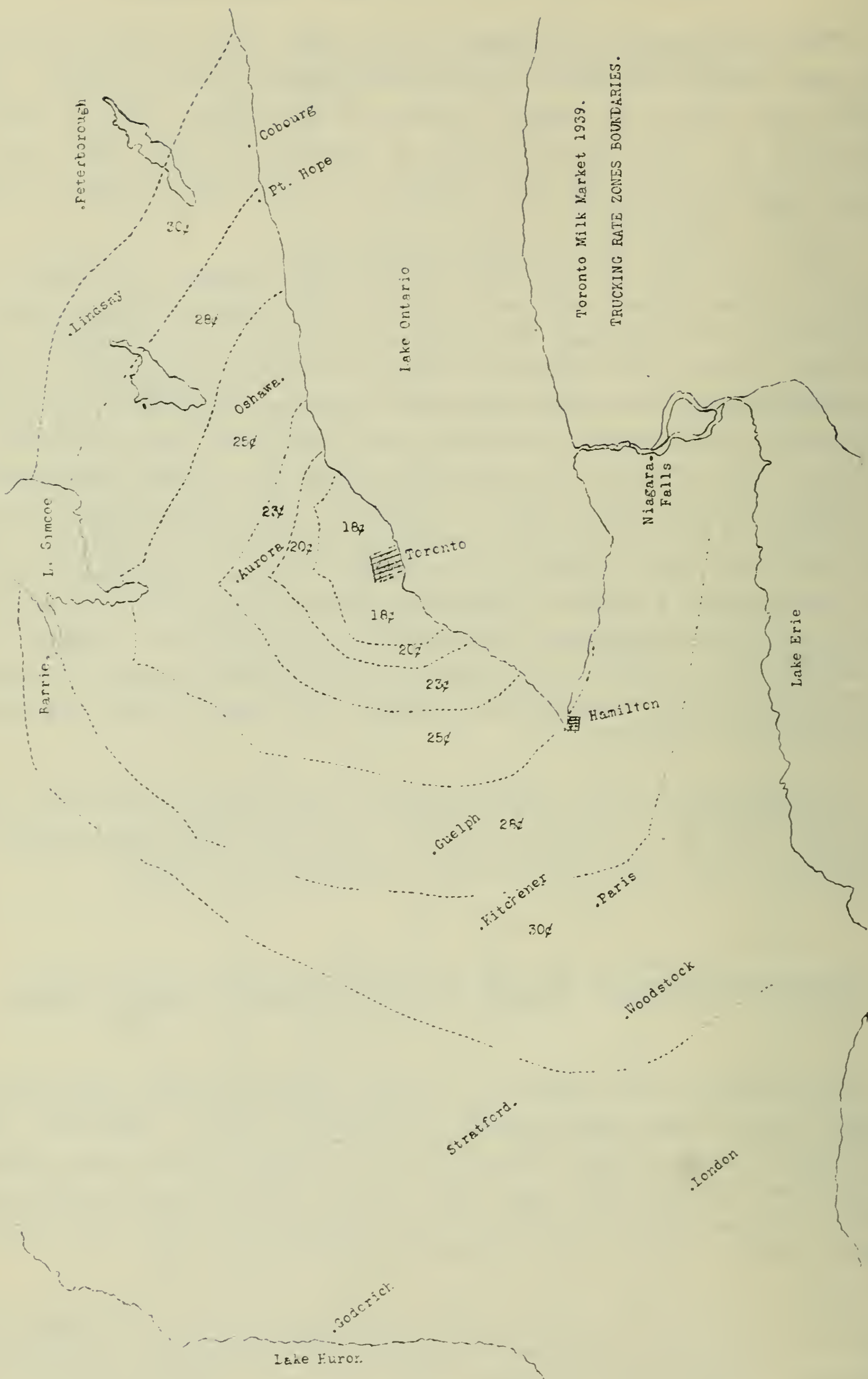
Before the days of the motor vehicle, milk shipment to Toronto was limited to those farmers who were located within wagon-hauling distances of the dairy or of a railroad. The advent of the motor truck, however, gave producers who are inconveniently located for rail transportation a means of participating in the Toronto fluid milk market and expansion during the last twenty years has been primarily into those areas not well served by railways. This movement has generally resulted in a greater concentration of shippers in the counties closer to Toronto. There still remains, however, the skeleton of the old milk shed as served by rail and in addition to this there are some other sections outside of the natural concentration which have developed as a result of aggressive truckers going into new areas to build up trucking businesses. The situation described above, together with a consideration of other factors such as soil conditions, types of farming and the competitive local markets, explains the present shape and extent of the Toronto milk shed.

The assembling of this great quantity of milk daily from such a wide production area by a comparatively new but firmly established system of transport provides a valuable and interesting field for study.

TRANSPORTATION RATES IN THE TORONTO MILK SHED

The advent of the trucker as a major factor in milk transportation brought about some readjustments in transport costs. When the milk moved by rail the producer delivered it to the station and then was charged one rate for transportation from that station to Toronto and an additional rate for transportation from the Toronto station to the dairy. The trucker's rates of course, cover the entire service from farm to dairy.

As a rule the trucks which replaced the railways charged comparable rates for comparable service but the trucks which opened up new territory apparently at first had no standard basis for rates. During the course of


Toronto Milk Market 1939.
TRUCKING RATE ZONES BOUNDARIES.
Lake Ontario
Lake Erie
Lake Huron
L. Simcoe
Peterborough
Cobourg
Pt. Hope
Lindsay
Oshawa.
Aurora
Toronto
Hamilton
Niagara Falls
Barrie
Guelph
Kitchener
Paris
Woodstock
Stratford.
London
Godcrich
30¢
28¢
25¢
23¢
20¢
18¢
18¢
20¢
23¢
25¢
28¢
30¢

time competition and other factors gradually brought about a general rate structure although many individual inconsistencies in rates were still apparent.

In June, 1939, the Milk Control Board approved, as a temporary measure, an agreement respecting milk transportation in the Toronto milk shed between the Toronto Milk Transport Association, the Toronto Milk Producers' Association and the Toronto Milk Distributors' Association. Among other things this agreement laid down a schedule of maximum milk transport charges. The schedule is as follows:—

Distance Farms located from centre of Toronto	Rate per 8 gallon can
for 15 miles and less	.18c
for 20 " " over 15 miles	.20
for 30 " " " 20 "	.23
for 45 " " " 30 "	.25
for 65 " " " 45 "	.28
for 90 " " " 65 "	.30
for over 90 miles—at such prices as producer and transporter may agree upon.	

Map number two shows in a general way the boundaries of the rate zones thus established.

This schedule of maximum rates was based on the general rate structure which had become established by custom, but by it many of the inconsistencies in rates were ironed out and a uniform and more satisfactory situation has since existed. The new structure also brought about a slight average reduction in milk haulage costs.

A further interesting provision of the agreement referred to, is the establishment in accordance with the provisions of the Regulations under the Milk Control Act, of a joint committee on milk transportation composed of equal representation of produucers, distributors and transporters whose purpose is to consider disputes in connection with rates, territories, etc., and to make recommendations regarding milk transport to the Board. Decisions of the committee are, of course, subject to appeal to the Board but it is interesting to note that the committee has worked very well and few appeals have been necessary.

OVERLAPPING MILK TRANSPORT SERVICES

From the reports which formed the basis of this study and the other records of the Milk Control Board in connection with the various milk trucking routes, it has been possible to arrive at some conclusions respecting the very evident economic wastage arising from duplication of trucking service.

To analyse this problem from the available information it is necessary to divide the mileage travelled by the truck into two sections. "Pick-up-mileage" is that mileage travelled by a truck over roads on which it is licensed to collect milk. "Bob-tail-Mileage" is the remainder of the mileage travelled by the truck and is really the mileage travelled before any milk is loaded and after the full load is on the truck.

Overlapping in "pick-up-mileage" comes from more than one truck picking up milk on the same road. Overlapping in "bob-tail-mileage" comes from unnecessary trucks travelling from the area of production to the plant. These will be considered separately and a total daily unnecessary mileage arrived at.

The overlapping in pick-up service is seen from the following table,—

Table 1

OVERLAPPING PICK-UP MILEAGE

	Mileage Served	Mileage Travelled	Overlapping Mileage
Single truck service	1,562	1,562	nil
Two truck service	291	582	291
Three truck service	162	486	324
Four truck service	92	368	276
Five truck service	71	355	284
Six truck service	17	102	85
Totals	2,195	3.455	1,260

This table shows the situation clearly. On 1,562 miles of roads where service is rendered, there is no choice of trucker but on the remaining 633 miles there is duplication of service which in total causes 1,260 miles of extra travelling per day.

From a study of costs not included in this report, it was estimated that if all trucks had been operated to the same percentage of capacity as the most efficient twenty-five per cent., the use of thirty-three of the present routes would have been unnecessary. In addition to the pick-up mileage which is included in the figures given in table "1", these unnecessary trucks travel a daily "bob-tail-mileage" of 2,064 miles.

It will, therefore, be seen that because of overlapping service on about 30% of the roads and because of the use of unnecessary trucks a total unnecessary daily mileage of 3,324 miles is travelled. This estimated unnecessary mileage amounts to 22% of the total mileage travelled and at .10c per mile puts an extra daily cost of $332.40 on the cost of milk or an extra and unnecessary cost of $120,326 each year.

With these general comments it is now possible to consider the conclusions arrived at from a detailed study of the 89 routes on which complete and accurate figures were available.

LOCATION OF 89 ROUTES USED IN DETAILED STUDY

The general location of the different rate zones and the maximum trucking rates for hauling milk to Toronto from these zones have already been discussed. The 89 routes used in this study were operated in a number of these different zones. The distribution of these routes among the various rate zones and the volume of milk hauled from each zone are shown in the following table,—

Table 2

ZONES IN WHICH 89 ROUTES WERE LOCATED

Rate Zone	No. of Routes	No. of Cans Transported	Receipts per can
.18c per can	11	205,765	18.9c
.20c " "	15	216,535	20.7c
.23c " "	26	481,838	21.4c
.25c " "	25	540,960	24.1c
.28c " "	6	146,062	26.6c
.30c " "	6	96,743	27.1c

Truck routes were classified as belonging to the zone from which they obtained the greatest proportion of their loads. The fact that the zone rates were maximum rates and that routes frequently cut across several rate zones prevented exact allocation of routes to the different zones. However, receipts per can obtained by the operators in the different zones indicates the fairness of this classification of routes. It will be noted that the routes operating in the lower rate zones have slightly higher receipts per can than the maximum rates. This was due to the fact that they obtained a small portion of their loads from higher rate zones. Similarly, the routes which obtained the bulk of their loads from the higher rate zones had receipts slightly lower than the maximum rates per can. This was due to the pick-up of cans in the lower rate zones on their way in to Toronto or to their failure to charge the maximum rates.

It is customary for the dairies to act as collecting agents for the truckers by deducting trucking charges from the milk patrons' cheques and transferring such accounts to the truckers. An average charge of approximately 1.5% is made for this service. Receipts per can shown in the above table are net receipts, collection service charges having already been deducted.

CAPITAL INVESTED IN MILK ROUTES

It has long been a common practice to buy and sell milk routes. While many operators built up their own rates, a large number of the operators who co-operated in this study were operating purchased routes. Although prices paid for routes covered a wide range during any period, it is apparent that during the late 1920's prices of milk routes followed the general price trend and advanced to higher levels. The following table shows the prices paid during different periods for 90 purchased routes. To obtain a better picture of the prices at which routes were purchased, this information was not confined to the 89 routes but was taken from all routes which reported.

Table 3

PRICES PAID FOR 90 MILK ROUTES

Year of Purchase	No. of routes	Average No. cans per route	Average Price per can
Prior to 1926	16	37.4	$ 71.00
1926 — 1930	22	51.4	101.00
1931 — 1935	42	66.6	78.00
1936 — 1939	10	46.0	82.00

Average price paid for 90 routes was $82.66 per can.

The prices paid for routes not only showed wide variation but apparently had little relation to the later earning power of the routes. The previous earning power is not known. The following table illustrates the lack of relationship between prices paid for 20 different routes that were purchased during the period 1934-1938 and the profits that the operators obtained from the operation of these routes in 1938.

Table 4

PRICES PAID FOR 20 ROUTES PURCHASES 1934-1938 AND PROFITABILITY OF THESE ROUTES IN 1938

Price class of routes	No. of routes	No. of cans per route	Average price per can	Profit per route
$101 and up	3	41	$116.93	$ 212.50
$ 76 — $100	9	56	86.26	1,202.45
$ 51 — 75	5	84	69.52	1,182.56
$ 0 — 50	3	58	44.74	1,597.62

The profits shown in the preceding table made no allowance for return on invested capital. The three routes which were purchased for more than $100 per can showed the lowest profits per route. They earned in 1938 only 4.4% on purchase price of the routes. On the other hand the three routes which had been purchased for less than $51. per can had the highest average profit. These routes earned 60.9% on their purchase price. It is interesting to note that the three routes which were purchased for more than $100 per can were hauling the same amount of milk in 1938 as they were at the time of purchase; whereas the three routes which were purchased at less than $51 per can had increased their daily volume by an average of 24 cans per route. This increase in volume was apparently an important factor in the increased earning power of these routes.

The average price paid for the 20 routes shown in table "4" amounted to $77.67 per can. Since none of these routes were purchased prior to 1934, this average value was considered to be a fair means of evaluating the capital investment in all milk routes at the time of this study. In later discussion therefore, where allowance is made for capital investment in routes, valuation will be made on the basis of $78 per can.

Of the 89 routes which were used in this study, 61 were purchased routes whereas 28 routes had been established by their current operators. There was no record as to the frequency with which ownership in milk routes changed.

TRUCKS USED TO TRANSPORT MILK

Variation in size and type of trucks

Of the 178 trucks listed in the schedules, 142 had stake bodies and were using tarpaulins for the protection of their loads. 36 trucks had closed bodies, 5 of these were panel deliveries, 17 were listed as vans and 14 were listed as insulated vans.

These trucks ranged in size from licensed capacities of 4000 lbs., to licensed capacities of 35,000 lbs. About one half of the trucks had licensed capacities of either 14,000 lbs., or 16,000 lbs. The smallest trucks served a small number of shippers located close to Toronto. In general, the size of the trucks tended to increase as the location of the route became farther from Toronto.

The classification of trucks on the basis of licensed capacity may be criticized due to the ability to increase the licensed capacity of a truck by increasing the tire surface. However, where the type and make of trucks covered a wide range, this seemed to be the most suitable method of classifying trucks with regard to size.

Table 5

CAPACITY, MILEAGE TRAVELLED AND LOAD OF TRUCKS ON 89 ROUTES

Licensed Capacity of trucks	No. of routes in class	Annual mileage per truck	No. of shippers per truck	No. of cans per trip	No. of cans per route per year
6,000 lbs. and under	4	12,525	6.2	16	5,872
8,000 lbs.	7	19,361	12.3	38	13,701
10,000 "	6	20,890	13.0	38	13,692
12,000 lbs..	16	28,214	16.9	47	17,319
14,000 "	18	30,630	18.6	54	19,727
16,000 "	22	25,593	15.4	48	17,641
18,000 "	4	41,681	19.7	56	20,343
20,000 "	12	45,926	23.3	88	32,055

The above table gives the distribution, on the basis of licensed capacity, of the trucks used by 89 routes. Some of the physical factors associated with the routes of these different sized trucks are also shown.

It will be seen from the above table that the most of the routes used a truck of 12,000 lbs. to 16,000 lbs., licensed capacity, which hauled a load of about 50 cans. There was a general tendency for increased size of truck to be accompanied by increased mileage and size of load. With the exception of the 8,000 lbs. and 18,000 lbs. capacity groups, all groups of trucks had average mileage of about 1.5 miles for every can of milk hauled.

Age of trucks used on 89 routes

Although the number of years that operators believed that they should operate their trucks varied from one to five years, less than one-fifth of the trucks were more than three years old. The necessity for daily dependable service was undoubtedly a factor in the general trade-in policy. Lower fuel and repair costs provided an added inducement to maintain as new equipment as possible. The following table shows the ages of the 89 trucks and the gasoline and repair costs per mile for the different age classes.

Table 6

AGE DISTRIBUTION OF 89 TRUCKS WITH COMPARATIVE GASOLINE AND REPAIR COSTS PER MILE

Year of Purchase	Number of trucks	Average lic. cap.	Fuel cost per mile	Repair cost per mile
Prior to 1936	16	13,400 lb.	3.3c	1.4c
1936	15	14,400 "	2.8c	1.0c
1937	20	14,200 "	2.9c	.9c
1938	21	14,300 "	2.5c	.8c
Unknown	17			

It is readily seen that the possible saving in fuel and repair costs provided a strong incentive to the operators to replace their trucks frequently.

Capital invested in trucks

The apparent need for frequent replacement of trucks meant that the trucking equipment required a considerable part of the operators' capital. There was a wide variation in the cost of new equipment due to variation in size and type of trucks purchased. However, the following table gives some idea of the average purchase price of different sized trucks.

Table 7

VALUE (When New) OF 89 TRUCKS

Licensed Capacity	No. of Trucks	Average Puurchase Price
6,000 lbs. and under	4	$ 975.
8,000 "	7	1,497.
10,000 "	6	1,248.
12,000 "	16	1,720.
14,000 "	18	1,829.
16,000 "	22	2,133.
18,000 "	4	2,068.
20,000 "	12	2,949.

The rate of depreciation charged by the operators averaged 1.5c per mile. Using this rate of depreciation in conjunction with the annual mileage, age of trucks and value of trucks when new, gave an estimated value of $120,000 for trucking equipment at the beginning of 1938 for the 89 routes.

COST OF TRANSPORTING MILK TO TORONTO (89 Routes)

Table 8

COST OF HAULING MILK TO TORONTO AS REPORTED BY THE OPERATORS OF 89 ROUTES IN 1938

Item	Amount	% of total cost	Cents per can
Labour	$106,642.86	34.2	6.3
Fuel	75,286.81	24.1	4.5
Depreciation	39,415.95	12.6	2.3
Repairs	27,775.46	8.9	1.6
Tires	18,579.93	5.9	1.1
License	8,001.63	2.6	.5
Storage	6,847.14	2.2	.4
Insurance	6,514.66	2.1	.4
Miscellaneous	3,255.00	1.0	.2
Total Operating Costs	292,319.44	93.6	17.3
Supervision, Telephone, etc.	20,036.63	6.4	1.2
Total Costs	$312,356.07	100.0	18.5

Bearing in mind the distribution of the 89 routes as to size of truck, rate zones from which they collected milk and the volume of milk that they transported to Toronto, it may be assumed that their costs of operation are fairly representative of the average costs of hauling milk to Toronto. The table (No. 8) on the previous page gives the average cost per can for hauling milk as reported by the operators of the 89 routes.

The average cost of hauling the 1,687,903 cans of milk transported by the 89 trucks during 1938 was 18.5c per can. The items, Labour, Fuel, and Depreciation accounted for approximately 70% of the cost of transporting milk. These items will be considered separately.

Labour Costs

Since labour was the most important single item of cost in hauling milk, it is worthwhile to examine this cost in some detail. Labour costs were composed of wages paid to hired drivers, wage allowances where trucks were driven by owners, and such expenses as workman's compensation which were directly associated with labour.

Wages and wage allowances amounted to $1,181.06 per route. The compensation costs amounted to $17.17 per route. This gave a total average labour cost of $1,198.23 per route. Wage costs ranged from a low of $146 for a part-time route to a high of an owner allowance of $2,380.00. However almost one half of the routes reported wage costs of from $1,200 to $1,400 per year. The average wage rate for all 89 routes amounted to 45c per hour. The following table shows the distribution of the different rates of wages and average hours per trip for the different wage groups.

Table 9

DISTRIBUTION OF 89 ROUTES ACCORDING TO WAGE COSTS

Wages per year	Number of routes in wage class	Average number of hours per trip
$ 000 — $ 599	3	3.0
600 — 799	10	6.3
800 — 999	6	7.7
1,000 — 1,199	10	7.7
1,200 — 1,399	42	7.7
1,400 — 1,599	14	7.6
1,600 and over	4	8.2

There was a tendency for routes whose drivers lived in Toronto to have higher wage costs than routes whose drivers lived in rural areas. 16 of the trucks were driven by drivers living in Toronto. The average wage cost for these routes was $1,340 or 53c per hour. The remaining 73 routes whose drivers were living outside Toronto had average wage costs of $1,146 per route or 43c per hour.

Fuel Costs

Gasoline was the second most important item of cost in hauling milk, amounting to an average of 4.5c per can. The average fuel cost per mile as reported for the 89 routes was 2.9c. Since there was considerable variation in fuel costs per mile from route to route, it is worthwhile to examine this cost in some detail. While there was some relation between size of truck and fuel cost per mile, size of truck was only one factor contributing to fuel cost per mile. This is shown in the following table.

Table 10

RELATION BETWEEN SIZE OF TRUCK AND FUEL COST PER MILE
(89 Routes)

Licensed Capacity	No. of trucks	Total cost of fuel	Total miles travelled	Cost per mile
6,000 lbs. and under	4	$ 1,046.13	50,100	2.1c
8,000 "	7	3,330.40	135,525	2.5c
10,000 "	6	2,896.09	125,340	2.3c
12,000 "	16	12,144.50	451,439	2.7c
14,000 "	18	15,790.44	551,341	2.9c
16,000 "	22	18,254.82	563,051	3.2c
18,000 "	4	4,582.16	166,727	2.7c
20,000 "	12	17,242.27	551,120	3.1c

While there was a tendency for the cost per mile to increase with increased licensed capacity of the trucks, other physical factors pertaining to the individual routes were of sufficient importance to prevent any graduated increase in cost from one class of trucks to another.

For the purpose of comparing other factors associated with fuel costs per mile it was necessary to eliminate the difference in cost per mile which would be the direct result of variation in size of truck. This was done by selecting from each of the eight "licensed capacity" groups shown in table "10" the two trucks with the highest and the two trucks with the lowest fuel costs per mile. These selected sixteen higher cost routes were then averaged and also the sixteen low cost routes, such selection and averaging eliminating the size of truck as a factor in fuel cost per mile.

The other factors which influenced fuel cost per mile are compared in table "11" by using the averages indicated in Table 10.

Table 11

PHYSICAL FACTORS (Other Than Size) ASSOCIATED WITH FUEL COSTS PER MILE (89 Routes)

Item	Average of 16 high fuel cost routes	Average of 16 low fuel cost routes
Fuel cost per mile	3.4c	2.0c
Daily mileage	65 miles	95 miles
Daily "pick-up" mileage	23.5 miles	26.3 miles
% of mileage paved	63%	66%
Daily miles per shipper	3.7 miles	6.8 miles
Plants served per truck	2.4	2.4
Age of trucks	4 years	2 years
Average licensed capacity	13,000 lbs.	13,000 lbs.
Daily load	51.5 cans	45.2 cans
Fuel cost per can	4.3c	4.2c

The high fuel cost routes were shorter routes. They had a relatively higher proportion of "pick-up" mileage and slightly lower percentage of paved mileage. The greater density of shippers on these routes resulted in more stopping and starting with consequent increase in fuel consumption. Their trucks were older and although of the same average licensed capacity as the low fuel cost routes carried heavier loads. The combined results of these factors was a difference of 1.4c per mile in fuel cost.

With the exception of the age of the trucks, these factors contributing to higher fuel costs were associated with larger volume. While greater density of shippers and heavier loads meant higher fuel costs per mile, the more important cost is the cost per can. The larger loads had more cans to share the fuel cost. This greater number of cans almost counteracted the higher fuel costs per mile, since the fuel cost per can for the high fuel cost group was only one-tenth cent per can higher than for the low fuel cost group.

Other cost items

Depreciation was the third most important cost item. The allowance for depreciation for all trucks averaged 1.5c per mile or about $440.00 per truck. This charge would seem to be quite adequate provision for depreciation since the year's charge was approximately 23% of the initial cost of the equipment. This compares favourably with the average write-off of

14.9% of Public Commercial Vehicle operators as given in the Report of the "Royal Commission on Transportation, Province of Ontario", 1938, page 272.

Truck repairs and tires were also important cost items. Repairs amounted to $312.00 per truck for the year or approximately 1.1c per mile. Tires amounted to $208.00 per truck for the year or approximately .7c per mile.

Office expense averaged some $225.00 per route. While some of this expense would be for such items as telephone, stationery, etc., a large portion should be classed as supervision. This included goodwill work among the shippers, aiding them to clear up trouble with their milk which might cause them to lose their contracts and thus cut down the volume of the route, and similar types of activity. The bulk of this so-called supervision work was of a competitive nature aimed at maintaining the volume of milk hauled on the particular routes and it is questionable if the cost of 1.2c per can for such service was worth while to either producers or consumers in general.

RANGE IN COST OF TRANSPORTING MILK TO TORONTO

The average cost of transporting milk to Toronto was shown in table number "8" to be 18.5c per can. However, there was a wide variation in the cost of hauling per can among the different routes. The following tables show the cost per can for the lowest and highest cost routes classified according to rate zones and according to the size of trucks. It is of some interest to note that only 11 of the 89 truck routes reported costs greater than receipts.

Table 12

RANGE IN COST OF HAULING PER CAN WITHIN DIFFERENT RATE ZONES

(89 Routes)

Rate Zone	Cost per Can Low Cost route	Lic. Cap. of truck	Cost per Can High Cost route	Lic. Cap. of truck
18c per can	11.2c	8,000 lbs.	17.8c	12,000 lbs.
20c " "	14.0	14,000 "	46.5	16,000 "
23c " "	12.9	16,000 "	24.0	12,000 "
25c " "	14.1	16,000 "	29.8	12,000 "
28c " "	13.1	12,000 "	25.4	16,000 "
30c " "	13.4	20,000 "	36.6	14,000 "

Table 12, on page 20, shows the wide variation in hauling costs in the different zones. Insufficient numbers of trucks in each zone prevented comparison between identical trucks in each zone. However, the table indicates that size of truck was a minor factor in causing difference in cost per can.

In table number "12" the frequency with which 12,000 lb. and 16,000 lb. trucks appeared in both high and low cost columns indicated that size of trucks was of minor importance in causing difference in cost per can. This table shows that, regardless of the zone from which milk was being hauled, there was a tremendous variation in the cost of hauling among the different operators in that zone. The following table classifies the routes on the basis of licensed capacity of the trucks.

Table 13

RANGE IN COST OF HAULING PER CAN WITHIN GROUPS OF SAME LICENSED CAPACITY (89 Routes)

Licensed Capacity of trucks	Cost per can Low Cost route	Cost per can High Cost route	Average Cost per can
6,000 lbs. and under	14.3c	28.4c	19.7c
8,000 "	11.2	24.5	19.4
10,000 "	12.3	21.0	17.6
12,000 "	13.1	29.8	18.2
14,000 "	12.5	36.6	19.7
16,000 "	12.9	36.5	18.4
18,000 "	17.3	24.0	19.9
20,000 "	13.4	24.2	17.8

The above table shows that trucks of the same licensed capacity varied widely in their cost per can of hauling milk and it is quite apparent that the differences in cost of hauling milk were due to a number of factors rather than to size of truck or location of route alone.

A COMPARISON OF LOW AND HIGH COST ROUTES

With the wide variation in cost of hauling per can among the different routes, it is worthwhile comparing the low and high cost routes. In order to minimize the effect of any peculiar advantages or disadvantages pertaining to individual routes, the three low cost routes from each of the six rate zones were averaged and compared with the average of the three high cost routes from each of the six zones. The following table compares the various items of cost for these 18 low cost and 18 high cost routes.

Table 14

COMPARISON OF 18 LOW COST ROUTES AND 18 HIGH COST ROUTES

	Average Cost per Truck		Average Cost per Mile	
Item	Low Cost routes	High Cost routes	Low Cost routes	High Cost routes
Labour	$1,100.43	$1,159.06	3.16c	3.74c
Fuel	867.17	900.34	2.49	2.91
Depreciation	459.31	417.93	1.32	1.35
Repairs	311.80	282.77	.89	.91
Tires	239.02	214.10	.69	.69
License	97.97	84.60	.28	.27
Storage	54.35	54.98	.15	.18
Insurance	62.44	82.42	.18	.27
Miscellaneous	56.07	16.50	.16	.05
Operating	3,248.56	3,212.70	9.32	10.37
Overhead	190.99	182.20	.55	.59
Total Cost	3,439.55	3,394.90	9.87	10.96

The difference in costs per truck were of little significance. The low cost trucks obtained their chief advantage from the items of labour and fuel. Wages paid by low cost trucks were slightly lower than the high cost trucks. In general, the low cost trucks were newer than the high cost trucks, only three were purchased prior to 1937, whereas seven of the high cost trucks were purchased prior to 1937.

The low cost trucks travelled an average of 3,873 more miles per year than the high cost trucks. Hence when labour and gasoline costs were expressed on a per mile basis the difference between the two groups becomes more apparent. These two items which accounted for the main difference in costs per mile showed a difference of 1c per mile in favour of the low cost group.

While cost per mile is of some interest from a purely transportation viewpoint, cost per can is much more important to both producer and trucker. The following table distributes the various items of cost for the two groups of trucks on a per can basis.

Table 15

COMPARISON OF 18 LOW COST ROUTES AND 18 HIGH COST ROUTES

Item	Low Cost routes	High Cost routes
Number of cans per route	63	38
	Average Cost per Can	
Labour	4.8c	8.4c
Fuel	3.8	6.5
Depreciation	2.0	3.0
Repairs	1.4	2.0
Tires	1.0	1.6
License	.4	.6
Storage	.2	.4
Insurance	.3	.6
Miscellaneous	.2	.1
Total operating cost	14.1	23.2
Overhead	.8	1.3
Total Cost	14.9	24.5

Table number "14" showed little difference in annual cost per truck or in cost per mile between the two groups of routes. However, when costs were expressed on a per can basis the influence of volume on lowering unit costs becomes apparent. The average cost for the 18 low cost routes was 9.6c per can less than the average cost for the 18 high cost routes. A number of different factors contributed to bring about this difference in cost per can. These factors are illustrated in Table 16.

Not only did the low cost per can routes have lower costs per mile but in addition they hauled bigger loads. The low cost routes had average loads of 62.9 cans while the high cost routes had average loads of only 37.9 cans. Although the low cost trucks travelled an additional 10.6 miles per day to obtain these extra 25 cans, they travelled less miles per can than the high cost trucks. Trucks on the high cost routes travelled 2.24 miles for every can collected at a cost of 10.96c per mile which resulted in a cost of 24.5c per can. Trucks on the low cost routes travelled 1.51 miles for every can collected at a cost of 9.87c per mile which resulted in a cost of 14.9c per can. Consequently their cost per can for hauling milk was 9.6c less than the cost of the high cost routes. The low cost routes enjoyed lower mileage per can as a result of the greater density of shippers on their routes and the fact that their shippers marketed an average of one half can of milk more per day than the shippers on the high cost routes.

Table 16

PHYSICAL FACTORS OF 18 LOW COST AND 18 HIGH COST ROUTES

	Average per Route	
Item	Low Cost routes	High Cost routes
Mileage per year	34,842	30,969
Cans per year	22,972	13,821
Miles per can	1.5	2.2
Number of shippers	18.7	13.4
Cans per shipper	3.3	2.8
Miles per shipper	5.1	6.3
Plants served	1.9	2.9
Licensed capacity	15,000 lb.	14,000 lb.
Daily load	5,034 lb.	3,029 lb.

While volume of milk and cost of operation per mile were the important factors in obtaining low cost per can, there were other factors which increased the efficiency of the low cost routes. Trucks on these routes delivered milk to fewer plants in Toronto, serving an average of 1.9 plants per truck as compared to 2.9 plants per truck on the high cost routes. The trucks on the low cost routes were slightly larger than those on the high cost routes as indicated by an average licensed capacity of 15,000 lbs. as compared to an average licensed capacity of 14,000 lbs. for the high cost group. The capacity of these larger trucks was used to a greater extent, since they hauled an average of 5,034 lbs. of milk per trip in comparison to 3,029 lbs. of milk per trip for the high cost routes. With an increase of 1,000 lbs. in average licensed capacity they hauled loads that were 2,000 lbs. heavier than the average load of the high cost trucks.

RELATIVE IMPORTANCE OF OPERATION COSTS AND VOLUME ON COST OF TRANSPORTING MILK

The cost of hauling a can of milk to market is obtained by the following method: Cost per mile × miles travelled per can = hauling cost per can.

Any reduction in either cost per mile or miles per can will lower the cost per can. The question arises which of these two factors is the more important. In the previous discussion, two groups of 18 trucks were compared. One group had a much lower cost per can than the other group. Not only did it have a lower cost per mile but also had a much heavier volume as indicated by the fewer miles travelled for every can hauled to the plant. By interchanging the cost per mile and the volume of the two groups it is possible to obtain a picture of the relative importance of the two factors on the hauling cost per can.

18 High Cost Routes

10.96c per mile × 2.24 miles per can = 24.5c per can.

18 Low Cost Routes

9.87c per mile × 1.51 miles per can = 14.9c per can.

If the high cost routes had been able to increase their efficiency of truck operations to lower their cost per mile to 9.87c (the average of the low cost group) their cost per can would have been as follows,—

9.87c per mile × 2.24 miles per can = 22.1c per can.

Assuming that they retained their former volume this increase in the efficiency of truck operation would have lowered their cost per can by 2.4c.

It is apparent from the above discussion that lower truck operating costs per mile were not a major factor in giving the low cost group lower costs per can. This being the case, it was necessary to examine the effect of volume on the cost of hauling per can. If the high cost trucks had been able to increase their volume of milk hauled and thus lower the number of miles per can to 1.5 (the average of the 18 low cost routes) without changing their operating costs per mile, their costs per can would have been as follows,—

$$10.96\text{c per mile} \times 1.51 \text{ miles per can} = 16.5\text{c per can.}$$

This increase in volume per mile would have lowered their costs 8.0c per can even if they maintained their former high operating costs per mile.

It is true that the effect of substituting operating costs and volume of one group of trucks for those of another group of trucks is hypothetical. Nevertheless it seems quite fair to assume that what one group of 18 trucks could accomplish was not an impossible feat for another group of 18 trucks. Consequently, from the above comparison of the two groups of high and low cost routes, it would seem that volume was at least three times as important in reducing costs of hauling milk for the low cost group as was their lower operating costs per mile. While operating costs and volume for these two groups of trucks would not necessarily apply to other truck routes, the above figures indicate that increasing volume is the most effective method of lowering the cost of transporting milk to market.

EARNINGS OF 89 MILK ROUTES

Net Earnings of 89 Routes

The previous material has been concerned with the cost of transporting milk to Toronto. The figures used have been derived from the data provided by the operators of these routes. Table number "8" showed the cost of hauling 1,687,903 cans of milk to be $312,356.07 or an average of 18.5c per can. This cost included the operators' estimates for depreciation on equipment and wage allowances where the operators drove their own trucks.

The charges to the producers for the trucking of this milk amounted to $386,150.53. From this amount the truckers paid the dairies a collection charge of approximately 1.5% to collect trucking charges from the milk shippers. This left net receipts to the truckers of $380,358.28 or an average of 22.5c per can. This gave the truckers net earnings of $68,002.21 or an average of 4c per can to pay interest on capital investment.

Return on capital investment 89 routes

The average price that was paid for 20 routes that were purchased since 1933 was approximately $78.00 per can. This average purchase price was considered to be a fair basis for evaluating the investment of the operators in their 89 routes. Hence, regardless of whether operators acquired their routes by purchase or built up their own routes, all routes were valued at $78.00 per can. This gave a total valuation of investment in routes of approximately $360,000.00.

The rate of depreciation charged by the operators averaged 1.5c per mile. Using this rate of depreciation in conjunction with the annual mileage, the age of the trucks, and the value of the trucks when new, gave an estimated value of $120,000.00 for trucking equipment.

Since allowance for office expense and truck storage had already been made, the capital invested in trucks and routes was considered as total investment in the business. Thus on a total investment of some $480,000.00 the operators of the 89 routes studied, made a profit of approximately $68,000.00. This was equal to slightly more than 14% return on their investment.

It must however, be recognized that the total investment given above may be high because in the purchase of routes an old truck was often included and to this extent there is overlapping in the figures given for valuation of investment and valuation of trucks. The return on investment would, therefore, be in excess of 14%.

SUMMARY

The almost complete change-over during the last twenty years from railway to motor truck as a means of milk transport in the Toronto milk shed has created many situations that are worthy of study—services to producers have increased, the shape and concentration, though not the extent, of the milk shed has changed and overlapping services have been quite evident.

Except for monopoly situations in some areas, milk transport rates were purely competitive until 1939, when a standard maximum rate structure, with the temporary approval of the Board, confirmed the generally existing rates, eliminated many of the remaining inequalities, and slightly lowered the average charges.

Prices which were paid for milk routes indicate that the prevailing rates were considered sufficiently high to insure satisfactory returns to operators.

Labour and fuel accounted for over half of the cost of trucking milk. These items amounted to 10.8c per can out of the total cost of 18.5c per can. Wage rates appeared to be good when compared with wages paid for other classes of motor transport but any reasonable change in these rates would have had little effect on the total cost of hauling milk.

While existing rates have made the trucking of milk a profitable business, it is apparent that any possible reduction in the cost of operating trucks would not be sufficient to permit a marked decrease in trucking rates. Volume of milk on the route had a much more important relation to the cost of hauling than operating costs of the truck. This was demonstrated in the comparison of the 18 low cost routes and the 18 high cost routes. This comparison showed that a difference in volume was more than three times as important as a difference in operating costs in lowering the cost per can. Evidently any decrease in the cost of hauling milk that would permit a worthwhile decline in trucking rates can be attained only by increasing the volume of milk per load on the individual routes.

It was shown in the comparison of the 18 low cost and 18 high cost routes that a reduction of 0.7 miles per can decreased the cost of hauling approximately 8.0c per can. The average number of miles per can for the 18 low cost routes was only slightly less than for the 89 routes. In the discussion of overlapping service, it was estimated that 22% of the total mileage travelled comes from overlapping service and the driving of unnecessary trucks. If part of this mileage could be saved by reorganization, the consequent decline in haulage costs would allow worthwhile rate reductions to be effected without penalizing the truck operators as a whole.

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Ontario Department of Agriculture

Statistics and Publications Branch

TORONTO, ONTARIO

HINTS ON JUDGING
FIELD CROP SEEDS, FIELD ROOTS AND POTATOES

BY

The Staff of the Field Husbandry Department

ONTARIO AGRICULTURAL COLLEGE

GUELPH, ONTARIO

Close and thorough observation is necessary for fair comparison.

GRAINS, GRASS AND CLOVER SEEDS, POTATOES AND FIELD ROOTS

The following notes have been prepared primarily for the use of young farmers in connection with their local short courses and judging competitions, but will be useful also to men preparing themselves for judging at fairs and exhibitions.

Score cards have been included, but it should be understood that these are intended only for the use of students in training. They are for the special purpose of calling attention to the main points which should be considered in judging, and to indicate approximately the relative value of these points. Score cards are seldom or never used in actual judging in the showroom or show-ring.

JUDGING BARLEY FOR SEED

The main points in judging barley may be discussed as follows:

1. Brightness of Colour. This point is always emphasized in barley, since it is the chief indication of freshness and ability to germinate quickly and evenly. Barley discolours very readily from exposure to weather or with age.

2. Size and Uniformity. The kernels should be of uniformly large size for the variety. This point should be carefully watched because the seed, especially of six-rowed varieties, naturally lacks uniformity in size, and for seed purposes the smaller seeds should be graded out, since they have not the same ability to give the resulting young plants a vigorous start in life.

3. Plumpness. Plump seeds are generally well matured and more capable of producing strong young plants than are the more shrunken ones.

4. Soundness. Barley is frequently more or less broken in the threshing process. The seeds break crosswise, so that the half containing the germ has not a full supply of plant-food material for the resulting young plant when it starts to grow; hence the discrimination against broken seeds.

5. Weight per Measured Bushel. High weight per measured bushel is an indication of quality, and is more important in judging barley than in judging oats, since there is less variation in the thickness of hull on barley.

6. Freedom from Foreign Seeds. This means freedom from weed seeds or seeds of other kinds of grain, and cannot be determined at a glance. At least a portion of each lot of seed should be thoroughly examined, so that the judge may know exactly how many and what kinds of foreign seeds are in it.

7. Purity of Variety. The sample should be free from kernels of other varieties of barley. This is important, though not so important as freedom from foreign seeds. The presence of other varieties will be indicated chiefly by difference in shape, colour and size of kernel.

Score Card

	Points
Size and uniformity	20
Plumpness	10
Soundness	10
Freedom from foreign seeds	20
Brightness of colour	15
Weight per bushel	15
Purity of variety	10
Total	100

JUDGING OATS FOR SEED

The main points in judging oats may be discussed as follows:

1. Germinating Power. In oats this will be indicated chiefly by the absence of any mouldy smell, dullness of colour, or a greenness of colour indicating immaturity.

2. Size and Plumpness. Kernels which are uniformly graded, plump and large for the variety will produce an even stand of rigorous young plants. Seed oats should not contain double oats or small pin oats.

3. Thinness of Hull. In judging oats, quality can usually be determined better by thinness of hull than by weight per bushel. Indeed, weight per bushel is of comparatively little value in judging oats, since it is not definitely correlated with thinness of hull. Sometimes samples with very thick hulls are heavy in weight per bushel, and sometimes the opposite is true. Often very plump-appearing oats have a very thick hull, and sometimes the opposite is true. The judge, therefore, should always take time to select at random not less than a dozen kernels from each entry, and to remove the hulls from these to determine, as nearly as possible, the proportion of hull to kernel, and the thickness or toughness of the hull. Thick, tough-hulled oats, even though they may have large kernels, are hard for animals to masticate, and hence have a low feeding value. Varieties having this characteristic should not be used for seed.

4. Freedom from Foreign Seeds. This means freedom from weed seeds or seeds of other kinds of grain, and cannot be judged at a glance. At least a portion of each lot of seed should be thoroughly examined so that the judge may know exactly how many and what kinds of foreign seeds are in it.

5. Purity of Variety. The sample should be free from kernels of other varieties of oats. This is important, though not so important as freedom from foreign seeds. The presence of other varieties will be indicated chiefly by difference in shape, colour and size of kernel.

Score Card

	Points
Germinating power	20
Size and plumpness	20
Freedom from foreign seeds	25
Thinness of hull	20
Purity of variety	15
Total	100

JUDGING WHEAT FOR SEED

The main points in judging wheat may be discussed as follows:

1. Germinating Power. In the threshing process wheat grains lose their chaff or hull, hence the germs are more exposed to adverse conditions, and are more likely to be injured than they would be in barley or oats which retain the hull. For this reason the germ end of the grain should be carefully examined to see that there is no mouldiness, discolouration or indication of previous sprouting.

2. Size and Plumpness. The grain should be uniformly large for the variety and nicely filled out, indicating capacity to produce vigorous young plants.

3. Freedom from Foreign Seeds. This means freedom from weed seeds or seeds of other kinds of grain, and cannot be judged at a glance. At least a portion of each lot of seed should be thoroughly examined so that the judge may know exactly how many and what kinds of foreign seeds are in it.

4. Weight per Measured Bushel. In wheat, high bushel weight is an indication of maturity, soundness and quality. At most large shows the weight per bushel of all samples is determined by the use of an instrument. This is usually done in advance of the judging, and the weight of each sample is placed on the entry card, or on a separate tag, to save time for the judge.

5. Purity of Variety. The sample should be free from kernels of other varieties of wheat. This is important, though not so important as freedom from foreign seeds. The presence of other varieties will be indicated chiefly by difference in shape, colour and size of kernel.

6. Kernel Texture. (a) Spring Wheat. Hardness indicates quality, and may be determined by biting or cutting some of the seeds, or by their appearance. Hard kernels appear a little darker in colour, and are more flinty or translucent in appearance.

(b) Winter Wheat. A soft, starchy kernel is desired in winter wheat. A uniform, starchy appearance is preferred to either mottled starchiness or a translucent appearance.

Seed wheat should be carefully examined for the presence of smut balls. These are a little smaller and rounder than wheat kernels, and usually have a light grayish or brownish colour. When broken they are found to contain a black mass of smut spores. Smut balls are very objectionable in seed wheat.

Score Card

	Points
Germinating power	20
Size and plumpness	15
Freedom from foreign seeds	25
Weight per bushel	15
Purity of variety	15
Kernel texture	10
Total	100

JUDGING CORN FOR SEED

Judging corn is an attempt to estimate its value for seed. By selecting well-matured seed ears, free from disease, of uniform size, straight rows, deep kernels and high shelling percentage, the production of nubbins, shallow kernels and other objectionable characters is diminished, and the productiveness correspondingly increased.

Standards have been established within the recognized varieties of corn which form the basis of corn judging. The description of such standards is what constitutes type for any kind of corn.

Points to be Observed

Preparing Exhibit. An exhibit usually consists of ten ears of corn. To judge kernels remove two from each ear two-thirds of the way from butt to tip. Place each pair of kernels at the butt of the cob from which they were taken.

Uniformity of Exhibit. The points that go to produce uniformity of exhibit are size, shape and colour of ear, appearance of tips and butts, and indentation of kernel.

Trueness to Type. The ears in the sample should possess similar or like characteristics, and should be true to the variety which they represent.

Length of Ear. The length of ear varies according to variety. Uniformity in length is to be sought for in a sample. Very long ears are objectionable, because they usually have poor butts and tips, broad, shallow kernels, and hence a low percentage of corn to cob.

Circumference of Ears. The circumference of the ear should be in symmetry with its length. An ear too great in circumference for its length is generally slow in maturing, and frequently results in soft corn.

Shape of Ears. The shape of the ear should conform to the variety type. Ear should be full and strong in the central portion, and not taper too rapidly toward the tip, indicating strong constitution and good yield.

Tips of Ears. The tip should be regular in form, with the kernels of uniform shape and size. The proportion of tip covered or filled must be considered. Long, pointed tips, flattened or double tips are objectionable.

Butts of Ears. The rows of kernels should extend in regular order over the butt, leaving a deep, clean depression, free from shredding or discolouration which indicate disease. Irregular, open and enlarged butts are objectionable.

Uniformity and Shape of Kernels. The kernels should be uniform in size and shape, not only on the individual ear, but also uniform within each ear in the sample. They should also be uniform in colour, and true to variety type. The kernels should be so shaped that their edges touch from tip to crown. The tip portion of the kernel is rich in protein and oil, and hence of high feeding value. Kernels with a large germ insure strong, vigorous growth, as well as richness in quality of kernel.

Colour of Kernel. Colour of grain should be true to variety and free from mixture. Differences in shade of colour, as light or dark red, white or cream colour, must be scored according to variety characteristics.

Colour of Cobs. Colour of cobs should conform to the standards as laid down for the variety.

Furrows Between Rows. The furrows between rows of kernels should be narrow.

Space Between Tips of Kernels at Cob. There should be no space between tips of kernels at the cob as it indicates immaturity, low yield, weak constitution and poor feeding value.

Proportion of Corn to Cob. Shelling percentage is a most important point. Depth of kernels, size of cob, maturity, furrows, and space at cob—all affect the proportion. Percentage of corn should be from 78–80. The reason for determining this point is primarily to discourage the production of a large cob, while it also encourages a deep kernel.

Vitality or Seed Condition. Vitality and good germinating power are indicated by plump, firm kernels and well-developed germs. Such kernels germinate readily, are resistant to disease, and furnish abundant food during the early growth stage. Maturity, which is a most important point in determining the seed value of corn, is commonly estimated by the firmness of the kernel on the ear and by the stiffness of the ear. Each ear should be taken in turn and twisted. If the ear twists easily, it is not well matured. If the cob is stiff, see if the kernels are loose on the cob. Looseness of the kernels indicates immaturity.

Score Card

	Points
Trueness to type	10
Length of ears	10
Circumference of ears	5
Shape of ears	10
Tips of ears	5
Butts of ears	5
Uniformity of kernels	10
Shape of kernels	5
Colour of kernels	5
Colour of cobs	5
Furrows between rows	5
Space between kernels at cob	5
Proportion of corn to cob	10
Vitality, or seed condition	10
Total	100

STANDARDS FOR ONTARIO-GROWN VARIETIES OF CORN

DENTS

Wisconsin No. 7

Ear—Length, 6½ inches to 9¼ inches. Circumference, 6¼ inches to 7½ inches.
Kernel—Colour, creamy white. Indentation, well dented.
Rows—Sixteen to eighteen.
Butt—Moderately rounded.
Tip—Well covered. Fairly full.
Cob—Colour, glistening white.

Yellow Dent

Ear—Length, 6½ inches to 9¼ inches. Circumference, 6¼ inches to 7½ inches.
Kernel—Colour, deep yellow. Indentation, nicely dented.
Rows—Fourteen to eighteen.
Butt—Moderately rounded.
Tip—Well covered, slightly tapering.
Cob—Colour, dark or cherry-red.

White Cap Yellow Dent

Ear—Length, 6½ inches to 9¼ inches. Circumference, 6¼ inches to 7½ inches.
Kernel—Colour, cap white, remainder yellow. Indentation fairly rough.
Rows—Fourteen to sixteen.
Butt—Moderately rounded.
Tip—Well covered, slightly tapering.
Cob—Colour, red or white.

FLINTS

Longfellow

Ear—Length, 10 inches to 12 inches. Circumference, 4½ inches to 5 inches.
Kernel—Colour, deep golden yellow. Indentation, none.
Rows—Eight.
Butt—No larger than half distance up ear.
Tip—Slightly tapering and well covered.
Cob—Colour, pure white.

Salzer's North Dakota

Ear—Length, 11 inches to 12 inches. Circumference, 5 inches to 5½ inches.
Kernel—Colour, pearly white. Indentation, none.
Rows—Eight.
Butt—No larger than one-third distance up ear.
Tip—Slightly tapering and well covered.
Cob—Colour, pure white.

Compton's Early

Ear—Length, 11 inches to 13 inches. Circumference, 5½ inches to 6 inches.
Kernel—Colour, deep golden yellow. Indentation, none.
Rows—Twelve.
Butt—No longer than one-third distance up ear.
Tip—Well covered.
Cob—Colour, pure white.

A good ear of Dent. *A good ear of Flint.*

JUDGING CLOVER SEEDS

In judging clover seeds, an acquaintance with the seeds of at least the more troublesome weeds is important, since the presence of a considerable number of seeds of the comparatively harmless weeds would not be of much consequence, while the presence of a very few seeds of the noxious weeds would be very objectionable. Comparative freedom from weed seeds is one of the most important points in judging any of the clover seeds.

COMMON RED CLOVER

The points to be considered in judging Red Clover seed are as follows:

1. Size and Plumpness. The seed should be of good size for the kind, and should be plump and well filled, indicating good maturity and a capacity to produce vigorous plants.

2. Colour. In Red Clover seed there is a natural variation in colour, from greenish yellow to dark purple, with a more or less distinct difference between the dark seeds and the light seeds. If these are equal in other characteristics it makes little difference whether there is a large or small proportion of dark seeds. Some strains have a large percentage of purple seed, while others are lighter in colour, but, whether the seeds be dark or light, they should have a distinct lustrous surface, indicating freshness and vigour.

3. Purity. The seed should be pure, not only as to freedom from weed seeds, but also as to freedom from other clover seeds; and in order to detect the latter kind of impurity the judge should be familiar with the other clover seeds which may closely resemble the light-coloured seeds of Red Clover. These may be Sweet Clover, Alfalfa or Yellow Trefoil.

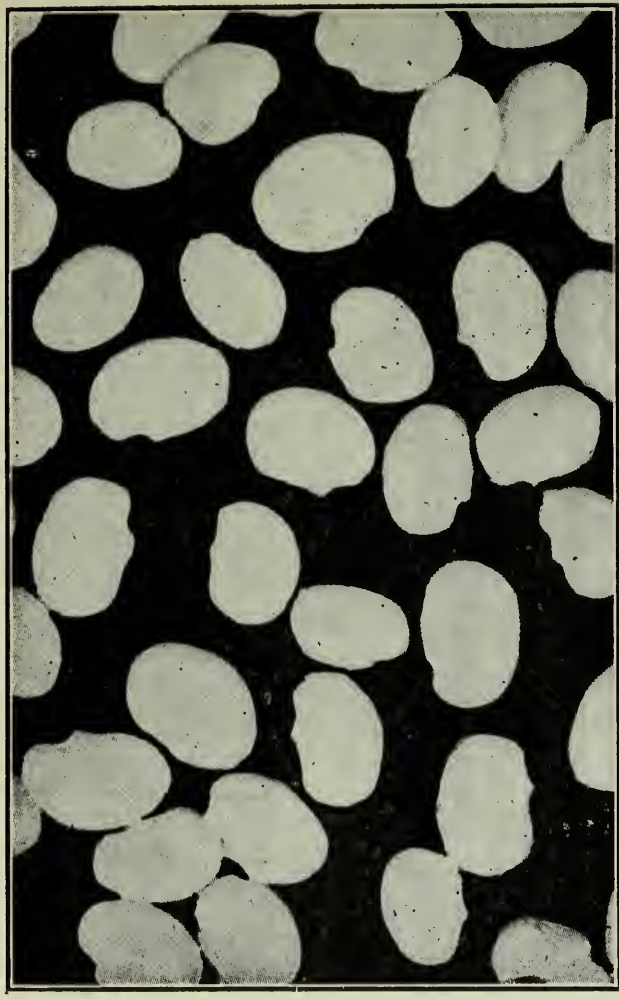
4. Freedom from Deadish Brown Seeds. All Red Clover seeds, whether yellow or purple, have a tendency to turn to a brownish shade with age, or with much exposure to the weather, and usually such seeds will not germinate so freely, nor produce such vigorous plants, as the fresh, lustrous yellow and purple seeds.

Score Card

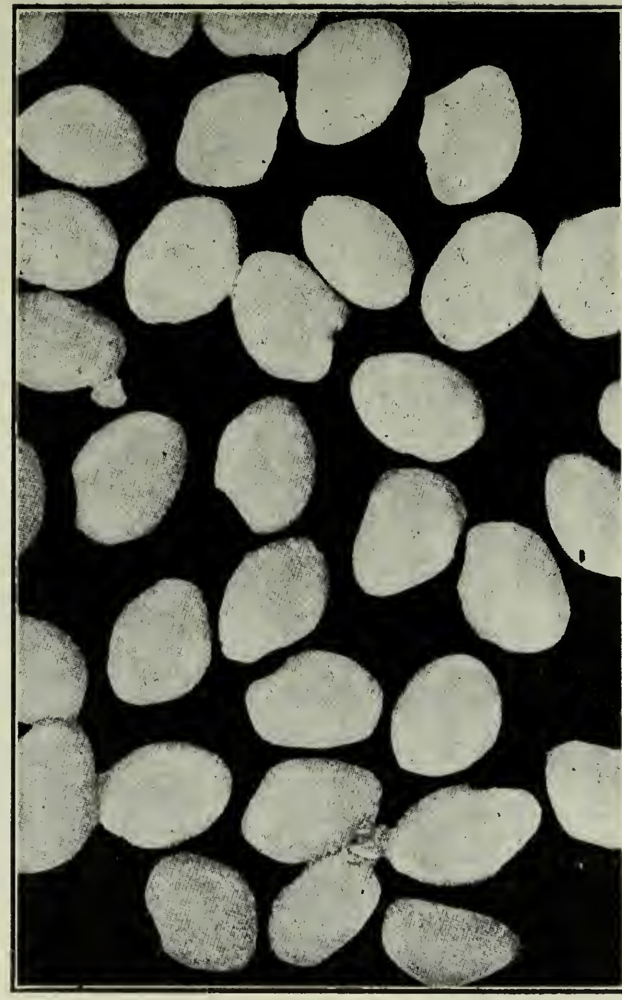
	Points
Size and plumpness	25
Brightness of colour	20
Purity	45
Freedom from brown seeds	10
Total	100

ALFALFA

The same general principles used in judging Red Clover seed will apply in judging Alfalfa seed, but in Alfalfa seed the colour should be uniform and slightly greenish yellow. There is a much greater variation in the shape of the Alfalfa seeds than in the shape of Red Clover seeds, the larger seeds frequently being kidney-shaped. Partly matured seeds are more green in colour, and often not so plump. In judging, this immaturity should be guarded against. There is also often found a proportion of brownish seeds, the result of immaturity and exposure, and these seeds either will not germinate or germinate weakly, and so are objectionable.



Yellow Trefoil (Medicago lupulina)
Magnified eight diameters
(After H. F. Roberts.)



Sweet Clover (Melilotus alba)
Magnified eight diameters
(After H. F. Roberts.)

Alfalfa (Medicago sativa)
Magnified eight diameters
(After H. F. Roberts.)

In judging Alfalfa seed, a close lookout must be kept for seeds of Sweet Clover or Yellow Trefoil, both of which are much like Alfalfa in size and colour, though different in shape.

Score Card

	Points
Size and plumpness	20
Brightness of colour and lustre	20
Purity	40
Freedom from green or dead seeds	20
Total	100

SWEET CLOVER

The same general rules apply as in judging Alfalfa and Red Clover. Good Sweet Clover seed has a marked uniformity of colour, and a little less lustre on the surface than Alfalfa seed. It also has a decided uniformity in shape which the Alfalfa does not have, and it has a distinct smell and taste different from the others. In the Sweet Clover there is less tendency to greenish and brownish immatured seeds, but the same general tendency to turn brown with age or exposure, and this must be watched carefully in judging, since either age or exposure tends to weaken germinating power.

Score Card

	Points
Size and plumpness	25
Colour	20
Purity	45
Freedom from brown seeds	10
Total	100

ALSIKE

Alsike seed is naturally about half as large as Red Clover, Alfalfa or Sweet Clover seeds, and is therefore not likely to contain any mixture of these, since they can be easily separated with screens. Good Alsike seed naturally varies from very light green to very dark bluish green in colour, and a preponderance of dark seeds is generally favoured. There is just as great a tendency to mixture of weed seeds in Alsike as in other clovers. There is also a tendency to mixture with White Dutch Clover, since Alsike and White Dutch Clover seeds are almost identical in size and shape. They differ distinctly in colour, however, the White Dutch seed varying from clear light yellow to deep orange.

Score Card

	Points
Size and plumpness	20
Colour—Lustre	15
Per cent dark seeds	10
Purity	45
Freedom from brown seeds	10
Total	100

JUDGING GRASS SEEDS

In judging grass seeds especial care should be taken to determine the size, purity (i.e., freedom from weed seeds and cheap adulterant seed) and germinating power, as it is largely on these qualities that the success of our pasture and meadow husbandry depends.

TIMOTHY

The points to be considered in judging Timothy seed may be discussed as follows:

1. Size and Plumpness. Shrivelled seeds make weak seedlings. The seed of our grasses is usually small, and there is only a limited supply of reserve food material in the seed available to the young seedling, hence the importance of large, plump, well-developed seed, with an abundance of reserve food nourishing vigorous seedlings which keep ahead of the weeds and are not so subject to disease.

2. Brightness of Colour (Lustre). Brightness of colour (and in Timothy a beautiful silvery lustre) indicates that the seed has been harvested under very favourable weather conditions. Dark, stained or bleached seed indicates weather damage, and consequently lowered germination power.

3. Purity. This is a most important point, and you will note that 45 marks are allowed for it. By purity of seed is meant freedom from weed seeds, foreign material, chaff, dirt, etc., and cheap adulterant grass seeds. Impurities are far more common in grass and clover seeds than in those of other crops, due to the fact that they are sown broadcast, which prevents cultivation, and it is rarely possible to keep the fields free from weeds. The meadows from which the seed is harvested are usually the last crops in the rotation, hence weeds have had a chance to increase. It is very difficult to construct machinery which will do a thorough job of cleaning grass and clover seed from the small weed seeds often found mixed with them. Therefore, great care should be exercised in judging and buying grass seed, as it is often through this source that our farms are contaminated by such noxious weeds as Ox-eye Daisy, Cockle, Sow Thistle, etc.

4. Freedom from Hulling. Naked or hulless Timothy seed loses vitality more quickly than that which has retained the hull, and should be discriminated against.

Score Card

	Points
Size and plumpness	20
Brightness of colour (lustre)	20
Purity	45
Freedom from hulling	15
Total	100

JUDGING POTATOES

In preparing to judge potatoes one should first make himself familiar with the types of the different varieties, also with the diseases that may appear on the tubers.

Potatoes are either shown as seed potatoes or table stock. Seed potatoes are shown in group classes such as Irish Cobbler, Green Mountain and Rural. These groups are classified according to their shape and time of maturity. They are also shown in variety classes. Table stock potatoes are shown as early table stock and late table stock.

The desirable size of tubers for a seed exhibit is eight ounces. Large tubers are not economical to use for seed purposes, as they increase the cost of seed per acre and do not keep as well as medium-sized tubers.

The important points to consider in judging potatoes for seed are:

1. Trueness to type of variety.
2. Uniformity in size.
3. Freedom from disease.
4. Freedom from cuts, bruises, sunburn and insect injury.

Disease is indicated by scabbiness, small black specks or cloudy dark spots on the skin, by discoloured portions, or by actual decay. It is also sometimes indicated by a softness at the point where the stem is attached. Good, sound potatoes usually have a very small portion of the stem adhering. If this is absent the point should be examined carefully for the beginning of disease which causes discolouration or streaks in the interior.

DESCRIPTION OF GROUPS

Irish Cobbler Group

Tubers—Roundish. Skin creamy white.

Sprouts—Base, leaf scales and tips slightly or distinctly tinged with reddish violet or magenta. In many cases the colour is absent.

Flowers—Light rose-purple; under intense heat may be almost white.

Varieties—Early Eureka, Irish Cobbler, Warba, Bliss Triumph. (The latter two varieties do not belong to this group, but are included on account of their type and time of maturity.)

Green Mountain Group

Tubers—Moderately to distinctly oblong, usually broad, flattened. Skin a dull creamy or light russet colour, frequently having russet-brown splashes toward the seed end.

Sprouts—Base, leaf scales and tips creamy white, or base usually white, occasionally tinged with magenta; leaf scales and tips tinged with lilac to magenta.

Flowers—White.

Varieties—Carman No. 1, Delaware, Empire State, Gold Coin, Green Mountain. (Chippewa variety has not been classified, but could be shown in this group on account of its shape.)

Tubers—Broadly round-flattened to short oblong, or distinctly oblong-flattened. Skin creamy white or deep russet.
Sprouts—Base dull white; leaf scales and tips violet-purple to pansy-violet.
Flowers—Central portion of corolla deep violet, with the purple growing lighter toward the outer portion; five points of corolla white, or nearly so.
Varieties—Carman No. 3, Dooley, Noxall, Rural New Yorker No. 2, Sir Walter Raleigh, Late Petoskey (Rural Russet), Katahdin.

Score Card—Judging Seed Potatoes

	Points
General appearance—shape, smoothness	15
Uniformity and size	15
Freedom from disease	25
Freedom from cuts, bruises, sunburn and insect injury, etc.	20
Purity of variety	25
Total	100

Score Card—Judging Table Stock Potatoes

	Points
General appearance	15
Uniformity and size	15
Purity of variety	20
Economy in peeling—	
Freedom from disease	20
Freedom from cuts, bruises, sunburn and insect injury, etc.	20
Varietal smoothness	10
Total	100

In judging table stock potatoes one should always keep in mind the requirements of the consumer. Tubers that are bright and clean, of uniform size and one variety, free from apparent disease, cuts, bruises, sunburn and insect injury, have the greatest appeal. The size of tuber most desirable for table stock is ten ounces. Large tubers are often rough, sometimes hollow, and usually of poor quality.

Typical Katahdin Potato.

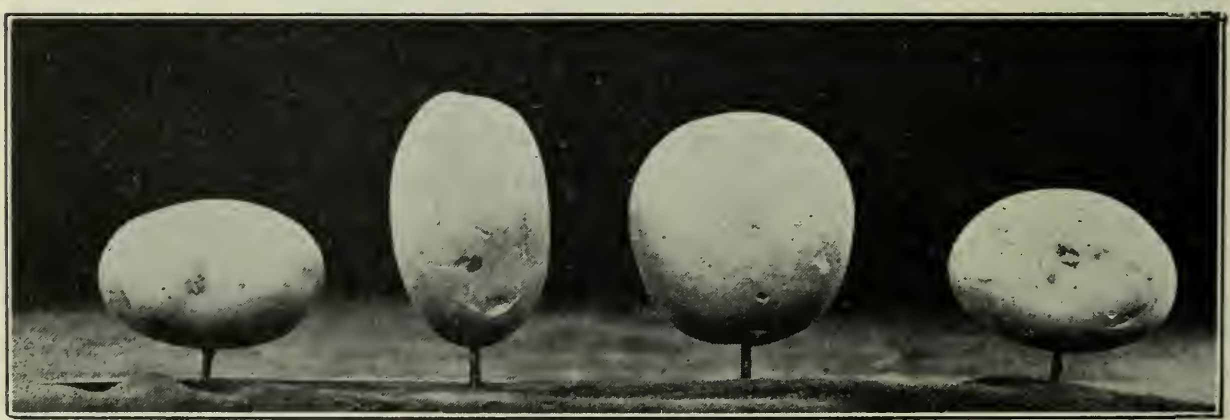
Katahdin (Medium Late Variety)

Tubers—Short elliptical to roundish and medium thick. Mean length, 3.23 inches; mean width, 3.16 inches; mean thickness, 2.38 inches. Skin smooth and creamy white. Flesh white. Eyes very few and shallow.

Typical Green Mountain Potato.

Green Mountain (Late Variety)

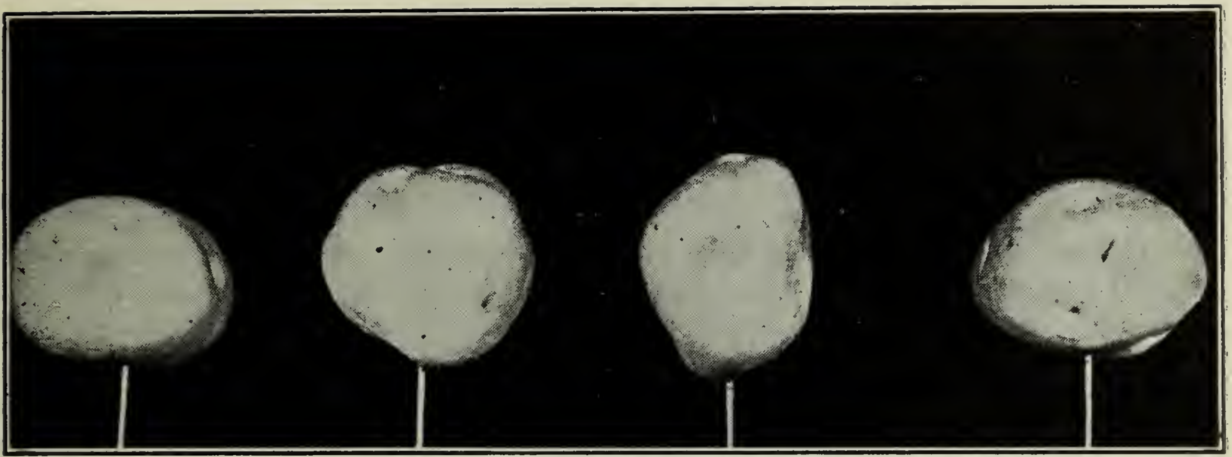
Tubers—Moderately to distinctly oblong, usually broad, flattened; ends usually blunt, especially seed end. Skin a dull creamy or light russet colour, frequently having russet-brown splashes towards seed end. Eyes quite shallow. Flesh white.



Typical Dooley Potato.

Dooley (Late Variety)

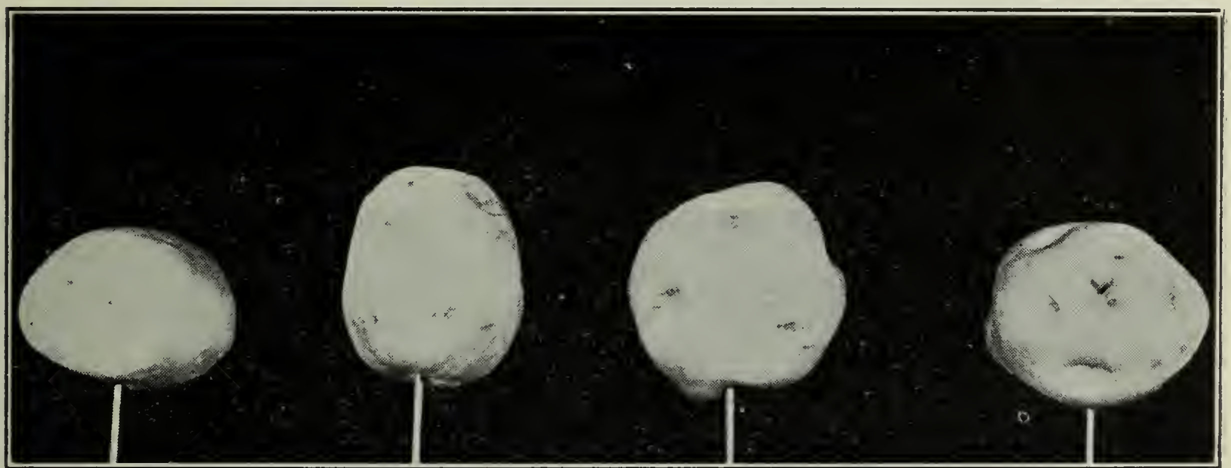
Tubers—Round-flattened to broadly roundish and slightly oblong. Eyes few and very shallow; bud-eye cluster strong and frequently depressed. Considerable variation in skin colour, ranging from creamy white to deep russet, depending on type of soil in which they are grown. Flesh white.



Typical Irish Cobbler Potato.

Irish Cobbler (Early Variety)

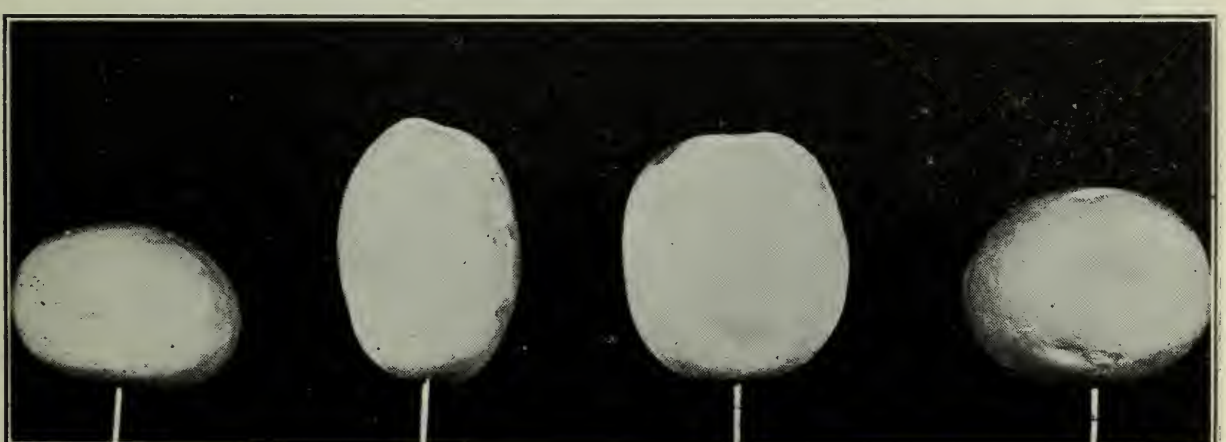
Tubers—Roundish. Skin creamy white. Flesh white. Eyes deep.



Typical Warba Potato.

Warba (Very Early Variety)

Tubers—Roundish. Skin creamy white with pinkish colouring around the eyes. Flesh white. Eyes deep.



Typical Chippewa Potato.

Chippewa (Medium Late Variety)

Tubers—The tubers of the Chippewa are oblong to elliptical, and slightly longer in proportion to width than the tubers of Katahdin. Mean length, 3.51 inches; mean width, 3.10 inches; mean thickness, 2.26 inches. They are smooth and regular in outline, with very shallow eyes. Skin white and very thin; easily bruised. Flesh white.

JUDGING TURNIPS

In preparing to judge turnips one should first make himself familiar with the more popular types and varieties. For shipping or table purposes a smooth, globe-shaped and clearly purple-topped root, with a rather small neck, is preferred, and the size should run from about four to six inches in diameter.

If the roots are being judged for feeding purposes the same general type is preferred, although an oblong-shaped turnip is not objected to, and the roots may be of somewhat larger size, providing they are smooth, sound and of good quality.

The main points to be considered in judging are:

1. Size and uniformity of roots.
2. Trueness to type or variety.
3. Smoothness.
4. Freedom from disease.
5. Quality.

The first two points need no further discussion.

Roots grown in shallow or hard soils are frequently misshapen and of poor quality, hence the premium given for smoothness.

A good type of Globe Turnip.

The presence of disease or mechanical injuries, which may result in rotting, is very objectionable. Hollow heart and water core are also decidedly undesirable.

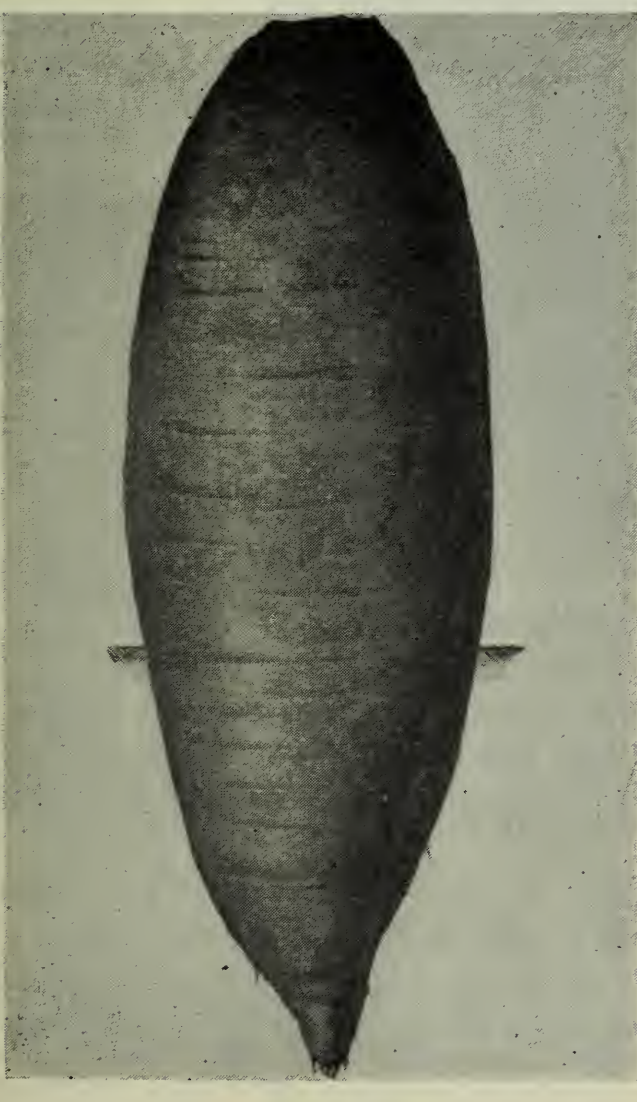
Quality is indicated by a uniform light colour of the flesh, by crispness and the lack of fibre, and by the absence of watery streaks in the interior (often called water core). Roots sown early in the spring, and allowed to grow until the end of the season, often develop a distinct fibrousness and poor quality.

JUDGING MANGELS

The same general principles are involved in judging both mangels and turnips. However, mangels are more easily damaged and somewhat more susceptible to disease, hence this type of field root must be carefully examined for both disease and injury.

There is a tendency to discriminate against extra large mangels, but this is not justified if the large roots are as uniform and smooth as the smaller lots.

Four main types of mangels are: long, intermediate, tankard, and globe. A half-long classification, about midway between long and intermediate, is



Long Type Mangel.

Intermediate Type Mangel.

sometimes used; also an ovoid type that is about midway between intermediate and tankard. The so-called sugar mangels, supposed to be originated from crosses of the mangel and sugar beet, may vary in type from long to intermediate. They are usually green-topped, and have a creamy to light green lower part. They are seldom higher in sugar content than the other types of mangels, consequently no premium should be allowed because of supposed extra sugar content.

Tankard Type Mangel.

The following score card gives an approximate valuation of the various points to be considered in judging turnips and mangels.

Score Card—Judging Roots

	Points
Size and uniformity of roots	30
Trueness to type or variety	20
Smoothness	10
Freedom from disease	15
Quality	25
Total	100

GIVING REASONS

1. Speak with confidence directly to the presiding judge when giving oral reasons.

2. Stand in a comfortable position, but do not lean on the table on which the exhibits are placed.

3. Keep the hands quiet, unless it is absolutely necessary to point out some particular thing in one of the exhibits.

4. When training for judging competitions practise the use of simple, direct statements based on obvious differences in the exhibits. Do not weaken your reasons in the opinion of the judge by using words or phrases which imply doubt.

Example:

Wrong—"I think that No. 1 may have a little brighter colour than No. 2."

Right—"No. 1 has brighter colour than No. 2."

When differences are so small that there is doubt about their existence, it is better to omit mention of them than to leave the judge with the impression that the candidate is not sure of the correctness of his statements.

5. Avoid the improper use of such standardized statements as "No. 2 types in well with No. 1," and "This is a very close placing."

Such statements are frequently used by candidates who are not sure of the correctness of their statements, but who are attempting to make an impression on the presiding judge.

6. Give comparative reasons, by stating how the first-prize exhibit excels the second, how the second excels the third, and the third excels the fourth.

Do not give descriptions of the various exhibits in a class without making comparisons.

7. Learn the proper terms, and use them.

Examples:

Wrong—"pickle," "ann."

Right—"kernel," "awn."

8. Avoid grammatical errors.

Example:

Wrong—"No. 1 is more plumper than No. 2."

Right—"No. 1 is plumper than No. 2."

9. In written reasons use properly constructed sentences, and punctuate them correctly. Poor construction and improper punctuation often give a sentence an entirely different meaning from that intended by the candidate.

THE EVALUATION OF PLACINGS IN JUDGING

A phase of the judging of field crops which is little discussed, but very essential, is the proper evaluation of the various placings encountered in any competition. Seldom indeed do all competitors place every class correctly. Some penalty must be imposed for each incorrect relationship of the various lots of any class. The problem is to assign a proper penalty for each variation from the correct order.

If each lot of material in any class could be selected so that there was a regular and equal degree of difference between their desirability, the matter of the determination of penalties would be much simplified. The exchange of any two lots in a class would call for a similar deduction from the possible points.

Unfortunately, it is seldom possible to secure classes so uniformly graded. This fact necessitates a variable penalty, the extent of which is determined by the degree of superiority of any lot over its nearest competitor.

When any lot is moved more than one position from its proper placing, the penalty must be increased in proportion to the extent of variation from the proper relationship. When 50 points are allowed for placing, and 50 for reasons, the sum of the relationship penalties imposed should not exceed 15 in a class of four entries.

The following example will serve to illustrate the method of applying misplacement penalties:

Classes with a variable difference between the various lots are treated as follows: Assume a class 1–2–3–4, in which 1 and 2 are quite similar and 3 and 4 are somewhat similar but both distinctly poorer than either 1 or 2. Reasonable misplacement penalties for such a class would be
2 6 4
1–2–3–4.

In this instance a complete reversal of the placing would be computed as follows:

2 6 4
1–2–3–4—Correct placing with misplacement penalties.
4–3–2–1—Placing submitted.

Penalty for incorrectly placing 4 over 3	4
" " " " 4 " 2—4 plus 6	10
" " " " 4 " 1—4 plus 6 plus 2	12
" " " " 3 " 2	6
" " " " 3 " 1—6 plus 2	8
" " " " 2 " 1	2
TOTAL PENALTY	42

Value of placing: $50-42=8$.

An intermediate case where the placing was 2–3–1–4 would be computed as follows:

2 6 4
1–2–3–4—Correct placing with misplacement penalties.
2–3–1–4—Placing submitted.

Penalty for incorrectly placing 2 over 1	2
" " " " 3 " 1—6 plus 2	8
TOTAL PENALTY	10

Value of placing: $50-40=10$.

All placings of any class can be evaluated and computed in a similar manner.

BULLETIN 419 OCTOBER, 1941

Ontario Department of Agriculture

Statistics and Publications Branch

TORONTO, ONTARIO

CARE AND METHODS USED IN OBTAINING POULTRY BLOOD FOR PULLORUM TESTING

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CARE AND METHODS USED IN OBTAINING POULTRY BLOOD FOR PULLORUM TESTING

Pullorum is a highly infectious, bacterial disease of poultry and is the cause of heavy chick, and even some adult, mortality. Losses are heaviest in chicks and occur from two days to four weeks old. Infected chicks which apparently recover may reach maturity and may act as carriers of the disease. These birds, if used for breeding purposes may transmit the infection to their offspring through the eggs. The infection when present is most frequently located in the reproductive organs of both males and females, but other organs frequently carry the infection.

There are no symptoms by which Pullorum infected birds may be located in a flock. Testing birds individually is the best known method of identifying carriers. There are three methods employed for testing poultry for this disease, namely:

1. The tube test;
2. The whole-blood or rapid test;
3. The intradermal test.

The tube test is considered the official test in Canada at the present time.

Fig. 1

With the increasing interest in testing work, there is increasing inquiry for information on how to take blood samples and the proper method of handling them so they may arrive at the testing laboratory in the best possible condition.

Time to Test

Birds may be tested at any time but it is advisable that this be done each year just previous to the hatching season. Flocks should be healthy, the majority of the pullets mature and, preferably, in laying condition.

How to Take Blood Samples

There are two methods employed in the taking of blood samples; one in which the operator remains in a standing position, holding the bird under the one arm while drawing the blood, as shown in Fig. 1. In the other method the operator is seated when taking the blood, the legs of the bird held between the operator's legs, with the body of the bird held in a transverse position, with the head to the left. This method is shown in Fig. 2.

There are operators equally efficient in either method of holding birds. The latter method is preferred, however, especially for persons who are not experienced in the taking of blood samples.

It is important that heavy laying birds be handled very carefully, as rough handling may result in injury to the birds or cause a decided drop in egg production.

Banding Birds

Birds from which blood samples are to be taken must be leg-banded with numbered bands for identification purposes. If the banding is done at the time the samples are taken and consecutively numbered bands used, the recording and checking of the work is simplified.

Catching the Birds

Too many birds should not be crowded into a small pen at one time. This will prevent over-heating or the possibility of some birds being suffocated from over-crowding. The attendant should handle the birds carefully and never hold them by their feet with their heads down as this may cause the death of the bird, especially old or over-fat hens.

Holding the Bird

After placing the bird in the proper position, the left wing is raised and held between the first two fingers of the left hand, thus exposing the under surface and the operating area. At the same time the bottle is held between the thumb and index finger of the left hand so that it may be taken quickly by the right hand to collect the blood after piercing the vein. It is usually necessary to pluck a few feathers covering the elbow joint, thus exposing the vein which crosses in this area. It is at this point the vein is pierced, as shown in Figs. 3 and 3A. In Fig. 3A the operator retains the needle in his hand while collecting the blood in the tube. This saves time and the possibility of losing the needle.

Fig. 2

Fig. 3

Fig. 3A

The Needle

There are many kinds of instruments used, such as small bag needles, darning needles, shoemaker's awl, or a piece of No. 9 wire ground down and finished off with a flat-sided or three-cornered sharp point. The handle of the needle may be wrapped with a tape to give convenient size for holding. Some attach a piece of string through the eye of the needle and fasten around the wrist or to clothing to prevent losing it and to have it convenient for use. Fig. 4 shows a variety of needles.

Fig. 4

If any blood collects on the needle while the sample is being taken it should be removed and the needle kept clean at all times.

Taking the Blood Samples

Pierce the vein with the needle and collect from one-half to three-quarters of an inch of blood in the tube. These tubes are 3/8" by 3" long. Small samples of blood tend to dry up or fail to yield sufficient serum to make a test. When collecting the blood the bottle should be held steady, below the opening in the vein. Any change in position may stop the flow of blood or cause bleeding under the skin. When a sufficient amount of blood has been collected one frequently passes the mouth of the bottle over the opening in the skin to stop bleeding. In piercing the vein, the point of the needle should not be forced into the wing joint so as to permit joint fluid (synovial fluid) escaping.

Care of Blood Samples

As the blood samples are taken the bottles should be placed flat to allow the blood to clot in a slanting position in the tube. Fig. 5 shows samples of blood, clotted in various positions and showing varying amounts of serum.

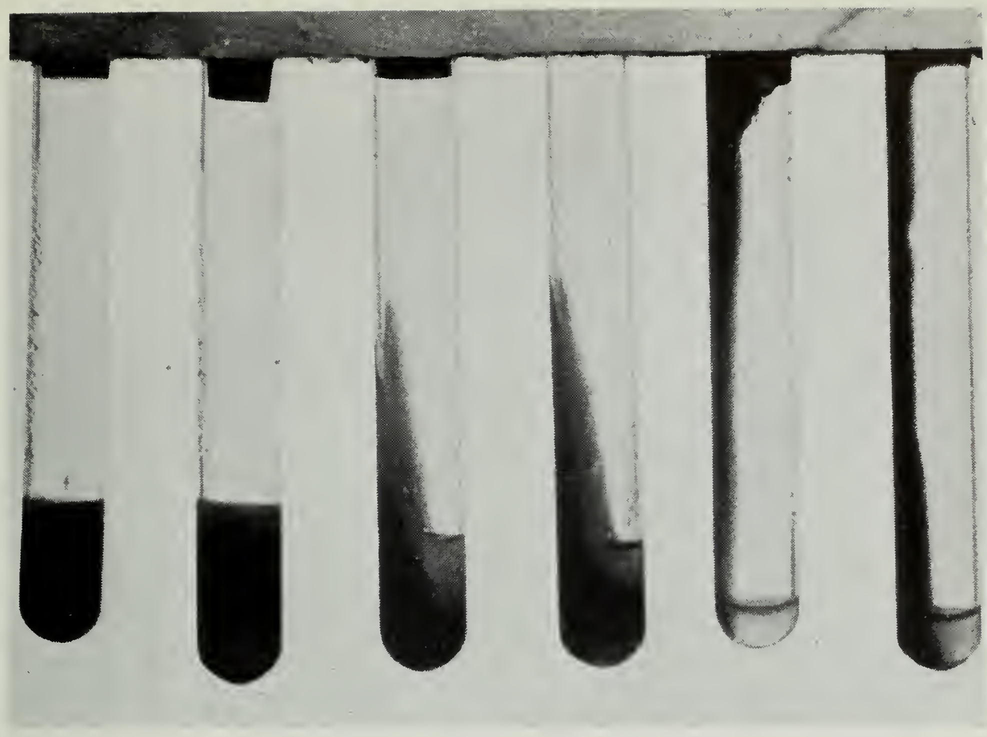

Fig. 5

After the blood has clotted on the side of the tubes, which requires approximately one hour, depending upon the temperature of the air, they may be placed in an upright position. Considerably more serum will settle out of the slanted clot than where the blood is allowed to clot in the bottom of the tube. The serum is the light coloured fluid which separates from the blood-clot and is the material used in making the test.

Chilling of blood often causes the serum to harden and produce a jelled sample, which is impossible to test. Collecting blood in frosty bottles is one way in which blood may be chilled. Freezing or over-heating causes samples to haemolize and if they are badly haemolized they cannot be tested. Freezing causes a breaking down of the red blood cells and the escaping haemoglobin causes the serum to become red. Over-heating causes the sample to decompose.

If the weather is hot when the samples are being taken it is essential that they be cooled down before closing the shipping container. This may be accomplished by placing in a cool room for a short time. Then the samples are packed in a well insulated box for shipping.

When taking the samples during very cold or windy weather it is equally necessary that they be cooled slowly. In many instances it is advisable to supply heat to prevent too rapid cooling. An insulated box, similar to that used to ship samples in, fitted with a hot water bottle or warmed bricks, with adjustment made to regulate the amount of heat coming in contact with the tube and blood samples, will prevent too rapid cooling. In Fig. 6 is shown one method of keeping blood samples warm in cold weather.

Fig. 6

The efficiency of the work in the laboratory in making the tests depends on the efficiency of the work in connection with the taking of the blood samples.

Records

Accurate records of the work done must be made so that any bird reacting to the test may be identified for removal from the flock. If these records are made in duplicate and one set retained by the flock owner, much time and effort may be saved in locating reacting birds. Copy of record sheet, 6" wide by 9" long, is shown in Fig. 7.

System of Handling Bottles

Some laboratories send out labelled bottles in wire baskets, packed in insulated boxes, similar to that shown in Fig. 6. With this system the bottles are numbered consecutively, as used, and the leg-band number of the bird recorded on the record sheet opposite the bottle number. This necessitates extra care in numbering the bottles correctly; however, it aids in any checking, as well as in the handling of the blood samples when cooling or warming is being done.

Another system used by some laboratories is the "Block System." A solid block of wood 5½" wide, 14½" long and 2¾" high is made use of. One hundred holes are bored into the block and a number placed below each hole. Record sheets, as shown in Fig. 7, are used to record the birds' leg-band number. The bottle is removed from the block for use and replaced after the blood sample has been collected. The block may be placed at whatever angle is desired for the clotting of the blood in the tube.

Name..Date..............................193........Lab. No.............................

P. O. Address..Samples by...............................Tested by...........................

County..1st........2nd..........3rd........Date Rec'd..............Date Tested............

BOTTLE NUMBER	√	BAND NUMBER	√	BOTTLE NUMBER	√	BAND NUMBER	√	BOTTLE NUMBER	√	BAND NUMBER	√	BOTTLE NUMBER	√	BAND NUMBER	√	BOTTLE NUMBER	√	BAND NUMBER	√
01				21				41				61				81			
02				22				42				62				82			
03				23				43				63				83			
04				24				44				64				84			
05				25				45				65				85			
06				26				46				66				86			
07				27				47				67				87			
08				28				48				68				88			
09				29				49				69				89			
10				30				50				70				90			
11				31				51				71				91			
12				32				52				72				92			
13				33				53				73				93			
14				34				54				74				94			
15				35				55				75				95			
16				36				56				76				96			
17				37				57				77				97			
18				38				58				78				98			
19				39				59				79				99			
20				40				60				80				00			

Date Reported..............................Reported by..............................Date bands returned..............................

Pullorum Test Record   Poultry Dept. O.A.C.

20M June 1932

Fig. 7

By warming the block in cold weather the rapid cooling of the blood samples may be prevented; however, there may be some difficulty in cooling the blood in the block in hot weather.

A block with cover top, for shipping, is shown in Fig. 8.

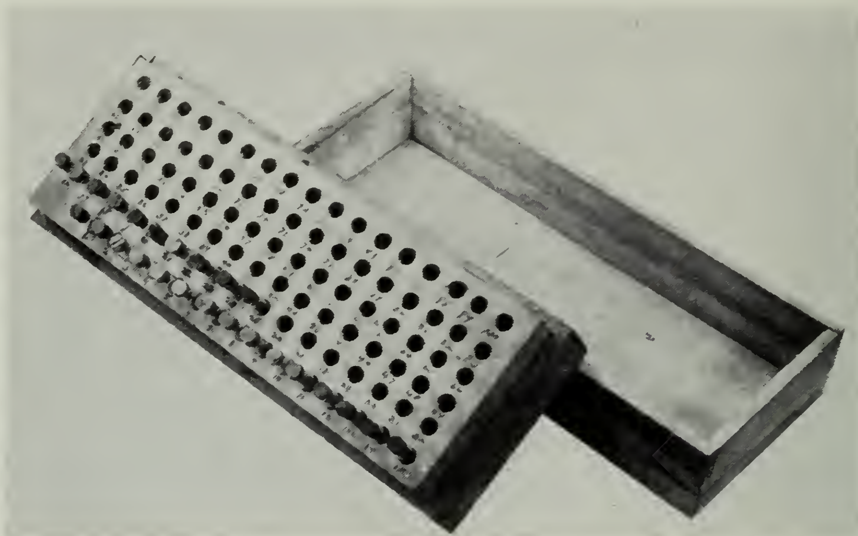

Fig. 8

Shipping Blood Samples

When shipping blood samples to the laboratory the box should be marked with a label "Keep from frost and excessive heat."

Clean Up

Birds not banded at testing time should be immediately disposed of and on receipt of the test report all reacting birds should be removed from the flock and killed immediately. These birds are fit for meat purposes if otherwise healthy. All birds (males and females) chickens, turkeys, guineas, etc. retained on the premises during the breeding season should be tested.

After removing the reactors, the poultry houses and equipment should be thoroughly cleaned and, if possible, disinfected to prevent further spread of the disease.

The whole blood or rapid test is completed in the poultry house and may, if properly conducted, have some merit. To conduct this test, however, requires special training, a qualified technician in Veterinary Science or Bacteriology, being the only persons capable of making the proper interpretation of the test.

Because of the inefficiency of the intradermal test its use is practically discontinued.

The photographs in this bulletin were taken by W. D. Tolton
Ontario Agricultural College, Guelph

BULLETIN 420 MARCH, 1942

Ontario Department of Agriculture

Statistics and Publications Branch
TORONTO, ONTARIO

CATTLE LICE
AND
HOW TO CONTROL THEM

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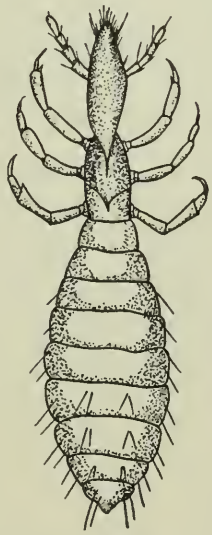


Long-nose Cattle Louse (x 20)

15M (A3561)

CATTLE LICE

FOREWORD

The losses caused by cattle lice are generally overlooked by herd owners until numerous animals rub out some hair and manifest unthrift and unrest. The rattling of tie chains and stanchions going on in the stable where louse-infested cattle are housed may be the first wake-up signal to the herdsman that his cattle are being tormented by lice. Poorly kept cattle frequently are seen with large patches denuded of hair and the skin scraped and scored. This results from the animal trying to get relief from the torment caused by millions of lice, by rubbing when and where it can. The loss is a very considerable one that must be borne by the cattle owner that permits these insect pests to annoy his cattle. The total loss in Ontario caused by cattle lice each winter would amount to many thousands of dollars. Some farm herds experience no loss from cattle lice, as control measures are instituted in the late autumn when the cattle are placed in winter quarters. On other farms nothing is done until the lice have multiplied to such an extent as to be noticed by the most careless herdsman. At this stage, considerable loss in cattle thrift, milk and meat production has taken place.

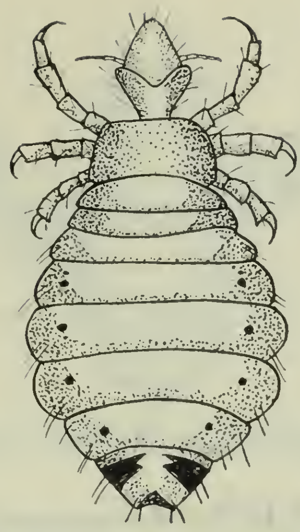
Lice require favourable conditions for breeding; otherwise, reproduction will be limited. If the conditions are ideal, the increase from one pair of lice would reach the total of over twenty million in the four months, November, December, January and February. Undisturbed and under favourable conditions, the louse population will reach its peak in early March. In November, when lice really get busy on Ontario cattle, the reproduction of one pair adult lice will reach a figure of 1,250, hardly noticeable on a big cow. The December multiplication from 625 female lice, each laying an average of 50 eggs, would reach a figure of 31,250 lice; this number would be quite noticeable. In January the increase would be approximately to 800,000 lice—a number that would be quite noticeable on any cow. In February the increase would be from approximately 400,000 female lice (each of which would lay an average of 50 eggs). This would be approximately twenty million lice as the increase from one pair by the end of February. There are from 1,500 to 3,000 hairs per square inch of cowskin (depending on the fineness). A well-grown Holstein heifer will have a body surface of approximately 30 square feet, which would support 3,000 hairs per square inch—approximately ten million hairs. When lice are allowed to breed uncontrolled, there may be more lice than hair on the animal. Limiting factors, such as overcrowding of the lice, anaemic condition of the host animal and food shortage, keep the numbers of lice down to some extent, so that we seldom see more than one louse per hair. That is probably enough to bring on a high degree of tormentation, and defeat in a large way all possibility of profit from the keeping of cattle if the louse factor is neglected.

These figures have been given in order to impress herdsmen with the fact that it is much better to start the warfare against cattle lice in early November, when there are but few to combat, instead of waiting until February and March. For every pair of lice killed in November, there will be twenty million less to kill in March, and all the damage done by the steadily increasing host of lice will be avoided. It is a foregone conclusion that nearly all cattle will carry at least one pair of lice, hidden away on the inside of the legs well up near the body, when the cattle go into winter quarters in November. The problem is to destroy these few that have survived the summer and thereby prevent them and their increase feeding at your expense on your cattle.

Calves, yearlings and old, weak or poorly nourished cattle suffer most from the presence of lice. Heavily infested cattle cannot show a profit for feed consumed, and they lose weight over the winter period, often going out in the spring in the "skin and bones" condition. Cattle that are regularly groomed during the stabling season seldom stay louse-infested, as a good brushing creates conditions unfavourable to multiplication.

The question, what becomes of the cattle lice during the summer, can be easily answered. When the cattle go out to pasture in the spring carrying the maximum load of lice, they encounter conditions quite different from the protection of dry winter quarters. The spring and summer conditions are favourable to the cattle, but not favourable to the lice. The hair coat with its load of lice and nits loosens and falls off; the rains wash the skin, drown or wash off the lice; the rays of the sun, playing on the thinly covered body of the animal, aid in creating conditions unfavourable to lice. This exposure to the great outdoors, while the body is thinly covered with hair and subject to washing by rain many times during the spring and summer, results in a clean-up, allowing the cattle to eat and grow.

Three species of lice are commonly found on Ontario cattle during the winter period only, as practically all Ontario cattle are at pasture during six or more months of the year. The principal exceptions are service bulls and young calves that are housed. These protected animals aid very materially in keeping the "seed stock" of lice going over the summer.

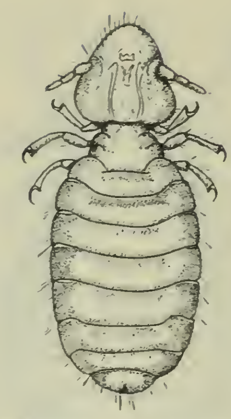


Short-nose Cattle Louse (x 20)

BITING LICE (*Trichodectes scalaris*)

The Biting louse is a small, reddish-yellow creature, about 1½ mm. in length, marked with transverse bars on the abdominal segments. The head is broad, blunt and reddish in colour. The eggs or nits are whitish in colour and attached to the hair of the host animal. The entire life history from egg to producing eggs requires twenty-one days, divided approximately as follows: incubation requires ten days (some variation due to temperature and moisture); growth from hatching to sexual maturity and egg laying requires about eleven days (as with incubation there may be variations in length of time).

The Biting lice feed on scales and exudations from the skin of the host. They locate generally at points where it is difficult for the animal to disturb them, as on the withers and tail-head. When numbers increase greatly the lice spread over the entire body. Lice when present in large numbers produce raw lesions that may resemble scab and cause great irritation. Biting lice will live for about seven days away from the host animal, if temperatures are favourable. Eggs will incubate after being removed from the animal on which they were deposited, if conditions are favourable, some time within twenty days. These orphan lice must find their way onto the body of an animal within two or three days, otherwise they starve. Infested premises, once cleared of cattle, should not be used again for at least twenty-three days, unless a thorough clean-up is made. In cleaning up, everything movable should be taken out, all surfaces cleaned and saturated with coal-tar creosote dip, followed by a thorough spraying with lime whitewash.



***Biting Louse of Cattle* (*x 20*)**

SUCKING LICE (*Linognathus vituli*)

This louse is commonly called the Long-nose Blue Louse. The abdomen is segmented and blue in colour, hence the name. The head and thorax are a light-brown colour. The head is long and furnished with sucking mouth parts and prominent antennae. Three pair of legs, well armed with claws, are attached to the thorax. The adults are about one-eighth of an inch long. The entire life of this Blue louse is spent on the host animal. The dark-coloured eggs are attached to the hair close to the skin of the host. Hatching takes place in ten to fourteen days, depending on weather conditions. The young Blue lice require eleven or twelve days to reach the egg-laying state. This makes the life of the Blue louse from egg to laying eggs from twenty-one to twenty-six days.

The Short-nose Cattle Louse (*Haematopinus eurysternus*) is also a blue louse. It differs from the Long-nose louse in that it has a short nose and a much stouter body and legs. The life history is practically the same for both varieties of sucking blue lice. Sucking lice are most abundant if present on the sides of the neck, brisket, inner surface of the thighs. If the infestation is heavy, blue lice will attach themselves on the body wherever the skin is thin and soft enough to puncture. The eggs of the Short-nose Sucking louse are white in colour. They are attached firmly to the hair of the host animal at egg-depositing time by the female louse.

The feeding habits of the Blue or Sucking lice differ from those of the biting lice, due to the mouth parts being entirely different. The Sucking louse lives on blood and tissue fluid obtained from the host animal by inserting its sucking tube into the tissues. At the same time it attempts to retain its position by digging in with its claws; this doubly irritates the animal on which it is feeding. When not feeding on and very much tormenting the host animal, blue lice move about actively through the hair, attaching their eggs near the skin in locations favourable to incubation.

Eggs of Biting Cattle Louse (x 20)

Control of Lice

Various methods for the application of a variety of drugs and drug mixtures are known to most cattle owners. Methods and drugs are only a part in the killing of lice; neither is of any value unless used with persistence and vigour. Lice are energetic, they know no rest, their object in life is to increase their kind to the limit offered by their environment; hence, they must be combatted with vigour by methods that will destroy them effectively. The common method in Ontario is hand application of washes or dusting powders. A second method used on some of the larger herds is a spray-pump application of stock-dip fluid. This method takes more material, but it is more effective than the hand-application method. A third method is dipping the animals into a suitable fluid dip held in a dipping tank. This is the most effective method where many animals are to be treated, but it is seldom used due to lack of dipping vats large enough for cattle.

Raw Linseed Oil

Stabled cattle can be economically treated with raw linseed oil. Applied with a brush at the rate of four ounces per cow, a condition of oiliness of hair and skin is attained that is destructive to lice. The treatment should be repeated at intervals of twenty days or less. Raw linseed oil is free from poisonous properties, and is beneficial in that it keeps the skin from becoming dry and favourable to lice. Oils interfere with the respiratory function of the louse and kill in that way. Cattle so fed as to have plenty of natural oil in the skin and hair are not troubled by lice to the same extent as the dry-skinned animals. When applying raw linseed oil do not brush the skin too hard. After animals have received treatment with raw linseed or any other oil, they should not be exposed to strong sunlight for at least twelve hours, so as to avoid the danger of oil-burns. The cattle should remain quietly in the stable and not be exercised or overheated. Boiled linseed oil or paint oils should not be used on any living animal. Both the Biting lice and Sucking blue lice are destroyed by raw linseed oil.

Sodium Fluoride

Sodium fluoride can be used as a louse destroyer in a number of ways, but against the small Biting louse only. The pinch method of using sodium fluoride is to take a small quantity between the tip of forefinger and thumb, applying directly to the skin in areas where the lice are numerous. The sodium fluoride applied by this method will spread for some distance. The dusting-powder method is accomplished by mixing one pound of commercial sodium fluoride with three or four pounds of flour or talc, and placing the mixture in a shaker can to facilitate applying it to the skin and hair of the louse-infested animal. The wash or liquid method of using sodium fluoride is to mix one ounce of commercial sodium fluoride with one gallon of warm soft water.

Dusting Powders

Dusting powders made with powdered derris root and a suitable filler substance can be used very effectively in holding down the increase of lice on cattle. Dusts are not as effective as washes or dips; nevertheless, they have their advantages in that dusts can be used during cold weather when it is out of the question to saturate the hair of an animal unless warm quarters are provided. Other substances, such as powdered sabadilla seeds, sulphur, pyrethrum and helebore, can be mixed with diluting substances like flour, talc, road dust or slaked powdered dry lime. These mixtures serve a useful purpose if dusted through the hair of infested cattle at intervals of fifteen days. All are easy to apply with the aid of a perforated shaker top on the container.

Tobacco dust is useful in checking the increase of lice if applied frequently (every two weeks) and thoroughly to the hair of infested cattle. The tobacco dust must be very fine to be useful. Dry tobacco leaves and stems can be reduced in a hammer mill to the required degree of fineness. Care should be exercised when applying to animals, or sneezing will be induced. A shaker can, held close to the surface to be dusted, is the usual method of application. Tobacco dust can also be mixed with warm soft water and applied with a brush to the body surface of the animal. Keep tobacco out of the eyes of the animal being treated, or some distress will be caused.

Fumigants

Fumigation of the animal body with fumes created by burning tobacco is effective in destroying lice, providing suitable arrangements can be made for its application. Fumigation methods require too much time and supervision to be practical on the average farm. The animal body is exposed, with the exception of the anterior portion of the head, as it is very necessary to protect the eyes and nostrils. The arrangement of the fumigation chamber must be such that the animal will breathe pure air during the fumigation process. A tight box stall can be used, if satisfactory arrangements can be made to extend the head of the animal to the outside air and keep it there while the body is being subjected to the fumes. Two ounces of tobacco slowly burned will create sufficient fumes for one animal treatment.

Lice-Killing Dip Solutions for Cattle

Coal-tar creosote dip may be purchased, and when mixed with either cold or warm soft water is ready to use. The directions of the manufacturer should be carefully followed in preparing dip solutions. Soft water is best. If it seems necessary to use hard water, a test of its suitability should be made in a small way before mixing a tankful. To test the suitability of hard water for mixing with coal-tar creosote fluid, a measured small quantity can be placed in a clean bottle or jar of suitable size and the required proportion of the water added. After thorough mixing it is allowed to stand for one hour or more. If an oily layer appears at either top or bottom of the mixture, it is not safe to use and some other water should be sought. Creolin of commercial grade used in two per cent solution in warm soft water is an old and favoured wash for the control of cattle lice. (Keep in mind that creosote and creolin are quite different substances.)

Considerable time is required to wash animals thoroughly, and it is generally a messy job not too popular with stable help. Coal-tar stock-dip solutions or two per cent creolin solutions can best be applied by using a woollen cloth or medium stiff brush. Solutions should be at body temperature when applied. Every part of the body, including the inner surface of the ears, the legs, thighs and ventral surface, should be well saturated. A large, long bottle, fitted with a cork to deliver a small quantity at a time, is an aid to applying the solution and is easier than obtaining the fluid dip from a pail. (The same system as is in use in the barber shop.)

The spray-pump applications of coal-tar creosote solution or other louse-killing solution are or can be more thorough than hand applications. Unless carefully used the spray pump will take more fluid to saturate the hair and skin of an animal than will the hand method, due to run-off of the fluid, as it takes longer for the spray to penetrate the unruffled hair. Two persons are required to operate a spray outfit unless electric power is at hand to operate the pump. Hand-operated spray pumps answer very well for spraying cattle if operated by careful men. Keeping the spray fluid out of the eyes of cattle is important, and for this reason a brush should be used on the head. Spraying should be repeated in fifteen or sixteen days following the first application. A pail of clean water should be kept at hand in case it is necessary to bathe the eyes of any animal so unfortunate as to get creosote or creolin or any other dip into its eyes.

The dipping-tank method of applying louse-killing solutions to the body surface of cattle is the most efficient, as complete immersion in fluids insures the wetting of every louse. Dipping tanks for cattle must be constructed deep enough to require the cattle to swim. Cattle should be fed and watered two or three hours previous to dipping. If the dipping is done during cold weather, provision for sheltering the animals should be made, as chilling on a cold night may result in loss. The quantity of dip solution in the tank must be maintained at proper level, as each thousand-pound animal passing through will remove two to four quarts of fluid in its hair. Animals should be held on a draining platform for a few minutes after passing through a dipping vat. This will salvage some of the dip solution that can be returned to the dipping vat. Animals should be allowed to rest quietly following dipping, as any excitement, overheating or undue exertion is harmful if cattle have been in an oil or arsenical dip solution. The temperature of a dip solution should be maintained at 90 to 95 degrees F.

SUMMARY

Poorly nourished animals are the most heavily infested, due to the food not supplying the necessary oil to keep the skin in the normal condition to be seen when animals are on June grass.

The up-to-date, energetic stockman will not let his cattle suffer infestation with lice. He takes steps early in the season to prevent the lice increasing.

Both Biting lice and Sucking lice may be present on the same animal. The contact remedies, as oils, washes or dusts, will destroy both varieties

Eggs or nits are not usually rendered unhatchable by the treatment that kills the parent lice, so animals must be retreated in fifteen or sixteen days following the first treatment in order to kill the recently hatched young lice before they can lay their eggs.

Washes and dip fluids containing arsenic or nicotine (tobacco extract) must be used with caution, particularly on thin cattle, where there is a possibility of the fluid accumulating in depressions and being licked up by the treated animal.

Lice will live in a pen or stall for about a week after it has been vacated by infested animals. The eggs left in pens and stalls will continue to hatch up to twenty days after the cattle have left the premises. Pens should, therefore, be thoroughly cleaned up before being used again.

Begin louse-control work as soon as the cattle go into winter quarters.

Suitable coal-tar dip concentrates and dusting powders are available at the office of the local veterinarian.

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Ontario Department of Agriculture

Statistics and Publications Branch

TORONTO, ONTARIO

The Value of Soil Analyses

As An Aid

in Truck Crop Production

In Ontario

(Progress Report)

By

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GUELPH, ONTARIO

THE VALUE OF SOIL ANALYSES AS AN AID IN TRUCK CROP PRODUCTION IN ONTARIO

(Progress Report)

by

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R. Goodwin-Wilson[2]

J. H. L. Truscott[3]

This is a report of investigations covering only one growing season and it is therefore properly labelled a *progress* report. But we believe that the information is sufficently reliable to have immediate value to the growers of truck crops especially at a time when maximum efficiency in the use of fertilizers is important.

Chemical analysis of greenhouse soils in Ontario is acknowledged to be of value in determining the feeding schedule of both ornamentals and those vegetables which are grown under glass. But conditions of water supply, leaching, temperature and uniformity of soil are under little or no control in the field and it should be expected therefore, that obtaining a representative picture of the chemical conditions in the field would be much more difficult than it is under glass. Moreover there are many conditions affecting crop production which are not made evident by chemical analysis. Drought, sunshine, drainage, disease and temperature are a few of the conditions which are not readily taken into account unless they are *obviously* limiting factors to crop production.

Because of the foregoing difficulties and uncertainties it was decided in the Spring of 1941 to make a broad attack on the problem of the usefulness of chemical analyses of truck crop soils. It was hoped that, if the scope of the work were broad enough to make comparisons possible, some of the unmeasured and unnoted factors affecting growth might cancel to some degree and that the effect of measured soil factors might become apparent. In brief, the question to be answered was with which accuracy can analyses of soil samples be used to aid in the intelligent feeding of truck crops?

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The senior Author selected the districts in which to work and an attempt was made to include the chief soil types which are being used for the commercial production of vegetables. Several growers were included in each district some of whom had the reputation of being good growers and others whose capabilities were unknown. The regular practices of the growers were not altered but definite information as to amounts and kinds of manure was obtained for both 1940 and 1941 and any chemical fertilizers used in 1941, broadcast or as side-dressings, were recorded. The senior Author personally took all of the soil samples on from three to seven occasions during the growing season in each field for each crop. He made notes on the general condition of the crops on each visit and he made a final rating of the crop when ready for harvest under the classification, Good, Fair or Poor. In Table 1 is summarized the soil types, the districts and the number of growers involved in the production of each of the crops included in this study. Thirty-four growers in eight districts are included.

Table 1

Crops Studied in Relation to Soil Type, District and Number of Growers

Crop	*District*	*Number of Growers*	*Soil Type*
Beets	Humber Bay	2	Clay loam
	London	2	Sandy loam
	Burlington	2	Sandy loam
Cabbage	London	3	Sandy loam
	Humberside	1	Sandy loam
	Humber Bay	2	Sandy loam
	Brantford	1	Sandy loam
	Islington	1	Sandy loam
	Burlington	2	Sandy loam
Cantaloupe	Brantford	1	Sandy loam
	Aldershot	3	Sandy loam
Carrot	London	3	Sandy loam
	Brantford	1	Sandy loam
	Bradford Marsh	2	Muck
	Islington	1	Sandy loam
Cauliflower	Brantford	1	Sandy loam
	Humber Bay	2	Sandy loam
	London	4	Clay loam
	Burlington	3	Sandy loam
	Islington	1	Sandy loam
Asparagus	Burlington	2	Sandy loam

Celery	Burlington	2	Sandy loam
	London	10	Muck
	Humber Bay	3	Clay loam
	Bradford Marsh	1	Muck
Head Lettuce	Brantford	2	Sandy loam
	Bradford Marsh	4	Muck
	Burlington	1	Sandy loam
Egg Plant	Brantford	1	Sandy loam
Onions	Humber Bay	1	Clay loam
	Brantford	2	Sandy loam
	Bradford Marsh	3	Muck
	London	2	Muck
Radish	London	1	Muck
Sweet Pepper	Burlington	1	Sandy loam
	Brantford	1	Sandy loam
Tomatoes	London	3	Sandy loam
	Brantford	2	Sandy loam
	Aldershot	1	Sandy loam
	Burlington	2	Sandy loam
Parsnips	Brantford	1	Sandy loam

The soil samples were analyzed by the second Author at the Soils Laboratory in the Department of Horticulture here, using a standard Spurway procedure (2) except that the test for reserve phosphous was made according to the technique of Carolus (1). A Potentiometer with glass electrodes was used to determine pH. Assays were made of available nitrogen, phosphorus and potash, reserve phosphorus, potash, iron and manganese, and for calcium, magnesium, sulphates and chlorides

RESULTS

Roughly 800 complete analyses were made on soil samples. About 200 of these are not included in the present discussion, usually because the auxiliary data were not completed, sometimes because there were only one or two soil samples collected from a field and these were not considered sufficient. Data included in Table 3 are the average readings of the several analyses made from the soil producing each crop on each farm. The validity of making such averages, and indeed, the validity of all the analytical data, depends on the uniformity of the results obtained in successive samplings of each field. Such uniformity

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1. Carolus, R. L. The Use of Rapid Chemical Plant Nutrient Tests. Vir. Truck Exp. Sta. Bul. 98.
2. Spurway, C. H. Soil Testing. Mich. Agr. Exp. Sta. Tech Bul. 132. Revised.

depends on accurate technique in the laboratory and on good soil sampling technique in the field. On the whole the results were satisfactory and it was possible to detect readily when an individual reading was probably influenced by error in sampling or during assay. Two examples (Table 2) illustrate the data obtained from individual fields. Figures which we believe to be unreliable are underlined. Such figures occurred infrequently and the data are characterized by either consistent drifts in the amounts of elements present or by uniformity. We believe therefore that our data are sound.

Table 2

Example of Soil Analysis Data
(Obtained from Fields 76 and 123)

No. 76

Date	pH	Available N	Available P	Available K	Reserve P	Reserve K
May 15	<u>7.0</u>	5	15	30	50	100
June 4	6.4	12	14	25	50	80
June 25	6.6	9	15	15	50	70
July 10	6.6	8	14	15	50	80
July 26	6.6	8	15	15	45	60

No. 123

Date	pH	Available N	Available P	Available K	Reserve P	Reserve K
May 27	6.5	5	20	30	50	80
June 13	6.5	9	19	25	50	70
July 3	6.6	9	20	15	45	90
July 19	6.6	8	15	20	50	40
Aug. 2	6.6	2	10	10	20	<u>10</u>

When the analytical data were summarized it was immediately apparent that in nearly all instances the amount of calcium, magnesium, sulphates and chlorides was adequate in the soils studied and that they were probably not present in excessive amounts. Certainly it was not possible to correlate these elements with the conditions of the crops studied. They are therefore not included in Table 3.

Table 3 contains the data on which our conclusions have been founded. The data are largely self explanatory. They show for each crop studied the place where it was grown, the soil type, the number of soil analyses made, the average analysis in parts per million for available nitrogen (the range of available nitrogen is given also since it tends to fluctuate greatly during the growing season), available phosphorus and potash, and the less soluble or reserve phosphorus, potassium, iron and manganese. A column headed 'Initial Feeding' refers to chemical fertilizers placed on or in the soil in 1941 prior to the planting of the crop. Side-dressings include those chemical fertilizers which were fed in restricted areas near the plants or during the growth of the crop. Barnyard manure as added to the fields in both 1940 and 1941 is given in tons per acre. Where winter rye was grown as a green manure crop during the winter of 1940-41 the information is given and if straw or other organic material was used as a surface cover during the production of the crop the type of material is indicated. The condition of the crop at harvest is indicated as good, fair or poor and the column headed 'Remarks' is used to summarize any observations made by the senior Author on any factors which might have influenced the crop produced.

The term 'available' as used in connection with nitrogen, phosphorus and potash has a definite chemical meaning but for practical purposes the term refers to that portion of the three substances in the soil which are considered to be in such a form that the plant can utilize them readily. The term 'reserve' as applied to phophorus, potassium, iron and manganese refers to forms of those substances which are considered to be less readily available to the plant but they constitute a reserve from which available forms of the same substances are obtained more or less slowly. In no instance except perhaps potassium does the measurement of reserve indicate the total amount of those four substances present in the soil.

Discussion of the Data in Table 3

The data from each crop will be discussed separately in an endeavour to obtain information on the following points of interest: the range of levels of N, P and K (nitrogen, phosphorus and potash) in relation to the rating of the crop; evidence of unwise or wasteful* use of chemical fertilizers.

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* Wasteful use of chemical fertilizers. It is generally agreed among soils men that, especially in soils of low organic matter content, there is little storage from one year to the next of added soluble nitrogen or potash. Phosphorus may be rendered insoluble and largely retained. Therefore while not-needed feedings of phosphorus may have justification, feedings of soluble nitrogen or potash in quantities or in a manner not utilized by the current crop is probably poor economy, and indeed it may disturb the chemical balance in the soil to the extent of harming the crop. Adding such small quantities of fertilizer that they cannot be expected to influence materially known deficiencies is probably poor economy in that little return may be obtained.

Beets

Seven fields are included. The crops on all of them are rated as good. Available nitrogen averages approximately 3 ppm. with a range of from trace to 10 ppm. Available phosphorus ranges from 12 to 16 ppm. with reserves of from 50 to 50+ ppm. Available potash ranges from 20 to 45 ppm. in all but one instance with reserves of from 52 to 100 ppm. except in the instance mentioned previously (No. 4, Available K, 8 ppm., Reserve K, 25 ppm.). No. 4 had 25 tons of manure added in both 1940 and 1941 but no other additions were made to the soil. Judging from general experience with greenhouse soils all but No. 4 would be considered to have adequate supplies of available potash and phosphorus and of reserves of the same elements. Even No. 4 would not be considered seriously short of potash although a potash fertilizer is indicated.

The actual chemicals supplied by the growers have apparently little reference to the chemical condition of the soil. Probably No. 7 got little return for the side-dressing of nitrogen which he applied since that portion of his soil not affected by the side-dressing averaged 4 ppm. which is higher than any other except No. 1, and No. 7's crop was not conspicuously better than any other crop. No. 3 used a heavy application of lime, he has a pH of 7.3 and a calcium analysis of 190 ppm. which is slightly above average for Ontario upland soils. It is doubtful indeed if the lime application was necessary or beneficial. Probably No's. 1, 2 and 5 would have been better advised to use side-dressings of mixed fertilizer to replace any losses from the harvested crop rather than a general dressing on land already well supplied with N, P, K. No. 5 especially with no manure added in two years probably lost by leaching most of the nitrogen and potash supplied.

Cabbage

Nine fields are included. Six of the crops are rated good and three are rated fair. Available nitrogen averages approximately 5 ppm. with a range of from 1 to 15 ppm. Available phosphorus ranges from 12 to 20 ppm. except in Nos. 12 and 13 which averaged respectively 1 and 7 ppm. Reserves of phosphorus were 43 to 50+ ppm. except in the cases noted where the amounts were 3 and 30 ppm. Available potash ranged from 23 to 43 ppm. except in No. 12 which averages 5 ppm. The reserves of potash ranged from 62 to 100 ppm. with number 12 an exception with 5 ppm. All had added manure within the years 1940-41. Judging from general experience with greenhouse soils all but No. 12 would be considered to have adequate supplies of phosphorus and potash and No. 12 would be considered seriously low in potash and phosphorus.

The chemicals supplied by the different growers sometimes fit the chemical condition of the soil and sometimes do not. No. 8 has fed nitrogen both as side-dressing and a general application of cyanamid. He had added fresh strawy manure which would probably need nitrogen and he has not unnecessarily added phosphorus or potash. No. 10 has almost certainly added phosphorus and potash unnecessarily. A side-dressing would have effected a replacement with less material used. The same general situation applies to growers No. 15 and 16. Grower No. 12 supplied a light application of nitrogen when phosphorus and potash were needed and he has only a fair crop. Grower No. 9 who had only a fair crop has plenty of phosphorus and potash but needs nitrogen and probably should have used a nitrogen side-dressing. The remaining example of a crop rated less than good is No. 13 in which instance there is nothing in the data to indicate why the crop was rated only fair. His phosphorus is low enough that some might be added.

Carrot

Eight fields are included, six of which are rated good, one is rated fair and one is rated poor. Available nitrogen averages 3 ppm. in both upland and muck soils with a range of from trace to 10 ppm. Available phosphorus ranges from 4 to 21 ppm. in upland soil and from 3 to 7 ppm. in muck soil. Reserves of phosphorus in upland soils range from 20 to 50 ppm. and in muck soil from 15 to 18 ppm. Available potash ranges from 12 to 43 ppm. in upland soil and from 7 to 11 ppm. in muck soil. Reserves of potash range from 51 to 100 ppm. in upland soils and from 17 to 28 ppm. in muck soil.

Of the five upland soils two might be considered low in available phosphorus and their reserves of phosphorus are not high. All except No. 40 produced crops of carrots rated good. There is no indication from the data as to why No. 40 produced only a fair crop, unless sufficient strawy manure was added in 1940 to make the nitrogen supply not sufficient for the growing crop. Probably grower No. 41 wasted a large part of the 1,600 lbs. of fertilizer in a soil already well supplied with phosphorus and potash. Grower No. 36 used only 300 lbs. of mixed fertilizer and got as good a crop rating. Information on the Bradford muck will be examined in a later section.

Cauliflower

Eleven fields are included. Six of the crops are rated good, four are rated fair and one poor. Available nitrogen averages 5 ppm. with a range of from 1 to 25 ppm. Available phosphorus ranges from trace to 13 ppm. with reserves of from 2 to 55 ppm. Available potash ranges from 5 to 40 ppm. with reserves of from 9 to 95 ppm. With one exception (No. 50) those crops rated fair were low in phosphorus and potash. No. 50 has edequate phosphorus but there is a marked unbalance with potash. No. 49 appears to be very low in both phosphorus and potash and while the crop rating is good, it was judged on leaf growth only. No. 52 is graded poor with slow growth and there is nothing in the soil analysis to indicate why growth was poor.

The chemicals fed by growers 46, 47, 48, 49 seem definitely to have reference to actual deficiencies in the soil. Probably all four would be well advised to use heavy applications of manure. No. 50 should have used a high potash fertilizer to correct his state of unbalance. His crop was probably not benefited by the side-dressing of nitrogen. No. 54 probably fed twice too much 4-8-10 and his nitrate side-dressing was almost certainly unnecessary. The analysis for No. 44 is rather low in both phosphorus and potash but he fed chicken manure during 2 years and got a good crop rating.

Head Lettuce

Six fields are included. Two fields are rated good, three fair and one poor. The available nitrogen averages 4 ppm. with a range of from trace to 9 ppm. The available phosphorus ranges from 1 to 27 ppm. with reserve phosphorus 4 to 50+ ppm. Available potash ranges from 5 to 24 ppm. with reserves from 8 to 75 ppm. Those two crops marked good have a satisfactory soil analysis. Those marked fair to poor are definitely deficient in phosphorus and potash.

Growers 90 to 93 almost certainly need to feed rather heavily and Nos. 90 and 91 probably need manure in quantity.

Onion

Ten fields are included. Five are rated good and five are rated fair. Available nitrogen averaged 6 ppm. with a range of from 1 to 20 ppm. Available phosphorus ranged from 1 to 12 ppm. with reserves of 1 to 43 ppm. Available potash ranges from 5 to 33 ppm. with reserves of from 6 to 95 ppm. The muck soil will be dealt with in a later section.

Growers on upland soils have fed chemical fertilizer with reference to the soil analysis fairly intelligently. No. 100 had a crop rated only fair but the analysis does not indicate why.

Tomatoes

Ten fields are included, nine of which are rated good and one rated fair. Available nitrogen averages 4 ppm. with a range of from trace to 15 ppm. Available phosphorus ranges from 2 to 21 ppm. with reserves of from 7 to 50+ ppm.

Available potash ranges from 9 to 30 ppm. with reserves of from 19 to 100 ppm. Grower No. 111 with a crop rating of fair is the only one seriously low in phosphorus and he is also the lowest in potash which may account for his crop rating. The remaining fields show analyses which are reasonably satisfactory especially when the chemical feedings are taken into account.

Miscellaneous Crops

Asparagus. All crops marked good and the analyses agree except in No. 115 where there is a definite shortage of phosphorus.

Egg Plant. There is only one field represented and its analysis is very low in both phosphorus and potash. The crop was rated poor.

Radish. Only one field represented. It is on muck soil, the feeding appears to fit the analysis and the crop is marked good.

Sweet Pepper. Three fields are represented, only one of which (No. 121) appears to be seriously deficient. There was apparently a seasonal difficulty with sweet peppers last season.

Parsnip. Only one field represented. It has a satisfactory soil analysis and a good crop rating.

Celery

Thirty-three fields are included. There are three examples (Nos. 65, 76 and 85) where the soil analyses are satisfactory and yet the crop rating is only fair. In twenty-eight instances a satisfactory analysis is associated with good crop rating. Where the remaining crop ratings are only fair low nitrogen probably accounts for the low rating in six instances (Nos. 55, 62, 67, 70, 73, 74). Low phosphorus probably accounts for the fair crop rating in Nos. 70 and 71. No. 72 had similar soil characteristics and in addition had sufficient carrot fly injury that the crop rating was poor.

There are too many fields to consider them individually but an examination of the data makes immediately apparent the fact that there was no uniformity among the various growers concerning the amounts of chemical fertilizer fed. Selecting those fields with adequate and fairly uniform supplies of N, P, K different growers have fed from nothing at all to a ton of mixed fertilizer as initial feeding and from nothing to 1700 lbs. of nitrogenous fertilizer as side-dressing without any noticeable crop difference. Most of the growers have used manure in some quantity and their soil analyses indicate that the feeding and manure practice has been maintained over considerable periods of time and that the combination has built up good reserves. It would appear that where this is demonstrated by soil analysis the grower need add only sufficient fertilizer to maintain his reserves and according to the recommendations by the Ontario Fertilizer Advisory Board 750 lbs. of 4-8-10 should be sufficient.

Cantaloupe

Nineteen fields are included. Ten crops are rated good, eight fair, and one poor. In general the available nitrate averages lower than in other crops studied. This is true also for both phosphorus and potash, both available and reserve, but in all but two instances (Nos. 30, 31) supplies of N, P, K are not seriously deficient where the crop is marked good. Nos. 30 and 31 appear to have no serious deficiency and yet the crop is marked fair. All other fair or poor ratings are associated with visible soil factors; Nos. 25 and 26 side-dressed at planting time in such a manner that there was evidence of direct root injury. Growers 32, 33, 34, 35 have soils in which the phosphorus is probably at or below the border line of sufficiency.

It may or may not be significant that those growers who fed mixed fertilizer had crops which were rated less than good no matter whether the soil analysis appeared to be satisfactory or not. All of the cantaloupe crops in the Aldershot area were subjected to greater or less moisture deficiency depending largely on the type of soil, its organic content and its slope. It is difficult to evaluate the effect of moisture variation in this area.

Muck Soil

Those muck soils on which celery was grown gave an analysis quite similar to those obtained from upland soils in which celery was grown successfully.

The soil analyses in those muck soils where head lettuce, onions and carrots were grown is summarized in Table 3. Crops marked good were produced in five instances in soils in which the analyses for phosphorus and potash would be considered borderline or low in upland soils. We do not have sufficient information to come to any conclusion except that in some instances at least it is not safe to apply knowledge derived from upland soils to determining the fertilizer requirement of muck soils.

Conclusion

1. So far as our information goes it is possible by an examination of data from soil analyses taken throughout the growing season, and from data concerning the current and past year fertlizer-manure program, to estimate with at least 80% accuracy whether a crop will be good or less than good, when obvious features such as extreme drought and disease are taken into consideration.

2. It would appear to be possible to feed soils much more intelligently than was done on the average in those fields included in this study, if such feeding was based on soil analyses. Undoubtedly there were many instances where fertilizer was wasted.

3. The results of the present work to date with truck crops supports and emphasizes the repeated recommendations of the Ontario Fertilizer Advisory Board to use soil analyses for the intelligent feeding of truck crops.

4. Our information on nutrient levels for upland soils in relation to truck crop production in Southern Ontario is summarized in Table 4.

Table 4

Nutrient Levels for Upland Soils in Relation to Truck Crop Production in Southern Ontario as Indicated by the Present Investigation

Nitrogen in ppm.		Phosphorus in ppm.		Potassium in ppm.		
Average	Range	Available	Reserve	Available	Reserve	
4+	trace to 20	12+	20+	20+	50+	Adequate
2	trace to 6	6	12	10	20	Marginal
		Below the above levels				Deficient

Explanation of Table 3

1. Burl. (Burlington), Lon. (London), Br.M. (Bradford Marsh), Bran. (Brantford), HumB. (Humber Bay), Ald. (Aldershot), HumS. (Humberside), Isl. (Islington).
2. C.L. (Clay Loam), S.L. (Sandy Loam), Mu. (Muck), S.L.G. (Sandy Loam, Gravelly).
3. Ppm. (Parts per million). (Multiply by 8 to approximate lbs. per acre in top 6 inches.)
4. Initial Feeding, (Chemical fertilizers fed before crop was planted).
5. Side-dressing, (Cnemical fertilizers fed near the plants during the growing season).
6. Manure, amounts added in 1940 and 1941 are indicated in tons per acre.
   * after tons per acre of manure indicates chicken manure.
   † after tons per acre of manure indicates farm yard sheep manure.
7. A question mark (?) indicates that the quantity is not known.
8. KCl (potassium chloride or muriate of potash); $NaNO_3$ (sodium nitrate); $(NH_4)_2SO_4$ (ammonium sulphate).
9. T, indicates a trace. A dash (—) indicates none.

Table 3
Summarized Data from Soil Analyses
Vegetable Crops Grown in 1941

No.	Place	Soil Type	No. of tests	pH	Average Soil Analysis in Ppm. Available Nitrogen Av.	Nitrogen Range	Available P	Available K	Reserve P	Reserve K	Fe	Mn	Initial Feeding	No.	Side Dressing	Organic Material Manure '40	Manure '41	Rye	Mulch	Crop Rating	Remarks
Beets																					
1	HumB.	C.L.	2	6.9	6	2-10	13	45	55	85	T	T	4-8-10?	1		45	45			good	Early
2	Lon.	S.L.	3	6.8	2	1-3	13	33	50+	63	T	T	750 lbs Ammophos + KCl	2		35	—			good	Early
3	HumB.	S.L.	3	7.3	3	1-5	16	43	50	100		T	3 ton grade A lime	3		?	—			good	Early
4	Burl.	S.L.	3	7.3	2	T-5	13	8	50	25	T	T		4		25	25			good	Early transplanted beets
5	HumB.	S.L.	3	6.6	2	2-3	12	32	50	80	–	T	500 lbs 4-8-10	5		—	—		1940	good	Early
6	Burl.	S.L.	2	6.6	3	2-5	13	30	50+	100	1	1		6		30	—			good	Early
7	Lon.	S.L.	3	6.5	4	T-10	12	20	50+	52	T	1	1200 lbs 4-8-10	7	400 lbs $(NH_4)_2SO_4$	20	30			good	Early
Cabbage																					
8	Lon.	S.L.	3	6.6	1.5	T-3	20	35	50+	76	–	2	600 lbs Cyanamid	8	150 lbs $NaNO_3$	?	?			good	Fresh strawy manure
9	Lon.	S.L.	4	6.8	1	0-2	18	23	50+	66	1	T		9		20	20			fair	Crop not growing rapidly enough size of heads good —not firm
10	Lon.	S.L.	3	6.6	4	3-5	13	32	50+	95	2	2	800 lbs Ammophos+800 lbs KCl	10		30	–			good	Early
11	HumB.	S.L.	3	7.1	6	5-7	15	36	46	100	–	T		11	2 appl. 150 lbs $NaNO_3$	?	35			good	Early
12	Bran.	S.L.	3	7.0	3	2-5	1	5	3	5	T	–	300 lbs Cyanamid	12		10	10			fair	Early
13	Isl.	S.L.	3	7.0	4	2-6	7	25	30	62	T	1	600 lbs fish manure	13		?	?			fair	Early
14	HumB.	S.L.	3	6.7	5	2-10	12	43	43	80	T	1	400 lbs 4-8-10	14		30	30			good	Early
15	Burl.	S.L.	2	6.6	6	5-7	13	30	50	100	3	1	12-1400 lbs 4-8-10	15		30	–			good	Early
16	Burl.	S.L.	1	6.8	15		15	40	50	80	T	1	12-1400 lbs 4-8-10	16		30	–			good	Early
Cantaloupe																					
17	Bran.	S.L.	4	6.5	4	3-5	9	17	40	48	3	1		17		10*	10*			good	Root injury due to too deep cultivation—no crop
18	Ald.	S.L.	5	6.4	9	9-10	3	10	23	41	4	2		18		8†	–	1940		good	Growth of vines not equal to normal—drought
19	Ald.	S.L.	5	6.4	5	3-8	4	12	28	34	6	2		19		8†	–			good	" " " "
20	Ald.	S.L.	5	6.4	5	2-9	3	8	27	31	2	2		20		8†	–			good	" " " "
21	Ald.	S.L.	5	6.4	5	3-7	5	11	32	56	3	2		21		8†	8†	1941		good	" " " "
22	Ald.	S.	5	6.3	3	5-8	3	9	17	31	6	2	Cyanamid?	22		15	—			good	
23	Ald.	S.	5	6.4	4	1-9	5	15	29	44	6	2		23		15	—			good	
24	Ald.	S.	5	6.4	2	T-3	4	10	19	32	4	1		24		15	–			good	
25	Ald.	S.	5	6.4	6	4-8	5	14	38	50	5	3		25	1 handful per plant of 6-6-6	—	15			fair	Stunting of plants and fruits
26	Ald.	S.	5	6.4	3	1-6	3	10	16	28	5	1		26	1 handful per plant of 6-6-6	—	15			fair	" " " "
27	Ald.	S.	5	6.5	3	T-6	6	10	41	51	4	2		27		4	10			good	
28	Ald.	S.L.	4	6.5	T	0-1	1	6	7	27	3	2		28		5	5	1941		fair	Very gravelly soil
29	Ald.	S.L.	4	6.4	1	T-2	2	7	13	30	5	1		29		–	–			good	Buckwheat planted in 1940 as green manure
30	Ald.	S.L.	4	6.5	2	T-6	4	17	17	74	6	3	666 lbs. 4-8-10	30		10	10	1941		fair	Vine growth short
31	Ald.	S.L.	4	6.5	2	0-8	5	8	21	35	4	3	666 lbs 4-8-10	31		10	10	1941		fair	" " "

Table 3—(*Continued*)

No.	Place	Soil Type	No. of tests	pH	Average Soil Analysis in Ppm. — Available — Nitrogen Av	Nitrogen Range	Available P	Available K	Reserve P	Reserve K	Reserve Fe	Reserve Mn	Initial Feeding	No.	Side Dressing	Organic Material — Manure '40	Manure '41	Rye	Mulch	Crop Rating	Remarks
Cantaloupe—Continued																					
32	Ald.	S.L.	4	6.5	2	T-3	3	7	11	25	5	3	666 lbs 4-8-10	32		10	10	1941		fair	" " "
33	Ald.	S.L.	4	6.4	3	1-4	2	15	13	50	10	3	666 lbs 4-8-10	33		10	10	1941		fair	Vine growth short—very gravelly
34	Ald.	S.L.	4	6.6	3	1-6	2	12	8	47	1	4	666 lbs 4-8-10	34		10	10	1941		fair	Medium vine growth
35	Ald.	S.L.	4	6.4	1	T-1	1	7	7	40	2	3	666 lbs 4-8-10	35		10	10	1941		poor	
Carrot																					
36	Lon.	S.L.	5	6.5	T	T-2	17	12	50+	56	T	1	300 lbs Cyanamid, Ammophos, K, Fe, Mn	36		—	—		1940	good	Tops showing yellowish-green
37	Lon.	S.L.	3	6.6	6	3-8	21	43	50+	100+	T	1	500 lbs Ammophos + potash	37		30	—			good	
38	Bran.	S.L.	6	6.8	7	3-10	6	16	17	51	T	T	750 lbs 4-8-10	38		—	—			good	
39	Brad.	Muck	5	6.6	4	2-8	7	11	18	18	T	T	750 lbs Ammophos + KCl	39		—	—			good	
40	Isl.	S.L.	3	6.5	2	T-6	4	22	20	70	T	T	500 lbs 4-8-10	40		—	—		Straw '40 —	fair	Tops slightly yellow-green
41	Lon.	S.L.	3	6.5	3	T-8	16	22	50+	52	1	1	1600 lbs 4-8-10	41		20	—			good	
42	Brad.	Muck	5	6.4	3	T-10	3	7	16	17	–	T		42		—	—			poor	Yellowish to light green tops
43	Brad.	Muck	4	6.3	2.5	T-6	3	9	15	28	–	–		43		—	—			good	Tops slightly yellowish-green
Cauliflower																					
44	Bran.	S.L.	3	6.8	4	1-6	4	6	12	15	1	T		44		10*	10*			good	Late
45	HumB.	S.L.	3	7.2	6	3-9	10	30	43	60	T	T	4-8-10?	45		?	?			good	Early
46	Lon	C.L.	4	6.9	5	3-7	T	5	2	9	–	–	1500 lbs 5-8-7	46	575 lbs Cyan, KCl, Super	—	—			fair	
47	Lon.	C.L.	4	6.8	4	4-5	1	5	10	11	–	T		47	575 lbs Cyan, KCl, Super	—	—			fair	
48	Lon.	S.L.	5	6.9	6	1-11	2	10	10	18	–	–	600 lbs Cyan., 600 lbs KCl	48	200 lbs KCl, 200 lbs Super 200 lbs $NaNO_3$. Starter Sol.	—	—			fair	
49	Lon.	S.L.	3	6.8	3	1-5	1	5	4	10	–	–	600 lbs Cyan., 600 lbs KCl	49	200 lbs KCl, 200 lbs Super 100 lbs $NaNO_3$	—	—			good	Judged on leaf growth only. No heads had formed
50	Burl.	S.L.	3	7.2	5	3-8	11	7	50	20	T	1	1500 lbs 5-10-5	50	200 lbs $NaNO_3$	20	20			fair	Some buttoning occurred
51	Burl.	S.L.	3	7.0	6	2-10	12	18	53	47	T	T	1000 lbs 4-8-10, 500 lbs $NaNO_3$	51		18	18			good	Early
52	Isl.	S.L.	4	7.2	4	T-6	12	40	40	80	T	T		52		40	—			poor	Slow growth
53	HumB.	S.L.	2	6.7	4	2-6	13	40	55	95	T	–	400 lbs 4-8-10	53		30	30			good	Early
54	Burl.	S.L.	3	6.8	14	12-25	12	26	46	70	1	1	1200 lbs 4-8-10	54	300 lbs $NaNO_3$	35	—			good	
Celery																					
55	Burl.	S.L.	4	7.1	3	0-7	7	16	32	32	T	T		55	1000 lbs 4-8-10	15	15			poor	Yellows
56	Burl.	S.L.	4	6.8	7	5-10	16	15	50	45	–	1	1250 lbs 4-8-10	56	1250 lbs $NaNO_3$	30	—			good	
57	HumB.	S.L.	6	6.5	8	4-15	7	35	40	100	–	–	500 lbs 4-8-10	57	300 lbs $NaNO_3$	30	—			good	Early
58	HumB.	S.L.	6	6.6	6	4-8	13	30	45	80	T	T	500 lbs 4-8-10	58	2 appl. 400 lbs $NaNO_3$	50	—			good	Late
59	HumB.	S.L.	4	6.7	6	2-12	15	35	50+	100+	–	T	500 lbs 4-8-10	59	400 lbs $NaNO_3$	—	—		1940	good	Late
60	HumB.	S.L.	4	6.7	5	2-7	17	50	47	100	–	–	500 lbs 4-8-10	60	2 appl. 400 lbs $NaNO_3$ +1 appl. 300 lbs $NaNO_3$	—	—		1940	good	

Table 3—*(Continued)*

No.	Place	Soil Type	No. of tests	pH	Available Nitrogen Av	Available Nitrogen Range	Available P	Available K	Reserve P	Reserve K	Fe	Mn	Initial Feeding	No.	Side Dressing	Organic Material Manure '40	Organic Material Manure '41	Rye	Mulch	Crop Rating	Remarks
Celery—Continued																					
61	HumB.	S.L.	5	6.7	7	6-10	14	36	50	100	–	–	500 lbs 4-8-10	61	300 lbs $NaNO_3$	30	30			good	Late
62	Lon.	S.L.	4	6.5	3	2-5	11	20	50+	80	T	T	1800 lbs 4-8-10	62	1200 lbs $(NH_4)_2SO_4$	20	30			fair	
63	Lon.	S.L.	3	6.5	5	1-9	17	20	50	45	T	2	500 lbs Super, 200 lbs KCl	63	200 lbs $(NH_4)_2SO_4$, 1500 lbs $NaNO_3$	30	30			good	
64	Lon.	S.L.	5	6.5	8	1-14	18	45	44	97	1	T	200 lbs 4-8-10	64		25	—		1941	good	
65	Lon.	S.L.	5	6.5	7	3-13	8	35	42	86	1	1	200 lbs 4-8-10	65	2 appl. 200 lbs $NaNO_3$	25	—		1941	fair	Slight browning on the roots
66	Burl.	S.L.	4	6.6	7	3-15	13	34	50	100	1	T	12-1400 lbs 4-8-10	66	150 lbs $NaNO_3$	—	?			good	
67	Burl.	S.L.	6	6.6	2	T-3	12	31	46	96	1	T	250 lbs $NaNO_3$, 150 lbs KCl	67		?	?			fair	
68	Burl.	S.L.	6	6.6	5	2-10	13	31	50	90	–	1	1000 lbs 4-8-10	68		25	—		1941	good	
69	Burl.	S.L.	6	6.6	8	2-18	14	30	50	68	T	1	1000 lbs 4-8-10	69		25	—			good	
70	Lon.	S.L.	5	6.7	3	2-6	2	17	7	35	–	T	600 lbs Cyan., 1000 lbs 4-8-10	70	500 lbs 4-8-10, 500 lbs KCl, 1000 lbs Super, 1000 lbs $NaNO_3$	—	—	'40'41	1941	fair	
71	Lon.	S.L.	2	6.5	4	2-7	4	20	8	47	–	T	600 lbs Cyan., 1000 lbs 4-8-10	71	Same as No. 70	—	—	'40'41	1941	fair	
72	Lon.	S.L.	2	6.4	11	2-20	4	65	10	90	–	–	600 lbs Cyan., 1000 lbs 4-8-10	72	Same as No. 70	—	—	'40'41	1941	poor	Some carrot fly injury
73	HumB.	C.L.	5	6.9	3	T-6	12	20	43	59	T	T		73		40	30			fair	Fairly light green leaves in early growth
74	Lon.	S.L.	6	6.6	2	1-4	12	20	20	52	T	2	600 lbs Cyan.	74		—	40			fair	Some yellow leaves
75	Lon.	S.L.	6	6.6	9	1-15	20	26	50+	65	T	1	600 lbs Super	75	4 appls.: 250, 300, 450 and 500 lbs $NaNO_3$ + 100 lbs KCl	20	20			good	
76	Lon.	S.L.	5	6.6	8	5-12	15	20	50+	78	T	1	700 lbs fish manure	76	3 appls.: 150, 150, and 200 lbs $NaNO_3$	30	—			fair	Medium sized stems—good root development
77	HumB.	S.L.	3	6.9	4	2-6	10	33	38	90	T	T	3 ton lime	77		?	?			good	Early
78	HumB.	S.L.	6	6.8	7	1-16	12	21	43	68	–	–	2000 lbs 4-8-10	78	2 appl. 200 lbs $NaNO_3$	25	30			good	Leaves slightly light green
79	HumB.	S.L.	6	6.9	5	1-10	13	22	42	78	–	T	2000 lbs 4-8-10	79	2 appl. 200 lbs $NaNO_3$	25	30			good	Tall well developed plants
80	HumB.	S.L.	7	6.8	8	3-15	10	26	43	79	T	–	2000 lbs 4-8-10	80	200 lbs $NaNO_3$, 400 lbs Ammophos	25	30			good	
81	HumB.	S.L.	3	6.8	15	12-20	16	66	47	100+	–	–		81	2 appl. 200 lbs $NaNO_3$ + 2 appl. 300 lbs Ammophos	20	40			good	
82	HumB.	S.L.	3	6.9	10	7-15	9	46	37	100+	–	–		82	Same as 81	20	40			good	
83	Brad.	Mu.	2	6.6	5	2-8	8	38	30	85	1	–		83						good	Early
84	Brad.	Mu.	3	6.8	6	3-8	7	17	30	40	–	T	800 lbs KCl+300 lbs Ammophos	84	2 appls.: 400, 200 lbs $NaNO_3$	—	—			good	Late
85	Lon.	Mu.	4	7.0	8	3-10	6	35	42	72	T	–	600 lbs Cyan. + 400 lbs KCl	85		—	—			fair	
86	Lon.	S.L.	2	6.6	5	3-6	10	27	35	40	–	T	500 lbs Super, 200 lbs KCl	86	300 lbs $(NH_4)_2SO_4$	—	30	1941		good	
87	Lon.	S.L.	2	6.6	4	T-8	13	35	45	50	–	T	500 lbs Super, 200 lbs KCl	87	200 lbs $(NH_4)_2SO_4$	—	30	1941		good	
Head Lettuce																					
88	Bran.	S.L.	2	6.5	2	1-4	27	22	50+	75	3	2	200 lbs Cyan.	88		10*	10*			good	
89	Bran.	S.L.	3	6.5	8	6-9	24	24	50+	75	3	2	200 lbs Cyan.	89		10*	10*			good	
90	Bran.	S.L.	3	6.6	3	2-4	4	10	15	33	3	3		90		—	—			fair	
91	Bran.	S.L.	3	7.0	3	2-4	1	5	2	8	T	–		91		10	10			fair	
92	Brad.	Mu.	3	6.3	3	T-6	4	10	14	21	T	–		92		—	—			fair	Some tip burn
93	Brad.	Mu.	2	6.5	7	7-8	1	7	4	12	T	T		93		—	—			poor	

Table 3—(*Continued*)

No.	Place	Soil Type	No. of tests	pH	Average Soil Analysis in Ppm. Available Nitrogen Av	Range	P	K	Reserve P	K	Fe	Mn	Initial Feeding	No.	Side Dressing	Organic Material Manure '40	'41	Rye	Mulch	Crop Rating	Remarks
Onion																					
94	HumB.	C.L.	6	6.9	9	2-15	11	37	43	90	–	T		94		?	?			good	Spanish
95	Bran.	S.L.	6	6.7	6	4-6	12	33	36	95	1	T	750 lbs 4-8-10	95		—	20			good	Spanish
96	Brad.	Mu.	4	6.5	3	1-7	5	9	16	10	–	T	500 lbs Super., 350 lbs KCl	96		—	—			good	
97	Brad.	Mu.	4	6.6	5	3-6	5	17	18	34	–	T	500 lbs Super.	97	400 lbs KCl	—	—			good	
98	Bran.	S.L.	6	7.0	5	3-8	1	6	7	10	–	–	1000 lbs 4-8-10	98		10	10			fair	Spanish
99	Bran.	S.L.	2	7.1	5	3-8	T	5	1	6	–	–	1000 lbs 4-8-10	99		10	10			fair	Spanish
100	Lon.	S.L.	4	6.6	3	1-4	9	25	41	56	1	3	300 lbs Cyan., 700 lbs Super + KCl	100		35	35			fair	
101	Brad.	Mu.	5	6.4	3	1-4	4	7	15	20	T	T		101		—	—			fair	Some yellowing at the tips
102	Brad.	Mu.	5	6.0	11	2-20	7	15	25	43	T	1	800 lbs K 2 pts., Phos. 1½ pts., NH_3 1½ pts.	102		—	—			good	
103	Brad.	Mu.	5	6.7	8	7-10	3	17	9	28	–	T	200 lbs Ammophos., 500 lbs KCl, 250 lbs Super.	103	50 lbs $CuSO_4$	—	—			fair	
Tomatoes																					
104	Lon.	S.L.	6	6.5	2	T-4	21	28	50+	78	T	T	Complete N P K + Mg + Fe?	104	75 lbs $NaNO_3$, 150 lbs $NaNO_3$	—	—		'40'41	good	
105	Bran.	S.L.	7	6.5	4	T-8	9	9	30	24	4	1	200 lbs Cyan.	105		10*	—			good	
106	Ald.	S.L.	3	6.3	4	2-6	2	12	16	26	3	2		106		—	—			good	
107	Ald.	S.L.	3	6.4	4	2-5	6	9	41	44	6	1		107		4†	—			good	
108	Bran.	S.	6	6.8	4	T-9	5	18	15	50	T	T		108	200 lbs $NaNO_3$	—	—		'40'41	good	
109	Burl.	S.L.	4	6.6	4	3-7	12	30	50+	90	3	2	1000 lbs 3-18-5	109		?	—			good	Very good crop
110	Burl.	S.L.	4	6.6	3	T-5	8	25	41	100	2	2	1000 lbs 3-18-5	110		?	—			good	" " "
111	Lon.	S.L.	5	6.4	4	2-8	3	14	7	19	1	2	750 lbs 4-8-10	111		20	—			fair	Grower's rating
112	Burl.	S.L.	4	6.5	6	2-15	4	22	27	72	4	1	750 lbs 2-12-6	112		?	?			good	
113	Burl.	S.L.	6	6.5	4	2-13	4	17	23	46	4	2	750 lbs 2-12-6	113		?	?			good	
Miscellaneous																					
Asparagus																					
114	Burl.	S.L.	3	6.6	2	1-3	5	20	47	57	2	2		114		40	—			good	Sixteen-year-old bed
115	Burl.	S.L.	3	6.4	4	2-8	1	13	2	50	T	T		115		40	—			good	Six-year-old bed
116	Burl.	S.L.	3	6.4	4	3-4	3	16	25	70	4	1		116		?	—			good	All asparagus was rated on leaf and stem growth only.
117	Burl.	S.L.	3	6.4	3	2-3	4	16	32	70	4	1		117		?	—			good	
Egg Plant																					
118	Bran.	S.L.	7	7.1	3	T-7	1	5	9	7	T	T		118		10	10			poor	
Radish																					
119	Lon.	Mu.	1	6.7	6		5	10	25	10	–	–	250 lbs 0-12-15	119	20 lbs $CuSO_4$	—	—			good	
Sweet Pepper																					
120	Burl.	S.L.	7	6.4	3	1-7	3	18	22	58	6	T	200 lbs bonemeal	120		30	20			fair	
121	Burl.	S.L.	7	6.1	2	0-5	1	9	5	35	7	T		121		—	—	1941		poor	Leaves dark green, plants poor
122	Bran.	S.L.	7	6.5	10	5-20	11	20	45	62	2	1	200 lbs Cyan.	122		10*	10*			poor	
Parsnips																					
123	Bran.	S.L.	7	6.5	6	2-9	15	20	47	70	2	1		123		10	10			good	

BULLETIN 422 OCTOBER, 1942

Ontario Department of Agriculture
Statistics and Publications Branch
TORONTO, ONTARIO

SWINE PARASITE CONTROL

by

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Swine Parasite Control

FOREWORD:

The problem to be solved in parasite control is to successfully protect new-born pigs from the parasites harboured by the brood sows and older pigs on the premises.

Pigs require special care to protect them from parasites during the first few weeks of life when they are very susceptible to the attack of any disease-producing organism.

Due attention to the protection of the young pigs by the practice of good swine husbandry will save swine breeders the losses expressed by the lack of condition, the stunting and the unthriftiness of the herd.

Pigs with a comparatively light parasitic infestation do not appear definitely sick. They may become unthrifty.

Pigs with a heavy infestation of parasites are likely to be quite seriously injured and become very unthrifty; some may die.

Conditions that favor the various worm parasites may also favor protozoa and disease-producing bacteria.

Pigs infested with worm parasites are frequently also handicapped by semistarvation, an unbalanced or faulty diet and diseases due to bacteria or exposure. These "multiple condition" cases are much more common than "single condition" cases where worm infestation alone is the cause of unthrift.

In swine herds where "multiple condition" infestations, including the effects of numerous kinds of parasites, a nutritional disease and a bacterial disease are combined in one individual, the numerous young members of the herd will have a hard time retaining life. Many will end as unthrifty, stunted, crippled and emaciated victims of bad management.

PARASITE CONTROL MEASURES:

Start the newborn litter of pigs in sanitary surroundings and protect them by keeping them as clean as possible until they are at least three months old. The pen floors, walls and feed troughs should be of such a structure as will permit easy and thorough cleaning. The farrowing pen can be cleaned free from worm eggs and other low forms of life by removing all visible manure, litter and dirt; then, following with a generous application of hot water and lye. A floor once clean and free from worm eggs can be kept that way, only by closing every avenue by which worm eggs could enter. The various avenues of worm eggs entry are: the eggs clinging to the body and feet of the brood sow, the eggs in the faecal matter discharged by the brood sow, the eggs carried on the boots of the herdsman, the eggs carried in by older pigs. Young pigs should not be permitted to run over yards or pastures frequented by old pigs. The older, worm-infested pigs in the herd must be regarded as the source of worm eggs. It is a well-known fact that all ascarids, infesting pigs, come from eggs produced by worms inhabiting the body of a worm-infested pig, usually an animal over three months of age. This fact indicates that the very young pig should not come in contact with any pig other than its mother or litter mates until it is at least three months of age. Pigs kept free from the worm handicap and otherwise well raised are usually strong enough to endure later moderate infestations of worms

A colony house located on clean, fresh ground makes an ideal home for the young pigs. It is during the period of babyhood that the damage is greatest from worm infestation. Give the young pigs a colony house located in a corner of the clover field in which to start life.

without showing any harm. A worm-infested brood sow will of course start her litter of young under a heavy worm handicap from which it cannot shake free, until it is long past the age for profitable bacon production.

TREATMENT FOR THE REMOVAL OF PARASITES:

Treatment of worm-infested swine, particularly the brood sows, for the removal of the egg-producing worms is an important part in good management. With worm egg production prevented or greatly reduced, the danger to the new-born pigs is very largely removed, and it becomes possible to rear them free from any worm handicap. The start in worm control should, therefore, be made by applying worm treatment to the brood sows in the herd, if they need it, at an early date in pregnancy and then keeping them in a worm-free environment until they are ready to go into the specially-cleaned, worm-egg-free pen where the young are to be born.

The faeces of all brood sows should be carefully examined microscopically for round worm eggs. The presence of worm eggs in the faeces indicates the presence of the egg-producing worms in the intestine. All sows proving positive for worm eggs should be treated for the removal of the worms. Young pigs born of a worm-infested mother cannot escape worm infestation.

The drugs most successful in removing round worms from infested pigs are Oil of Chenopodium, Tetrachlorethylene and Phenothiazine. All are effective in removing a good percentage of worms, if used as recommended. All are safe for use by those experienced in administering medicine to pigs, providing of course that the pig is normal in every way, except being parasitized. All drugs must be administered in correct dosage for the weight and size of the pig being treated. Drugs that are as injurious to parasites as those mentioned may be temporarily injurious to pigs, if used in a careless way.

Drug treatment is not a substitute for sanitation, and represents just so much waste time and waste effort unless it is backed up fully by improved sanitary practices. Treated animals if allowed to remain in infected areas will soon acquire another load of worm eggs and continue to be unthrifty. Hygiene and sanitation fully applied to pig production will remove any need for the use of drugs in worm control.

THE COMMON ROUND WORM OR ASCARID:

This is the most serious worm pest that pigs on Ontario farms have to contend. Ascarids are injurious in both the migratory, larval and in the adult form.

DAMAGE PRODUCED:

Digestive disturbances, retarded growth and general weakness. Pigs may become anemic, very unthrifty, and more susceptible to the various bacterial diseases.

TREATMENT:

(a) The administration by stomach tube, capsule or dose syringe, of Oil of Chenopodium at the rate of one-half to one fluid dram to a pig weighing 100 pounds. This is to be followed by the administration of at least two ounces of Castor Oil. Sows weighing 300 pounds or over could be given two fluid drams of Oil of Chenopodium along with two ounces of Castor Oil. Bred sows should not be given Oil of Chenopodium if pregnancy has advanced to within 60 days of expected farrowing date. Swine should be without feed for 18 hours previous to the administration of Oil of Chenopodium and should not be fed or watered until three hours following treatment. Young pigs under 50 pounds in weight should not be given Oil of Chenopodium.

(b) The administration by capsule (Nema capsule) of Tetrachlorethylene to worm-infested pigs in the following dosages can be undertaken by those skilful enough to perform the task.

For pigs weighing up to

50 pounds use	1 c.c. tetrachlorethylene
100 pounds use	2 c.c. tetrachlorethylene
200 pounds use	5 c.c. tetrachlorethylene
500 pounds use	10 c.c. tetrachlorethylene

Tetrachlorethylene is better suited to pigs under 50 pounds in weight than either Oil of Chenopodium or Phenothiazine. It is also well suited to brood sows.

(c) The administration by capsule, bolus, or with suitable feed of Phenothiazine to worm-infested pigs in the following dosages will remove a good proportion (about 60 per cent) of the mature round worms. A repeated dose given after an interval of two weeks would increase the total number of worms removed.

For pigs weighing up to

25 pounds, use	5 grams Phenothiazine
25 to 50, use	9 grams Phenothiazine
50 to 100, use	12 grams Phenothiazine
100 to 200, use	20 grams Phenothiazine
over 200, use	30 grams Phenothiazine

Phenothiazine has but little effect on immature ascarids so its use had best be confined to pigs old enough to be infested with ascarids that have developed to mature size (three months). Overdosing or double dosing with Phenothiazine may lead to loss. The weight of the pig should be known and the dose accurately measured and administered.

Mass treatment to large groups of pigs with Phenothiazine may lead to loss as some pigs will get more than the intended share of the medicated feed.

When it is decided to administer Phenothiazine to worm-infested pigs by mixing the drug in the feed, the following factors should be kept in mind: (1) The mixture of Phenothiazine and feed should be "stiff," not sloppy; (2) The number of pigs in the pen at one time should not exceed six; (3) The pigs should all be the same size or weight and have equal fighting ability to insure each one getting an equal share; (4) Feed troughs that are sectioned to prevent greedy feeding are an aid in insuring each pig an equal share; (5) The medicated feed should be placed in the trough in such a way to permit all pigs in the group to start at exactly the same time; (6) It is not necessary to starve or withhold feed from pigs that are listed for treatment with Phenothiazine as pigs will take it readily in their usual feed; (7) See that the medicated feed is evenly distributed in the feed trough before the pigs are admitted. Trouble is likely to follow any carelessness that will permit overdosing with Phenothiazine; (8) Phenothiazine in the correct amount should be most thoroughly mixed with the feed and fed at once; (9) Pigs should not be exposed to the sun for 24 hours following being treated with Phenothiazine.

THE LUNGWORMS:

Three species of lungworms occur in pigs. The degree of injury caused by lungworms depends upon the number present and the resistance of the pig to such invasion.

DAMAGE CAUSED BY LUNGWORMS:

During the early stages of invasion by lungworms, the lungs of the pig are peppered with hemorrhages resulting from the perforation of the walls of the delicate blood vessels. In heavy infestations the finer bronchi and bronchioles are plugged with worms and thus produce a localized pneumonia.

TREATMENT:

There is no medicinal treatment that is effective in removing lungworms from pigs. Infected animals should be placed on clean, dry floors and supplied with abundant good food and clean water. Tonics may be helpful. The elimination in so far as possible of all factors injurious to the welfare of pigs will enable them to withstand a lungworm attack until they reach slaughter weight. Sows harbouring a few lungworms should be removed from the herd or at least kept on cement floors while so infested.

PREVENTION OF LUNGWORM INFESTATION IN SWINE:

The problem of lungworm control can be solved by preventing pigs eating the common earthworm, especially those that appear in pig yards and permanent pastures. Earthworms thrive in old hog yards where manure and litter accumulate. Permanent pasture areas and low, poorly drained fields favor earthworms. Well drained, cultivated lands are relatively free from earthworms, near the surface. Earthworms feeding on soil contaminated with swine manure swallow the eggs of the lungworm and become infected. A single earthworm may harbour as many as 2,000 lungworm larvae. The infected earthworms are the source of the lungworm trouble when eaten by pigs. The use of temporary pastures, the movable colony house, and cement floors for yards and pens in the permanent swine premises, will prevent lungworm infestation in pigs. Any carelessness in management that permits the pig to eat earthworms that inhabit hog yard soil, barn yard soil, permanent pasture lots, or areas where pig manure is spread, is likely to lead to lungworm infestation of the pig. Pigs root for worms. Hog rings will stop rooting to a large extent, if properly placed and maintained.

THE NODULAR WORM OF SWINE:

The nodular worms of swine are a contributing cause to unthriftiness in pigs on premises where the swine sanitation is not well looked after. While nodular worm infestation is common, the actual damage caused is relatively light.

TREATMENT:

Phenothiazine will remove 90 per cent of all nodular worms present in the lumen of the pig's intestine. (See treatment for round worm.)

CONTROL:

The swine sanitation system. The shelters should be moved weekly on the temporary pastures as nodular worm larvae accumulate in shaded places from eggs dropped in the faeces of infested pigs.

THE THORN-HEADED WORM:

The thorn-headed worm is largely confined to a limited area in the south-western section of the Province where it causes some loss by contributing to the unthriftiness in young pigs.

TREATMENT:

No medicinal treatment is of any value in removing thorn-headed worms.

CONTROL:

Sanitation, keep pigs out of old yards and permanent pasture areas where the June beetle larvae abound. Pigs root for June beetle larvae or White Grubs. The White Grubs that develop in soil where worm egg infested pig manure is present are likely to be carriers of the infective stage of the thorn-headed worm. Therefore, protect the pigs by preventing them from eating June beetle larvae or the common White Grub so abundant in uncultivated light soils.

THICHINAE:

Slender, thread-like worms, occurring in the small intestine of pigs as adult worms, in the blood as migrating larvae, and in the muscles as encysted or encapsulated worms.

TREATMENT:

There is no known effective treatment.

CONTROL:

Protect pigs by preventing them from eating trichinous pork or the flesh of infested rats, mice or other animals. Uncooked garbage containing pork scraps is always a danger. A swine sanitation system will aid materially in preventing trichinosis.

TAPEWORM:

Domestic pigs are not infested by adult tapeworms, but are occasionally found to be infested with any one of the larval form of three tapeworm species. Pork containing the larval forms of tapeworm is called "measly pork"; it is dangerous to human health and must be removed by government inspection at the abattoirs.

TREATMENT:

There is no practical treatment for the removal of tapeworm larvae or bladder worms.

CONTROL:

A sound system of rural sanitation and the control of dogs that are infested by the mature form of tapeworms.

SARCOPTIC MANGE:

The young sarcoptic mange mites irritate the skin and cause it to become wrinkled, hairless, and crusted. Sarcoptic mange may spread over the entire body of the pig and reduce it to a very unprofitable condition.

TREATMENT AND CONTROL:

Lime-sulphur dip repeated in 7 to 10 days. The free use of an oiled rubbing post that is kept well serviced with a supply of suitable oil (a mixture of crude oil and raw linseed oil).

DEMODECTIC MANGE:

This condition is rarely seen in Ontario. It is difficult to treat. Control by quarantine and slaughter. Start again with clean breeding stock.

LICE:

Lice, if present, in large numbers on pigs, will worry them so as to make weight increase impossible and thereby defeat the primary reason for keeping pigs.

CONTROL:

A well-serviced rubbing post should be in reach of every pig. Oils, such as raw linseed oil or mixtures of raw linseed oil and crude oil or tractor oil will create conditions on the

Young pigs reared away from the old pens and old buildings have a much better opportunity to escape the worm handicap than those pigs that spend their early life around such places. Green feed, sunshine and pure air play a part for which there is no substitute in rearing pigs.

pig's skin that are unfavorable to the lice. Derris powder compounds are very effective against lice.

SUMMARY:

The colony house system with well planned temporary pastures on land that is used for pigs but one year in three is the most important aid in keeping pigs thrifty and worm free. Suckling pigs should be kept entirely away from older pigs, other than their mother.

Damp areas that harbour earthworms, grubs and insects at all seasons should not be used for pigs.

The presence of the infected White Grub or June beetle larvae or the adult June beetle is necessary in the development of the thorn-headed worm.

The presence of infected earthworms is necessary in the life cycle of the lungworms that infest swine.

Pigs that do not eat White Grubs, earthworms, snails or crayfish remain free from thorn-headed worms, lungworms and flukes.

Pigs will root hard for worms and insect larvae, if they are hungry. Liberal feeding and nose rings will reduce rooting.

Avoid the use of uncooked garbage. Keep rats and mice out of the pig yards and pens. If any animal dies, burn or bury deeply at once. Drugs are useful only as an aid in reducing the number of some kinds of worms present in pigs. A simply-constructed oil post or oil sand bath placed within reach of pigs at all times will keep down mange and lice.

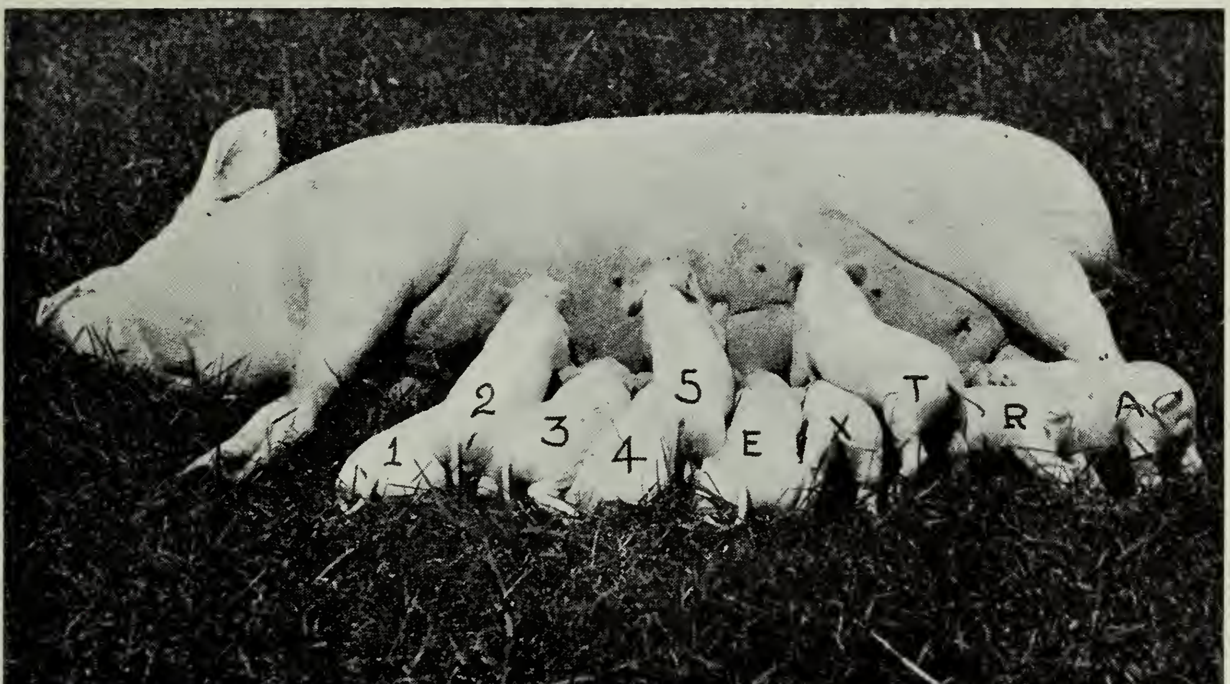
Save by protecting the pigs from these parasites.

BULLETIN 423 DECEMBER, 1942

Ontario Department of Agriculture

Statistics and Publications Branch
TORONTO, ONTARIO

SAVE THAT LITTER!



EVERY **EXTRA** PIG SAVED IS **120** LBS. MORE

BACON FOR BRITAIN

5 PIGS PER LITTER PAY FOR THE SOW'S KEEP
AND
THEIR OWN FEED.
PROFIT COMMENCES WITH THE **SIXTH** PIG.

Prepared by

THE SWINE COMMITTEE OF THE
ONTARIO FEED BOARD

DECEMBER, 1942

Published by Authority of The Honourable P. M. Dewan
Minister of Agriculture

Dec. 1942—50M—B2289

CANADA'S OBLIGATION FOR 1942-43

Canada has undertaken to supply Great Britain with 675,000,000 lbs. of bacon during the year commencing in November, 1942. This enormous quantity of bacon represents the product of approximately five and three-quarter million hogs. Hog marketings in 1942 will likely be in the neighbourhood of 6,500,000 head. At least 20% of the hogs marketed in any year are unsuitable for export because of imperfections in type, weight or finish, and mechanical injuries. When this number is deducted from the total marketings, the remainder falls short of the number required to fill the contract by approximately 500,000 head.

In the light of these facts, an increase in hog production is necessary if the present contract is to be filled. Feed supplies are sufficient to provide for the expansion in swine production. Canada harvested the largest crop in her history in 1942, and it is estimated that there is sufficient feed on hand to meet all probable requirements of the next two years.

There are two ways in which hog production can be increased:

(1) By increasing the number of sows, and particularly by increasing the number being bred during the Fall and Winter months of 1942-43.

(2) By raising a higher percentage of the little pigs that are farrowed. The latter procedure is especially applicable in the case of litters farrowed during the Winter months as those litters represent the pigs intended for market during the months when marketings are usually at lowest levels.

The Ontario Department of Agriculture believes an increase in hog production of 25% is necessary in this Province. Farmers who have the accommodation are urged to breed at least one additional sow. Saving more little pigs should be the objective of every hog producer. It is estimated that 25% of the little pigs farrowed die previous to weaning. The saving of one extra pig per litter will effect an increase of 12½%. Hence, half of Ontario's objective can be brought about through the application of better methods in care and management. It is hoped that the information contained in this publication will assist Ontario hog producers in attaining that objective.

SAVE THE LITTLE PIGS

The size of the litter, the health and vigour of the little pigs are dependent upon the following factors:

(1) The health and condition of the boar and sow at the time of breeding.

Overworked, poorly fed boars are not as fertile, nor is the semen as active as in the case of boars that are well fed and are not bred to too many sows over a short period of time. The thin, underfed sow cannot be expected to have ovaries sufficiently healthy and vigorous to produce ova (eggs) in large numbers and be vigorous as well. **The number of fertilized ova determines the size of the litter.**

(2) The type of ration fed to the pregnant sow.

The pregnant sow should be fed a balanced ration in sufficient quantities to enable her to maintain her own body in a satisfactory condition as well as develop the unborn young. The ration should include the feeding of the element (iodine) as a preventative against hairless pigs.

(3) **Clean and sanitary quarters.**

Clean, sanitary quarters are essential at all times, especially previous to and following farrowing. The sow should be washed and placed in a thoroughly disinfected pen at least three days before she is due to farrow. Sows with litters should be kept out of yards or runs where other pigs have been running.

(4) **Temperature of farrowing pens.**

Warm pens are necessary in cold weather. To prevent chilling in extreme weather, put the little pigs in a box or barrel immediately after they are born, especially if the sow is floundering about. Return them to the sow for feeding at least every two hours. Hot water jugs or warm bricks placed in the box will prove to be a considerable help in keeping the pigs from chilling. An electric brooder is a very satisfactory piece of equipment, provided that it is properly installed with respect to insulation and fire hazard. The brooder can also be used as a creep later on.

(5) **Protection to the young pigs.**

Use guard rails around the pen 8 inches from the floor and 8 inches from the wall. Bed the pen at farrowing time with short straw.

(6) **Removal of the needle teeth.**

Break off the needle teeth of the little pigs within twelve hours after they are born. These needle teeth very often pierce the udder of the sow with the result that she gets up quickly and may crush one or more of the little pigs. They have no value so far as the thrift of the pig is concerned.

(7) **Prevention of the occurrence of anemia.**

For the prevention of anemia, feed the little pigs individually iron sulphate (ferric, granular form) once a week, commencing when they are from 7 to 10 days of age, the dosage being an amount equal to what can be held on the old-fashioned, small Canadian five-cent piece per pig. If this is not possible, a simple method of preventing this condition is to provide each nursing pig once per week with a 6-inch square of sod on which has been sprinkled 1 teaspoonful of iron sulphate dissolved in a quart of water. This solution is sprinkled on the earthen side of the sod. Sods used for this purpose should be procured from areas on which pigs have not been running so as to guard against infestation of parasites.

(8) **Creep feeding.**

As soon as little pigs show an inclination to eat, they should be provided with a creep of some kind so that they can eat by themselves at will.

(9) **Supplementary feeding.**

Access to well-cured alfalfa hay, preferably the second or third cut, in a rack in the pen will provide a considerable amount of vitamins, vegetable proteins and minerals for the brood sow and later on for the little pigs. (See rations.) In view of the fact that protein-rich by-products are expensive, well-cured alfalfa hay is an economical feed as a source, **in part**, of these food nutrients.

NOTE: If it so happens that two litters are born within 24 to 36 hours of one another, and one litter is large and the other small, it is possible to transfer some of the large litter to the other sow. If there is any fear of any objection being taken on the part of the foster mother, sprinkle a weak solution of disinfectant on all of the pigs in the litter, both those belonging to the mother and those which you want her to adopt.

REMEMBER!

1. That one must have suitable equipment for farrowing in Winter weather to make early Spring pigs profitable. Every additional pig that a sow raises means more profitable production. Every time a pig is killed or dies, the cost of maintaining the sow and raising the litter is increased. Every time a pig dies, it means 120 pounds less Wiltshire for Britain.
2. That all breeding stock should get exercise.
3. To record breeding dates and have the pen ready for farrowing in 111 days, three days before you expect the pigs.
4. That kindness and quietness are just as essential to the confidence of the brood sow as is the case with any other animal. The sow that does not have confidence in her owner or attendant invariably will jump up to protect her young, and in doing so may kill a pig.
5. That feeding a sow lightly for a few days before farrowing and for a few days after farrowing may prevent the occurrence of caked udders and pig scours.
6. That minerals and vitamins are very essential in the ration of a pregnant and nursing sow and a growing pig, and that home-grown grains are low in calcium (lime) content.
7. That the occurrence of pigs being born hairless can be prevented by feeding 1 tablespoonful per day of a solution of 1 ounce of potassium iodide dissolved in 1 gallon of water to the pregnant sow during the latter half of the period of pregnancy.
8. That the most economical gains during a pig's life are made when it is nursing a well-fed sow and feeding from a creep.
9. That swine, like all other classes of stock, should always be supplied with plenty of water.
10. That pens should be kept clean at all times and should be washed down and whitewashed at least twice a year.
11. **That young pigs will not thrive in dirty, dark or crowded quarters.**

RATIONS FOR PIGS

All of the common coarse grains may be used in pig feeding, although each has individual characteristics and limitations. Mixtures of coarse grains make a basal ration that will produce better results than a single grain. They must, however, be supplemented with additional protein, mineral, and vitamins. Too little protein leads to slow growth and inefficient feed utilization, while failure to provide sufficient mineral and vitamins may result in crippled pigs.

The pig feeder who has dairy by-products has a satisfactory protein supplement available. When these feeds are not available, some other source of protein should be provided. In view of the present limited supply of protein-rich by-products, especially those of animal origin, the following protein-mineral supplements are suggested:

	PARTS		PARTS		PARTS
Tankage or Meat Meal (50%)	25		25		25
Soyabean Oilmeal	20		30		40
Linseed Oilmeal	45	or	35	or	25
Iodized Salt	5		5		5
Bonemeal or Limestone (95% pure)	5		5		5

or

any mixture of the above, provided that it contains at least 25 parts of tankage or meat scrap. Fishmeal, if obtainable at a price that would warrant its use, may be used as a part of the protein supplement,

or

tankage alone, if no other protein-rich feeds are available.

There are many satisfactory commercially prepared protein concentrates of this type for the man who does not wish to mix his own.

Hogs of all ages require an ample supply of fresh water.

For the prevention of crippling, feed one tablespoonful per pig per day of a standard feeding oil (cod liver oil, pilchard oil, etc.) until the pigs weigh 100 pounds.

RATIONS FOR PREGNANT SOWS

Oats, barley, wheat and corn may be used in the basal ration for a pregnant sow. Barley or corn should not constitute more than one-third of the grain ration, nor wheat more than two-thirds. Over-fat sows will produce weak, unthrifty pigs. This can be prevented by properly balancing the ration.

(1) Two or more farm grains, as above, plus skim milk or buttermilk at the rate of 1 to 1½ lbs. per lb. of grain.

or

(2) Two or more farm grains, as above, 94 parts, plus a combined protein-mineral supplement, 6 parts.

or

(3) Two or more farm grains, as above, 95 parts, plus tankage, 5 parts.

During the Winter months, roots and well-cured alfalfa hay should be supplied. Roots aid in keeping the digestive system in order, while alfalfa hay is a source of protein and minerals. A small rack filled once a day enables the sow to eat the hay at any time. Suitable pasture should be provided during the Summer months.

If a combined protein-mineral supplement is not being fed, minerals should be provided in some other form, even though a sow has access to well-cured alfalfa hay. In addition to protein and mineral, the sow's Winter ration should include a standard feeding oil at the rate of one tablespoonful per day.

A pound to a pound and a quarter of meal per day per 100 pounds live weight will maintain a dry brood sow in satisfactory breeding condition.

RATIONS FOR NURSING SOWS

Oats, barley and wheat are the most suitable grains for use in the ration for a nursing sow. Barley should not constitute more than one-third of the basal grain ration by weight, nor wheat nor oats more than one-half.

(1) Two or more farm grains, as above, plus skim milk or buttermilk at the rate of 2 to 3 lbs. per lb. of grain.

or

(2) Two or more farm grains, as above, 88 parts, plus a combined protein-mineral supplement, 12 parts.

or

(3) Two or more farm grains, as above, 90 parts, plus 50% tankage or meat scrap, 10 parts.

For Winter feeding, roots and well-cured alfalfa hay should be supplied. Roots aid in keeping the digestive system in order, while alfalfa hay is a source of protein and minerals. A small rack filled once a day enables the sows to eat the hay at any time.

If mineral is not being fed in the ration, nursing sows should have access to a combination of minerals at will. In addition, the nursing sow's Winter ration should include a standard feeding oil at the rate of one tablespoonful per day.

When nursing pigs are four weeks old, the sow should be receiving one pound of meal per day for each pig she is raising, with a minimum of five pounds per day.

Afford nursing pigs the opportunity to eat in a creep the meal mixture which they will receive after weaning. It is important to get the young pigs well started on feed before they are weaned. The above mixtures, if sifted, will be quite satisfactory.

RATIONS FOR GROWING HOGS UP TO 100 LBS.

For satisfactory results, oats should not constitute more than one-third of the grain by weight, nor wheat more than one-half. If corn is used in place of barley, the protein supplement should be increased by one-third.

(1) Two or more farm grains, as above, plus skim milk or buttermilk at the rate of 3 lbs. per lb. of grain.

or

(2) Two or more farm grains, as above, 88 parts, plus a combined protein-mineral supplement, 12 parts.

or

(3) Two or more farm grains, as above, 90 parts, plus tankage or meat meal, 10 parts.

Growing hogs, when pen fed, should have access to well-cured alfalfa hay at all times. **This will not supply a sufficient amount of protein, mineral or vitamins, but will help.** In addition, it increases the variety of feed.

In the case of ration (3), a box containing one part of iodized salt, one-half part bonemeal and one-half part pure limestone, or one part salt and one part pure limestone, should be placed where the pigs can eat it at will.

RATIONS FOR MARKET HOGS OVER 100 LBS.

A combination of all farm grains may be used. Oats should not constitute more than one-third of the grain by weight, nor wheat more than two-thirds.

(1) Two or more farm grains, as above, plus skim milk or buttermilk at the rate of 1 to 1½ lbs. per lb. of grain.

or

(2) Two or more farm grains, as above, 94 parts, plus a combined protein-mineral supplement, 6 parts.

or

(3) Two or more farm grains, as above, 95 parts, plus tankage, 5 parts.

or

(4) Two or more farm grains, as above, 92 parts, plus equal parts of soyabean oilmeal and linseed oilmeal, 8 parts.

In the case of (3) and (4), a box containing one part of iodized salt, one-half part bonemeal and one-half part limestone, or one part salt and one part limestone, should be placed where the pigs can eat it at will.

N.B.: Soyabeans should not be used in any hog ration.

MAKE THE MOST PROFIT AND SAVE THE MOST BACON

The marketing of hogs at improper weights results in heavy annual losses to the swine industry and to hog producers. When hogs are marketed at light weights and in an underfinished condition fewer pounds of pork are available for shipment overseas or for home consumption. Heavy overfinished hogs produce undesirable carcasses; hence feed is consumed that otherwise might be used to better advantage.

Farmers marketing light or overweight hogs suffer direct losses as a result of deductions. These penalties can be avoided if hogs are marketed at the proper weight. The following chart will assist producers in determining the weight at which hogs should be marketed.

WEIGHTS OF CARCASSES FROM HOGS OF VARIOUS WEIGHTS AND DRESSING PERCENTAGES

Live Wt. of Hogs	CARCASS WEIGHTS ACCORDING TO DRESSING PERCENTAGE										
	70%	71%	72%	73%	74%	75%	76%	77%	78%	79%	80%
170	119	121	122	124	126	127	129	131	133	134	136
180	126	128	129	131	133	135	137	139	140	142	144
190	133	135	137	139	141	142	144	146	148	150	152
200	140	142	144	146	148	150	152	154	156	158	160
210	147	149	151	153	155	157	160	162	164	166	168
220	154	156	158	161	163	165	167	169	172	174	176
230	161	163	166	168	170	172	175	177	179	182	184
240	168	170	173	175	177	180	182	185	187	190	192
250	175	177	180	182	185	187	190	192	195	197	200

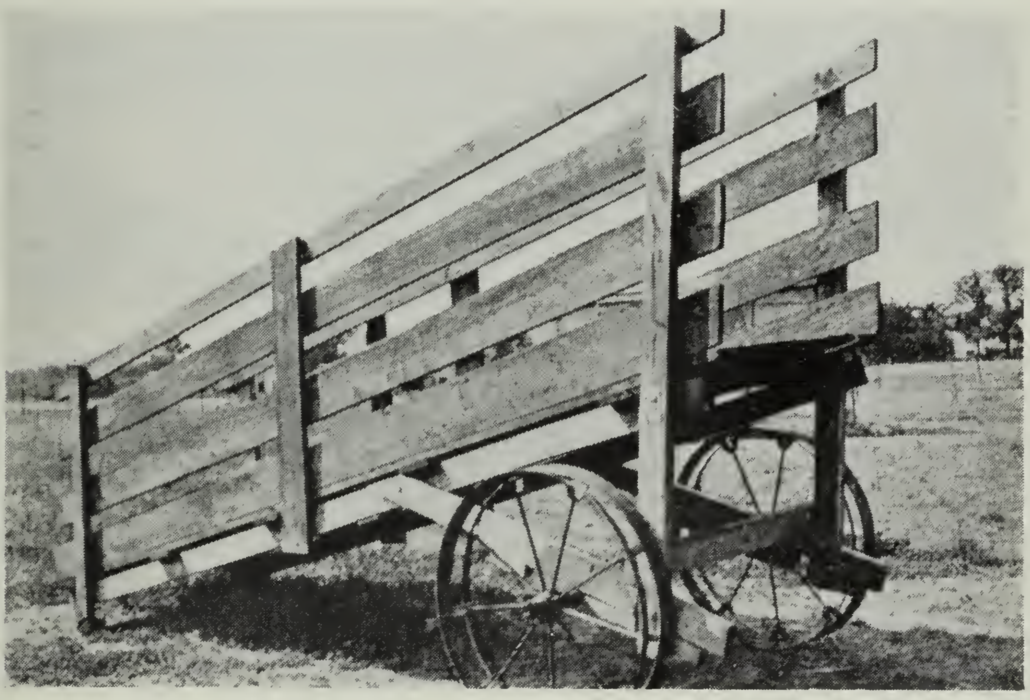
All carcasses in the shaded area are the correct weight for "A" grade (140-170 lbs.).

The dressing percentage of hogs varies, usually running from 70% to 80%.

Dressing percentage is an important factor in determining carcass grade.

Hogs weighing from 200 to 210 pounds alive will yield carcasses of the proper weight, regardless of dressing percentage.

Thousands of dollars are lost annually as a result of bruising. Much of this damage does not appear until the carcass has passed through the cure. Hence time and money have been expended in preparing a carcass for a particular market, only to discover that it cannot be sent to that market on account of unsightly blemishes. Producers are not responsible for all the damage. Nevertheless, some does occur on the farm and particularly during loading operations. A swift kick may cause a damaged ham; a jab in the ribs may result in an unsaleable side of bacon. Much of the damage can be avoided if adequate loading facilities are available. The following picture shows an easily constructed, adjustable, portable loading chute.



This movable hog loading chute is mounted on low wheels with an axle of 1-inch iron pipe. The height of the floor of the chute is changed by shifting the axle to the various notches in the angle braces to provide for different heights of wagons and trucks. The distance from the ground to the high point of the floor is 40 inches. The chute proper is 3 feet wide, 3 feet high, and 12 feet long.

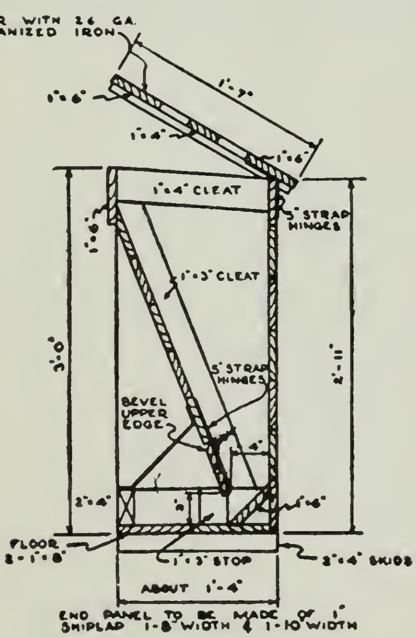
HOMEMADE LABOUR-SAVING DEVICES FOR RAISING HOGS

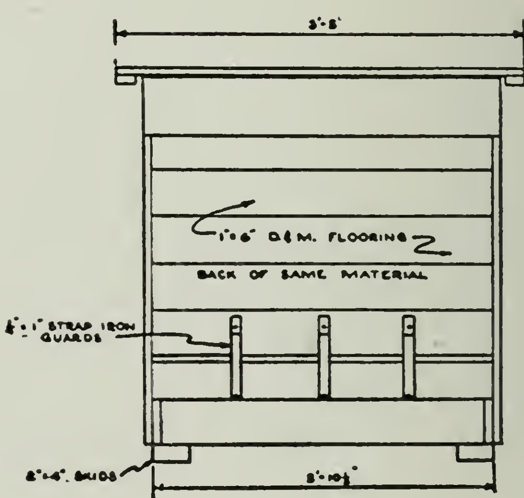
Self-feeders

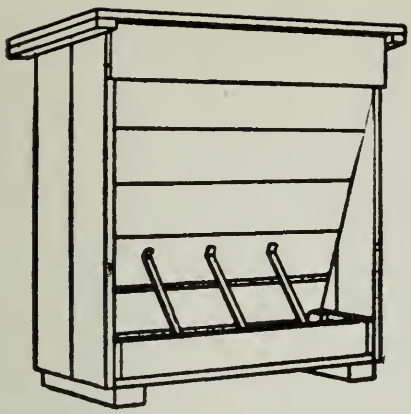
Where more than ten hogs are fed, the self-feeder will definitely save labour. This is especially true if there are little or no dairy by-products available.

Fig. 1. Oil drum in binder wheel.

A simple inexpensive feeder using a 50-gal. drum and an old binder wheel attached to a platform. The spokes make excellent guards and prevent the hogs from rooting and wasting feed.







BILL OF MATERIALS

1—2″ x 4″— 6′ long	Cleats
1—1″ x 4″—10′ long	
1—1″ x 6″—16′ long	
1—1″ x 4″—10′ long	
1—1″ x 8″— 6′ long	Floor
1—1″ x 8″— 6′ long	Shiplap for Ends
1—1″ x 10″— 6′ long	
2—1″ x 6″—12′ long	D & M Flooring
1—1″ x 6″—16′ long	
2 pr.—5″ Strap Hinges with Screws	
1 sheet 26 Ga. Galvanized Iron 20″ x 42″ for Cover	
3—1″ x ¼″—1′-2″ Strap Iron Guards	

Fig. 2. A simple feeder built with a minimum of material.

The above material is for a one-sided feeder 5 ft. long. The measurements given are only suggested and may be altered depending upon number of hogs to be fed or material available.

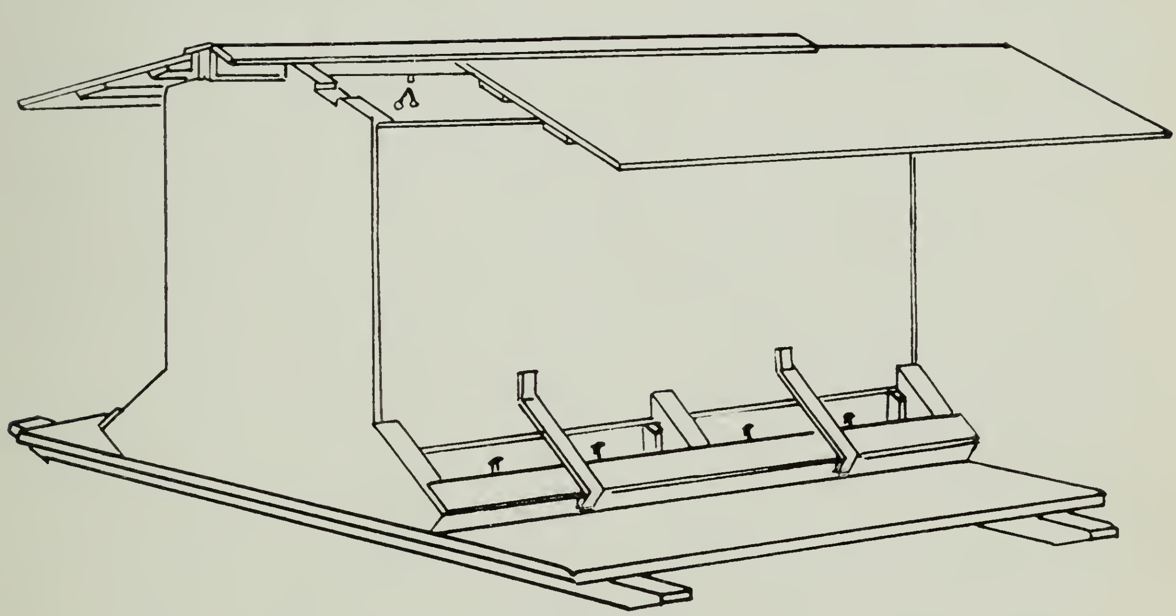
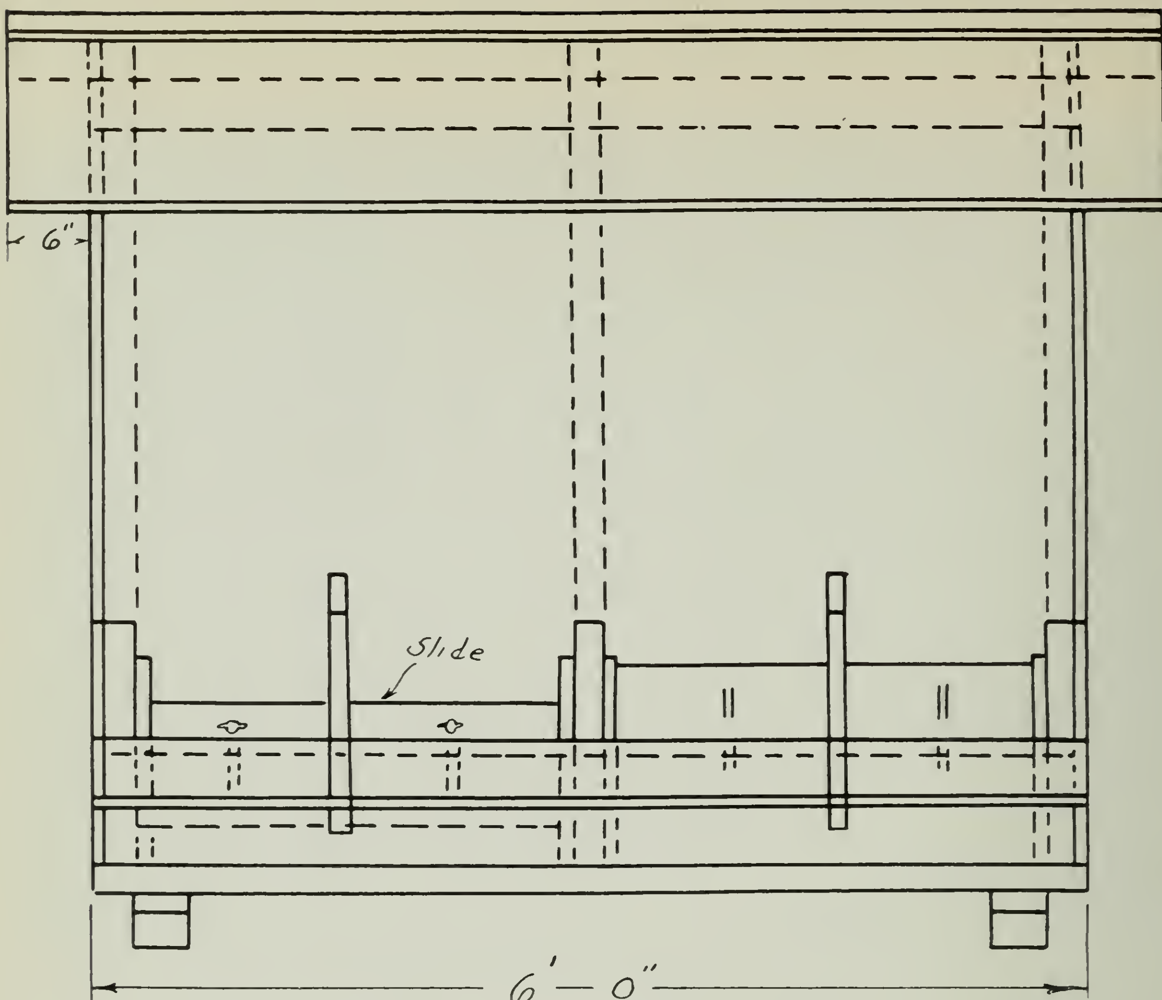
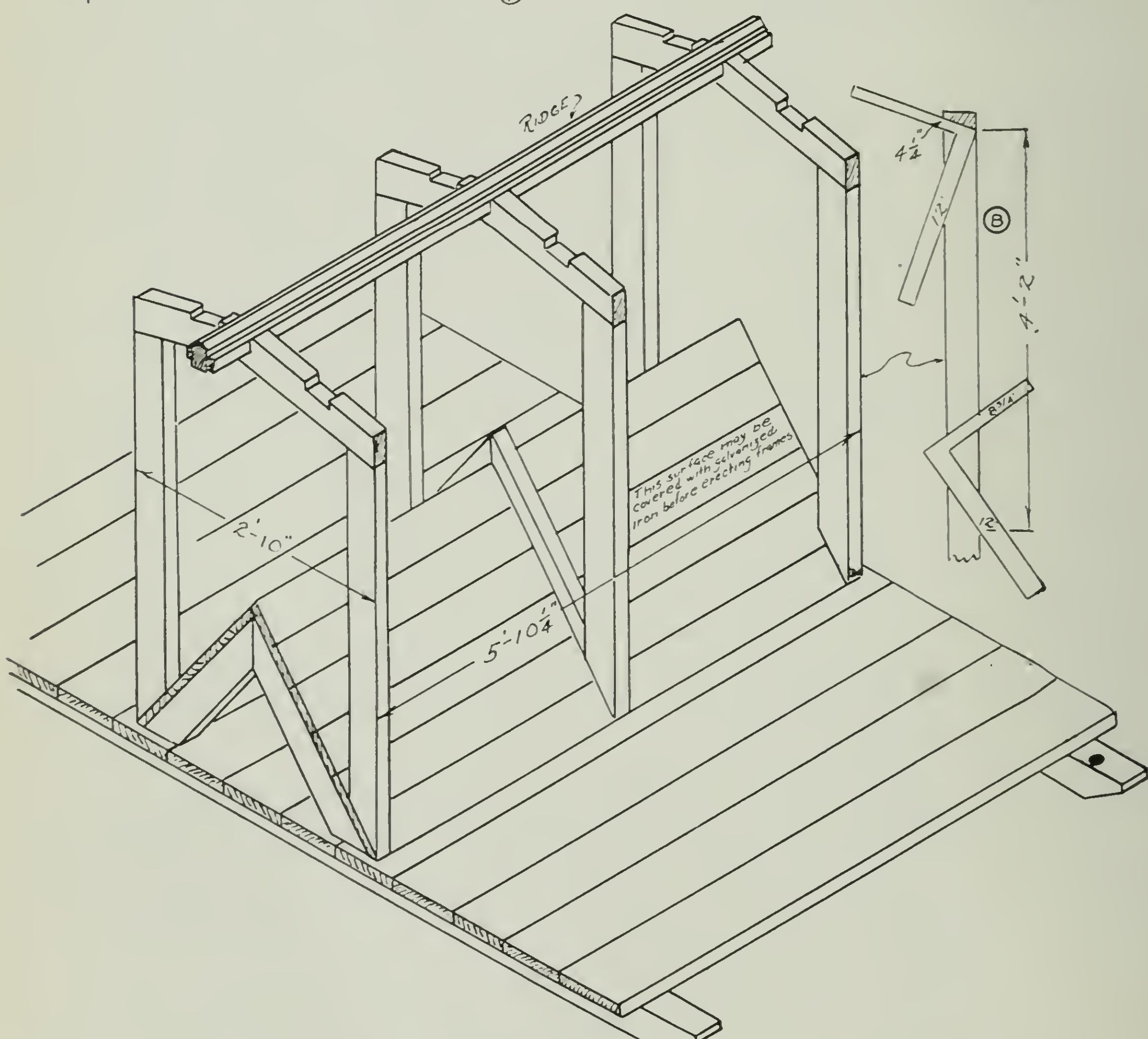


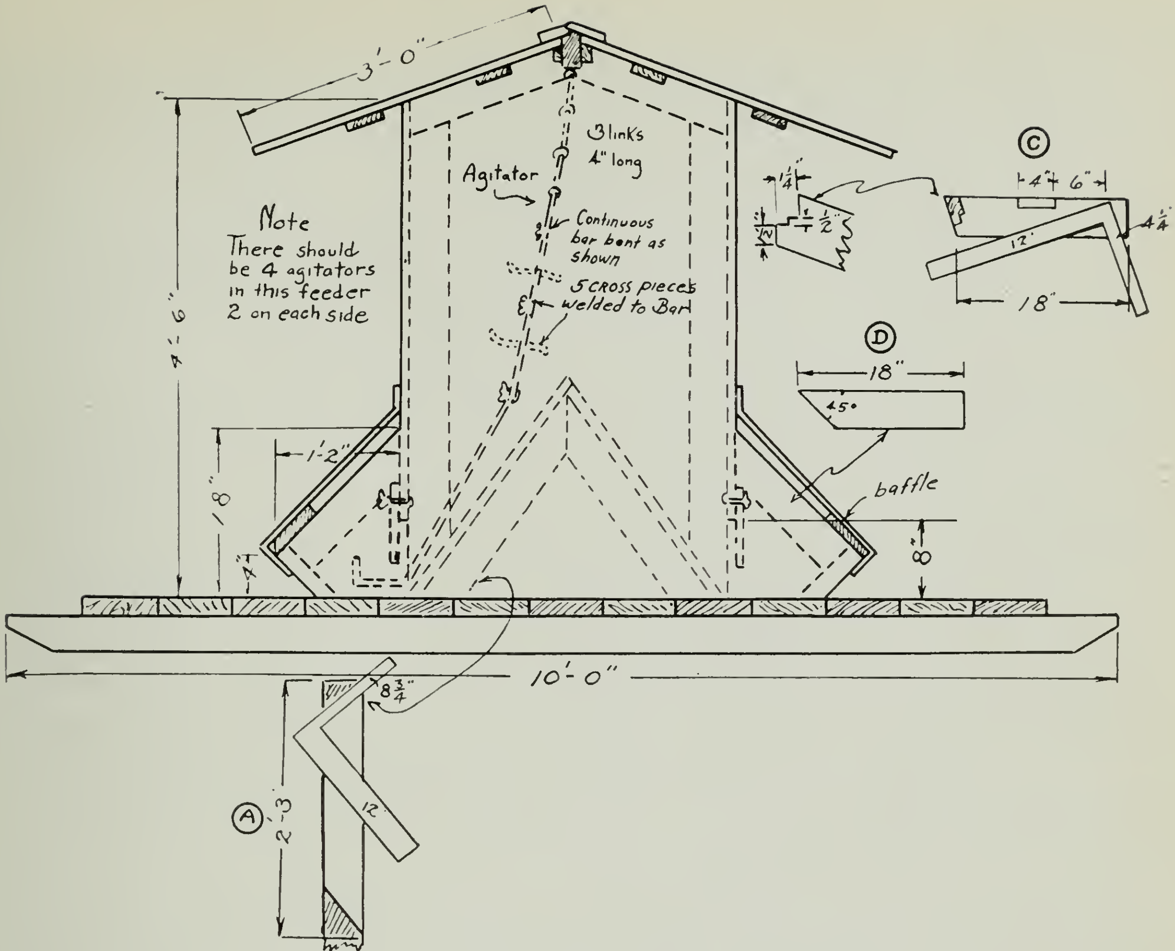
Fig. 3. A permanent self-feeder.

(For detailed instructions see pages 12 and 13.)

The above feeder is more expensive and takes considerably more material. However, if given proper care, it should last at least 10 years. Where over 40 hogs are being fed continuously, it might be wise to consider this more permanent type of feeder.


6"
Slide
6'—0"


RIDGE
4½"
12
B
4'-2"
8¾
12
This surface may be covered with galvanized iron before erecting frames
2'-10"
5'-10¼"



SELF FEEDER

MATERIALS

Floor	2 pcs	4 x 4 — 10 ft	Fir	D4
	7 pcs	2 x 8 — 12 ft	Fir	D4
Frame	2 pcs	2 x 4 — 10 ft	Pine	D4
	2 pcs.	2 x 4 — 14 ft	"	D4
	1 pc	2 x 4 — 8 ft	"	D4
	1 pc.	2 x 4 — 16 ft	"	D4
	12 pcs	1 x 6 — 6 ft	"	D & M
	2 pcs	1 x 1½ — 7 ft		D4
Roof	7 pcs.	1 x 6 — 12 ft		D&M
	2 pcs.	1 x 4 — 14 ft	"	D4
	1 pc.	3 ft x 14 ft Roll Roofing		
Walls and Partition	200 B.F.	1 x 6 D&M Pine in 12 ft. lengths		
Slides and Guides	1 pc	1 x 10 — 12 ft	Pine	D4
	8 pcs	1 x 2 — 15 in.	"	D4
Trough	1 pc	2 x 8 — 12 ft one edge bevelled at 45°	"	D4
	6 pcs	2 x 4 — 20 in	Pine	D4
	1 pc	1 x 6 — 12 ft	in	D4
Metal	1 pc	3/8 x 1¼ 9 ft Iron		
	4 pcs.	3/8 round iron each 8 ft long		
	8	3/8 x 2½ rd. head bolts - wingnuts		
	2	3/8 x 3½" Eye bolts		

Note D4 Dressed on 4 sides
D - M Dressed and Matched The above or any other suitable lumber

CONSTRUCTION

1. Build floor first
2. Cut 6 pieces as at Fig A Toe-nail them to the floor 7/8" in from each end and nail 1x6 D&M to them
3. Cut pieces for frames Figs B C Nail them in position with RIDGE
5. Construct partition on Centre frame
6. Nail sides in place Starting 8" from bottom and place Top edge to slope of frames
7. Cut pieces Fig D to pattern Plane a 45° angle on 2+8 piece for front of trough. Mark and plane it to 7 3/8" wide. Then nail the pieces Fig D so that they come opposite to the frames. Nail all in place to form Trough (and add 1x6 baffle)
8. Nail end covering in place Start at bottom.
9. Construct sliding tops and fix ridge boards in place so that top does not bind
10. Suspend agitators in place
11. Make and instal Slides & guides.

Hog Waterer

On farms where a number of hogs are fed from self-feeders on pasture, it is necessary to provide the hogs with a constant supply of fresh water.

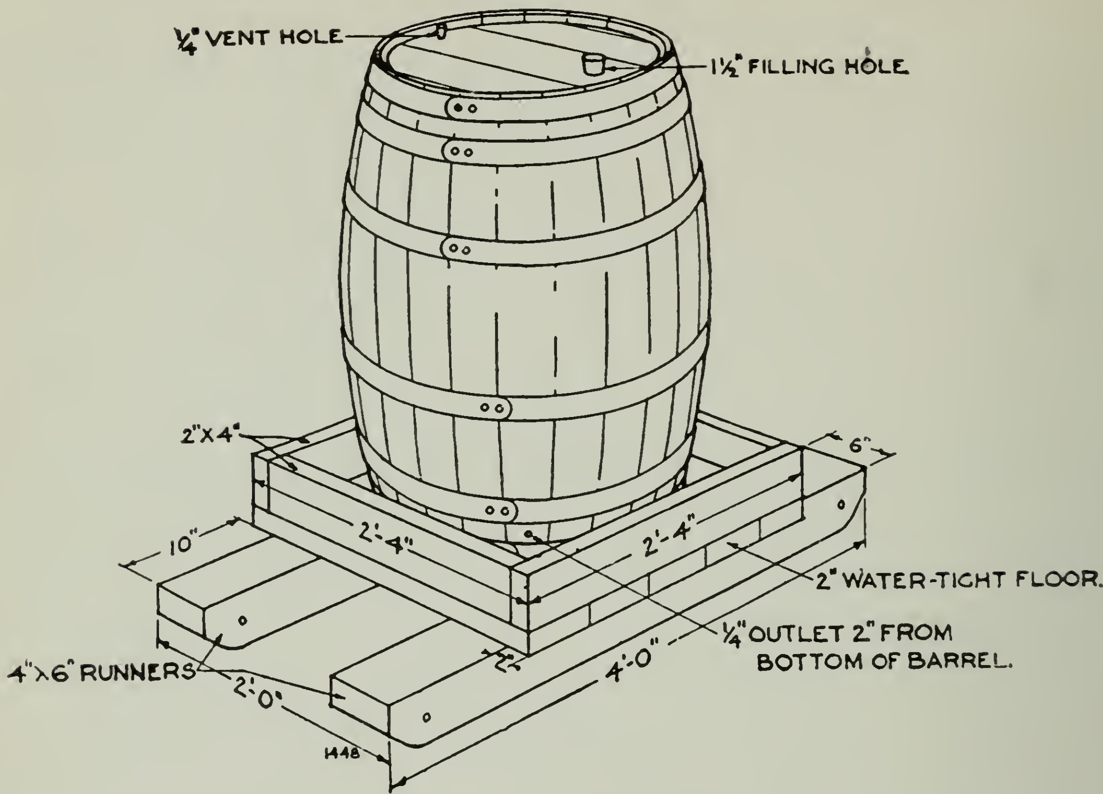


Fig. 4. A homemade hog waterer.

A 40- or 50-gal. barrel can be made into a satisfactory water fountain. The barrel is placed on end in a small square trough lined with tin or galvanized iron. A small hole is drilled in the barrel at proper height for water. When barrel is refilled, this small hole is plugged and water poured in opening at top end. As soon as filled, plug is screwed back in tightly to prevent air from escaping, and small wooden plug removed.

Electric Fence

The problem of fencing for hogs creates a difficulty on many farms. Permanent hog fences, while desirable, are expensive to buy and erect and, at present, the material is difficult to secure.

The electric fence fits in very well and, if properly constructed, proves satisfactory, especially for hogs over 75 lbs. It enables the hogs to be moved periodically to fresh pasture and may also be used to divide permanent runs, part of which may be sown to annual pastures.

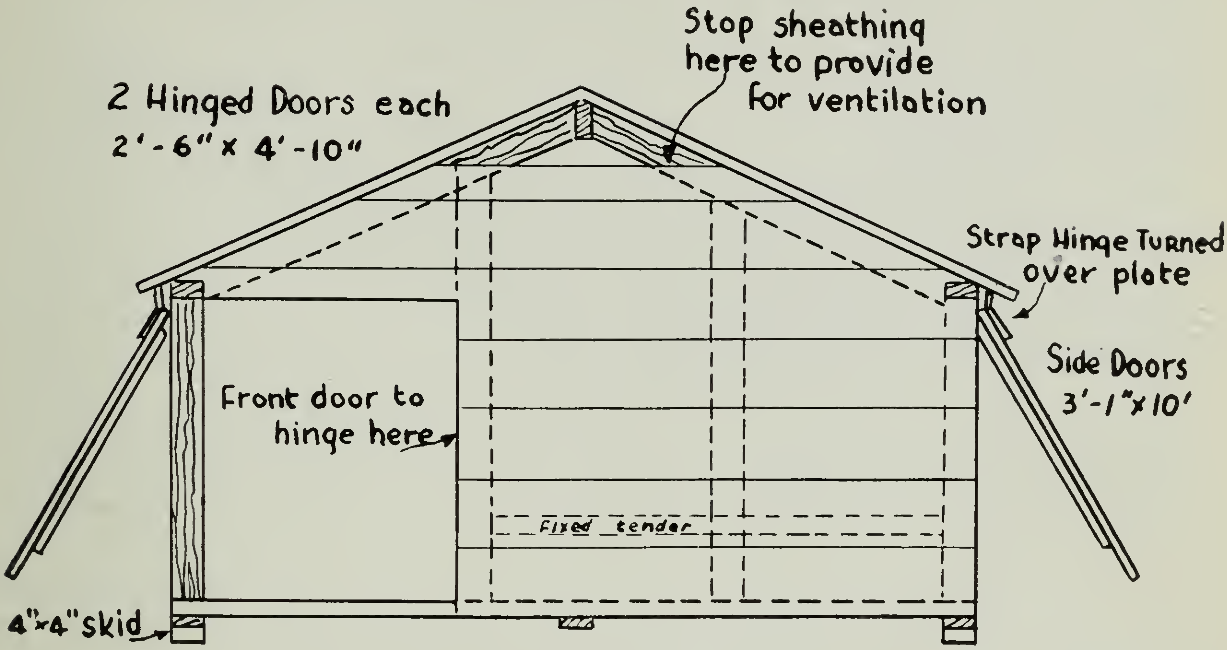
Following is a list of materials required:

1. Instrument
2. Dry cell battery
3. Roll of smooth wire (any gauge)
4. Sufficient number of short posts or stakes
5. Insulators for each post

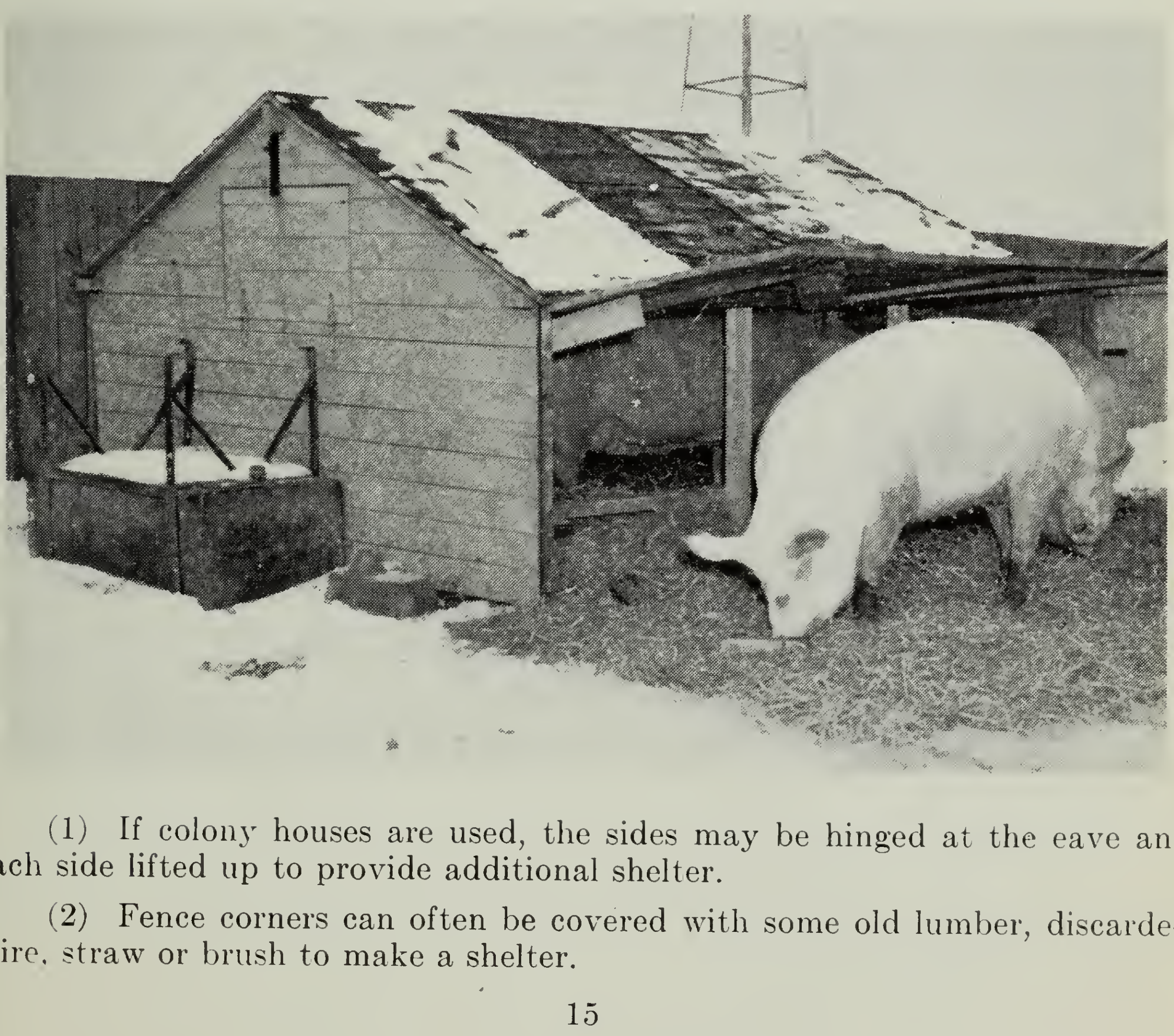
Shelters

Hogs of any age require protection of some kind while running on pasture. Otherwise, they will blister, sun scald, and their growth will be checked

Following are a few suggestions for temporary shelters:

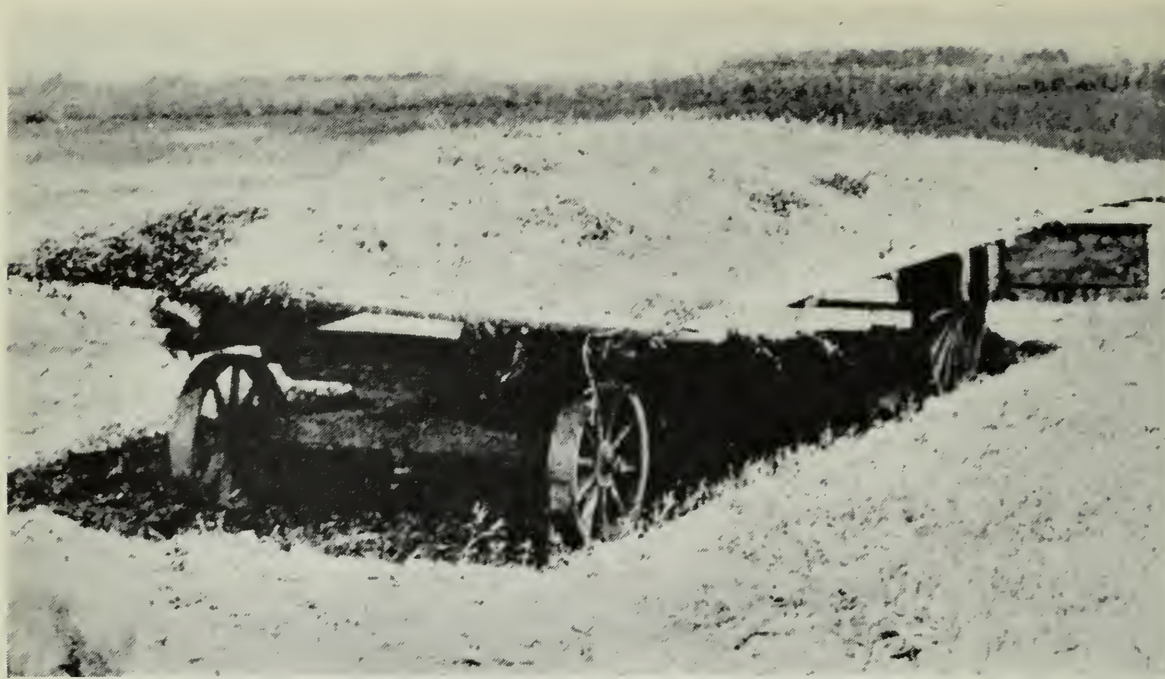


Plan of a portable colony house.



(1) If colony houses are used, the sides may be hinged at the eave and each side lifted up to provide additional shelter.

(2) Fence corners can often be covered with some old lumber, discarded wire, straw or brush to make a shelter.



(3) The gear of an old manure spreader or wagon can be used to good advantage as a portable shelter. The gear is covered lengthwise with either long poles or old timbers extending from 5 to 8 feet beyond the bolsters. Old boards or scantlings can be placed crosswise and the entire top covered with a layer of straw or brush. When straw is used, a piece of discarded wire fencing placed on top will keep straw in place. The shelter can be moved about the pasture and thus keep the hogs on clean ground. A growing hog requires from 6 to 8 square feet of shade space during hot weather.

(4) **Sunflowers.** In cases where permanent runs are without trees or any natural shade, sunflowers may be planted along the outside of the fence. By midsummer, they will reach sufficient height to provide a fair amount of shade along the fence, especially for young pigs.

PASTURE CROPS FOR SWINE

Pasture crops may be said to be valuable for breeding and growing swine from several viewpoints. In addition to the provision of green, succulent feeds, there is a supply of proteins, minerals, and vitamins in a readily available form, all of which hold a very important place in a hog's ration. A suitable swine pasture is any combination so managed that it supplies fresh, growing feed from early Spring until late Fall and one which does not fail in dry, hot weather. Pregnant sows and breeding boars may be economically maintained in a satisfactory manner on suitable pasture during Summer months. **They should, however, be fed some grain, the amount depending upon their condition.** Likewise, nursing sows will benefit from grazing on good pasture, as will the little pigs, not only from the standpoint of eating the tender leaves, but because of the mineral which they may pick up out of the soil. There is another important advantage of pasture crops for hogs. By rotating or changing the pasture areas each year, one is enabled to control worm infestation to a very considerable extent.

A suitable pasture may form a part of the ration for commercial hogs, growing hogs in particular. They should not, however, be required to depend upon pasture alone, but should be fed a ration, properly balanced, as well. When hogs approach the finishing period (150 to 160 pounds), they should be confined to smaller quarters than growing hogs. During the finishing stage, hogs should be fed a full ration of grain. Hogs that are raised on pasture during the growing stage will not be ready for market at as early a date as those that are fed in a pen from time of weaning until marketing.

When swine are running on pasture, it is possible to use such labour-saving devices as self-feeders and hog waterers, and thereby reduce the labour involved to a considerable extent. **If a self-feeder is used, particular care should be taken to see that the ration is properly balanced.**

Shade, under all circumstances and for all hogs, should be provided and, in the case of little pigs, it is not advisable to turn them into wet rape, or to leave them out in the hot sun for too long a period of time because of the danger of sun scalding.

GOOD SWINE PASTURE CROPS FOR ONTARIO

Kind of Pasture	When to Sow	Seed per Acre	When at Its Best	Management
Fall Rye and Oats	Fall of previous season	8 pecks (6 Rye, 2 Oats)	Early Spring and late Fall	Best results obtained if pastured closely
Alfalfa	Spring of previous season	12-15 lbs.	Throughout growing season second growth	Best results obtained if pastured fairly closely
Red Clover	Spring of previous season	6-8 lbs.	Spring and early Summer and Fall	Follow with Sweet Clover or Soyabeans
Rape (Dwarf Essex)	Early Spring to Midsummer	4-6 lbs.	Summer and Fall	Pasture until cold weather. Do not pasture when wet.
Soyabeans	Spring	6 pecks (broadcast)	Summer	Must not be pastured once pods commence to form. Soyabean seed makes soft pork.
Sweet Clover (White Biennial)	Early Spring in grain crop	12-15 lbs.	Late Summer and Fall of same season and very early Spring to late Summer of next	More palatable if kept down from 6 to 8 inches high.

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BULLETIN 424 DECEMBER, 1942

Ontario Department of Agriculture
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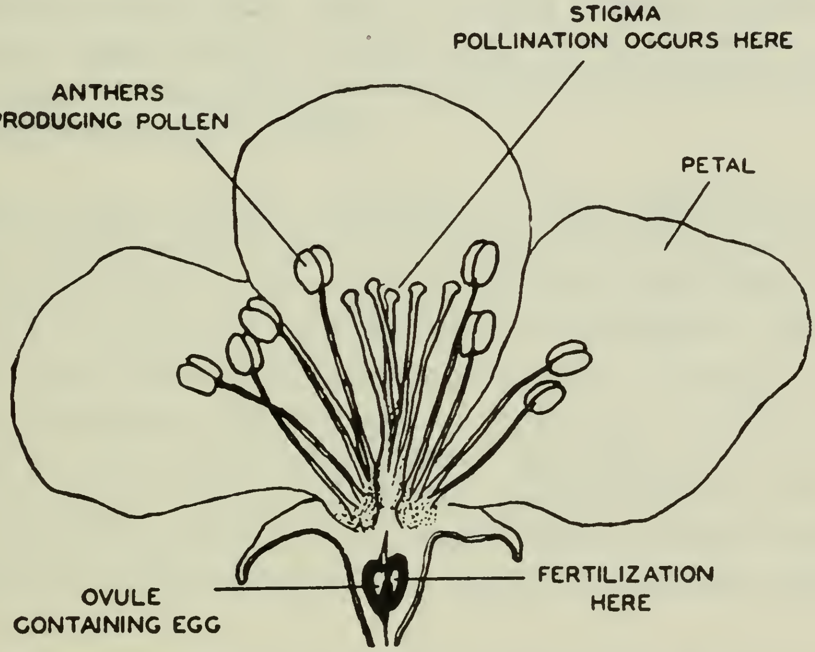
POLLINATION IN RELATION TO ORCHARD PLANNING



An apple flower shown in section (After A. E. Murneek)

BY
G. H. DICKSON

HORTICULTURAL EXPERIMENT STATION
Vineland Station, Ontario

Dec. 1942–5M–B——

Pollination in Relation to Orchard Planning

BY

G. H. DICKSON

Horticultural Experiment Station,
Vineland Station, Ontario

The fact that sex exists in plants, and pollination is therefore necessary, has been known since 1691, when it was first proven experimentally by Camerarius. The importance of this to fruit growers has, however, only been realized in comparatively recent years. During the period when fruit growing was carried on mainly as a sideline to general farming the orchards were made up of a mixture of varieties. Thus, there was ample provision for cross-pollination and little or no difficulty was encountered from insufficient set of fruit. Later, as fruit growing became more commercialized and large blocks of single varieties were planted, the poor set of fruit on these trees caused concern and the necessity of adopting some remedial measures became evident.

In some of these blocks, consisting of single self-unfruitful varieties, heavy bloom would be noted but little, if any, fruit would set. Occasionally in such orchards variety mixtures were present and it was noted that in the proximity of these odd varieties good crops would be harvested. This observation, along with other information, led to intensive studies being made of the pollination question and its relation to orchard arrangement. Today much is known about the problem but, when one sees some of the orchard layouts and hears some of the recommendations that have been given to prospective planters, it is evident that a further emphasizing of the necessity of orchard planning in relation to proper pollination is in order.

Sometimes misinformation in regard to pollination is given with all honesty of intention. At one meeting the writer was informed by a school teacher that the question of pollination offered no problem at all. If he were shown the blossom of any variety he could tell whether it required pollination or not. In theory this might be so but practically, except in the case of grapes, strawberries and certain other fruits where the anthers are noticeably abortive, this would not hold. With tree fruits the pistil is always present in well-developed and uninjured flowers, and in most flowers, anthers, which produce the pollen, are present to some degree. If the pistil is injured during cold weather, as sometimes happens, especially with peaches, then no fruit will set from that particular flower. If it remains healthy and proper pollination results, fruit should follow. But even if pollen is present in quantities on a variety we have no assurance that it will be compatible with it; i.e., set fruit from that pollen, or as Darwin puts it, "Nature abhors perpetual self-fertilization," and consequently has made provision in many cases to prevent inbreeding.

POLLINATION AND FERTILIZATION

With certain fruit varieties the slow development and penetration of the pollen in the stigmatic fluid of its own variety may prevent selfing; for example, at ordinary temperatures, Rome pollen on Rome blossoms requires 90 to 120 hours to traverse or grow down the pistil, whereas Jonathan pollen will traverse the Rome pistil in 48 hours. The Rome pollen, because of the long time required to traverse its own pistil, disintegrates and loses its vitality. As a result no fruit sets and, although from the observer's viewpoint a "perfect" flower was present, practically there was a lack of compatibility.

At high temperature the progress of Rome pollen on Rome bloom is greatly accelerated. At 90° F. Rome pollen will traverse its own style in 24 hours. Thus, due to higher temperatures, and probably also better nutrition, in certain years crops may be obtained on isolated trees or blocks of single varieties which normally do not set fruit. These conditions may also account for certain varieties proving self-fruitful in one locality and self-unfruitful in others.

POLLEN DISTRIBUTION

An understanding of how pollen is distributed should be a first step in intelligent orchard planning. It has been repeatedly demonstrated that, because fruit pollen is heavy, wind has no direct influence on its spread. The chief agents of pollen distribution are insects and, in the case of cross-pollination, only active winged insects are useful. Of these honey bees are the most dependable largely because the orchardist has some control over them. Most of the wild insects winter over in limited numbers and the spring population is still too small, especially in well-cultivated areas, to be of other than supplementary value. The hives of the honey bee may be moved about the orchards at will, insuring their presence in sufficient numbers. They have also another virtue lacking in other insects. When the honey bee starts out on a certain type of blossom—for example, apples—they work on that type of bloom for the whole day. Other insects are not so constant in their endeavors and any flower which contains nectar is satisfactory to them.

The honey bee being accepted as our main distributor of pollen, we should plan our orchard with the idea of obtaining the most efficient service from these bees. Unless hampered by wind or unfavorable weather conditions bees will travel long distances to blossoms, but can only work over a limited area when they arrive at the source of supply. A movement from one variety to another is necessary to insure cross-pollination. Therefore, although it is known bees will range over a distance of 300 feet, for a satisfactory set of fruit, this should be reduced to not more than 100 or at most 125 feet. It is better to plan liberally because, although a heavy crop can be reduced by thinning, a light crop will always be light. Without sufficient pollen distribution we cannot get the fruit.

To meet the complaint that, occasionally, over-setting of fruit results from the use of bees, it is suggested that more attention might very profitably be given the efficient handling of bees in an orchard. We are told that there should be one hive of bees per acre of orchard and that the bees be spread out in that proportion. However, a number of qualifying factors should be taken into consideration. For instance the age of orchard should be considered. A strong colony of bees should be able to handle 8 to 10 acres until the orchard is 10 to 12 years old. From that time on the area should be reduced until the proportion of one hive per acre of mature orchard is reached.

Weather too should be considered. If the weather is cold, wet or windy, the bees should be left in the orchard for the whole blooming period. If ideal weather conditions prevail, two or three days at most might be sufficient time to leave the bees in the orchard to insure a crop. More study might well be given to this phase of the question.

PLANTING DISTANCE IN RELATION TO POLLINATION

A common recommendation for orchard planting is that every third tree in every third row be a pollinator (1 to 8). This is not always a satisfactory arrangement for pruning, spraying, fertilizing or harvesting. Solid rows of a variety are much more easily handled, especially if one has to depend on inexperienced help. If, therefore, we favor the solid row idea, pollinators should be set so that none are more than 100 feet away from the farthest tree to be pollinated. Thus, for apples planted 40 by 40 feet, every sixth or seventh row might provide ample pollination facilities under ideal conditions, but every fifth row would be much safer and is the distance usually recommended.

With pears planted 20 feet between rows every seventh row is a safe distance. With sufficient bees present this *might* be increased to every ninth row. However, although only 80 feet would have to be covered (working from the pollinating rows on each side), still the extra number of trees would increase the proportion to be pollinated and perhaps make sufficient pollination less certain. A pollinating row should be near the outside edge of the orchard, more especially if the bees have to work against a prevailing wind. The grower must plan against the possibilities of poor weather; thus maximum distances are not encouraged.

The actual planting arrangement will depend to a large extent on the relative importance of the varieties. If two varieties of equal value are to be planted, one would plant a certain number of rows of one, then the same of the other. If only half the number of trees of the second variety are wanted, then only half the number of rows would be used, not equal numbers.

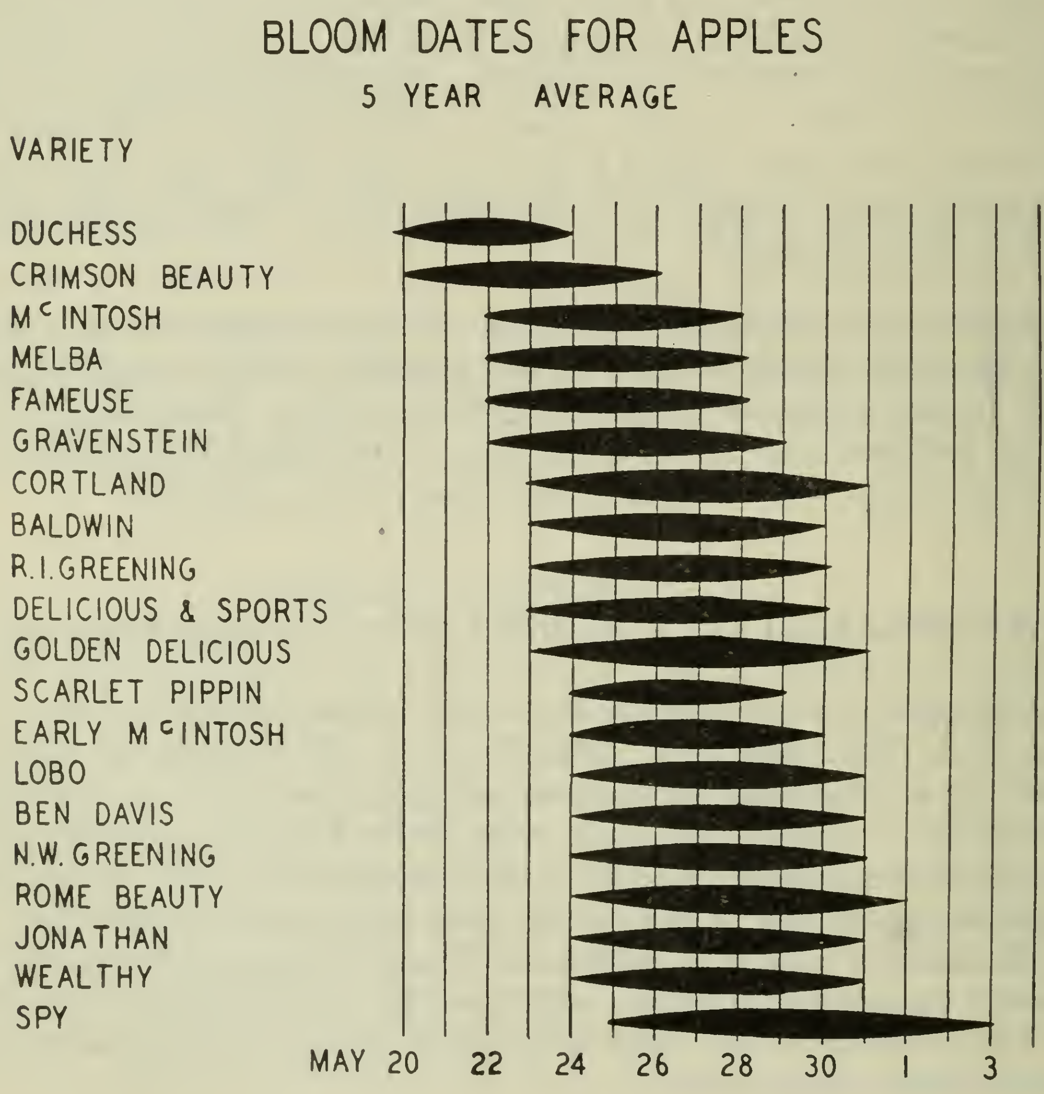


Chart showing average blooming period for apples at Vineland. Duchess, for example, begins blooming May 20, is at full bloom May 22, and falling bloom May 24. Spy starts blooming May 25, after Duchess is complete, and is not through until June 3.

CHOICE OF VARIETIES

In the choice of varieties to plant together, certain other factors must be kept in mind as follows:

(1) The blooming periods of the varieties must overlap sufficiently to insure cross-pollination.

(2) The varieties must produce good pollen.

(3) The varieties must intercross.

(4) The varieties should have commercial value.

(5) The varieties should preferably be annual bearers.

1. **Blooming Periods Must Overlap.** Cherries, grapes and peaches offer little difficulty in this respect, as all varieties bloom closely enough together to overlap sufficiently. With pears, as a general rule, varieties bloom together but we find that Kieffer blooms slightly ahead of Bartlett and, although Bartlett overlaps sufficiently to pollinate Kieffer, very often the late pollen of Kieffer is abortive and therefore of no value on Bartlett. Trees of a third variety should be included to pollinate Bartlett when a Kieffer-Bartlett orchard is planted.

Apple and plum varieties bloom over a long period as illustrated in the accompanying charts. Spy trees are the last to bloom and, although an early blooming variety, like McIntosh, may overlap it in some years, it does not always do so. In 1935 McIntosh bloom was all off before any Spy blossoms opened. A cold wet spell hastened the drop of McIntosh bloom and delayed the opening of the Spy bloom. In one orchard where this combination was found the grower counted his loss at several thousand barrels of apples.

2. **The Varieties Must Produce Good Pollen.** The following varieties are recognized as poor pollen producers. Some of these produce no pollen. None of the following should be depended on to provide pollen for itself or for any other variety:

APPLES	PEARS	PEACHES	GRAPES
Baldwin	Kieffer	J. H. Hale	Brighton
Blenheim	(See	June Elberta	Herbert (Rogers 44)
Bramley	under 1)	Vimy	Lindley (Rogers 9)
Gravenstein			Salem (Rogers 22)
King			Wilder (Rogers 4)
Ribston			*Agawam (Rogers 15)
R. I. Greening			
Stark			
Winesap			

*Although Agawam may be sufficiently self-fruitful in itself, it should not be depended on to successfully pollinate other varieties.

BLOOM DATES FOR PLUMS

5 YEAR AVERAGE

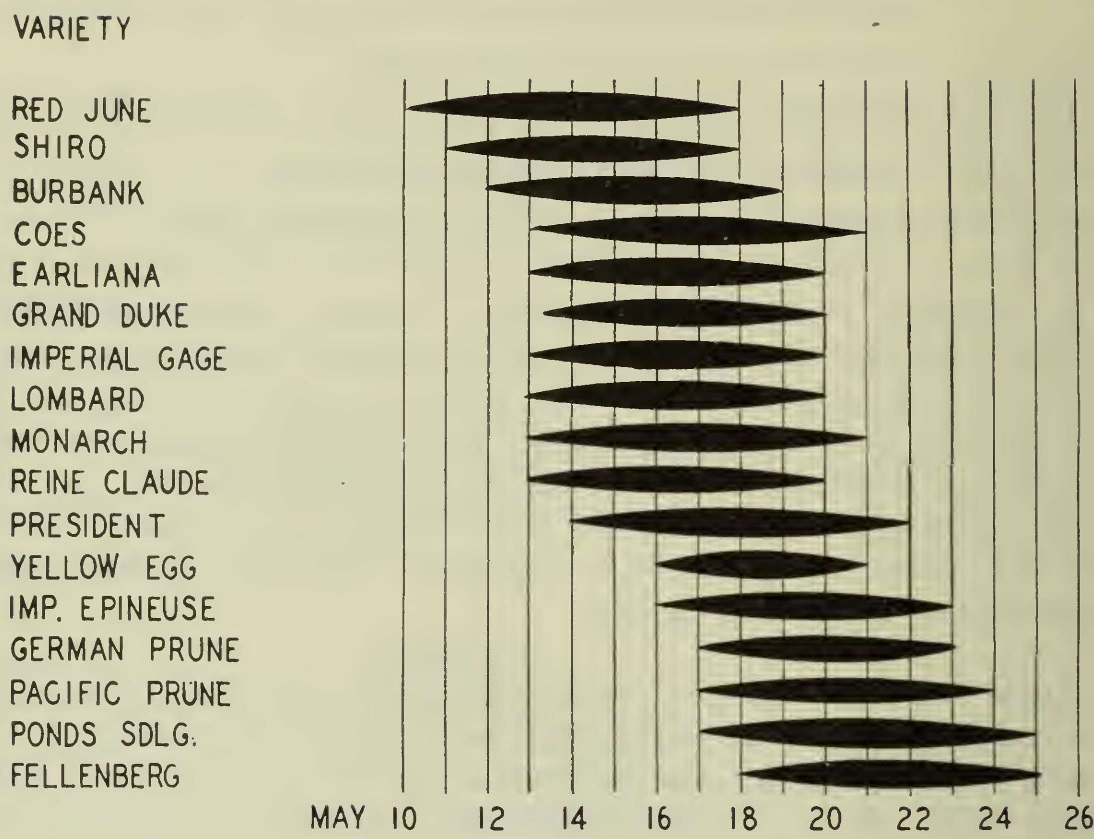


Chart showing average blooming period for plums at Vineland. Two newer varieties, Albion and Stanley, bloom as follows:—Albion with President, and Stanley with Pacific Prune. Note that the Japanese varieties, Red June, Shiro, Burbank, start blooming well ahead of European sorts, and in fact complete their bloom period before many of the latter have well started.

3. **The Varieties Must Intercross.** (a) PEARS. Bartlett and Seckel are inter-sterile and therefore do not effectively pollinate each other although they may be suitable cross-pollinizers for other varieties.

(b) CHERRIES. Bing, Lambert and Napoleon are inter-sterile although, as with Bartlett and Seckel pears, they may be effective pollinizers for other varieties.

(c) PLUMS. Burbank is not a satisfactory pollinizer for Shiro, the other main Japanese variety. Generally also, European varieties are not considered effective pollinizers for Japanese varieties, and vice versa.

4. **The Varieties Should Have Commercial Value.** Certain varieties are regarded as being excellent as pollinators for other varieties, but today

have little or only limited market value. Tolman Sweet has been considered an excellent pollinator for Spy, but one would hesitate to plant it for that purpose alone. If however, one had an established Spy orchard, where insufficient fruit setting due to an inadequate supply of pollen was a problem, perhaps one could do no better than graft a branch of Tolman Sweet into every tree or so. In such a case the Tolman apples might never be harvested but the increase in set of Spy should be quite material. In planting a new orchard the fruit value would have to be considered. In such circumstances few would use Tolman, some other late blooming varieties having the preference.

In one old Bartlett orchard Duchess pear trees provide pollen and heavy crops of Bartletts result. The grower realizes little over the cost of production as direct returns from the Duchess trees, but feels they are nevertheless a great asset because of increased Bartlett crops. In such circumstances Duchess is satisfactory but, because of its low value, this grower would not include it in any future Bartlett plantings. A more profitable variety having good pollen should be sought.

5. **The Varieties Should Be Annual Bearers.** This applies mainly to apples. For instance, Wealthy is a fair pollen producer, blooms over a long period, frequently producing both spur and terminal blooms which further extend the blooming period, but some years it does not bear. Wealthy may easily become biennial in its bearing habit. If a biennial-bearing variety is chosen as the pollen variety, care must be taken to insure that some bloom is produced every year; otherwise crop failures on the main variety are inevitable in the off-year.

CLASSIFICATION AS TO FRUITFULNESS. PLANNING THE PLANTING

How then are we to know what varieties are self-fruitful and may be planted in solid blocks and what varieties are self-unfruitful, requiring provision for cross-pollination? Experience and experimental work over many years have made this information available. As a general rule, of which there may be a few exceptions, the fruits may be classified as follows:

Apples. Under Ontario conditions all varieties must be considered as commercially self-unfruitful and therefore requiring cross-pollination. Some varieties may be partially self-fruitful, or self-fruitful in some seasons and under favorable conditions, but not dependably so year in and year out. They are therefore classed as *commercially* self-unfruitful.

Following is an example of apple orchard planning, applying the information already set forth and assuming that the grower will follow the present tendency of planting 50 per cent McIntosh, 25 per cent Spy and 25 per cent various varieties adapted to the grower's peculiar requirements of soil, location, markets, etc. This 25 per cent "various" should probably include R. I. Greening, and may also include, or have to include if for pollination purposes only, some such varieties as Melba, Wealthy, Cortland, Delicious (listed in order of maturity).

From the standpoint of pollination an orchard of McIntosh, Spy and R. I. Greening is incomplete as the first two do not overlap sufficiently in their blooming periods to effectively pollinate each other, and Greening produces poor pollen even though its blooming season sufficiently overlaps both McIntosh and Spy. Wealthy, Cortland and Delicious fill the requirements of good pollen and overlapping blooming periods (see chart which also lists other varieties the grower may prefer), and are otherwise sufficiently acceptable commercially. Ten per cent of any one of them, properly interplanted, would satisfactorily complete a McIntosh-Spy-Greening orchard insofar as pollination is concerned.

Pears. All varieties, as with apples, must be considered commercially self-unfruitful, requiring mixed plantings to insure adequate pollination. In addition some varieties as Bartlett and Seckel are *inter-sterile,* i.e., they will not pollinate each other. Note also the limitations of Kieffer as detailed under "1. Blooming Periods Must Overlap." In a Bartlett-Kieffer orchard therefore provision should be made for a third variety, such as Anjou, Howell, Bosc., etc.

Cherries, Sweet. All varieties are self-unfruitful necessitating mixed plantings. Also a few varieties, Bing, Lambert and Napoleon particularly, are inter-sterile as well, and will not pollinate each other. Therefore an orchard planted to these three varieties, or any two of them, would still require another variety such as Black Tartarian or Windsor, for cross-pollination.

Cherries, Sour. All commercial varieties are self-fruitful. Montmorency, for example, may therefore be planted in solid blocks.

Peaches. With few exceptions, peach varieties are self-fruitful and may be planted in solid blocks. Three exceptions are J. H. Hale, June Elberta and Vimy, all of which must have some other abundant pollen producer interplanted.

Plums, European. With the exception of Italian Prune, all European varieties (e.g., Grand Duke, Lombard, Monarch, Reine Claude, etc.) should be considered self-unfruitful requiring mixed plantings for pollination. Even Italian Prune probably benefits from cross-pollination. In this case, since Italian blooms late, another late blooming variety such as Pacific or Stanley is required. Lombard, Reine Claude, etc., start blooming earlier than Italian and cannot always be relied upon for pollination.

Plums, Japanese. Burbank and Shiro, the main Japanese varieties, are self-unfruitful and because they bloom earlier than most European varieties, other Japanese varieties such as Abundance and Red June need to be planted with them for pollination. Also Burbank and Shiro planted together are not satisfactory as though Shiro will pollinate Burbank, Burbank will not pollinate Shiro. Reine Claude, an European variety, is proving a satisfactory pollinator for Shiro so that an orchard consisting of Burbank, Shiro and Reine Claude would be satisfactory as regards pollination. Even so, however, it is better to arrange for Japanese pollinators for Japanese varieties.

CHANGING EXISTING PLANTINGS TO IMPROVE POLLINATION CONDITIONS

Many existing orchards, young and old, have pollination problems due to faulty planning. If the orchard is quite young or under five years planted, perhaps the simplest and most effective plan is to replace a sufficient number of the trees with a good pollinating variety.

If the orchard has reached or nearly reached bearing age then the best plan is to topwork the necessary number of trees to a satisfactory pollinator. In such an orchard, and until the topworked trees start blooming, a useful temporary expedient is the introduction of "bouquets" of a pollinating variety scattered throughout the orchard. These bouquets should be placed in water to keep them fresh and hung up in the trees to make sure that bees and other pollen carrying insects work to advantage.

Even hand pollination, that is the transfer by hand of pollen collected from one variety on to another, has been resorted to in the States of New York and Washington, and the results in increased yield are recorded as commercially successful.

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BULLETIN 425 DECEMBER, 1942

Ontario Department of Agriculture
Statistics and Publications Branch
TORONTO, ONTARIO

LEGUMES FOR PROFIT

Milk flows where alfalfa grows.

BY

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Professor of Field Husbandry

ONTARIO AGRICULTURAL COLLEGE
GUELPH, ONTARIO

LEGUMES for PROFIT

LEGUMES HAVE A FOURFOLD USE

1. As soil improving crops.
2. As hay and pasture crops.
3. As silage crops.
4. As sources of grain concentrates.

1. AS SOIL IMPROVING CROPS

Legumes are the only class of farm crop that has the ability to fix in the soil plant food that was not originally there. **Nitrogen is the plant food thus fixed.** In the present period of nitrogen scarcity such a source of nitrogen should not be overlooked. Even when a legume crop is cut and removed the nitrogen content of the soil is not appreciably reduced. However, legumes are heavy feeders on other mineral plant foods, particularly phosphates and potash, hence the removal of a hay crop lowers the plant food reserve of such minerals. The **plowing down of the entire legume,** usually the second cutting, is thus the logical way to increase soil nitrogen and organic matter while maintaining the original amounts of lime, phosphates, and potash. The deeply penetrating roots of the legumes also open up the soil, and leave it in a more friable condition.

Plowing down alfalfa to enrich the soil.

Where legumes have been used in a rotation more nitrogen has been found in the soil and also in the crops following the legume. This increased nitrogen has been accompanied by higher yields of associated and following crops.

The second growth of a good crop of legumes such as alfalfa, red clover, and alsike clover may be plowed down with profit. The entire crop of such annual legumes as soybeans may also be used to advantage. A one ton crop of alfalfa contains about fifty pounds of nitrogen in the tops and eighteen pounds in the roots. Sweet clover and red clover also contain almost equivalent amounts of this valuable plant food.

2. AS HAY AND PASTURE CROPS

(a) Annual Legumes for Cheap Milk

Annual legumes mixed with oats or millets produce feed abundantly and cheaply. The following are some satisfactory combinations.

Mixture	Rate of Seeding Per Acre	Date of Seeding	Time to Cut
Common Vetch Oats	½ bus. 1½ bus.	As early as possible	When oats begin to head
Field Peas Oats	1 bus. 1½ bus.	"	"
Common Vetch Peas Oats	½ bus. 1 bus. 1 bus.	"	"
Sweet Clover Oats	15 lbs. 2½ bus.	"	"
Soybeans Early Foxtail Millet	1½ bus. 15 lbs.	Latter part of May	When pods begin to form on beans
Sweet Clover Foxtail Millet	20 lbs. 15 lbs.	Latter part of May	8-10 days after millet has headed

(b) Biennial and Perennial Legumes

There are biennial or perennial legumes to meet nearly every requirement. However, the most commonly grown are alfalfa and red clover. Sweet clover, particularly for lighter soils, still finds a place. Alsike clover, the mammoth white clover known as Ladino, and the common white are most commonly used in pastures and as additions to hay and pasture mixtures.

Although all these legumes are planted singly they are most frequently used in combination with various grasses. The amounts of seed suggested when planted alone and in several proven combinations are given in the following table. Besides being suitable for longer rotations, these suggestions are suitable also for **short rotation conditions** where the legumes may be plowed down for soil improvement.

Crop	Combinations of the Various Crops For Different Conditions				
	Seeded Alone	Where Alfalfa Does Well	Where Alfalfa Does Not Do Well	For Lighter Land and Drier Conditions	For Areas Wetter Than Usual
Alfalfa	15-20	6		4	
Red Clover	10-12	4	8	3	6
Alsike Clover	5-7	2	2		3
Ladino Clover	5-7	1	1		2
White Clover	5-7	1	1		1
Sweet Clover	15-20			5	6
Timothy	10-12	4	6		
Orchard Grass	14	2	2		
Meadow Fescue	14				2
Awnless Brome	14			8	
Total Pounds Per Acre	As above	20	20	20	20

Other legumes such as Korean lespedeza, crimson clover, burr clover, sanfoin, and the various trefoils find uses in particular areas, but strains have not yet been developed that yield as much as the more commonly grown sorts.

3. AS SILAGE CROPS

Most legumes have been successfully made into silage both with and without added preservatives.

For ensiling, the legumes either alone or in combinations with grasses, are cut at the same time as for the production of cured hay. **A moisture content of around sixty-five percent gives the best quality silage.** If the crop is cut during dry weather very little wilting will be needed. With lush growth two or three hours drying may be necessary to reduce the moisture content before ensiling the crop.

Legumes or grass for silage purposes should be **cut fine** and **thoroughly tramped** in the silo. When molasses can be secured the addition of about sixty pounds per ton of green fodder at the time of ensiling adds to the feeding value of the ensilage, and aids the ensiling processes.

4. AS SOURCES OF GRAIN CONCENTRATES

The seed of several of the annual legumes is a satisfactory and cheap protein concentrate. The two legumes most commonly used in this connection are field peas and soybeans. More use could be made with profit of the two crops mentioned, especially under conditions of protein scarcity. The acreage of soybeans has increased nearly four hundred percent in the past two years, and it has been demonstrated that satisfactory yields of seed can be secured in most agricultural sections of older Ontario.

Excellent quality Hay may be made on Tripods.

Investigations of the past two years indicate that as satisfactory yields of field peas may be secured at the present time as were possible in earlier years if proper attention is paid to the food requirements of this crop. A soil test will act as a guide to growers for the fertilizer requirements necessary for satisfactory yields. Of course insect enemies of the pea crop must be kept under control.

HOW TO SECURE A SATISFACTORY STAND OF LEGUMES

Weather plays an important part in securing a satisfactory stand of legumes. This cannot be controlled, but much can be done to ensure profitable stands. Some of the most important considerations are as follows:—

1. A Plentiful Supply of Good Seed

A little extra money spent on heavier rates of seeding, particularly of the legumes, makes all the difference between a thin and a thick stand. It pays good dividends to be generous with seed.

2. A Well Prepared Seed Bed

There are around two hundred and fifty thousand seeds to the pound of alfalfa, sweet clover and red clover, and around seven hundred and fifty thousand seeds to the pound of alsike, Ladino and white clovers. Such small seed needs a well prepared seed bed. Shallow seeding on a **firm**, well-worked seed bed will go far to ensure good germination of the seed.

3. A Sufficient Supply of Plant Food

Because legumes are heavy feeders on potash and phosphoric acid special attention should be paid to providing a sufficient quantity of these in the soil. The use of moderate applications of fertilizers such as 2-12-6 or 2-12-10 is good crop insurance when seeding down. On established stands 0-14-7 and 0-12-10 can be used to advantage.

4. Sane Planting

The most favorable time for the seeding of legumes is usually early spring when temperature and moisture conditions are most frequently suitable for seed germination. Seeding after early July greatly increases the danger of winter killing of the newly established stand. Legumes thus differ from grasses which may be fall seeded with success.

Soybeans may be grown for fodder or ripe seed.

Legumes may be seeded successfully either with or without a nurse crop. Where a spring planted nurse crop is used it should be seeded at a lower rate than usual. Oats and barley are the annual cereals most frequently used as nurse crops, but successful stands of legumes and grasses have been secured also by using most other annual cereal crops grown in Ontario. Seeding in the spring on new winter wheat stands is a common and satisfactory practice.

5. Inoculate the Seed

All legume seed should be inoculated before planting unless satisfactory crops of the particular kind of legume being used have been grown previously on the land intended for seeding. The ability of a legume to store up nitrogen in the soil depends on the presence of an abundant supply of the necessary bacteria. Unless these are present naturally in the soil they must be added as a culture if the full benefit of the legume is to be secured.

CARE OF THE NEW SEEDING

There are two considerations of particular importance in protecting new seedings. The first is to **remove the nurse crop,** if such has been used, **as early as possible.** Care should be taken to **prevent stooks or coils of the nurse crop from remaining** on one location long enough to smother the young seedlings. A serious thinning of the stand may result from neglect in this connection.

The second consideration of prime importance is to see that the new seeding has a sufficient growth in the fall to protect it against winter killing. At least eight or nine inches of growth is desirable. This means care in clipping and fall grazing.

CURING THE CROP

It has been estimated that as much as forty percent of the digestible food of legume hay is frequently lost by improper methods of handling the crop. Unfavorable weather conditions may be responsible for a portion of this loss, but much loss may be prevented.

Early cutting is necessary to secure the highest amounts of digestible food. This is particularly true of the protein. Early cut, well cured hay requires less protein supplements for successful feeding. Alfalfa and sweet clover should be cut for hay when the bloom is just starting. Red clover, alsike clover, and the white clovers may be left until the first blossoms begin to turn slightly brown.

The leaves of most legumes constitute around forty percent of the total harvested weight, but contain around sixty percent of the digestible protein of the plant. Therefore every effort should be made to retain the leaves.

A few practices that help to make better hay are as follows:

(a) Do not cut too large an area ahead of the curing operations as loss of plant food due to rain or bleaching is greater in the swath than in the windrow or cock.

(b) Where labor is available the cocking of hay is an insurance against losses due to unfavorable weather.

(c) Fewer leaves are exposed to the weather if the raking is done in the opposite direction to that in which the mower was operated.

(d) Under conditions of extremely unfavorable weather hay that might otherwise be lost may be saved by the use of tripods. The ensiling of the crop is another possibility under such conditions.

SEED PRODUCTION

Satisfactory seed of the various legumes common to Ontario can be raised in many sections of the province. In most years weather conditions permit the development of sufficient seed to make harvesting a profitable effort.

More and cleaner seed crops have been secured when the crop has been planted in rows about thirty to thirty-six inches apart. However, clean stands planted in the usual way have given satisfactory returns also. A legume seed raising project in any community is good insurance of a sufficient supply of seed for profitable planting.

For detailed information regarding the raising of seed of either legumes or grasses consult your nearest agricultural office, college or experiment station.

BULLETIN 426 DECEMBER, 1942

Ontario Department of Agriculture

Statistics and Publications Branch

TORONTO, ONTARIO

FARMYARD MANURE SERVES BEST ON THE LAND

Hauling Manure by sled and applying it direct is one of the speediest and most economical methods of spreading.

BY

THE ADVISORY FERTILIZER BOARD FOR ONTARIO

Dec., 1942 — 50M — B 2400

MANURE PILES SUFFER LOSS of NITROGEN and POTASH from SEEPAGE

When manure is allowed to heat there is loss of Nitrogen in the form of ammonia, also loss of organic matter of manure.

1. WHAT IS BEST TO DO WITH MANURE?

Get it out on the land!

On most farms there will be more time to haul manure in winter than in the busy crop season of 1943.

It is estimated that 40% of the soluble plantfood is lost by storing manure in barnyards.

When manure is spread on the land, soluble plantfood washes into the soil where much of it is retained for next year's crops.

The rotting bedding of straw or other litter has absorbed much of the liquid manure,—hence it is full of valuable plantfood.

Litter forms valuable humus for the soil, increasing its water-holding capacity, improving its aeration and constituting a home in the soil and food for bacteria and other soil organisms.

2. MANURE IS WORTH DOLLARS

Ontario farmyard manure usually includes manure from various types of livestock. When sufficient litter has been used to absorb the liquid manure, the average ton of Ontario farmyard manure carries 11 to 13 lbs. of Nitrogen, 2 to 6 lbs. of Phosphoric Acid, and 9 to 11 lbs. of Potash, according to Dominion of Canada, Dept. of Agriculture Farmers Bulletin No. 40). If this plantfood is valued at current prices for the same nutrients in fertilizers, it means that farmyard manure has a value varying from $1.89 to $2.47 per ton.

Over half the nitrogen and potash is quickly available as plantfood. The phosphoric acid is largely in organic form (in straw and solids of manure). This becomes available with the disintegration of the straw or bedding.

DON'T LET MANURE DETERIORATE IN THE BARNYARD

SPREAD IT ON THE FIELDS DAILY OR WEEKLY

3. WHERE SHOULD THE MANURE BE APPLIED?

Some good farmers favor spreading manure on land that is to grow corn or roots next spring. These are deep and abundant-rooted crops which probably make the best use of manure.

It is common practice also to spread manure on lighter soils and knolls where other cultivated crops are to be grown.

Some farmers prefer top-dressing meadows with manure, to increase the hay yield.

Fortunately it is often convenient to top-dress meadows when other fields cannot be treated.

A WELL-BUILT MANURE PILE

Where it is necessary to put manure in a large pile in the field, losses can be most effectively reduced by building the sides of the pile as near vertical as possible. The pile of manure should also be kept compact so as to allow as little air as possible to circulate in it.

4. HOW MAY LOSSES OF MANURE BE PREVENTED?

(a) Loss of liquid manure.

If liquid manure is allowed to run away, either in the stable or in the field, there is tremendous loss of valuable plantfood. All liquid manure should be absorbed by abundant bedding with straw or other litter.

	Nitrogen	Phosphate	Potash
Solids in manure contain...........	50%	nearly all	40%
Liquid manure contains............	50%	very little	60%

(b) If manure is piled underneath the eaves of the barn so that every rain or melting snow washes through it, there is very great loss of nitrogen and potash in the streams that run away from the barnyard.

(c) If manure is piled loosely in the barnyard or in the field, bacterial action in the interior part of the pile is increased. Nitrogen is lost as ammonia is given off. Firefanging causes a breaking down of the straw or litter with liberation into the air of the gas carbon dioxide; hence the humus of the manure is destroyed. If piling is necessary, firefanging can be avoided by keeping the manure pile packed fairly compactly.

5. HOW HEAVY SHOULD MANURE BE APPLIED?

Several leading Experiment Stations report that larger returns per ton of manure are realized from moderate light and frequent applications than from heavy and infrequent dressings. The following figures give some of the more recent findings:

	Rate per ac.	Value of increase per ton of manure
Station No. 1	4 tons per ac. (light)	$2.43
	8 " " " (medium)	2.19
	16 " " " (heavy)	1.44
Station No. 2	6 tons per ac. (light)	2.16
	8 " " " (medium)	1.66
	10 " " " (heavy)	1.44
Station No. 3	4½ tons per ac. (light)	2.45
	9 " " " (heavy)	1.78

General experience indicates that when manure is spread moderately thin and supplemented by phosphates or suitable combinations of phosphate and potash, its power to produce increases is greatly enhanced, as is also the profit from the entire investment.

Where an excessive amount of straw is found in the manure it is good business to apply at least 100 lbs. per acre of a nitrogen carrier, such as Cyanamid or Sulphate of Ammonia, broadcast on top of the spread manure just before it is plowed into the soil. This additional nitrogen gives immediate food to the bacteria which cause the rotting down of the straw.

GET THE MANURE ON THE LAND
Piled in the barnyard it loses much Nitrogen and Potash from seepage.

6. IS PHOSPHATING MANURE A PROFITABLE PRACTICE?

Realizing that there is a considerable loss of nitrogen from manure as it is handled from the stable to the pile, many farmers are finding it good practice to use phosphate, sometimes called "stable phosphate," in the stalls. Superphosphate is scattered over the lower part of the stall and in the gutters at cleaning time at the rate of one-half pound per head per day. It absorbs much of the escaping ammonia, thus accomplishes a definite saving in the nitrogen of the manure. It also builds up the phosphoric acid of the manure, and makes manure a better balanced plantfood, especially for cereal crops. The superphosphate is a drying agent and to some extent a deodorant. Farmers who have conducted careful comparisons of phosphated manure vs. manure without phosphate find that the former manure is stronger as a plant grower and produces larger yields of plumper grain.

7. DON'T SELL MANURE!

Some farmers, in order to increase their cash income, are selling manure piles from their farms. This manure has been gathered from the livestock that fed on the products of the land. Surely the fertility that was taken out of the soil belongs to the farm from which it was taken. As well might one sell the foundation stones from his house or barn as to sell manure from the farm and expect to keep it a going concern. Manure is an essential part of the producing machinery of the farm.

8. MANURE PREVENTS SOIL EROSION

From many of the knolls and upper lands of rolling Ontario fields not only is plantfood washed out but the surface soil itself is in many cases washed to

If the organic matter of this soil had been kept up, partially by manuring, the summer deluge would not have eroded the higher lands, causing so much damage and the loss of so much fertile topsoil.

lower levels and frequently far from the farm where it originated. The primary cause of this erosion is the destruction of organic matter or soil humus. Strawy manure is one of the richest sources of humus for Ontario soils, hence it can be made a factor of first importance in preventing soil erosion.

9. THE 1943 MANURE PROBLEM

Farm operators are thinking about the plantfood question for their 1943 crops.

Ontario farmers harvested in 1942 over 191 million bushels of small grain and corn, as well as 12.6 million bushels of potatoes, 3.1 million tons hay and 24 million bushels of roots. These crops drew heavily upon the stores of plantfood in Ontario soils.

Some of this plantfood must be put back, if Ontario soils are to continue to produce such crops. Indeed, much heavier claim has been put recently on Ontario farms to produce the crops and livestock products to fill the commitments already entered into by our Government.

Manure does no good in the barnyard. Here is a pile of approximately 200 loads in a barnyard late in June—the farmer's crops were poor.

In view of present War conditions, difficulties in obtaining additional plantfood for our Ontario soils may be alleviated very greatly by paying more attention to the home source of plantfood,—manure.

Manure can be very profitably supplemented by suitable fertilizers or fertilizer materials, but it is of such great fundamental value to Ontario farmers that its care and most efficient use should be of major interest.

BULLETIN 427 FEBRUARY, 1943

ONTARIO DEPARTMENT OF AGRICULTURE

Statistics and Publications Branch

TORONTO, ONTARIO

BUCK RAKES

by

H. W. KITCHING

Department of Agricultural Engineering

ONTARIO AGRICULTURAL COLLEGE

GUELPH - CANADA

Published by Authority of The Honourable P. M. Dewan
Minister of Agriculture

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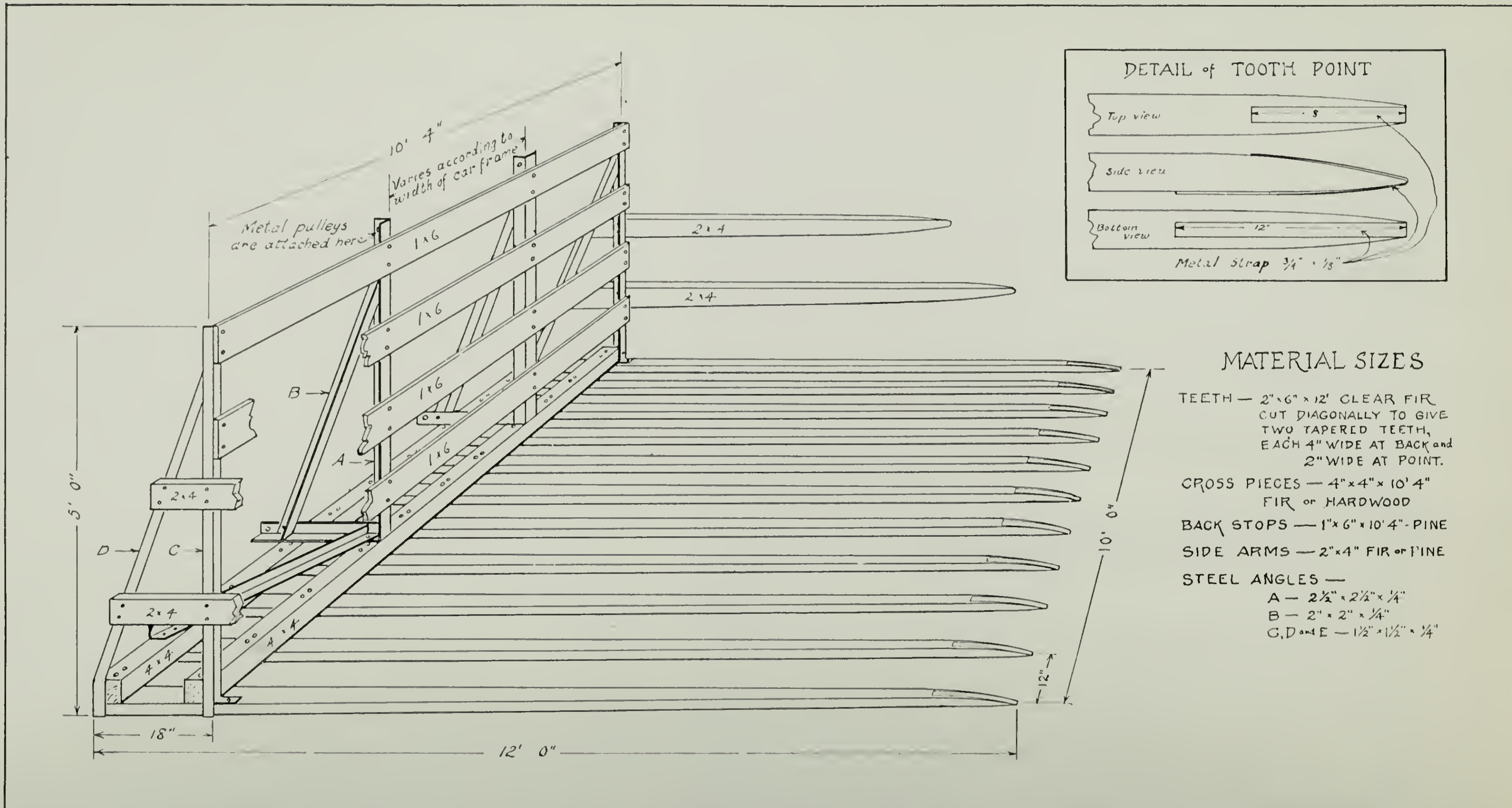


FIG. 1—BUCK RAKE FOR CAR OR TRACTOR

Fig. 2

AUTOMOBILE MOUNTING

Sweep rakes may be mounted on practically any type or make of auto chassis. Some makes, however, provide for an easier and more satisfactory mounting than others. Due to the fact that the front of the car acts as a counterbalance for the loaded rake, a **long wheelbase** is desirable. The longer wheelbase chassis also usually have a **strong frame** and a **good clutch and rear end assembly.** A **fairly heavy motor** is desirable, especially if the rake is to be used on steep gangways or very hilly land.

A power lift is essential for efficient operation. The simplest and most satisfactory lift is made from an old car differential, transmission and drive shaft. If the differential used has an open drive shaft, the transmission should be mounted as shown on Fig. 4. If an enclosed shaft type is used, the transmission must be mounted up near the front of the motor. A large V-pulley (8″ or more in diameter) is bolted or welded to the front end of the drive shaft, and the whole assembly then mounted so that this pulley will line up with the crankshaft pulley. On some makes the lift can be driven directly by the fan belt by using a longer belt. On other motors it is necessary to braze a small V-pulley (an old generator pulley) on the front of the crankshaft or fan drive pulley and drive the lift from this.

The lift differential must be mounted as far forward as possible on the chassis. This will allow the cable to pull in a more horizontal plane rather than downward, which would be the case if it were mounted too far back. A spool to wind the cable on is welded to the lift brake drum. The pipe used for this spool must be large enough to allow a socket wrench to enter to remove the axle shaft nut if necessary.

Fig. 3

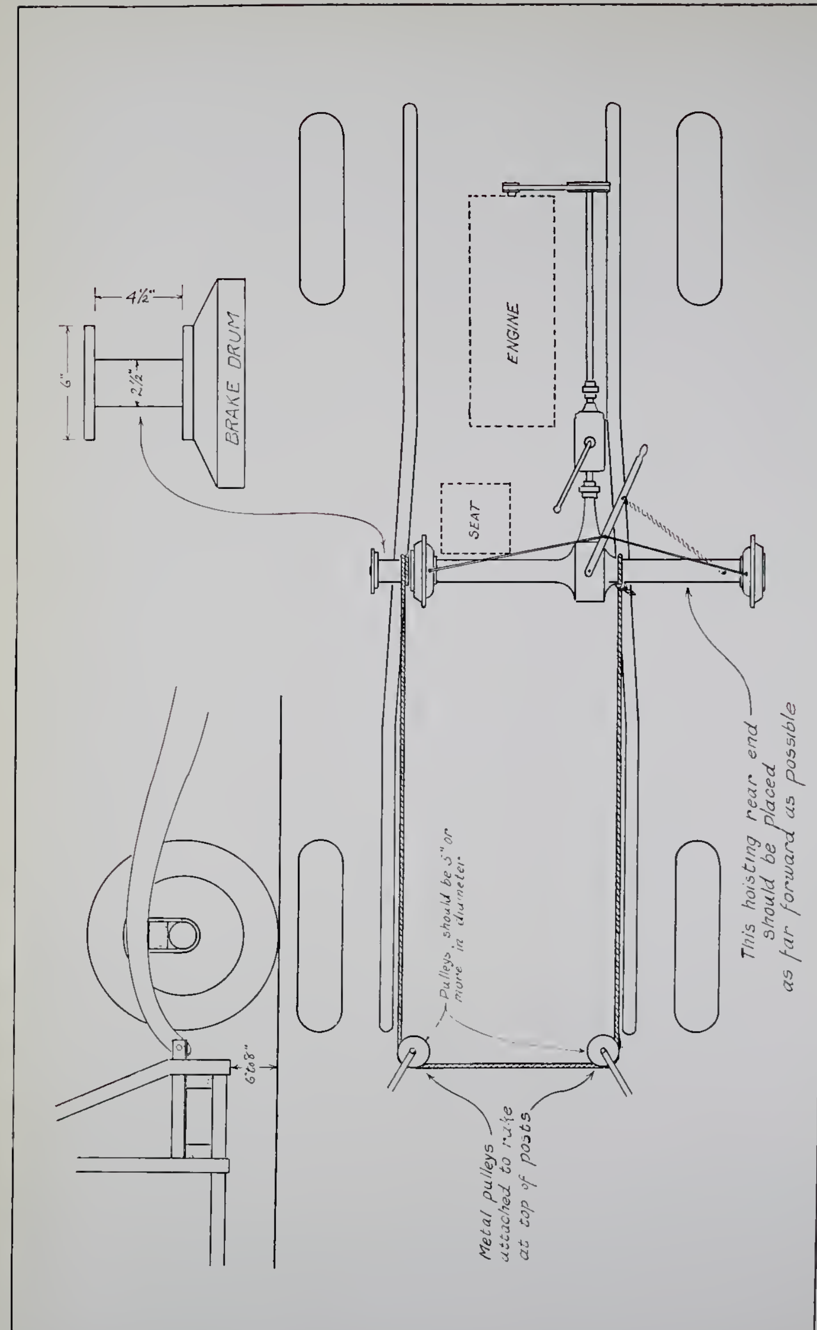


FIG. 4—DETAILS FOR AUTOMOBILE MOUNTING

Fig. 5

TRACTOR MOUNTING

To efficiently operate a buck rake, a tractor should be on rubber tires and should have a forward speed of at least 8 m.p.h. The rake must be mounted on the front of the tractor, as most reverse gears are too slow for good loading. If the tractor is one of the heavier types, the rake may be mounted directly to the frame or front axle. On the smaller types and especially on row crop types however, the weight of the load and the swing of the rake will injure the front tires and wheel bearings. To avoid this trouble the rake should be carried on wheels of its own. The most satisfactory method is to use a widened automobile front axle. This axle is pushed by a V-frame attachment under the tractor and is steered by a connection to the tractor front wheels.

Implement power lifts on tractors are not as a rule satisfactory for lifting the rake. A used automobile rear axle driven from the power take-off makes the best lift we have seen. It can be braced to the drawbar and the rear axle of the tractor. On row crop types, the rear tractor wheels may be widened out to allow the hoist axle to fit in between them. On standard wheel types, a frame can be made to set the automobile axle out behind the rear wheels of the tractor, or the axle may be cut down to fit between the tractor rear wheels.

To raise the rake, pull the control lever over so that the left brake is released and the right one is applied. When it has been raised to the desired height let go of the lever, and the spring will automatically apply the left brake and will release the right one, thus holding the rake in the raised position.

A water muffler is a worth-while precaution. This can easily be made by directing the exhaust into the side of a 5-gallon can mounted on the side of the chassis. Some water is kept in this can, and any sparks entering strike the water and are extinguished.

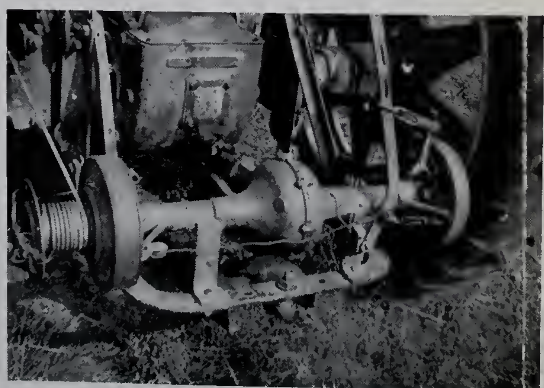


Fig. 6

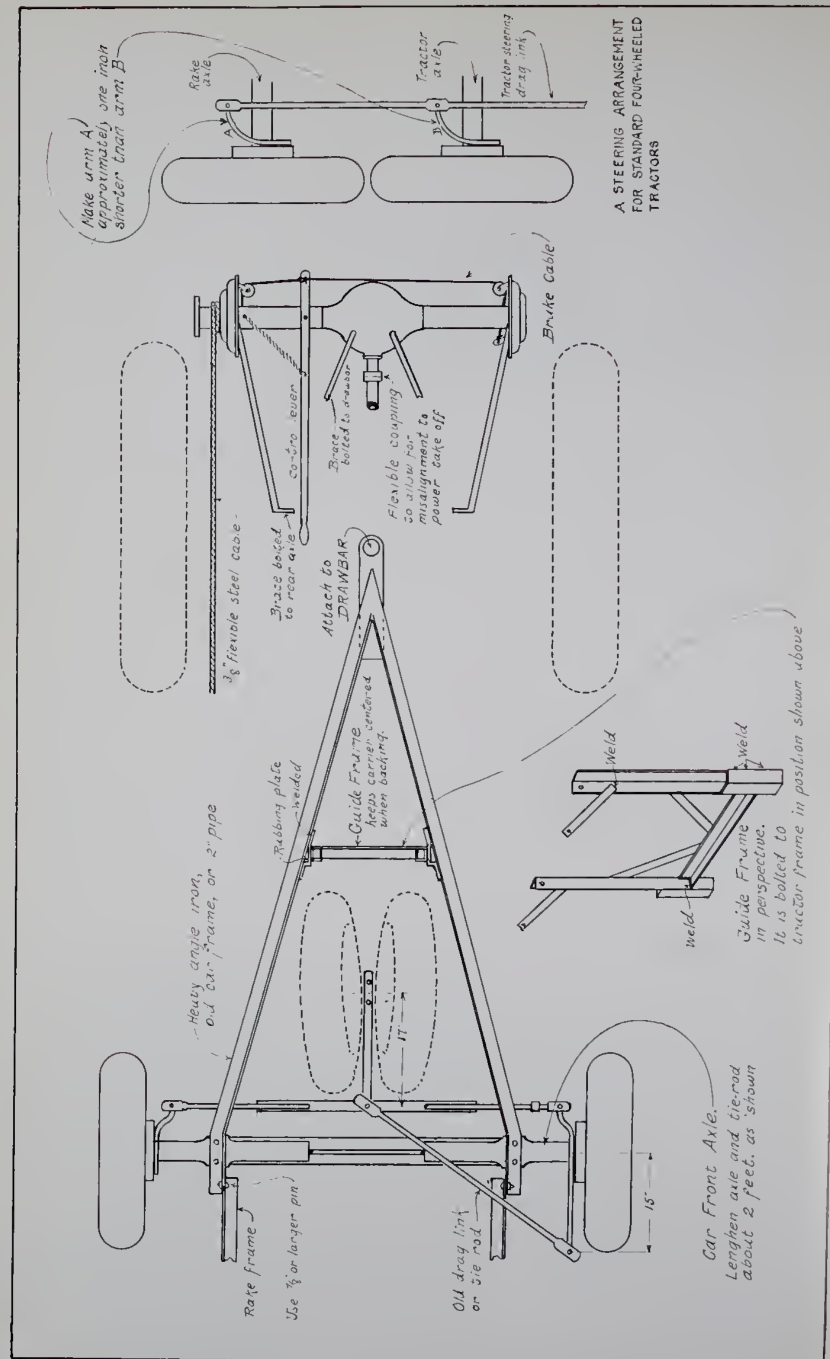
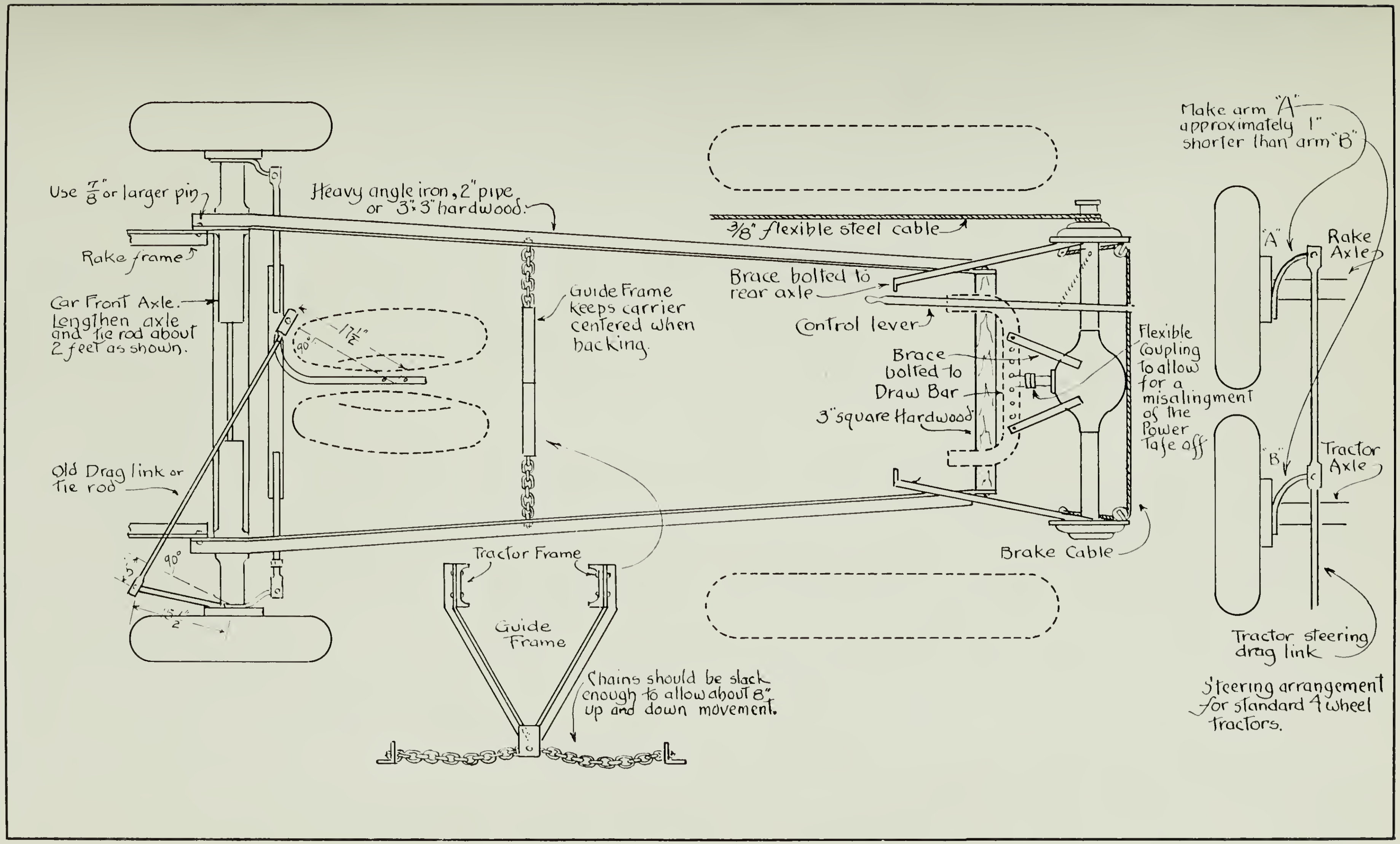


FIG. 7—DETAILS FOR TRACTOR MOUNTING



REPLACING FIGURE 7 IN BULLETIN 427

BULLETIN 428 JANUARY, 1943

Ontario Department of Agriculture

Statistics and Publications Branch

TORONTO, ONTARIO

POULTRY EQUIPMENT FOR THE BUSY FARMER

by

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Department of Poultry Husbandry

ONTARIO AGRICULTURAL COLLEGE

Guelph

Feb. 1943—25M—B2762

POULTRY EQUIPMENT FOR THE BUSY FARMER

Efficient, labour-saving equipment for the farm poultry flock is desirable at any time. It is, however, particularly so under wartime conditions, when increased need for poultry products is coupled with a widespread scarcity of suitable help. Equipment must not only be efficient and labour saving in use, but must be such as can be made of readily available material. It should also be simple in construction and inexpensive to make.

EQUIPMENT FOR LAYING FLOCKS

Feed Hoppers

Three satisfactory styles are shown, with necessary specifications and bills of materials for each.

It is wise to allow about 3 inches of feeding space for each layer. Thus a 6-foot, double-sided hopper, with about 140 inches of feeding space, will be sufficient for from 45 to 50 birds.

Fig. 1 illustrates a combination flat-bottomed, floor-style hopper suitable for either layers or for chickens on range. All dimensions for construction are plainly shown.

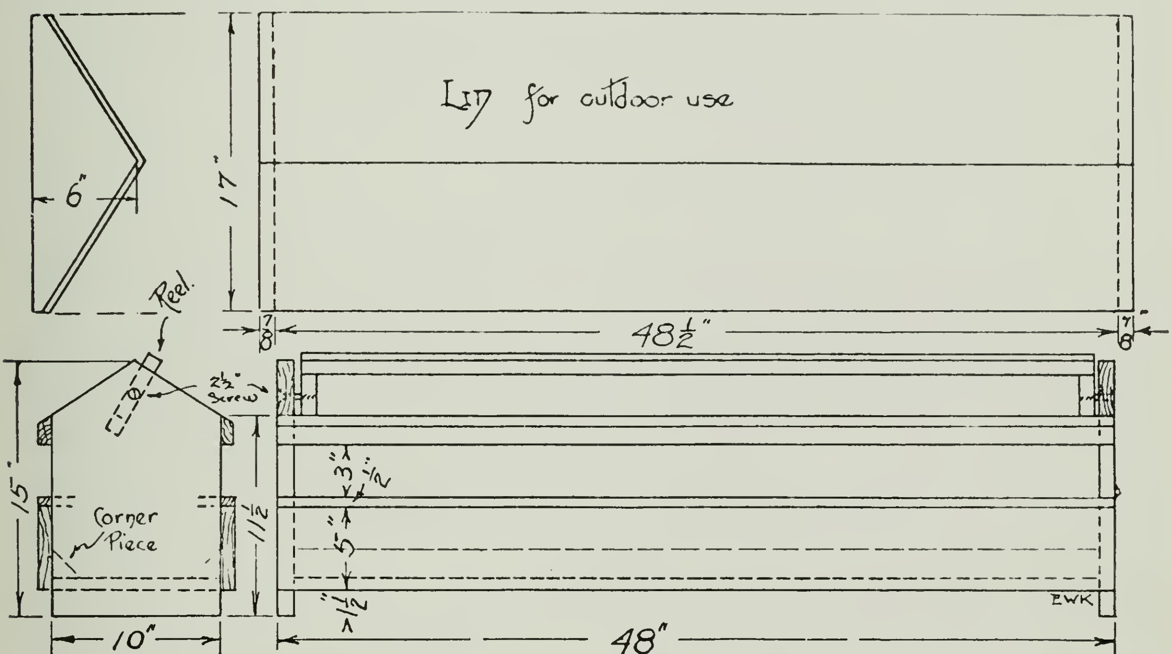

FIG. 1

Showing plans for the construction of a reel type of dry mash hopper. This is adapted for the feeding of dry mash to growing chicks on range, in which case the lid is used. It may also be used for feeding dry mash to laying hens by removing the lid and inserting the reel.

BILL OF MATERIALS

Bottoms	1 pc.	7/8" x 9¾" x 3'10¼"
Ends	2 "	7/8" x 9¾" x 19"
Sides	2 "	7/8" x 4¾" x 48"
	2 "	3/8" x 1¾" x 48"
Divisions	2 "	7/8" x 3 7/8" x 9¾"
Tumbler	2 "	7/8" x 7/8" x 3 1/10"
	2 "	7/8" x 7/8" x 2¼"
Top	2 "	7/8" x 6" x 17" (cut to detail)
	2 "	3/8" x 9¾" x 4'2½"
	2 "	7/8" x 1¾" x 48" (bevelled one side)

Fig. 2 shows an actual photograph of this versatile piece of equipment with the reel removed. Room for grit and oyster shell may be provided by a compartment at each end, as shown.

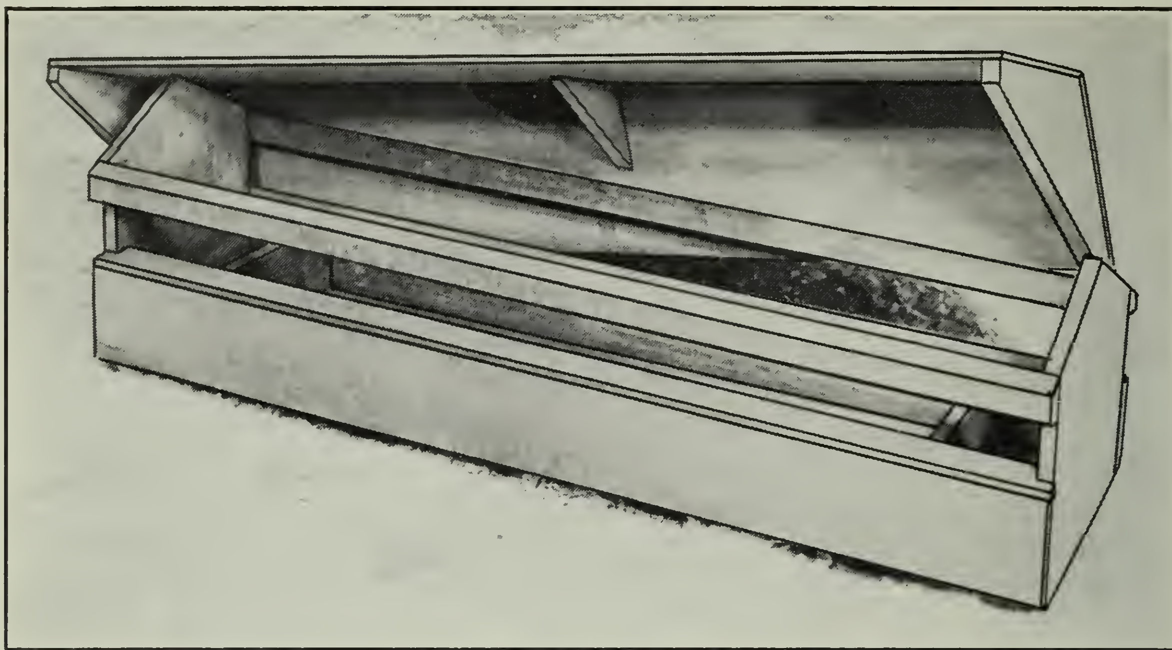

FIG. 2

Fig. 3 illustrates an excellent style of "stand" hopper. The stand is strong, easily made, and the feed trough is V-shaped. The feed is more easily eaten to the last bite from a V-shaped trough than from a flat-bottomed one, and

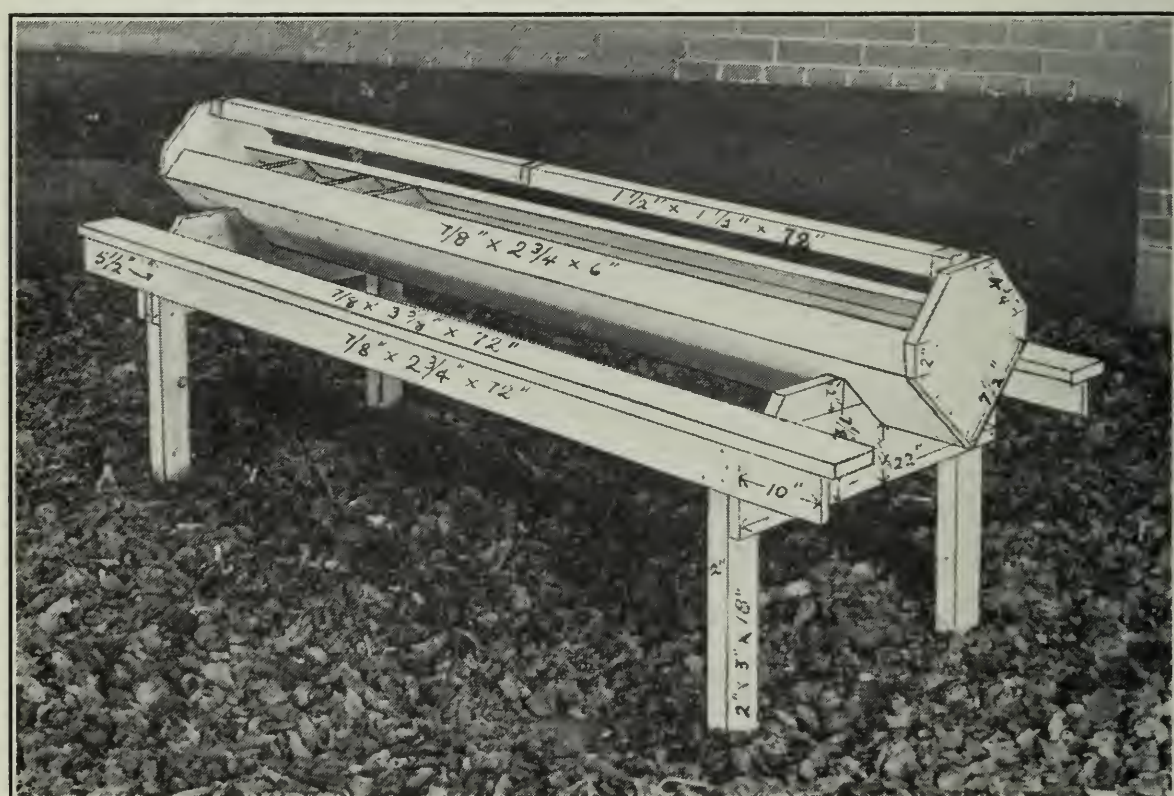

FIG. 3
A convenient, strongly made, stand-type feed hopper, with compartments for minerals as well as dry mash.

the stand allows additional room for birds on the floor. Separate compartments for grit, oyster shell and, where desired, bone meal make these materials readily available when and where the birds need them. This also removes the necessity of providing separate hoppers for these minerals.

BILL OF MATERIALS

(a) Stand:			
Legs	4 pc.	2″ x 3″ x 18″	
Ends of stand	2 "	⅞″ x 7½″ x 22″	
Perch	2 "	⅞″ x 3⅝″ x 6′	
Perch braces	2 "	⅞″ x 2¾″ x 6′	
(b) Trough:			
Sides	1 "	⅞″ x 5¾″ x 6′	
	1 "	⅞″ x 6¾″ x 6′	
Baffles	2 "	⅞″ x 2¾″ x 6′	
Ends	2 "	⅞″ x 10¾″ x 10¾″	

FIG. 4 shows a slightly more elaborate hopper, also of the "stand" type and very satisfactory. A smaller mineral trough, located above the mash trough, gives ready access to grit, oyster shell and bone meal, or one compartment may be used for beef meal or concentrate. Both troughs are readily removable from the stand for cleaning. The necessary plans and specifications are supplied in FIG. 5, and these are followed by a bill of materials.

FIG. 4
This stand-type hopper has the minerals in a separate trough above the mash trough, thus allowing more feeding space.

BILL OF MATERIALS FOR FIGS. 4 AND 5

Ends	1 pc.	2″	x 4″	(dressed)—	12′0″
Perch support	1 "	1″	x 4″	"	4′3″
Perch	1 "	1″	x 4″	"	9′0″
	1 "	1″	x 4″	"	8′1¼″

Large trough:					
Ends	2 pc.	1″	x 6″	(dressed)	—6″
Sides	2 “	1″	x 6″	“	4′½″
Baffles	2 “	⅜″	x 2¼″	“	4′2″
Small trough:					
Ends	2 “	1″	x 6″	“	8″
Sides	2 “	⅜″	x 2¾″	“	4′½″
Baffles	2 “	⅜″	x 1⅛″	“	4′½″
Reel	1 “	1½″	x 1½″	“	4′2″

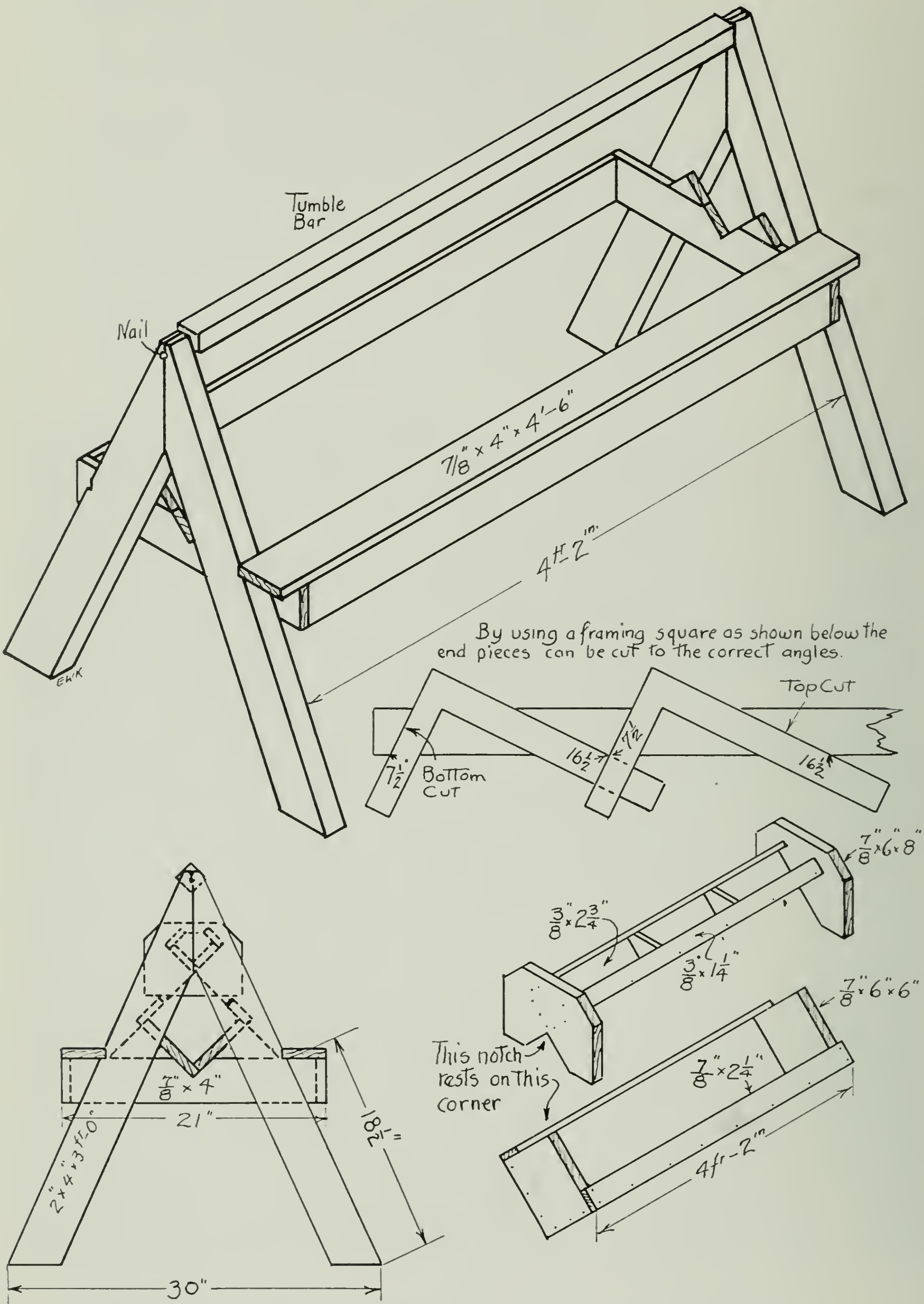

FIG. 5
This shows details for Fig. 4
The length may easily be increased to 6 feet or any size desired.

Laying Nests

Some farmers and poultrymen carry on specialized breeding for which trap nests are necessary. A practically fool-proof, roomy, well-ventilated nest, such as has long been successfully used by the O.A.C. Poultry Department, is shown in Fig. 6.

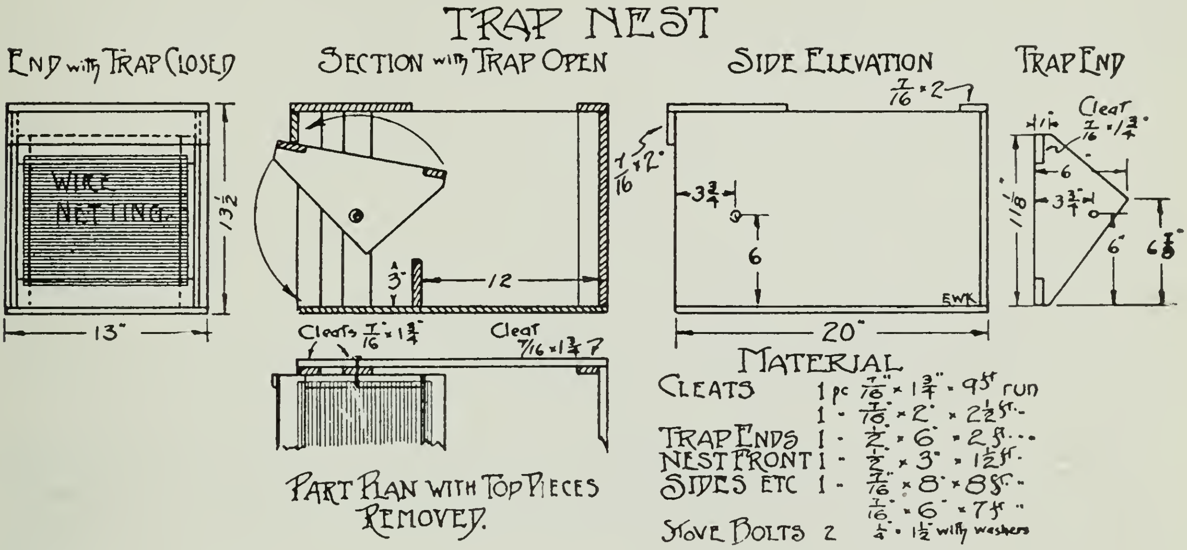

FIG. 6
Plans and specifications for the trap nest in which the type of construction of trap and its adjustment allows for the entire lower section of the front to open. This greatly facilitates removing the hens from the nest.

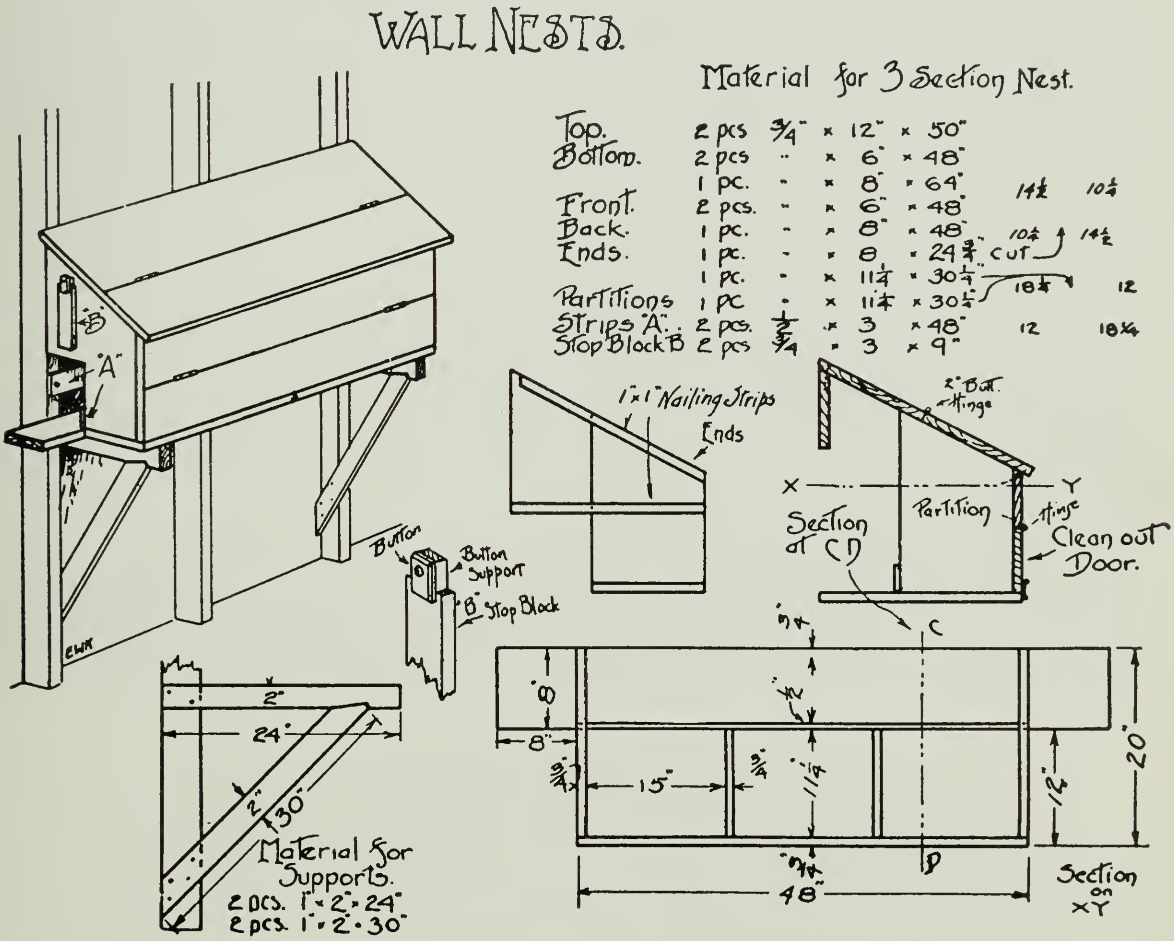

FIG. 7
A convenient type of open nest which may be supported on brackets on the wall, allowing free use of floor space for the hens.

FIG. 7 shows a useful style of wall nest. Such semi-dark nests aid in the prevention of egg eating, vent picking and cannibalism. This style may also be built two or three decks high. The individual nests are usually separated by partitions, but some farmers report fewer broken eggs when partitions are omitted, as there is then less crowding. If partitions are used, all nests should be from 12 to 14 inches square and from 4 to 6 inches deep, to hold plenty of bedding.

In FIG. 8 is illustrated a good open-front wall nest. This style may easily be extended in length and may also be built three tiers high. The landing perches may also be so constructed that they can be folded up over the nest openings at night. This will prevent the birds from soiling the nests by sleeping in them. These nests have no back, and the hinges allow the whole battery to be swung forward and upward for cleaning. The bedding material simply slides out the back.

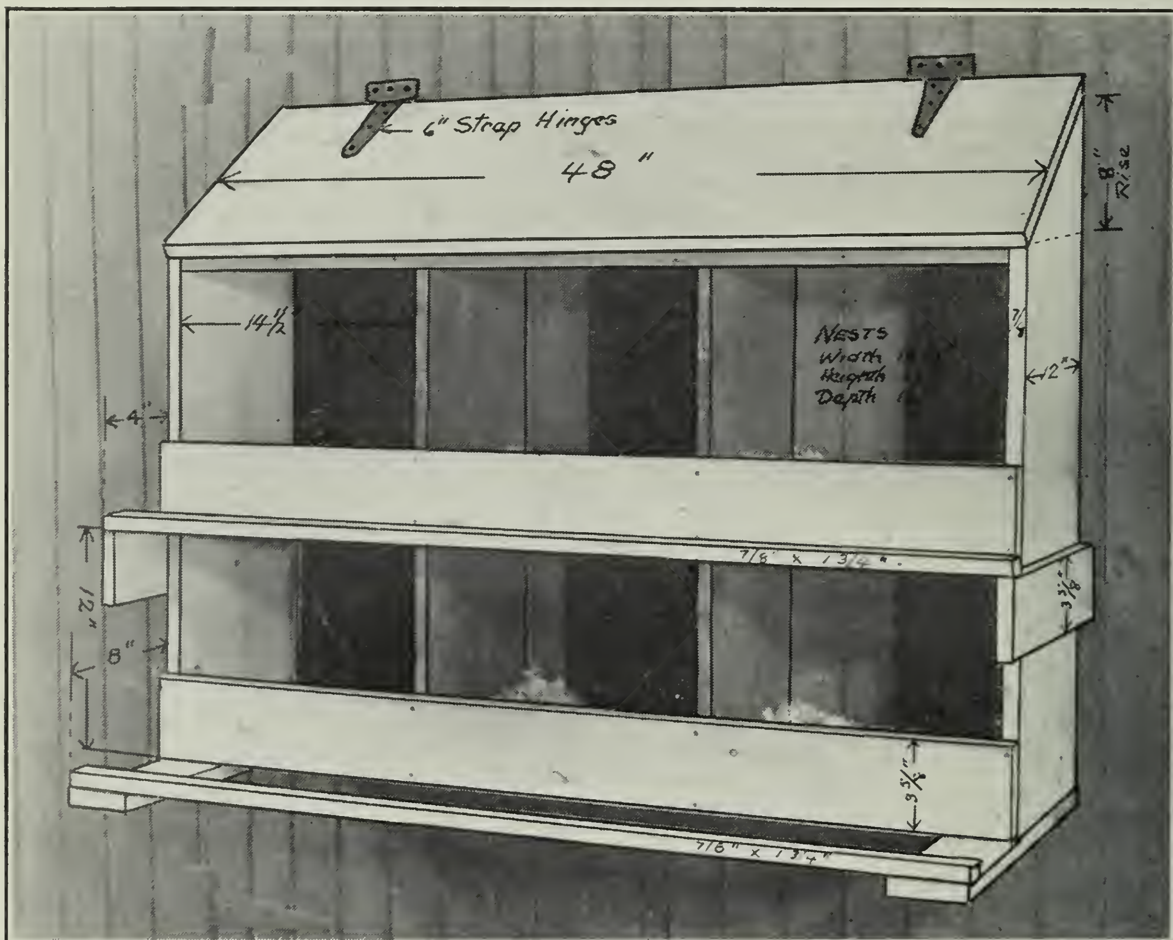

FIG. 8

BILL OF MATERIALS FOR 6-SECTION WALL NEST

Ends and partitions	4 pc.	⅞"	x 12"	x 34"
Nest bottoms	2 "	⅞"	x 12"	x 44"
Sloping top	2 "	⅞"	x 8"	x 46"
Perches	2 "	⅞"	x 2¾"	x 46"
Perch supports:				
Upper	2 "	⅞"	x 3⅝"	x 16"
Lower	2 "	⅞"	x 3⅝"	x 20"

Culling Equipment

Catching and confining birds for selection, culling or pullorum testing is greatly facilitated and the birds become much less alarmed when being caught if proper equipment is available for the purpose. Fig. 9 shows a good style of catching crate and illustrates its use. A trap door at one end is placed against a suitable opening in a range shelter or laying house and the birds are then driven in. They can be removed for examination through movable doors in each half of the top. The crate is best divided by a removable central partition to prevent crowding.

FIG. 9
Such a crate may be constructed 30 inches wide by 5 feet long and from 15 to 18 inches in height, or any other convenient size.

A catching hook made of stiff wire, firmly attached to an old broom or other handle, is a very handy piece of equipment no poultryman can afford to be without. Fig. 10 shows how such a catching hook may be made.

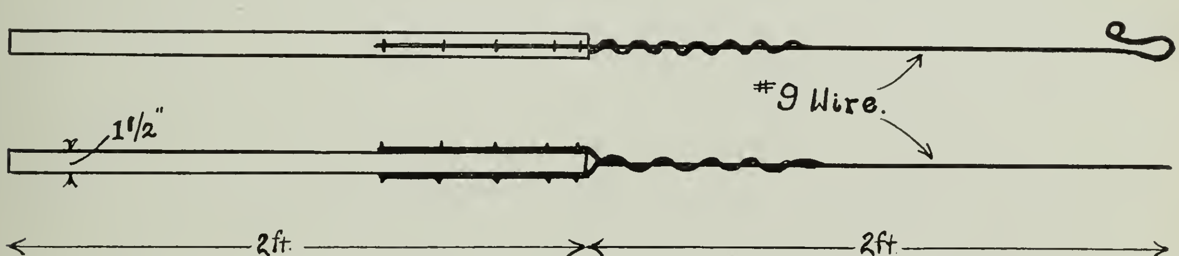

FIG. 10
Catching hook.

Twenty feet or so of close-mesh wire poultry fencing (not chicken wire) is very useful when stretched across a corner of a laying pen. The flock can be quietly encircled and easily caught in this way, and with the minimum loss of egg production or loss through injury. It also saves much time and temper and is inexpensive to buy if not already available.

Watering Equipment

Fig. 11 illustrates four styles of watering equipment, the glass sealers being suitable only for small chicks, but the other styles for either laying stock or for growing stock on range. A flared-side galvanized pan set on a raised wire-covered platform helps keep the water clean and the litter dry.

Covered, metal, float-controlled waterers are also satisfactory where obtainable. They are best set on a raised wire-covered platform or on a stand. Metal pig troughs, where still available, are very serviceable either in the laying pen or on the range. They are improved by the addition of a 2-inch-square tumble bar, as illustrated, to keep the birds out of the drinking water. A tumble bar also helps prevent fouling of the water.

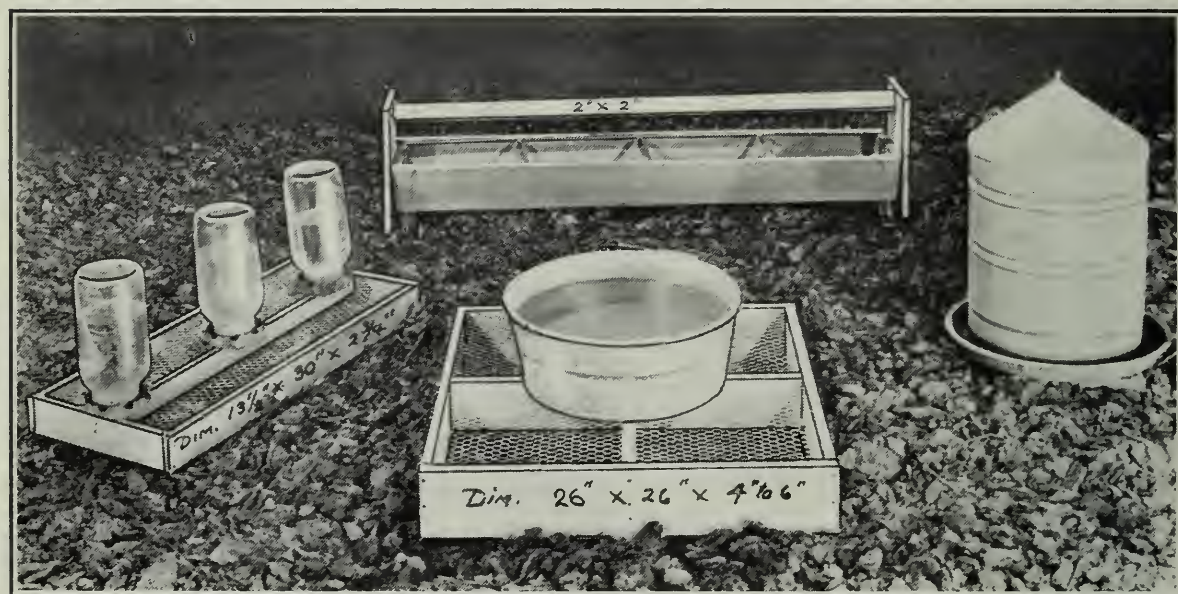

FIG. 11
Four useful styles of watering equipment.

Note the number and placement of waterers and feeders. The waterers may be set on a 2-inch wooden block or, better still, on a wire screen for improved sanitation. Galvanized metal or glazed crockery founts may be used instead of glass sealers, if available. As the chickens increase in size, galvanized or granite pans, set on screens, are good. For chickens over 3½ months of age a pig trough fitted with a tumble bar, as shown in Fig. 11, makes a suitable water dish, as it is durable and easily cleaned. V-shaped wooden troughs with 4- to 6-inch sides, and protected by easily removable tumble bars, will also do nicely where metal ones are not available.

A galvanized pan or a 3-gallon pail may be used, set on a stand. When fitted with a wire guard, as shown in Fig. 12, this makes a useful and inexpensive piece of equipment.

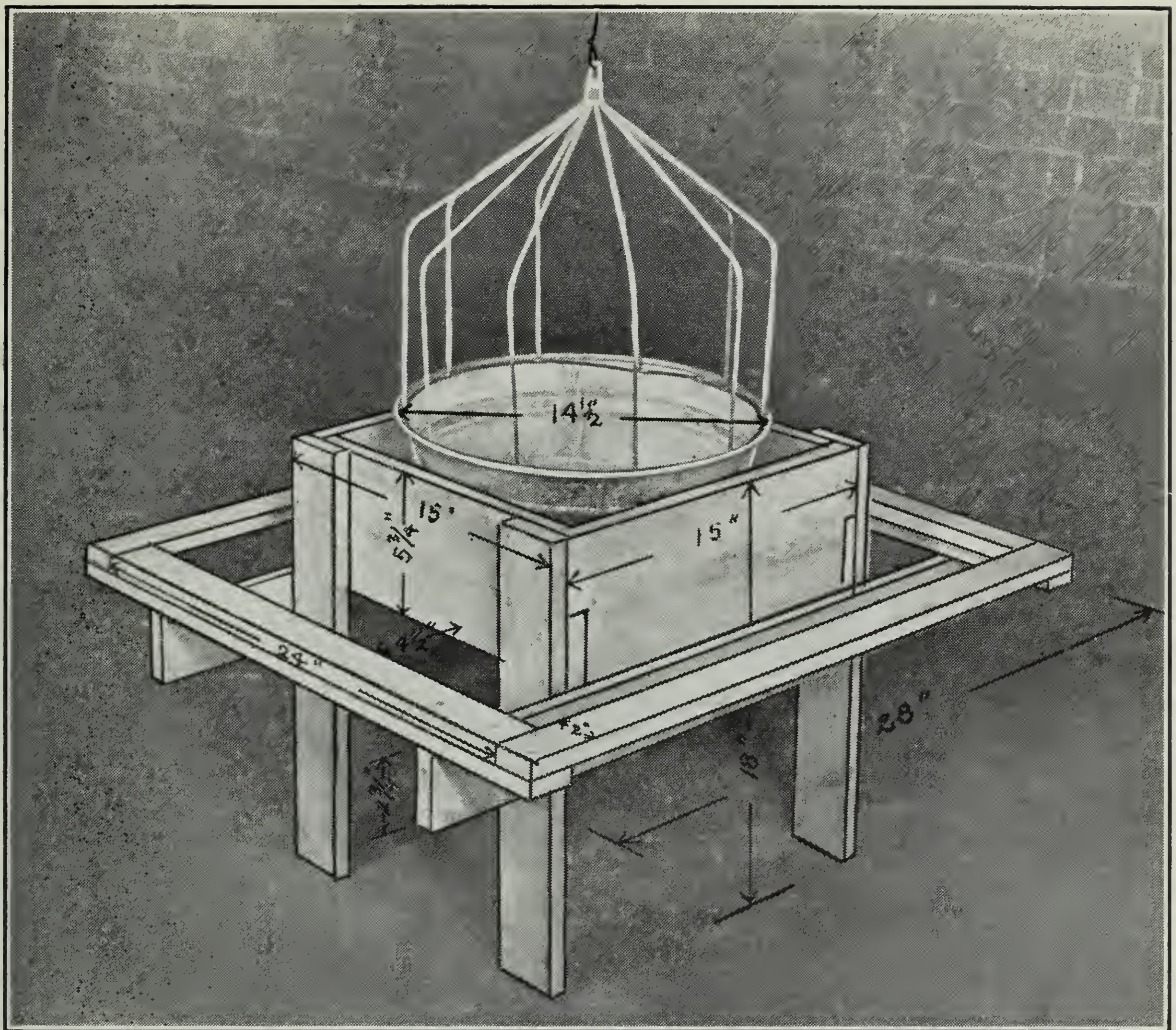

FIG. 12

The diameter of this stand will vary with the size of the water vessel used. No litter and very little filth will be found in a water dish so placed.

BILL OF MATERIALS FOR WATER STAND SHOWN IN FIG. 12

Legs	4 pc.	$\frac{7}{8}''$ x $2\frac{3}{4}''$ x 18″
Sides	4 "	$\frac{7}{8}''$ x $5\frac{3}{4}''$ x 15″
Perch	4 "	$\frac{7}{8}''$ x 2″ x 28″
	2 "	$\frac{7}{8}''$ x 2″ x 24″
Support	2 "	$\frac{7}{8}''$ x $2\frac{3}{4}''$ x 28″

The wire guard fits inside the water dish and is made of pieces of No. 9 brace-wire, spot-welded together, as shown.

Fig. 13 illustrates a labour-saving watering arrangement that can be used on the range with complete satisfaction. A cover helps keep the water cool, and regular cleaning prevents the inside of the barrel from becoming slimy.

A WATER SUPPLY
BARRELL ON SKIDS

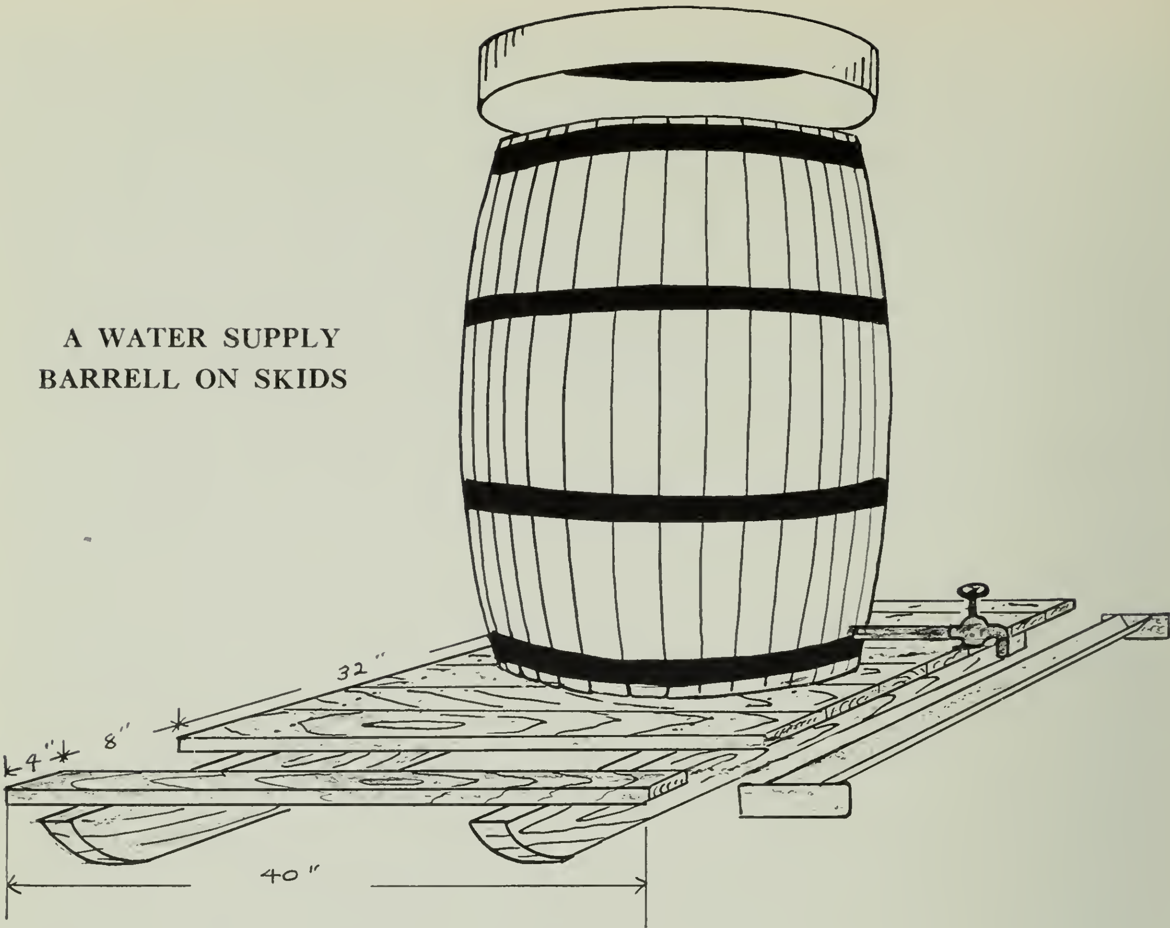

FIG. 13

Brooding and Rearing Equipment

Successful brooding and rearing of chickens is not difficult if one has the proper equipment. Again, this equipment need not be expensive, and much of it can be easily and quickly constructed by anyone at all handy with ordinary tools.

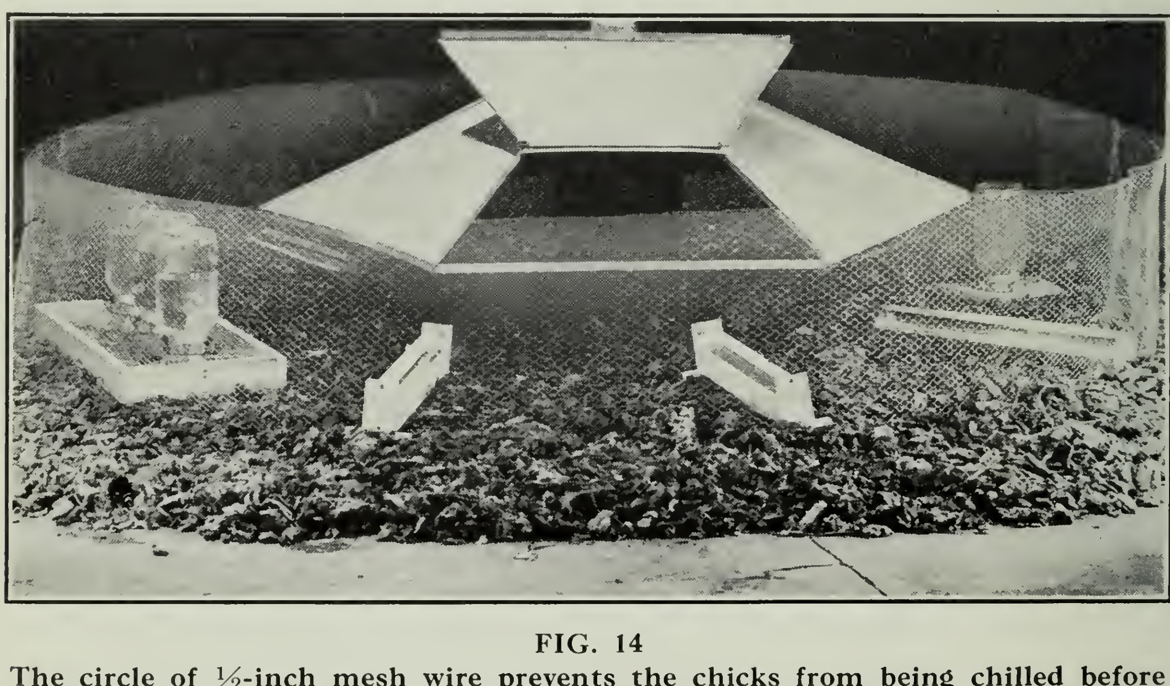

FIG. 14

The circle of ½-inch mesh wire prevents the chicks from being chilled before learning the source of heat. It is gradually enlarged until finally removed when no longer needed.

In Fig. 14 is illustrated a suitable set-up for satisfactory brooding.

Many chicks fail to grow properly because of unsuitable feed hoppers and insufficient feeding space. It is wise to have enough hopper space to enable at least one-half of the chicks to feed at any one time. Hoppers should be of the right size, easily constructed and easily filled and cleaned. On the range they should be covered. Waste of expensive chick starter and grower mash is never economical; under present conditions it is inexcusable. Properly constructed hoppers, never filled over two-thirds full, will save feed.

Fig. 15 illustrates a series of three simple, home-made hoppers that will work. They will fulfil the foregoing requirements. After 16 weeks of age a covered hopper, as in Figs. 1 and 2, has proven satisfactory.

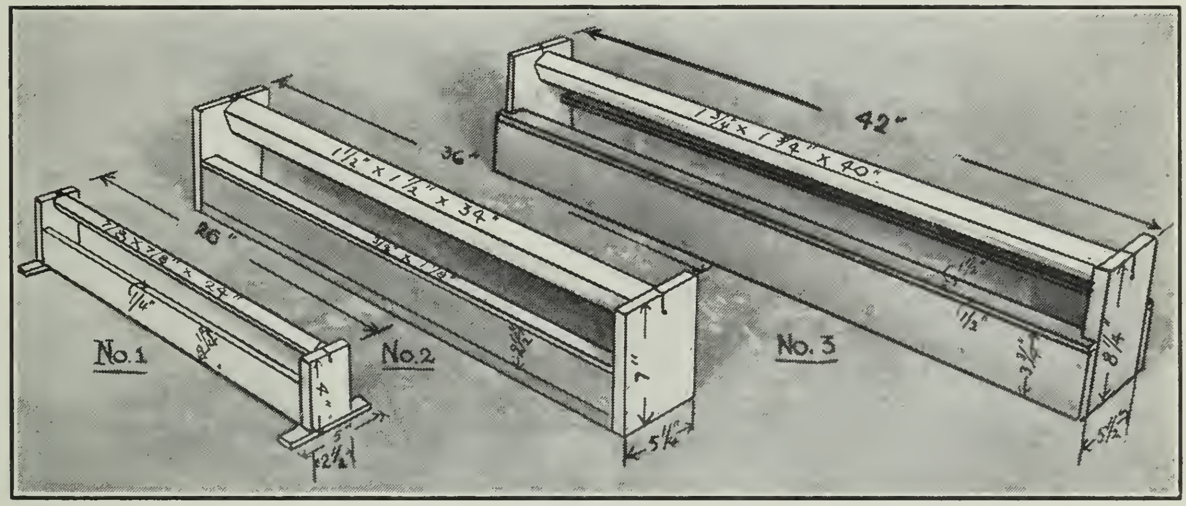

FIG. 15
These hoppers will serve chicks up to 3 weeks, 8 weeks and 16 weeks respectively.

Range Shelters

Range shelters to augment the colony house or houses are useful on any farm. Fig. 16 illustrates one type of shelter, while Fig. 17 shows how it may be moved for short distances to fresh pasture. For greater distances a sled, made of two 4″ x 4″ skids or cedar poles fastened together by brace cross-pieces, as shown in Fig. 18, saves time and prevents damage to shelters while being moved.

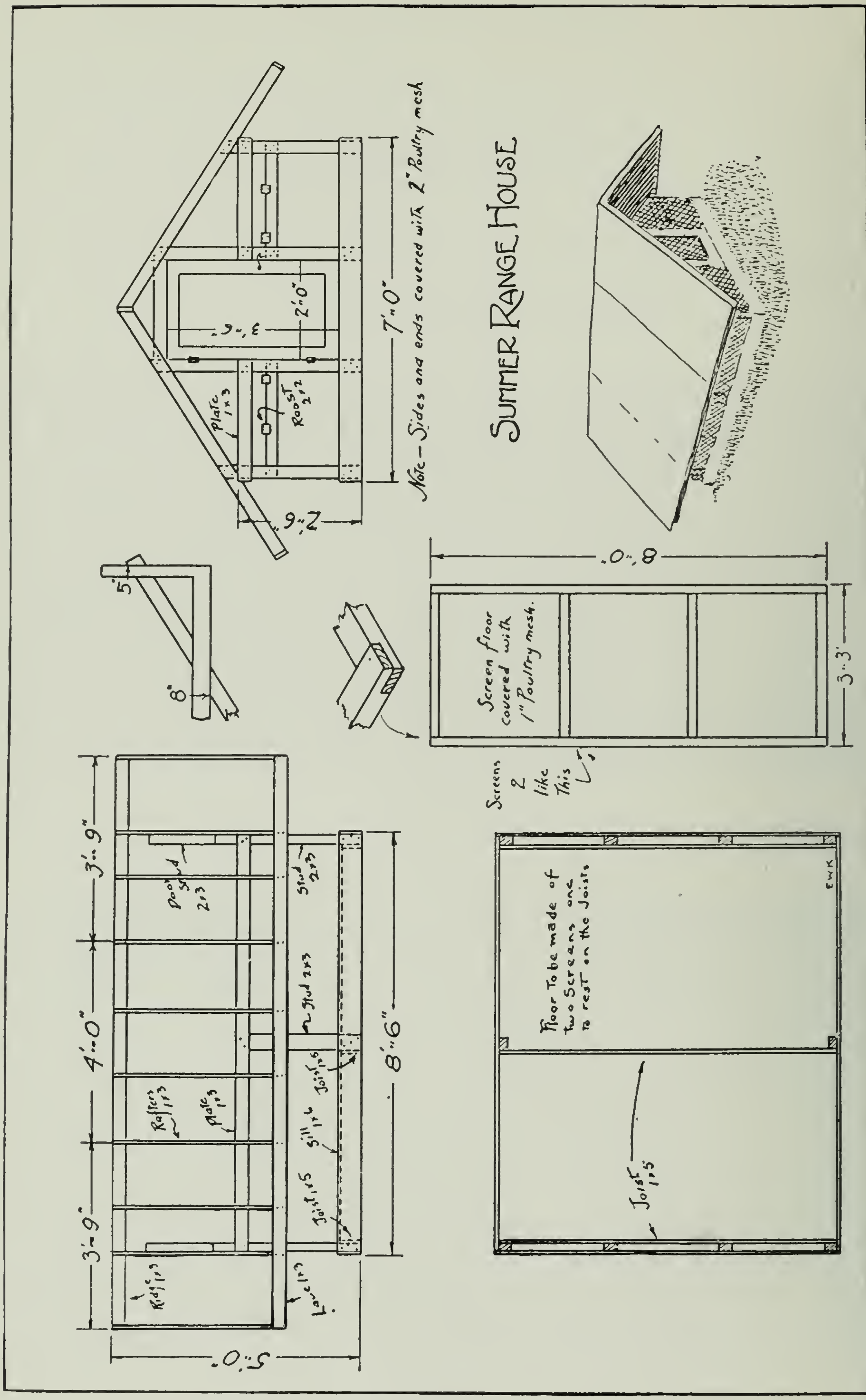

FIG. 16

Plans and construction detail for O.A.C. range shelter shown in Fig. 17.

BILL OF MATERIALS FOR RANGE SHELTER

Parts	Number of Pieces	Size	Length
Roof	12	3′ x 4′ (Masonite Prestwood)	
Rafters	20	1″ x 3″	6′
Ridges and eaves	3	1″ x 3″	11′5″
Plates—Side	2	1″ x 3″	8′4½″
Back	1	1″ x 3″	7′
Front	2	1″ x 3″	2′6″
Sills— Side	2	1″ x 6″	8′4½″
End	2	1″ x 6″	7′
Studs— Corners	4	2″ x 3″	2′8½″
Side	2	2″ x 3″	2′6″
Door	4	2″ x 3″	4′2″
Roosts	4	2″ x 2″	8′5″
Roost brackets	4	1″ x 3″	2′5″
Door— Stiles	2	1″ x 3″	3′5″
Rails	2	1″ x 3″	2′
Wire	14 yards—24″ wide		
Hinges	1 pair—3″ butts		
Hook and eye	1 set		
Joist for floor screens	3—⅞″ x 4¾″ x 6′10¼″		

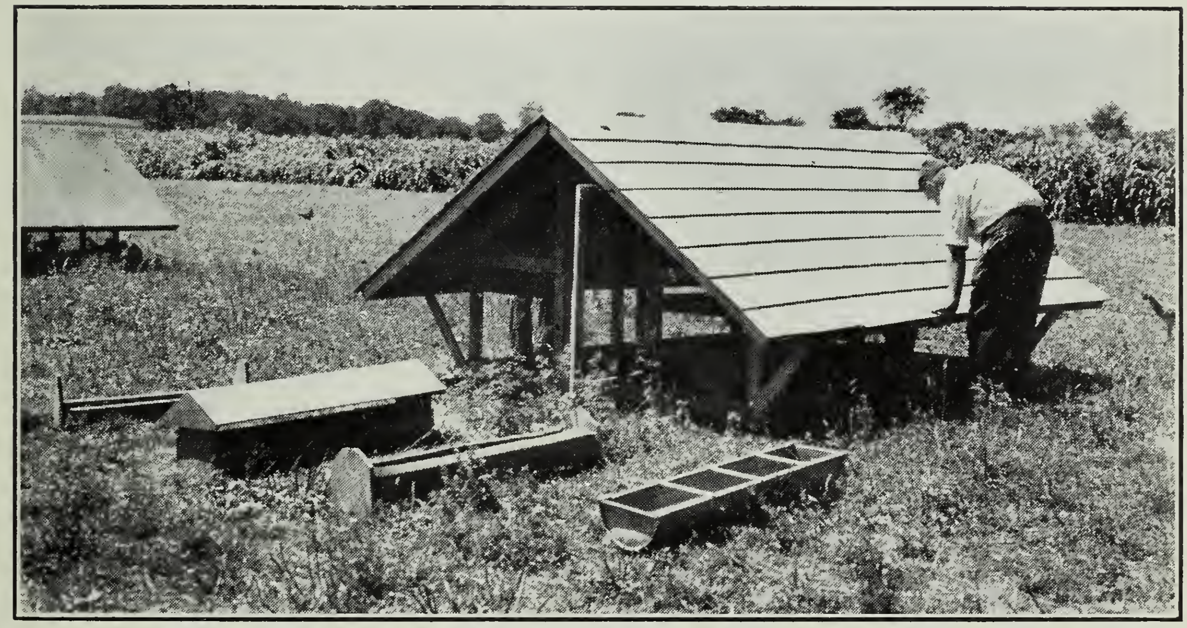

FIG. 17
Hand moving range shelter.

FIG. 18

The size of this sled may be suited to the size of range shelter used.

Range Nests

FIG. 19 illustrates a satisfactory type of range nest. Such nests will prevent loss from soiled eggs on range and will also teach the newly started pullets to lay in nests, thus helping to prevent trouble from floor eggs when the pullets are housed.

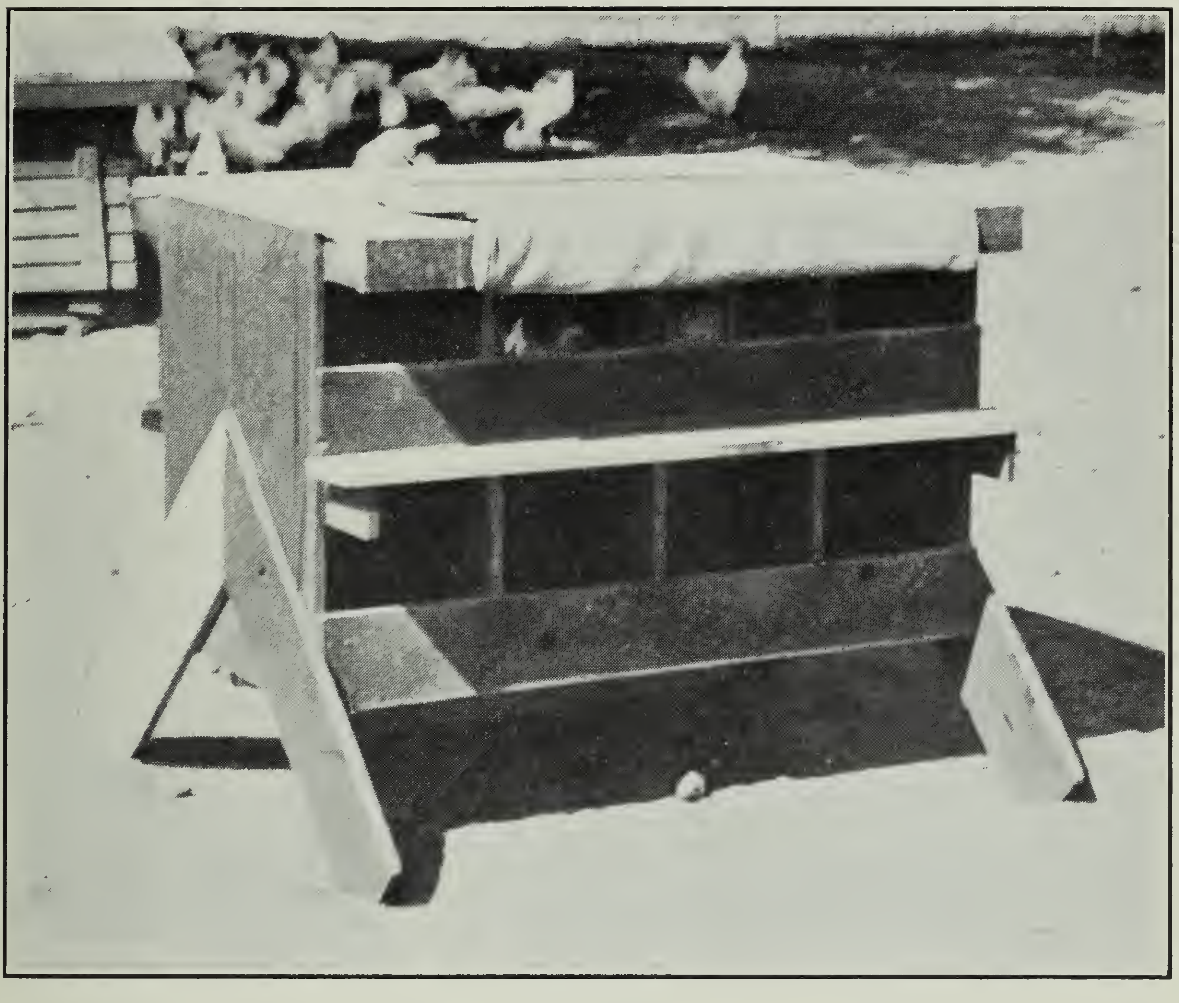

FIG. 19

Range nests as used on Spruceleigh Farm, Brantford, Ont. When in use a curtain hangs down over the front of the nests and affords privacy to the pullets.

Egg Pails

Eggs must be frequently gathered and quickly cooled to retain their original quality. A wire pail is excellent for this purpose, with a woven, open-weave wooden basket a poor second best. Metal pails tend to retain the body heat of the hen in the egg too long.

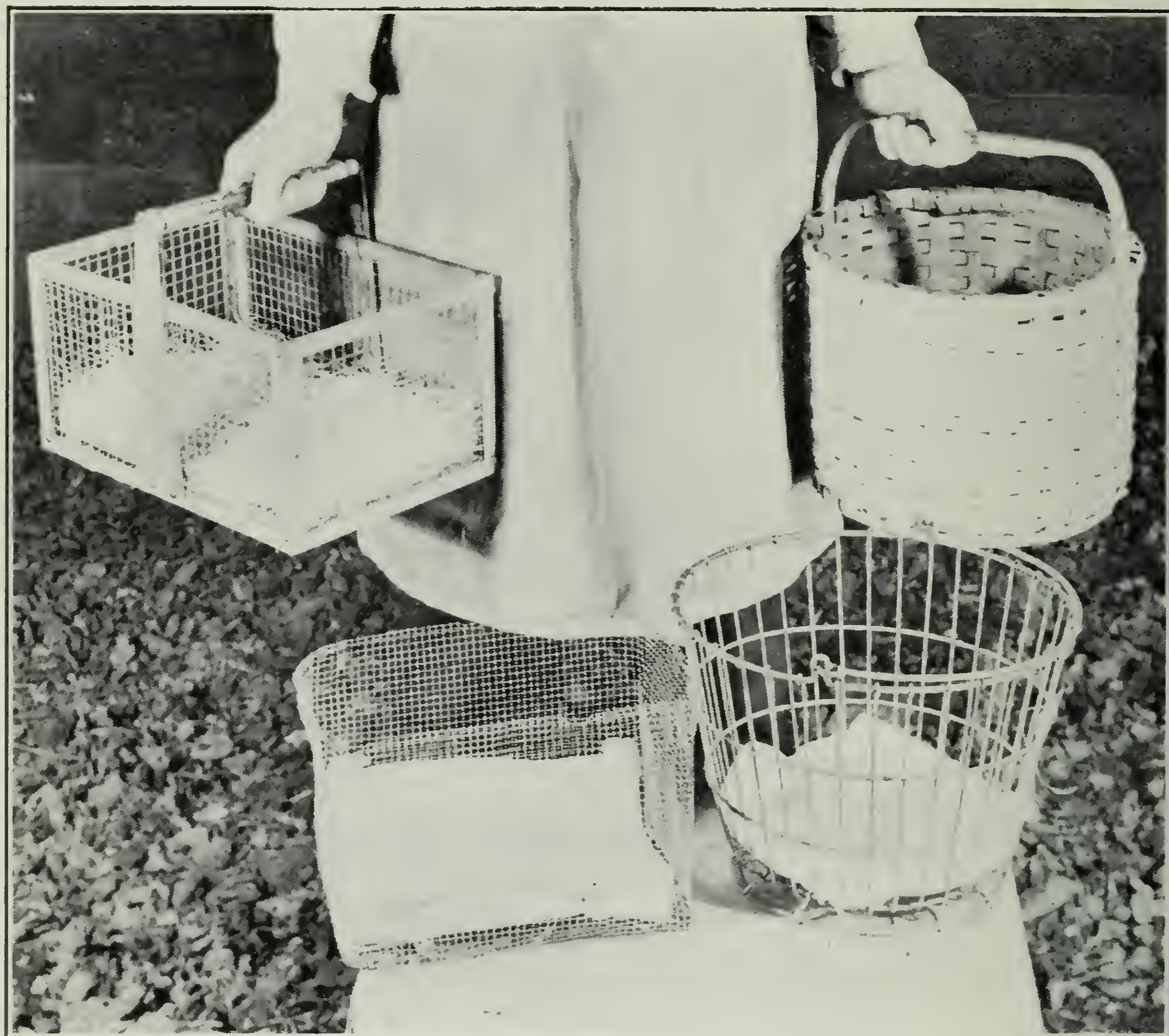

FIG. 20

Baskets for gathering and cooling eggs.

Fly Trap

Flies are a nuisance and carry disease. Catch and destroy them by the use of a fly trap, baited at the bottom with molasses or other suitable bait.

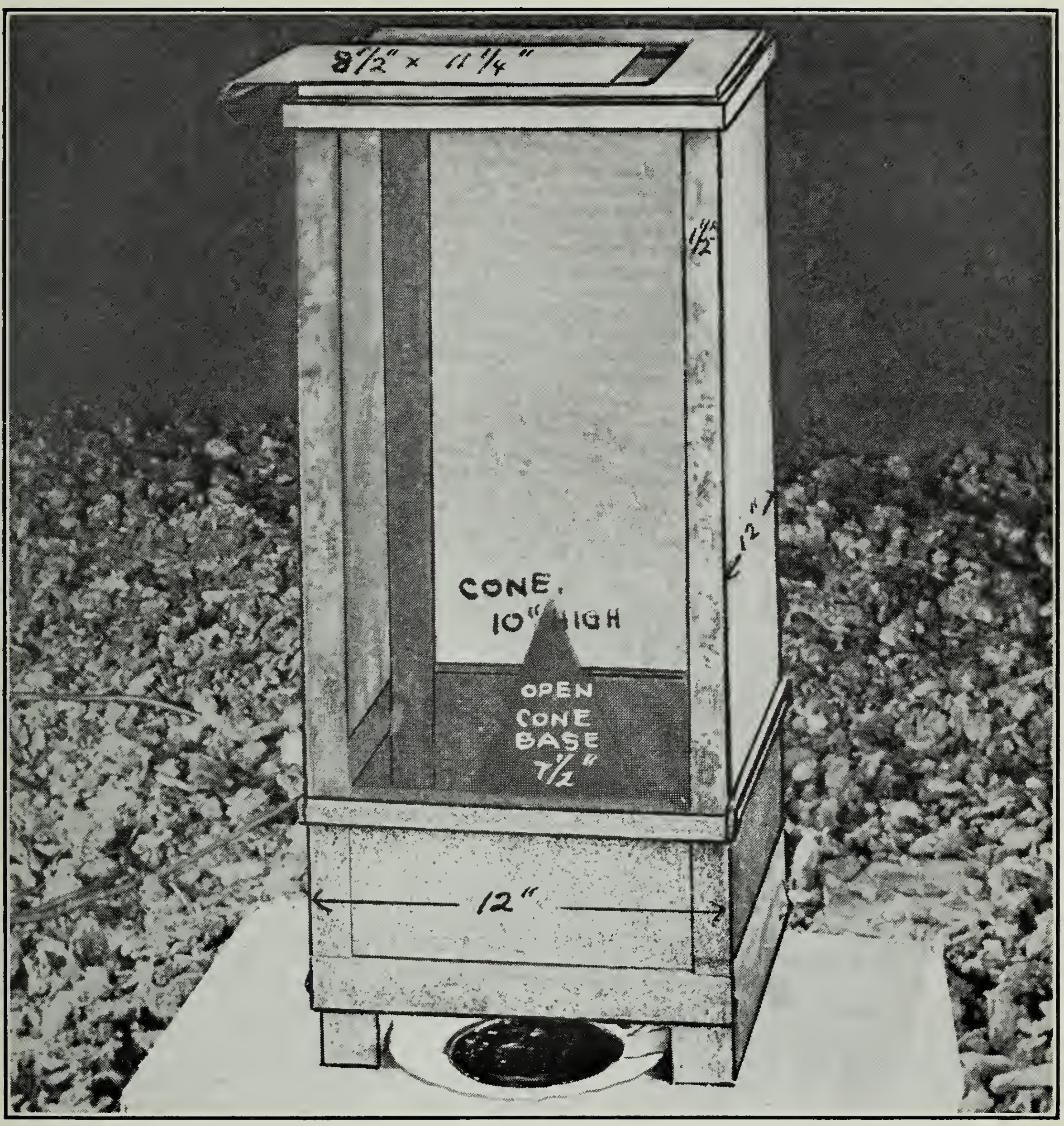

FIG. 21

The sides and cone are made of fly screen, the cone having a small opening at its apex, through which the flies enter the trap. After being destroyed the dead flies may be removed through the slide at the top of the trap.

Acknowledgments

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Statistics and Publications Branch
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BEE DISEASES
AND
PESTS OF THE APIARY

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View of Apiary
Ontario Agricultural College

BEE DISEASES

INTRODUCTION

Diseases of bees are divided into two main classes, namely, brood diseases and those which attack the adult bee. Although adult bee diseases have caused great damage in sections of Europe, so far they have not been serious in any parts of North America.

The three important brood diseases of Ontario are American Foulbrood, European Foulbrood and Sacbrood. In general these diseases have quite similar characteristics. Whereas European Foulbrood and Sacbrood are easily controlled, there is no cure for American Foulbrood. To avoid serious losses it is essential that beekeepers become sufficiently informed to correctly diagnose all three diseases.

The Ontario inspection system has held disease in check and beekeeping on a commercial scale is made possible. Complete eradication, however, can never be attained until every beekeeper becomes his own inspector. It is the aim of this bulletin to place before the beekeeper in a clear and simple form the essential facts regarding identification and control of bee diseases. Do not let disease destroy your colonies while waiting for the inspector. Learn symptoms and keep the colonies disease-free at all times. If not sure of your diagnosis, send a smear to the Apiculture Department, as explained later (Page 19).

THE BEES ACT

Bees are of greater economic importance as pollinators of fruit trees, clovers and other crops than they are as honey gatherers. Because of the very important place of bees in agriculture The Bees Act has been drawn up to safeguard the beekeeping industry. Its purpose is to combat disease and protect the careful beekeeper.

This Act stipulates that all beekeepers must register annually, and also that permits must be secured before bees or beekeeping equipment may be sold, moved or given away. All beekeepers should become familiar with this Act, a copy of which is available upon mailing a request to the Apiculture Department, Ontario Agricultural College, Guelph. Penalties are provided for those who do not abide by these regulations.

EXAMINATION OF COLONIES

Control of disease is best effected by giving the colonies two thorough inspections each year. The first examination should be made in the spring at the beginning of the fruit bloom and dandelion flow before the first super is added. If disease is controlled at this time the loss of one or more supers is avoided. In addition to this, the disease does not get a chance to spread to other colonies and cause trouble later on in the season when there is surplus honey in the hives. Any infection picked up by bees robbing diseased colonies during the fall and early winter is usually evident and may be brought under control before it spreads too far.

A second thorough examination is advisable during the summer just prior to the removal of the light honey crop, particularly where disease is suspected in the supers. When the bee escapes are being placed on the hives, very little additional effort is required to examine the brood combs. Finding disease at this time allows the beekeeper to keep diseased supers away from clean equipment. Colonies having disease during the fall will likely die before spring and act as a potent source of infection to other colonies.

Detection of disease is much easier on a bright day. When examining a frame shake most of the adhering bees into the hive. By standing in such a manner that the sun shines into the base of each cell, little difficulty will be experienced in detecting abnormalities of the brood. A thorough examinations in the above manner should always be given before interchanging frames of brood or honey with another colony.

Prevention of robbing from dead and weak colonies in the early spring is one of the most important duties of a beekeeper in the control of disease. All dead colonies should be examined on the first visit to the yard, and diseased colonies destroyed. If this is not possible, dead colonies should be made absolutely bee-tight, or, more preferably, removed from the yard. It is believed that much disease is spread by robbing from dead colonies in the spring.

It is impossible to control disease if colonies are kept in box hives. Infection cannot be detected unless combs are removable. Box hives are therefore a menace to the industry. The Bees Act demands that all bees in such hives be transferred to movable frame hives.

BROOD DISEASES

Normal Development of Healthy Brood

There are two types of insect development. In the case of the grasshopper for example, the egg hatches into a young insect or nymph very similar in appearance to the adult. This is called incomplete metamorphosis. The second type of development, under which the honey-bee is classed, is called complete metamorphosis. The honey-bee egg develops into a small white grub or larva. This later spins a fine cocoon and goes into the pupal or transition stage, from which it emerges a fully developed bee.

In order to detect unnatural conditions of the brood the beekeeper must know the life history and the appearance of healthy brood at every stage of its development. A study of the life history chart in conjunction with Figure 1 will give the story of this development.

AVERAGE LIFE CYCLE OF THE HONEY-BEE

Stage	Queen	Worker	Drone
Egg	3 days	3 days	3 days
Larva	5½ days	6 days	6½ days
Pupa	7½ days	12 days	14½ days
Total	16 days	21 days	24 days

The egg of the bee is a small, white cylindrical object about 1/10 of an inch long, somewhat larger at one end (future head end) and slightly curved. It is deposited on the base of the cell by the queen and is fastened in place by a secretion.

The larva, at first very small, grows rapidly, and in a few days occupies the whole of the base of the cell. The healthy larva before being sealed lies curled up in the base of the cell and is a glistening pearly white colour, with the segmentation of the body clearly shown. Three or four days before the larva actually transforms to the pupal stage, the cell is sealed by the nurse bees. The curled larva straightens out in the cell and spins a thin cocoon preparatory to transformation to a pupa. Figures "a" and "b" show the egg and larval stages before capping, "c" and "d" the larval and pupal stages after being sealed.

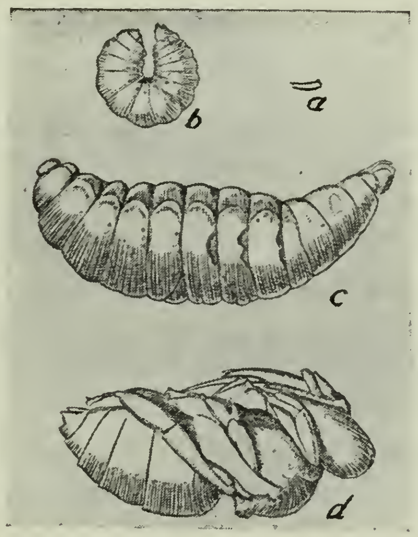

Fig. 1.

The honey-bee: a, egg; b, young larva; c, old larva; d, pupa. Three times natural size. (U.S. Dept. of Agr. Farm Bulletin 447.)

AMERICAN FOULBROOD

The term "American" is used simply to differentiate this disease from other brood diseases. It does not imply either origin or location of the disease.

(a) Symptoms

Appearance of Diseased Comb. If disease has been present in a colony for some time the comb will assume a mottled or pepper-box appearance. This is caused by open cells containing dead larvae or scales being interspersed with normal brood. This mottled effect is also characteristic of other diseases.

Condition of Cappings. Normal healthy cappings are light brown in colour, becoming slightly darker with age. They are somewhat rounded or convex in shape. If a diseased larva or pupa is present in the cell the capping frequently becomes sunken and dark brown in colour. Many cappings are perforated with one or two small holes by the bees as though they were investigating the tardy emergence of the brood.

Time of Death. Death occurs from American Foulbrood almost invariably two days before or two days after the transition to the pupal stage, at which time the cells are capped.

Position in the Cell. Larvae lie curled in the cell at the time capping takes place. After the cell is sealed the larva straightens out, lying flat along the bottom of the cell. Three to four days after capping the change to a pupa takes place. It is within two days either before or after this transformation that death occurs. Due to the uniform position in the cell at this time the decaying brood settles in a regular uniform mass, to the bottom of the cell. This characteristic is contrasted to European Foulbrood where the decaying brood is usually twisted in the cell.

Colour Changes. Healthy larvae are pearly white in colour. Decaying larvae dead of American Foulbrood are first a light yellow brown. As they settle down in the cell the colour changes gradually to a dark, coffee brown, which is of uniform shade over the entire body surface.

Appearance of Affected Pupae. Pupae dead of the disease go through the same process of decay and settling and similar colour changes as the larvae. The tongue of the pupa is nearly always extended towards the top wall of the cell. This is a definite sign of American Foulbrood.

Ropiness of American Foulbrood. American Foulbrood destroys the larval or pupal tissue. The body wall soon becomes soft and easily ruptured. Dead brood passes through several stages of decay, each stage varying in colour, shape and consistency. After about three weeks of decay, until the scale is formed, a characteristic ropiness is exhibited. During this period a toothpick inserted into the mass will draw out a fine gluey thread of decaying matter. (Fig. 2.)

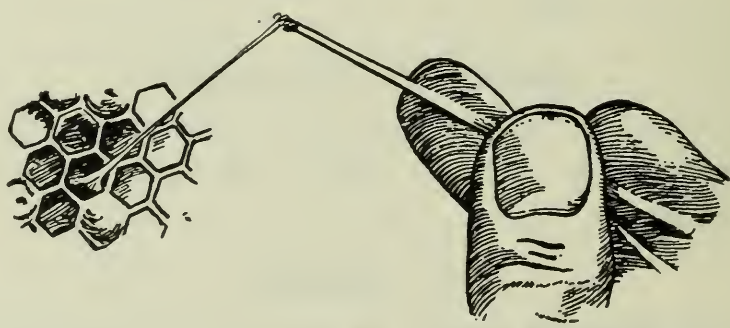

Fig. 2.

The ropiness of American Foulbrood
(U.S. Dept. Ag. Far. Bul. 442)

It should be remembered that this ropiness only occurs at a certain stage of putrefaction. When a suspicious cell is found during inspection, all other

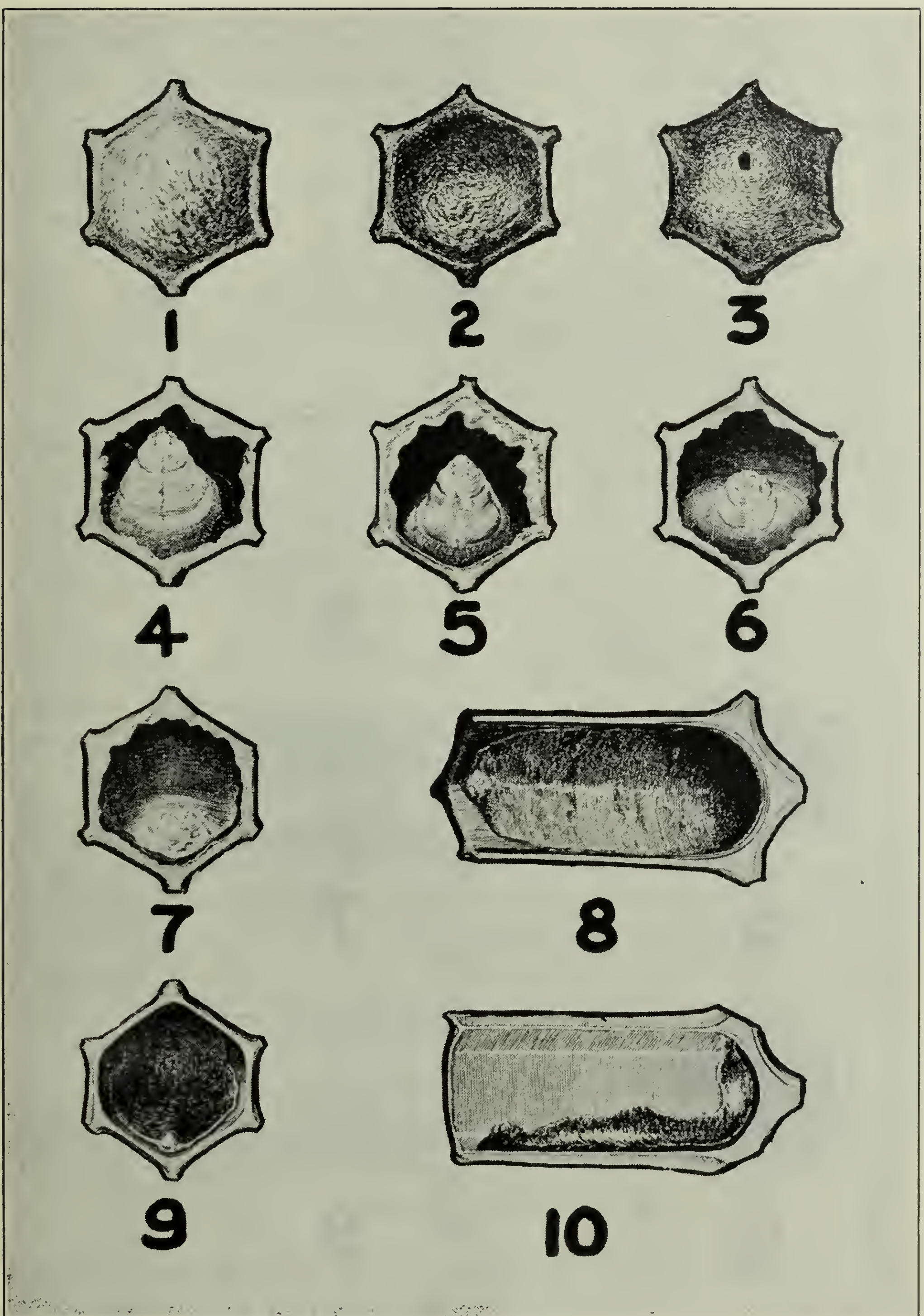

Plate 1.

American Foulbrood, death occurring in the larval stage: 1. Healthy capped cell; 2, 3. Capped cells containing dead larvae; 4. Healthy larva; 5, 6, 7, 8. Progressive decay; 9, 10. Dry scales.—(Reproduced from U.S.D.A. Bulletin 809.)

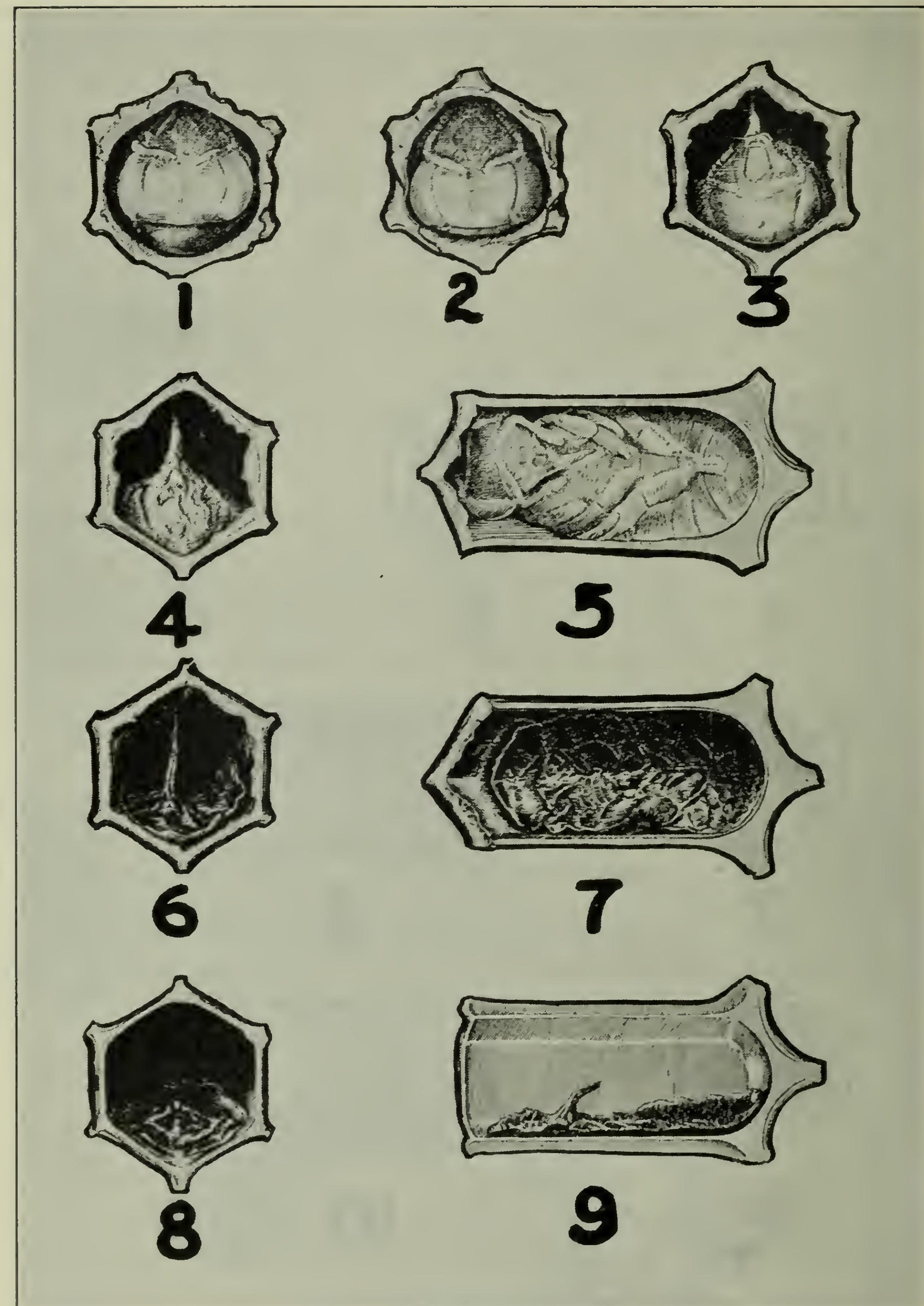

Plate 2.

American Foulbrood, death occurring in the pupal stage: 1. Healthy pupa; 2, 3, 4, 5, 6, 7. Progressive decay of dead pupae; 8, 9. Dry scales.—(Reproduced from U.S.D.A. Bulletin 809.)

symptoms should be carefully observed before inserting a toothpick and destroying the larva or pupa for further inspection. Too many beekeepers have the habit of inserting a toothpick immediately they see a suspicious cell. This destroys other important symptoms.

American Foulbrood Odour. In the early stages of American Foulbrood no odour is evident. In advanced stages, however, where much brood is dying and the disease has been present for weeks, the odour is quite distinct. The smell is characteristic, but is probably best described as resembling that of heated glue.

The value of odour is overlooked by many experienced beekeepers. Even when a small amount of infection is observed a diseased larva may be removed on a match or toothpick and an effort made to detect the characteristic odour. Some people have a very highly developed sense of smell and with such this point is a great help in diagnosis.

Formation of a Scale. After four to five weeks the decaying brood dries down to a hard dark scale. American Foulbrood scales are characteristically uniform in shape, covering the greater portion of the lower cell wall and extending part way up the back wall. The scale adheres tightly to the cell and cannot usually be removed without tearing the cell wall.

(b) Cause of American Foulbrood

In 1902 Dr. G. F. White, United States Department of Agriculture, first demonstrated that the disease was caused by a bacteria which he named Bacillus larvae. Certain bacteria have the ability to form a protective covering around themselves. In this stage, called spores, they are capable of existing for long periods away from their host. Bacillus larvae is a spore forming bacteria. It will live for years in honey and will often withstand boiling in water for twenty minutes. This spore forming characteristic makes B. larvae very difficult to exterminate.

(c) Method of Infection

When honey is stored in cells containing scale the spores of American Foulbrood become dispersed through the honey. Larvae fed with this diseased honey become infected and death occurs a few days later. Thus the cycle is maintained.

(d) Methods of Spread

American Foulbrood is spread chiefly by robbing infected honey from diseased colonies, either dead or alive. Great care should be taken to see that dead or weak colonies are not robbed out in the spring. The entrances of these colonies should be closed or the hives removed to a bee-tight dwelling about the first of April. This precaution is extremely important. It is possible for one diseased colony to infect a whole apiary. Infection may also be carried from one hive to another by drifting of the nurse bees, especially during manipulation of the colony. Great care should be taken in interchanging combs from one hive to another. Stray swarms should be hived on foundation rather than on drawn comb. Then if diseased honey is present in the crops of the swarming bees it is used up in drawing out the foundation, rather than being stored and later fed to the larvae.

Bee trees are often given too much credit for the spread of disease. Although colonies in trees may spread American Foulbrood, such swarms which become weakened and die from disease do not long remain a menace. They are soon cleaned up by wax moths, ants and other insects or animals.

(e) Immunity to American Foulbrood

Although workers are most commonly infected, drones and queens are also susceptible to the disease. From the results of experimental inoculations and beekeepers' experience, it appears that no race of bees possess any marked immunity to the disease. Some progress has been made during the last few years in the development of certain strains which show some resistance to disease. These so-called disease-resistant queens should not be relied upon to cure diseased colonies or prevent infection.

(f) Eradication of American Foulbrood

The old shaking treatment, whereby the bees of a diseased colony are shaken on to foundation and thus saved, can no longer be advocated. In fact, it has been found that the treatment in general tends to spread disease rather than eradicate it. When combs are shaken there is a tendency for young nurse bees, not having marked their location, to fly into nearby hives, carrying diseased honey with them. Another criticism of the treating system, aside from general spread of disease at the time of treatment, is that diseased combs are often stored for some time before being rendered. This is very dangerous, as there is always a grave danger of infection by bees robbing stored combs. The treating plan proved to be false economy. It is cheaper to kill diseased bees and make increase from healthy colonies.

Burning Diseased Colonies. The only known method at present by which American Foulbrood may be completely stamped out is by burning the bees and combs and sterilizing other parts of the hive by fire. Disease has been entirely cleaned up in restricted areas by this plan, and there is every reason to believe it could be completely eradicated from the Province. Immediately the disease is found it should be destroyed. Delay is generally costly.

Steps in Eradicating American Foulbrood

Considerable work has been done in an effort to find some drug or chemical that would effectively cure a colony of American Foulbrood. So far there has beeen no success along this line.

1. Inspect the colonies giving each frame a thorough examination. If disease is found, mark the colonies carefully so there will be no possible danger of overlooking them later.

2. Dig a hole in the ground large enough to accommodate all the combs. Unless the hole is large diseased honey will be spilled around the surface of the soil and spread disease. Do not dig the hole too near a tree or the fire

will wilt the leaves and injure the tree. Allow for the wind and be sure the fire is situated where there is no danger of spreading. Place some rough chunks of wood in the hole to ensure a good draft and sufficient fuel to thoroughly consume all diseased material.

3. Kill the bees. In the past gasoline was used for this purpose but it is not as satisfactory as cyanogas, which is a commercial preparation of cyanide in powder form. When gasoline is used the bees fly from the hive unless the entrance is closed. Cyanogas kills the bees without their realizing any danger. Field bees will also fly into the hive. When using cyanogas sprinkle a dessert-spoonful on top of the frames and a little in the entrance to catch the incoming bees. Five minutes is long enough to leave the colony after adding the cyanogas, otherwise many of the bees recover as the powder becomes spent and the gas drifts from the hive. Great care should be taken when using this poison as if inhaled it might easily prove fatal. There is no necessity to wait until evening to kill the colonies.

4. Light the fire. It is advisable to use coal oil and get a good strong flame so the diseased material may be disposed of as quickly as possible.

5. Carry the hives complete to the fire, and throw on the combs. Be sure no dead bees drop from the entrance, as most of them exude a drop of honey which sticks to their tongues and may be diseased. If the combs are heavy with honey, keep the fire well bolstered up with chunks of wood.

6. Scrape thoroughly and disinfect by scorching all boxes, bottom boards and covers. Covers and bottom boards may be sterilized by holding them over the fire for a few seconds, on a fork or long stick. Boxes may also be treated in this manner or else piled one on top of the other, sprinkled inside with coal oil or gasoline and ignited. The flame may be extinguished by placing a cover on the top box, thus excluding the air.

7. All dead bees and other debris that might carry infection should be scraped into the fire. When everything has burned down to an ash, fill the hole in thoroughly.

8. Hive tools should be disinfected with fire, and the hands washed with soap and water, before examining other colonies.

Disease in Super Combs

Chemical treatments such as the use of formalin, chlorine, etc. which were once recommended for diseased super combs, have been definitely proven unsatisfactory. If a beekeeper is suspicious of his super combs the best practice is to render them into wax and have it made into foundation. The actual cost of this procedure is not great, and it is considered sound economy by many successful beekeepers.

EUROPEAN FOULBROOD

Less than forty years ago this disease caused the beekeeping industry considerable anxiety. It spread with remarkable rapidity, wiping out whole apiaries. Today beekeepers have learned that it can be easily controlled by keeping the colonies strong and using resistant Italian stock. It is no longer a menace to the industry.

(a) Symptoms

The appearance of larvae dead of European Foulbrood varies considerably and the symptoms are more variable than those of American Foulbrood. Always keep in mind the appearance of healthy brood when inspecting for indications of disease.

Appearance of Comb. The presence of many uncapped cells, containing diseased larvae in the early stage of development, gives the comb a spotted irregular appearance. Should the majority of larvae die at a later stage of development after the cells are sealed, the cappings are sunken, perforated and decidedly greasy in appearance.

Time of Death. All larvae die before the transformation to the pupal period. About ninety per cent. die one or two days before the cell is capped. Probably ten per cent. die the first or second day after capping, i.e., when the larva is beginning to straighten out in the cell preparatory to its transformation to the pupa. Occasionally an outbreak of European Foulbrood takes place where colony after colony contains larvae most of which are attacked at this later stage. This type is often confused with American Foulbrood. The variability displayed in time of death makes diagnosis more difficult. In typical European Foulbrood, however, the cell is uncapped.

Position in the Cell. Larvae exhibit marked variation in their position according to the age at which they die. Young larvae dying at the characteristic stage while still curled generally squirm around as though in pain, assuming unnatural positions in the cell. Those larvae that die after capping are larger and lie more uniformly extended in the cell.

Colour Changes. The pearly white colour of healthy larvae changes to greyish yellow. As putrefaction continues the colour deepens to a dark greyish brown mass.

Consistency of Dead Larva. After approximately three weeks of decay the larva becomes a sticky, somewhat granular mass. The granular appearance at this stage is contrasted to the smooth glue-like appearance of American Foulbrood.

Tracheae Visible. The tracheae are glistening, silvery air tubes situated below the skin. In many larvae dead of the disease these tracheae may be plainly seen and remain visible during the complete process of putrefaction. The presence of tracheae is an important symptom to differentiate infection in the advanced larval stage from American Foulbrood.

European Foulbrood Odour. In advanced cases, especially where many larvae die in the capped-over stage, there is a very offensive odour. It is described as resembling that of rotten fish.

Scale Formation. The dried larval remains are less brittle and more rubber-like than American Foulbrood scales. They are shrivelled, brown in

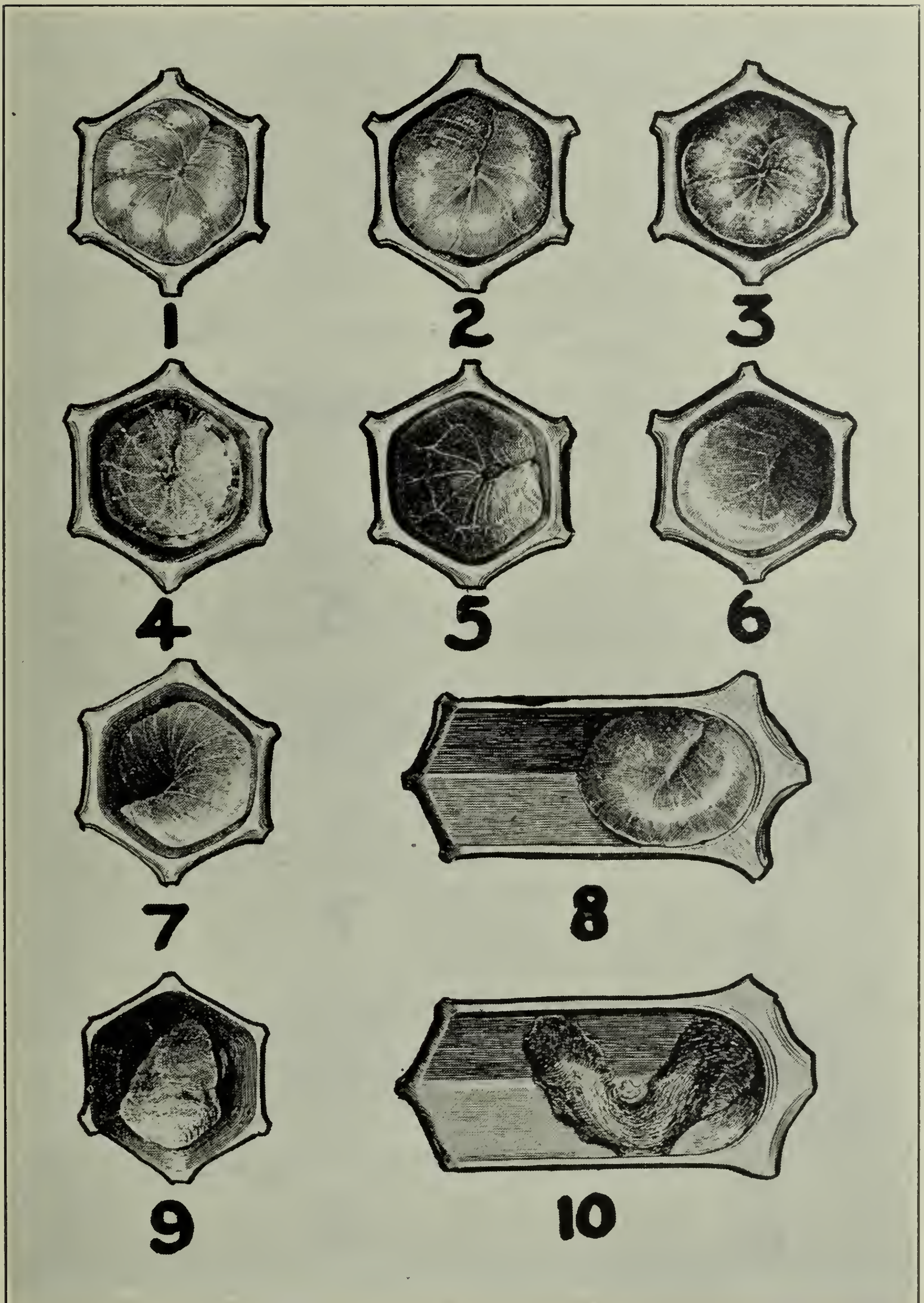

Plate 3.

Characteristic European Foulbrood, death occurring in the early larval stage: 1. Healthy curled larva; 2 to 10. Various stages of decay; 4, 5. Shows tracheae; 6, 7. Larva twisted in cell; 9, 10. Dried out scale.—(Reproduced from U.S.D.A. Bulletin 810.)

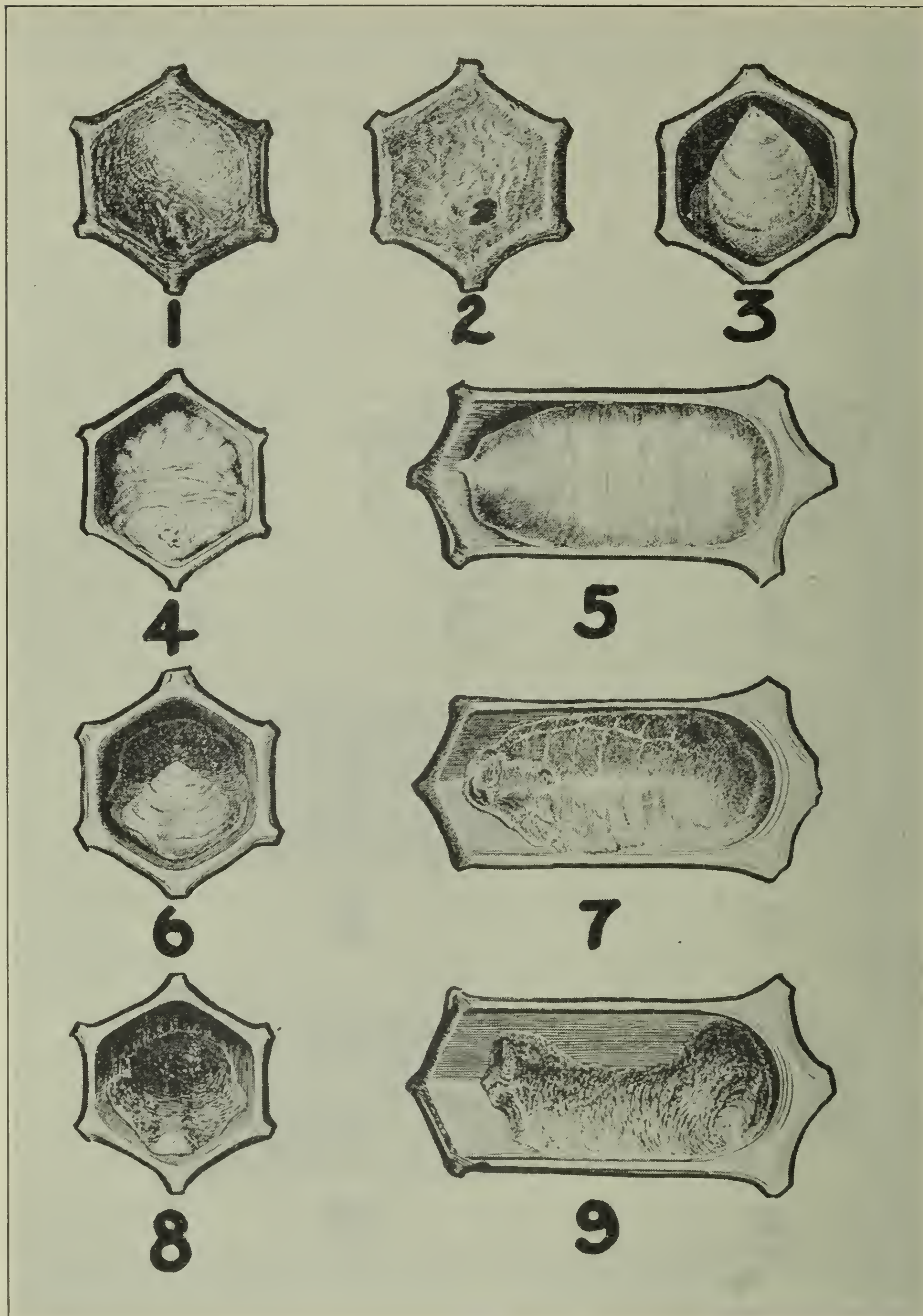

Plate 4.

European Foulbrood, death occurring in the late larval stage: 1, 2. Capped cells containing larvae dead of European Foulbrood; 4. Dead larvae showing part removed by the bees; 3, 5, 6, 7. Various stages of decay; 8, 9. Dried out scales.—(Reproduced from U.S.D.A. Bulletin 810.)

colour and can easily be removed from the cells. The fact that brood dead of European Foulbrood can be removed by the bees makes it possible for strong colonies to clean up the disease.

(b) Cause of European Foulbrood

Bacillus pluton, a non-spore former, is considered to be the organism which actually causes the death of the larva. Invariably, however, there are secondary organisms present, the chief of which is Bacillus alvei. When a laboratory diagnosis is made the presence of Bacillus alvei indicates European Foulbrood.

(c) Methods of Spread

The organism causing European Foulbrood does not form spores, so is unable to live over winter in honey. It is carried over in pieces of dead larvae. From this small beginning in the spring it can spread very rapidly under favourable conditions. If nectar is stored in contaminated cells and fed to larvae they contract the disease. Further spread may be caused by robbing, interchanging combs or drifting nurse bees.

(d) Immunity to European Foulbrood

Workers, drones and queens are all susceptible to European Foulbrood. Italian bees, due to their vigorous house-cleaning habits, stop the spread of disease and eventually eradicate it. Some strains are far more efficient in cleaning out dead larvae than others. Black bees are very susceptible to the disease.

(e) Eradication

European Foulbrood has not caused very serious trouble since beekeepers have learned the present preventive measures. Most definite progress in its control has been made through Italianizing all colonies and breeding queens from resistant stock.

It must be remembered that European Foulbrood is a disease of weak colonies. The introduction of an Italian queen to a very weak colony is useless if European Foulbrood is present. Weak colonies should be united to stronger ones before requeening. If resistant Italian queens are used and the best methods of beekeeping which ensure strong colonies are followed, there will be little trouble with European Foulbrood. A colony at the beginning of the honey flow should be strong enough to have eight combs of Langstroth size filled with brood.

Proper wintering of bees is a matter of highest importance in regions where European Foulbrood is found. As very little infection is carried over the winter, the first brood of the year usually escapes with little loss. For this reason it is essential to have your colonies build up as rapidly as possible in the spring. The emerging bees are then able to ward off the disease throughout the season.

Where the disease has become well established, it is sometimes difficult for the bees to make headway in cleaning it up. Removal of the queen for a few days causes a period in which no brood is being fed. This gives the bees a chance to make more rapid progress. As soon as the dead larvae are removed, the queen is returned, or, better still, the colony is given a young Italian queen.

How the disease spreads is not thoroughly understood. Honey has a definite devitalizing effect upon the organism, so is not a serious carrier. It is never necessary to destroy or disinfect combs, brood, or honey from European Foulbrood colonies. Normally, requeening and strengthening the colony will satisfactorily control the disease.

SACBROOD

Sacbrood is an infectious disease of the brood of bees. Although it is not particularly malignant and rarely, if ever, causes the death of a colony, it is responsible for the loss of much brood. Where the disease is advanced the death of many worker larvae results in the weakening of the colony. Brood rearing space may also be considerably reduced by the presence of dead larvae in the cells.

The disease has never proven very serious in Ontario, but it is essential that beekeepers be able to differentiate between it and other brood diseases, especially American Foulbrood.

(a) Symptoms of Sacbrood

Character of Comb and Cappings. As in other brood diseases the presence of affected brood, interspersed with healthy brood, gives an irregular appearance to the comb. Larvae die after the cells are capped. A considerable proportion of the cappings are uncapped by the bees. As a rule the proportion of brood affected is not large.

Time of Death. Affected larvae die after the cells are capped but before the change to the pupal stage is completed. The majority die during the two-day prepupal period, i.e., within the two days preceding the transformation. Many uncapped cells are generally observed on diseased combs but they are uncapped by the bees after the death of the larvae.

Position in the Cell. Dead larvae are extended lengthwise along the floor of the cell. The position is similar to that of larvae affected with American Foulbrood. Sacbrood, however, can be determined by the appearance of the head which is dark, somewhat shrivelled and turns up towards the roof of the cell.

Colour Changes. Soon after death the larval remains are slightly greyish white in colour. This greyish colour turns to a greyish brown tint, which deepens as the progress of decay continues. Throughout this period of decay the head end appears somewhat shrunken and much darker than the posterior, or hind, portion of the body.

Consistency of Dead Larva. The body wall of a larva dead of Sacbrood

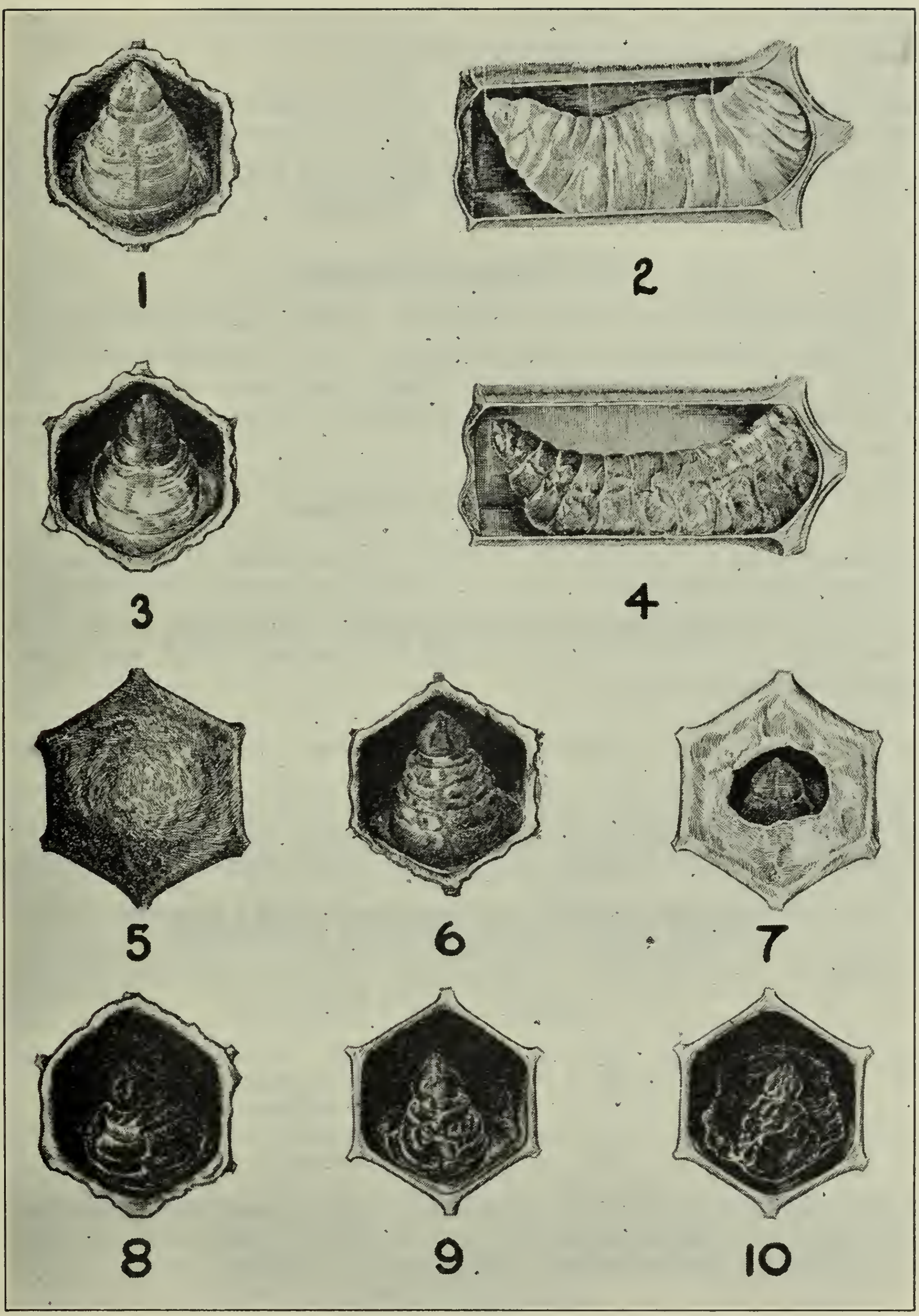

Plate 5.

Sacbrood: 1, 2. Healthy brood at the age at which it dies of Sacbrood; 3, 4. Brood recently dead of disease; 5, 6, 7, 8, 9, 10. Brood in various stages of decay.—(Reproduced from U.S.D.A. Bulletin 431.)

becomes toughened and may be easily removed intact from the cell. When removed from the cell the larva is sac-like in appearance. The contents of the sac are watery, containing many fine brown granules.

Odour. Sacbrood has no distinctive odour.

Scale Formation. Scales formed from Sacbrood are greyish black, roughened and generally curl up at the anterior or head ends. Scales are not common as the bees generally remove the dead larvae before the scale is formed. When present they are loose in the cell.

(b) Cause of Sacbrood

No organism has been found present in dead larvae which can be demonstrated to cause the disease. It has therefore been concluded that the disease is caused by a virus which will pass through the finest of filters. A colony may be inoculated with the disease by feeding syrup or honey containing the virus from dead larvae.

(c) Spread of Sacbrood

Sacbrood virus is readily destroyed. Larvae dead of Sacbrood cease to be infectious after one month. How the disease winters over is not known. Colonies infected in the spring generally recover during the honey flow. The weakening effect of the disease during the spring stays with the colony throughout the honey flow.

(d) Control Measures

Vigorous colonies rarely suffer to any extent from Sacbrood. Requeening and strengthening will generally clean up any infection that may occur. It is never necessary to destroy any part of a hive infected with Sacbrood.

COMPARISON OF BROOD DISEASES

	A. F. B.	E. F. B.	SACBROOD
Cappings	Many sunken, dark and perforated.	Usually none. When larvae in advanced stages of development, capping, sunken, perforated and greasy.	Many uncapped; some perforated.
Time of Death	During prepupal stage or within two days after transformation to pupa.	Before change to pupa. Generally quite early and before capping. Advanced larval stages often capped.	Before change to pupa, after capping.
Position in the Cell	Straightened out, regular and uniform. Occupies most of lower cell wall. Posterior, or hind end, extending up back wall of cell.	90% of cases curled in the cell and in unnatural positions. 10% in advanced larval stages fairly regular and extended in the cells.	Uniform shape and position in cell with head end curled up.

COMPARISON OF BROOD DISEASES—Continued

	A. F. B.	E. F. B.	SACBROOD
Colour Changes	From light yellow-brown to dark coffee-brown. Uniform throughout.	From greyish-yellow to dark greyish-brown. Not uniform.	From a light yellowish grey to dark brown. Rather uniform.
Appearance of Pupa	Same process of decay as larva, tongue extended upwards.	None die.	None die.
Consistency	Soft mass. Exhibits ropiness at certain stage.	Somewhat sticky and granular.	Body wall tough, contents watery.
Tracheae	Not visible.	Often plainly visible.	Not visible.
Odour	Odour of heated glue in advanced stages.	Fishy odour in advanced stages.	No odour.
Scale	Hard, dark, uniform scale. Adheres tightly to cell.	Rubber-like, irregular, shrivelled, dark brown scale. Easily removed.	Black, roughened, curled up at anterior or head end.

SENDING SAMPLES FOR DIAGNOSIS

Brood is frequently found dead in a colony from causes other than infectious disease. We find chilled brood, starved brood and overheated brood. Generally, the appearances are characteristic but at times the symptoms may be quite similar to one of the brood diseases. If in doubt a sample of comb, or more preferably a smear consisting of the diseased larva or pupa, folded in a piece of waxed paper, should be sent to the Apiculture Department, Ontario Agricultural College, for microscopical diagnosis. Also, if a beekeeper notices adult bees showing symptoms of disease he should send a good number to the Department for examination. Bees that have been dead for some time are not satisfactory. If pieces of comb are sent, no honey should be present, and the comb should not be crushed.

DISEASES OF ADULT BEES

To date there has been no serious trouble from adult bee diseases in any part of Canada or the United States. In England and other parts of Europe they have caused great loss. It is necessary that we know something of the symptoms of these diseases and be ready to stamp out any infestation that might occur. Most adult bee diseases have quite similar symptoms, making diagnosis from external characteristics difficult.

Isle of Wight Disease

This disease has been a very serious source of loss to British beekeepers. It is caused by a minute mite which crawls into the bee's spiracles, choking off its supply of air and possibly secreting a toxine which paralyzes the wing or flight muscles. This disease has not been reported in Canada.

Nosema Disease

This disease although fairly widespread is mild in character. It is caused by a protozoan or one-celled parasite, Nosema apis, which infests the alimentary canal of adult bees. Bees can be infested with Nosema spores without showing any marked symptoms of disease, and apparently with little effect on their ability to carry on. Death may result from infection, and in the case of excessive infection bring about a weakening effect on the colony through the shortening of the life of the individuals. Bees are often observed crawling around outside the hive, or climbing up blades of grass. Requeening and strengthening by giving additional capped brood usually brings relief. Cases of this disease have been known in Canada.

Dysentery

Dysentery is more properly a disorder than a disease of adult bees. Bees are only able to void faeces while in flight. During the winter waste matter accumulates in the lower intestine. If the food is good quality and the bees are not confined to the hives for too long a period, they will be healthy in the spring. If the food contains considerable indigestible material and the bees are unable to fly they often die in great numbers. In cases of advanced dysentery faeces are voided within the hive and the disorder becomes evident by the resultant spotting.

Material reduction in the adult population is a serious handicap during the spring building-up period. Dysentery can be prevented to a great extent by proper precautionary measurees. Bees wintered on good honey or sugar syrup are rarely affected. Poor food, such as honey-dew or honey of high water content, nearly always produces the disorder. Proper winter protection and freedom from disturbances during winter are also factors in the control of dysentery.

Paralysis

Very little is known about bee paralysis. It is possible that there are several conditions which result in the so-called paralysis. At any rate beekeepers frequently report that they have observed worker bees crawling in front of the hive with their abdomens trembling. They keep crawling up the side of the hive and up blades of grass and tumbling to the ground. Occasionally individual colonies become rapidly depleted in bees. There is a possibility that the disease may be caused by certain foods.

Spring Dwindling

Spring dwindling is the term used to describe the condition when adult bees in a colony die off more rapidly than they are replaced by emerging brood. The condition is brought about by poor wintering and by the colony going into winter with too large a percentage of old, worn-out bees. To prevent this, colonies should be supplied with vigorous queens that will continue brood rearing as late as possible in the fall.

PESTS OF THE APIARY

The Wax Moth

This is a pest of weak colonies and of stored combs. It is most prevalent in warm climates. The adult moths fly almost entirely at night. The eggs may be laid in masses between the supers or in corners and cracks within the hive. The tiny larvae emerge within a few days and being extremely active soon disperse throughout the hive. In brood combs they burrow along the midrib, out of reach of the bees. These larvae feed chiefly on pollen, pupal cases and other impurities in the comb. It is thought that very little, if any, wax is digested. When confined to wax and honey, as in comb honey infestations, the larvae are unable to develop into the adult stage. Adult moths do no damage to comb.

Combs left exposed act as breeding places for this troublesome pest, and the beekeepers should be careful to keep all combs out of reach of the moth.

When weak colonies are attacked, the beekeeper should remove as many of the bee moth larvae as possible, as well as the webbing and cocoons. The colony should then be united with a strong one. Italian bees are more resistant than black bees. Strong colonies are rarely infested. Weak or dead colonies in box hives form excellent breeding grounds for moths.

Extracted supers should be watched very closely, as considerable damage can be done within a short time after extracting.

There are no recommended methods for wax moth control which suit all occasions. It is therefore necessary for each beekeeper to determine the method that best suits his individual conditions. If a sudden outbreak occurs, rather than waste time trying several fumigants, it is cheaper in the long run to pay a licensed fumigator to do the job.

The following are some of the fumigants recommended at the present time:

Sulphur. The amount recommended is 3 pounds per 1,000 cu. ft. of storage space, burned for 24 hours in a room made as air-tight as possible. As the sulphur dioxide fumes given off do not destroy the eggs, it is necessary to fumigate again two to three weeks later.

Its use incurs considerable fire hazard. It is most conveniently used in the form of flowers of sulphur. To use, obtain a large flat pan and place some water in it. Stand the pan in which the sulphur is to burn inside this on two bricks. Place live coals in this pan and put the flowers of sulphur on top. Supers are criss-crossed in piles.

Carbon Bisulphide. Is a yellowish oily liquid which gives off a very disagreeable odour. It may be used quite effectively, although the gas does not kill the eggs, and, as is the case with sulphur, it is necessary to give a second treatment two or three weeks later. The method used is to place two tablespoonfuls or one ounce of the liquid in a small dish and place this **on top** of a stack of five supers. For best results, the cracks between the supers should be closed by means of gum paper, or they may be effectively sealed by moistening strips of newspaper and sticking them around the supers. The stack should remain sealed at least twelve hours. At low temperatures this evaporation is very slow, so it is necessary to have the room fairly warm.

Every precaution should be taken when using this disinfectant, as the gas given off is highly inflammable. When a dish of carbon bisulphide is used on the top super it is necessary to close off the pile by means of an empty super and lid.

Cyanogas. Is a commercial cyanide preparation which is extremely poisonous to humans and animals. Great care should be taken when using it. The gas given off is almost the same weight as air. Cracks in the pile of supers should be closed up and about one tablespoonful of the powder may be placed on a piece of paper somewhere in a pile of five supers. Be careful not to inhale any of the fumes. It is advisable to do the fumigation outside or in a well ventilated room. Do not tear the supers down for twelve hours. **Do not use cyanogas in a dwelling house—it is extremely poisonous.** Larger spaces may be fumigated by using 4 pounds per 1,000 cu. ft. For best results, the temperature should be above 60° F.

Methyl Bromide. Is a colourless liquid which comes under pressure in 1 pound cans and 10 pound cylinders. It boils at 40° F. and therefore evaporates as soon as the can is opened. Owing to its low boiling point, it can be used in cool weather, but is most satisfactory above 60° F. This is the only known fumigant that will destroy the eggs as well as the larvae of the wax moth. For this reason it is especially recommended for comb honey, as only one fumigation is necessary.

Although it is necessary to take all precautions when fumigating with this material, it does not react quite as quickly as cyanogas, and therefore is not as dangerous to use. It is not a fire hazard.

Methyl Bromide may be purchased through the Merck Chemical Company, Toronto, Ontario.

This fumigant should be used at the rate of 1 pound per 1,000 cu. ft. in tightly closed buildings, and 2 pounds per 1,000 cu. ft. in all others. The supers should be raised from the floor slightly and circulation supplied if possible by the use of a fan.

Mice

Bee yards in all parts of the Province are troubled by mice. These pests will destroy comb and build nests alongside the winter cluster in good colonies. The disturbance will generally result in the loss of the colony. They will also build nests in stored super combs during the winter. In some sections chipmunks will do similar things. Winter entrances should be constructed small enough that nice cannot enter, and piles of supers in storage should be protected both above and below with queen excluders. Poison grains are effective as a means of control. A commercial poison bait known as "Mouse Seed" may be obtained from the Bee Supply Companies, or a mixture of strychnine and grain may be prepared at home. This is done by dissolving 25 grains of strychnine in about 1½ pints of water and placing this in a large container. Completely soak some grain with this liquid. The grain must be dried before using, otherwise it will mold. A small amount of strychnine may also be combined with icing sugar and then mixed with flour or crumbs, or spread on bread. Strychnine is one of the most deadly of poisons, and every precaution must be taken when it is used.

Skunks

Skunks are troublesome in most sections of Ontario. They will scratch in front of a hive to annoy the bees. When the bees rush out they become entangled in the skunk's fur and are rapidly eaten. Skunks also do much damage in winter by destroying tar paper and exposing hives packed with this material. The control recommended for skunks is to make a small hole in an egg at the air cell end. Then stir one grain of strychnine well into the egg with a toothpick or small piece of wire. A grain of strychnine is about as big as a pin head. The egg is then half buried near the hive where the skunk can get at it. Every precaution must be taken when using strychnine. Where there is danger of poisoning domestic animals, the egg should be placed under the hive or some place where larger animals cannot get at it. **Persons placing out strychnine in this manner are responsible for any damage that may result to live stock.**

Ants

The ant is not a serious pest in this country. There are a few areas, however, where they make quite a nuisance of themselves. Two types of ants may be encountered, the sweet-loving form and the non-sweet-loving form. The sweet-loving form may be controlled by mixing ¼ teaspoon Tartar emetic to 1 tablespoonful honey, and placing the material where it is accessible to ants, but not to bees. The non-sweet-loving form may be controlled by substituting bacon fat or marrow for the honey.

Storage of Combs

Where much trouble is experienced from mice and wax moth, it is advisable to store the supers of comb in stacks of five with a metal lid or queen excluder at the top and bottom of each pile. One of the various disinfectants should be used and cracks sealed up as far as possible. When disinfecting supers, best results are obtained if the stacks are not made more than five supers high. Where the danger of wax moth is not particularly great, beekeepers stack the supers up with a sheet of newspaper between each super. Printers' ink apparently acts as a repellant to the wax moth. Poisoned grain or mouse seed should be sprinkled around the storage room to help keep the mice under control.

Storage of Comb Honey

Wax moth larvae can very soon spoil a season's crop of comb honey. Moths will lay their eggs in the cracks between the supers; on hatching the young worms crawl to the comb honey and destroy the wax capping. If trouble with wax moth is expected it is advisable to remove the honey from the colonies as soon as possible. Place eight to ten shallow supers of honey one on top of the other and use similar fumigation methods as used for stored combs. Some beekeepers use sulphur for this purpose, as the fumes tend to bleach wax, thus making the cappings whiter. Methyl Bromide is particularly recommended for use with comb honey. This fumigant will destroy the eggs as well as the larvae. If the sections are wrapped shortly after the fumigation, there should be no more trouble.

General Precautions

(1) Never buy colonies of bees unless they have been examined by an authorized Inspector and a permit granted by the Department of Apiculture.

(2) If drawn combs, irrespective of age, are purchased with used apiary supplies, they should be rendered into beeswax, unless positive no American Foulbrood existed in the apiary from which they came.

(3) Be sure to prevent spring robbing by closing the entrances of all dead colonies early in April, thereby avoiding the spread of disease. The entrances to weak colonies should also be reduced.

(4) Combs should not be interchanged from one colony to another where there is danger of foulbrood being present.

(5) Destroy all colonies having American Foulbrood immediately they are found. Make sure your diagnosis is correct before proceeding with the destruction.

If in doubt remove the contents of one or more cells and fold in a piece of waxed paper. Place this, with your name and address, in an envelope and forward to the Apiculture Department, Ontario Agricultural College, Guelph, for diagnosis.

(6) Since honey is one means of transmitting American Foulbrood, it should not be fed to bees unless it is known to be free from Foulbrood spores. When in doubt feed sugar syrup.

(7) When locating an apiary do not crowd any other beekeeper. Never keep bees in box hives. The control of American Foulbrood is the beekeeper's most important problem. In order to remain in the business and ensure success, constant vigilance must be maintained.

(8) Protect your combs at all times from the wax moth. It is estimated that more combs are destroyed annually by the wax moth than by disease.

Contents

BULLETIN 430 MARCH, 1943.

Ontario Department of Agriculture

Statistics and Publications Branch

TORONTO, ONTARIO

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By

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Horticultural Experiment Station

Vineland Station, Ontario

CONTENTS

FRUIT VARIETIES

THIS bulletin is intended primarily as a guide to the commercial fruit grower in what varieties to plant, and equally, what not to plant. To that end the recommended lists have been referred to, and revised by, growers' variety committees representing the Ontario Fruit Growers' Association and the Niagara Peninsula Fruit Growers' Association. Committee members have further consulted with growers in their respective fruit districts. The recommendations therefore are by growers, for growers.

The recommendations normally include two lists (except where otherwise indicated) for each kind of fruit, first, those proven varieties which are recommended for general planting, and second, varieties of recent introduction which are considered definitely promising and are suggested for limited commercial planting until their value is more definitely established. In both lists varieties are arranged in order of maturity, the earliest being named first.

As a useful supplement to the bare lists of recommendations, Parts II, III, IV, V and VI have been added. Part II gives in tabular form some figures on fruit tree populations secured as a result of recent local provincial surveys. Part III consists of maturity date charts which include not only the recommended varieties, but other varieties of interest particularly some of the older ones which serve as maturity date guide posts. For example, the peach chart includes Rochester, St. John, Early Crawford and Lemon Free, all old varieties now seldom planted. By reference to the charts the grower can readily determine the date of maturity of a given variety in relation to other standard varieties, and he can therefore judge of its value for his particular needs.

Part IV consists of a condensation of Ontario Department of Agriculture Bulletin No. 424, "Pollination in Relation to Orchard Planning", to which the grower is referred for more detailed information. However the condensation gives to the grower the essential guidance regarding pollination, in the selection of his varieties and the planting out of his new orchards.

Part V attempts to appraise, very briefly, the commercial value not only of the recommended varieties but also of a considerable number of others under test at Vineland and which are of probable interest to growers. Mostly these latter are newer varieties receiving considerable publicity.

Part VI is a complete alphabetically arranged list of all varieties of fruits which have been, or are now under test at the Horticultural Experiment Station. Those still under test are marked with an asterisk, and where they have been definitely identified as being true-to-name they constitute a dependable source, in limited quantity, of budwood, cuttings, plants, etc. The remaining varieties, constituting the bulk of the lists, are now mostly of little interest. Nevertheless the accumulated records of these varieties contain much useful information, available to growers on request.

PART I. RECOMMENDED VARIETIES OF FRUITS

FRUITS include Apples, Pears, Quinces, Cherries, Peaches, Nectarines, Apricots, Plums, Grapes, Blackberries, Raspberries, Currants, Gooseberries and Strawberries. List 1 consists of established varieties of known value, and list 2, unless otherwise noted, of newer varieties of distinct promise but not yet sufficiently tested commercially to warrant unlimited recommendation or planting. In several cases special lists have been included for that part of Eastern Ontario, east of Kingston, as lack of sufficient hardiness often precludes the growing of many otherwise desirable varieties. These hardy lists have been provided through the courtesy of the Dominion Horticulturist, C. E. F., Ottawa.

In evaluating the recommendations and determining their value for his particular conditions, the grower should freely consult the Variety Comments, Part V, of the bulletin.

RECOMMENDATIONS, TREE FRUITS

(Consult also Part V, Variety Comments)

Varieties arranged in order of maturity, from early to late.

PEARS

List No. 1 GENERAL PLANTING	List No. 2 FOR SPECIAL MARKETS (See Section V)	List No. 3 HARDY VARIETIES FOR EAST OF KINGSTON, RECOMMENDED BY C.E.F., OTTAWA
Bartlett	Giffard	Enie
Anjou	Clapp	Moe
Kieffer	Russet Bartlett	Menie
	Flemish Beauty	Miney
	Howell	Phileson
	Clairgeau	Parker
	Bosc	Flemish Beauty

QUINCES

Orange	No Recommendations

Varieties arranged in order of maturity, from early to late.

APPLES

List No. 1 COMMERCIAL PLANTING	List No. 2 TRIAL (Limited) PLANTING

A. (Eastern Counties, Kingston and East. Recommendations courtesy of the Dominion Horticulturist, C.E.F., Ottawa).

List No. 1	List No. 2
Red Melba	Lawfam
Joyce	Bancroft
Atlas	Newtosh
Lobo	Linda } Double worked
McIntosh	Sandow } on hardy stocks

B. (Hastings, Prince Edward, Northumberland, Durham and Ontario Counties).

List No. 1		List No. 2
Wealthy	Not to exceed 25% of total planting	Joyce
Fameuse		La Salle
Greening, N.W.		Secor
Delicious		
McIntosh	50%	
Northern Spy	25%	

C. (Southern Counties, Toronto to Sarnia and South).

List No. 1	List No. 2
McIntosh	Sandow
Greening, R.I.	
Delicious	
Baldwin (see description Part V)	
Northern Spy	

D. (Georgian Bay and Lake Huron).

List No. 1	List No. 2
Wealthy	Secor
McIntosh	
Greening, R.I.	
Northern Spy	

E. (Local and Special Markets).

Crimson Beauty (Kingston, East)
Yellow Transparent
Early McIntosh
Joyce
Wealthy
Fameuse
Jonathan
Cranberry

CHERRIES, SWEET

Varieties arranged in order of maturity, from early to late.

List No. 1 GENERAL PLANTING	List No. 2 TRIAL (Limited) PLANTING	List No. 3 *SPECIAL PURPOSE
Black Tartarian	Vernon	Seneca
Victor	Giant	Knight
Napoleon	Velvet	Early Rivers
Schmidt		Early Lyons
Windsor		
Hedelfingen		

List No. 3. *Varieties earlier than Black Tartarian which are recommended **only** where they can be adequately protected from birds.

CHERRIES, SOUR

Early Richmond (Kingston, East)	No Recommendations
Montmorency	

PEACHES

List No. 1 COMMERCIAL PLANTING	List No. 2 TRIAL (Limited) PLANTING	
Golden Jubilee	Buttercup	July Elberta
Vedette	Marigold	McGuigan
Halehaven	Fisher	Kalhaven
Valiant	Oriole	Veefreeze
Veteran	Redhaven	Victory
Elberta	Vanguard	Rio Oso Gem
	Early Halehaven	Geddes
	Triogem	

It will be noted that in List No. 1 above, there are no varieties earlier than Golden Jubilee or later than Elberta. For the early season, and to replace June Elberta, Arp, and Yellow Swan, it is recommended that the grower plant his choice of the first six in List No. 2—Buttercup, Marigold, Fisher, Oriole, Redhaven, Vanguard. All six mature within five days of each other, Buttercup being 12-13 days before Golden Jubilee, and Redhaven and Vanguard—first picking—a week before Golden Jubilee. All six are at least sufficiently good to warrant **limited** commercial planting until the best one or two can be determined for general commercial planting.

Similarly, to follow Elberta, there are two named varieties, Rio Oso Gem and Geddes, and Station Seedling 290159, which seem definitely superior to the older late varieties such as Wilma. Growers can see all three in bearing at the Experiment Station, Vineland, and elsewhere, and arrange to plant their choice. Probably in two or three years' time a more definite recommendation can be made with confidence.

NECTARINES

The nectarine is closely related to the peach, being in fact a bud and seed variation of that fruit. The tree is identical with the peach, the differences being in fruit characters. The nectarine fruit is definitely smaller, the skin is smooth like a plum, and the flavor is unlike that of the peach. On the other hand there are yellow and white flesh nectarines, and clings, freestones, and intermediates.

As a fruit, the nectarine cannot yet be considered for commercial planting. It is very subject to brown rot and curculio injury, and total yield, because of the relatively small size of the fruit, is much less than that of the peach. Nevertheless a few trees of one or more varieties might well be grown for home use. The following, which have fruited at Vineland, are suggested.

Garden State (yellow flesh freestone)
Goldmine (white flesh, freestone).

APRICOTS

In Ontario the apricot may be classed as a semi-commercial crop only. The problem is not one of hardiness as the apricot is in fact hardier than the peach in both bud and wood. However it blooms very early when weather conditions are so often unfavorable for pollination and fruit setting, with the result that crops are uncertain.

Of the many varieties tested at Vineland (See List Sec. VI) three of the best are MONTGAMET, MOORPARK and GENEVA, maturing in that order. The variety fairly generally known throughout the Niagara District as Rittenhouse, is in fact Montgamet, definite identification having recently been made. Garden City and Hungaria are also probably Montgamet renamed.

PLUMS, EUROPEAN

Varieties arranged in order of maturity, from early to late.

List No. 1 COMMERCIAL PLANTING	List No. 2 TRIAL (Limited) PLANTING	List No. 3 HARDY VARIETIES RECOMMENDED BY C.E.F., OTTAWA, FOR KINGSTON, EAST
Lombard	Earliana	Mount Royal
Imperial Gage	Pacific	
Italian Prune	Imperial Epineuse	
Damson	Stanley	
Grand Duke	Albion	
Reine Claude	President	

PLUMS, JAPANESE

Shiro	Crystal Red	Grenville
Burbank	Methley	Underwood
	Wrights Early	Fiebing
	Superior (Minn. 194)	Superior

RECOMMENDATIONS, GRAPES AND SMALL FRUITS

(Consult also Part V. Variety Comments)

Varieties arranged in order of maturity, from early to late.

GRAPES

	List No. 1 COMMERCIAL PLANTING	List No. 2 TRIAL (Limited) PLANTING	List No. 3 KINGSTON, EAST. HOME AND SMALL COMMERCIAL USE
Wine—	Ontario	Dutchess	Portland
	Niagara	Lomanto	Fredonia
	Concord		Ontario
			Brocton
			Moore
			Delaware
Market—	Portland	Seneca	
	Fredonia	Ruby	
	Ontario		
	Brighton (Roadside only)		
	Niagara		
	Salem		
	Agawam		
	Concord		
	Herbert		

BLACKBERRIES

Eldorado	Lowden

RED RASPBERRIES (GENERAL)

Brighton	See Notes	Monroe
Count	Part V.	Newburgh
Viking		Marcy
Cuthbert		Taylor
Latham		

RED RASPBERRIES (Kingston, East)

Monroe	Milton
Viking	Ottawa
Latham	Rideau
	Newburgh

BLACK AND PURPLE RASPBERRIES

(B indicates blackcaps, P purple varieties)

Plum Farmer (B)	Bristol (B)
Cumberland (B)	Dundee (B)
Columbian (P)	Naples (B)
	Sodus (P)
	Marion (P)

RECOMMENDATIONS, GRAPES AND SMALL FRUITS
(Continued)

It is probable that, as they become better known and more thoroughly tested, Bristol, Dundee and Naples blackcaps will eventually displace the old varieties, Plum Farmer and Cumberland. At the moment they are worthy of extended trial.

Similarly Sodus and Marion purple varieties, on the basis of present limited observation, are probably superior to Columbian and therefore likely to eventually displace it.

RED CURRANTS

Varieties arranged in order of maturity, from early to late.

List No. 1 COMMERCIAL PLANTING	List No. 2 TRIAL (Limited) PLANTING
Cherry	Stephens #9
Fay	Red Lake
Perfection	
Wilder	
Victoria	
Prince Albert	

While comparatively new, and therefore not fully tested, Stephens #9 and Red Lake are probably superior to the older varieties in List No. 1. Growers are therefore encouraged to give them extended trial in the expectation that they will eventually replace, to some extent at least, present commercial varieties.

BLACK CURRANTS

Climax	No Recommendations
Kerry	
Magnus	
Saunders	
Naples	

GOOSEBERRIES

Clark	Fredonia
Poorman	Silvia

STRAWBERRIES (GENERAL)

Premier	Valentine
Dorsett	Blakemore
Dunlap	Vanrouge
Parsons Beauty	Culver
Fairfax	Catskill
	Louise
	Tupper

STRAWBERRIES (KINGSTON, EAST)

Premier	Valentine
Dresden	Pathfinder
Catskill	Borden
Louise	Tupper

PART II. VARIETY DISTRIBUTION OF SOME FRUITS

The figures as to variety and distribution of apple trees as given below were collected from the individual growers of commercial orchards by the inspectors engaged in apple maggot control. The survey was practically completed for the Counties of Hastings, Prince Edward, Northumberland, Durham, Ontario and Norfolk. In the other sections, many of the orchards were not listed for export purposes under the Regulations and plans were made to complete the information in 1942. Unfortunately, due to war conditions, all field work had to be suspended.

While the figures are therefore not complete even for commercial plantings, they furnish a fair picture of the trends in variety planting. The addition of another estimated quarter-million trees would only emphasize the increasing importance of the two leading varieties — McIntosh and Spy. Owing to the severe damage following the winter of 1933-34, the figures in the age group "31 yrs. and Over" are misleading particularly in those varieties that proved tender like Blenheim, King, Baldwin, Greening and Ben Davis.

TABLE I. APPLE VARIETY CENSUS, 1941

Number of trees and percentage of total in various age groups.

Apple Variety	1-7 yrs.	%	8-15 yrs.	%	16-30 yrs.	%	31 and Over	%	Total	%
Duchess	2,530	1	4,026	3	12,545	4	3,406	2½	22,507	2½
Other Early Varieties	7,703	3	7,634	5	5,848	2	1,238	1	22,423	2½
Wealthy	6,219	2½	8,220	5	17,500	6	4,287	3	36,226	4½
Blenheim	275		140		3,776	1½	2,647	2	6,838	1
King	709		667		2,497	1	1,574	1	5,447	½
Jonathan	1,511	½	2,680	2	4,623	2	31		8,845	1
Snow	7,168	3	6,276	4	21,513	7	5,295	3½	40,252	5
McIntosh	99,284	40	56,358	38	59,978	20	14,475	10	230,095	28
Greening, R.I.	10,680	4	6,501	4½	7,280	2½	6,120	4	30,581	3½
Delicious	29,495	12	19,953	13½	5,600	2	366		55,414	6½
Stark	592		194		13,680	5	18,461	12½	32,927	4
Baldwin	2,832	1	1,222	1	13,901	5	16,475	11	34,430	4
G. Russet	764		439		2,202	1	4,453	3	7,858	1
Ben or Gano	2,462	1	163		7,294	2½	7,777	5½	17,696	2
T. Sweet	1,929	1	1,388	1	5,201	2	3,207	2	11,725	1½
Cranberry	1,375	½	107		2,873	1	1,149	1	5,504	½
N. Spy	50,834	20	20,213	14	75,808	27	41,400	28	188,255	23
Other Winter Varieties	22,799	10	11,361	8	24,088	8½	14,922	10	73,170	9
Totals	249,161		147,542		286,207		147,283		830,193	

The accompanying figures for pears, peaches, and plums and prunes were secured from a Questionnaire sent out in January 1942 to the 1407 growers of the Niagara District Spray Service. The area covered is from the Niagara River to Hamilton, inclusive of the Fonthill, Ridgeville, Fenwick District and the figures given are for the 55 per cent of growers who returned completed questionnaires.

TABLE II. VARIETY DISTRIBUTION OF PEARS IN THE NIAGARA DISTRICT

Number of Trees in Different Age Groups

Variety (in order of maturity)	1-7 years old	8-15 years old	16 and older	Totals	Percent of total trees
Clapp	847	546	635	2,028	.96
Bartlett	46,714	25,224	23,630	95,568	45.39
Anjou	1,494	588	2,162	4,244	2.01
Kieffer	63,724	18,453	14,907	97,084	46.11
Others	2,779	1,670	7,181	11,630	5.53
Totals	115,558	46,481	48,515	210,554	100.00

TABLE III. BEARING AND NON-BEARING PEACH TREES, 1942

Grouped as Early, Midseason and Late Varieties

	Non-Bearing	% of Total	Bearing	% of Total
June Elberta				
Arp and Swan	6,229		23,858	
Marigold	3,792	Early	1,800	Early
Fisher	10,966	21.62%	3,657	7.07%
Oriole	10,009		5,301	
Golden Jubilee	18,559		28,947	
Rochester	3,065		25,219	
Vedette	14,904	Mid	62,452	Mid
Valiant	12,995	45.47%	38,860	46.03%
Halehaven	3,746		3,158	
South Haven	3,449		29,948	
Veteran	8,463		36,856	
Early Elberta	2,726		15,094	
J. H. Hale	482	Late	2,237	Late
Elberta	43,968	32.91%	212,322	46.90%
	143,353	100.	489,709	100.

Attention is directed to the greatly increased planting of early varieties in recent years, the percentage jumping from 7.07 to 21.62. The 14 per cent increase is not yet (1942) a factor in the marketing of the crop. The real effect will come in 1944 and thereafter. Early varieties generally are not suitable for distant shipment and are not desired by the canner.

TABLE IV. VARIETY DISTRIBUTION OF PLUMS AND PRUNES IN THE NIAGARA DISTRICT, 1942

Number of Trees in Different Age Groups

Variety (in order of maturity)	1-7 years old	8-15 years old	16 and older	Totals	Percent of total trees
Shiro	9,567	3,987	3,549	17,103	10.32
Burbank	6,410	2,389	4,126	12,925	7.79
Lombard	5,206	5,742	3,842	14,790	8.92
Imperial Gage	2,271	1,371	1,940	5,582	3.37
Italian Prune	19,732	6,917	4,445	31,094	18.75
German Prune	3,386	1,924	767	6,077	3.67
Damson	1,175	5,193	5,671	12,039	7.26
Grand Duke	7,545	5,361	2,866	15,772	9.51
Reine Claude	14,615	6,825	3,884	25,324	15.27
Others	10,575	4,324	10,210	25,109	15.14
Totals	80,482	44,033	41,300	165,815	100.00

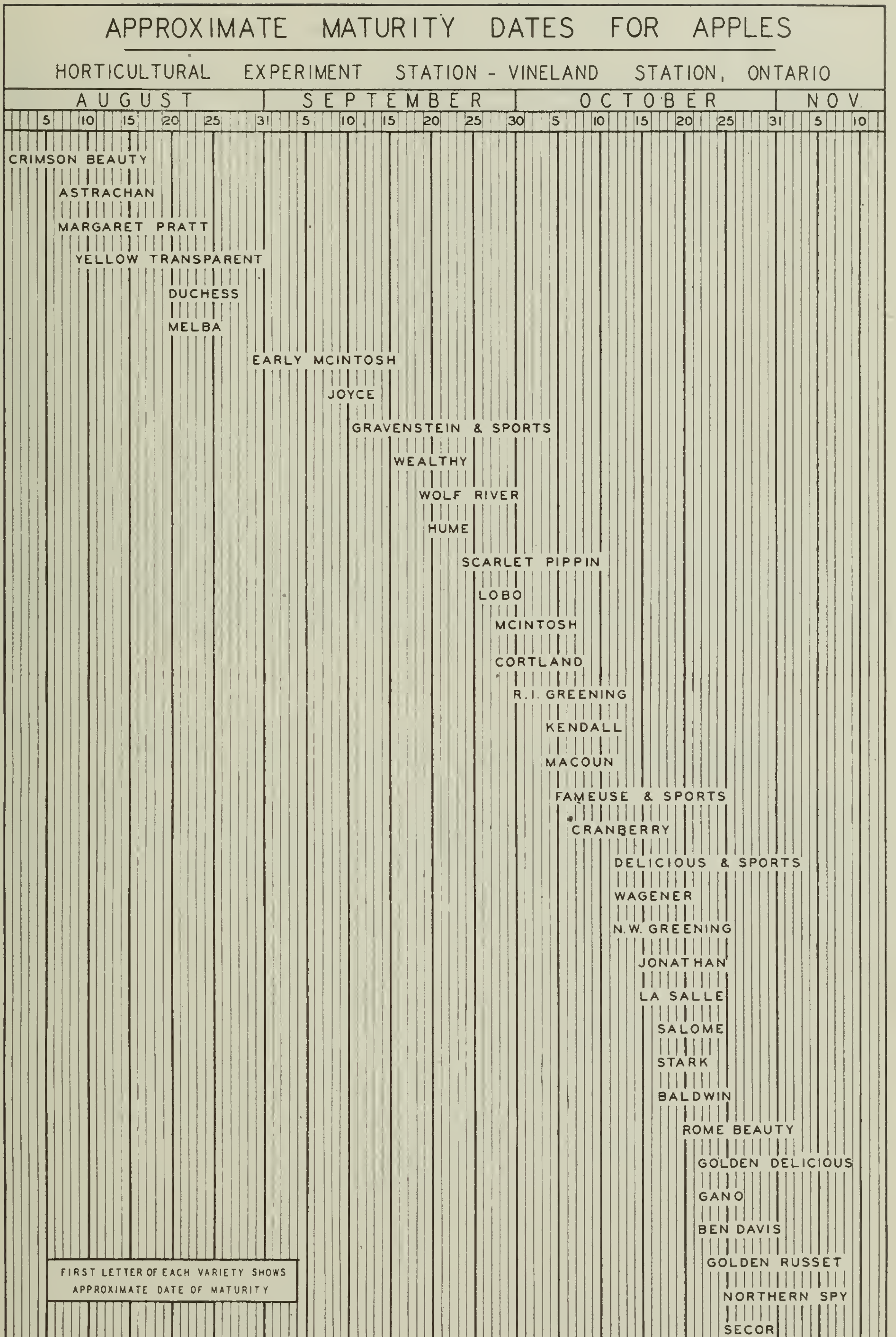
*PART III. MATURITY DATES FOR SOME FRUIT VARIETIES

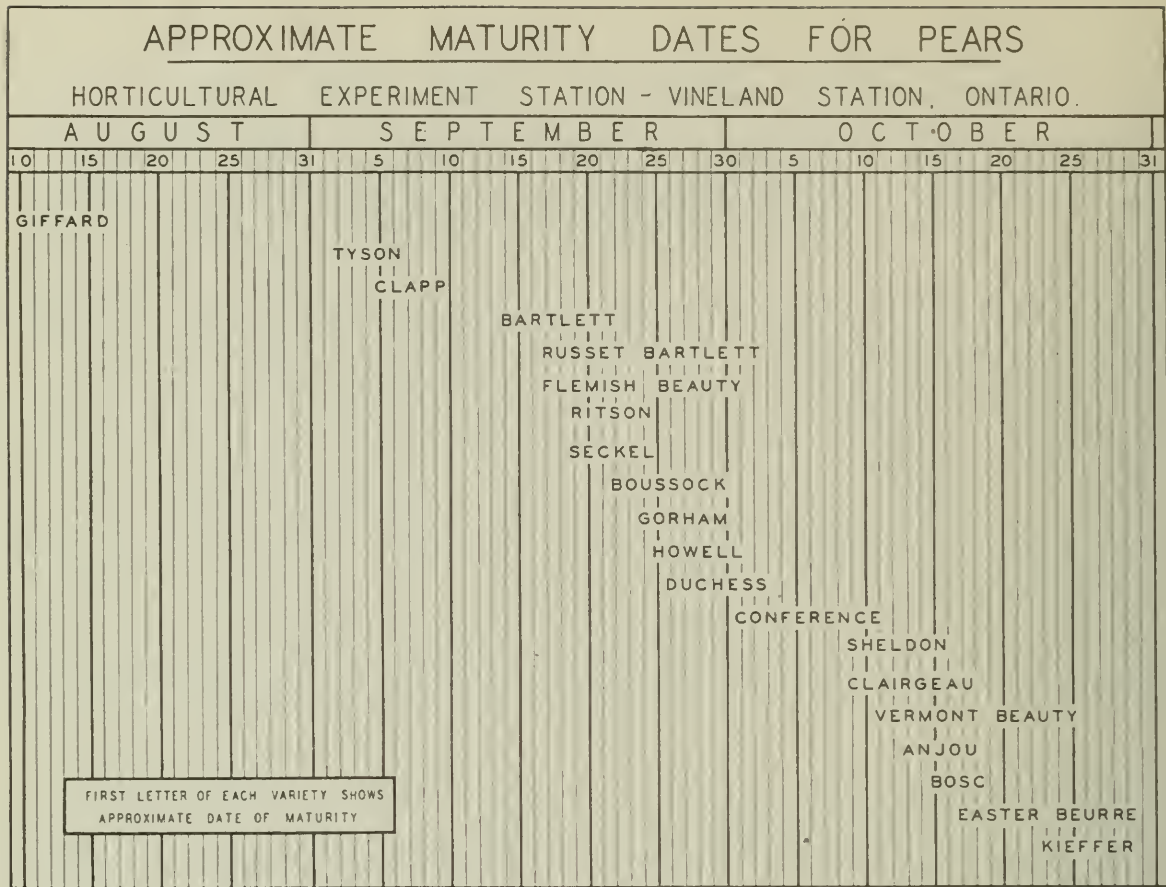
ONE of the perplexing problems confronting fruitgrowers, nurserymen and fruit dealers, is the question of maturity date, or season, of the various fruits that they must handle. In planning new plantings the fruit grower must draw his conclusions from the various nursery catalogs and from advice obtained from his neighbors. Nursery catalogs are often at variance with each other, and many of them merely list varieties as "early," "mid-season," or "late," which classification lends itself to misinterpretation, as will be evidenced by the charts submitted. The grower's friends very often do not remember just exactly where a certain variety comes in, particularly the newer ones, and therefore that source of information may not always be reliable. The fruit dealer often lacks definite information as to when to expect certain varieties of fruit and is therefore handicapped in advising ahead of time when certain varieties will be at their peak.

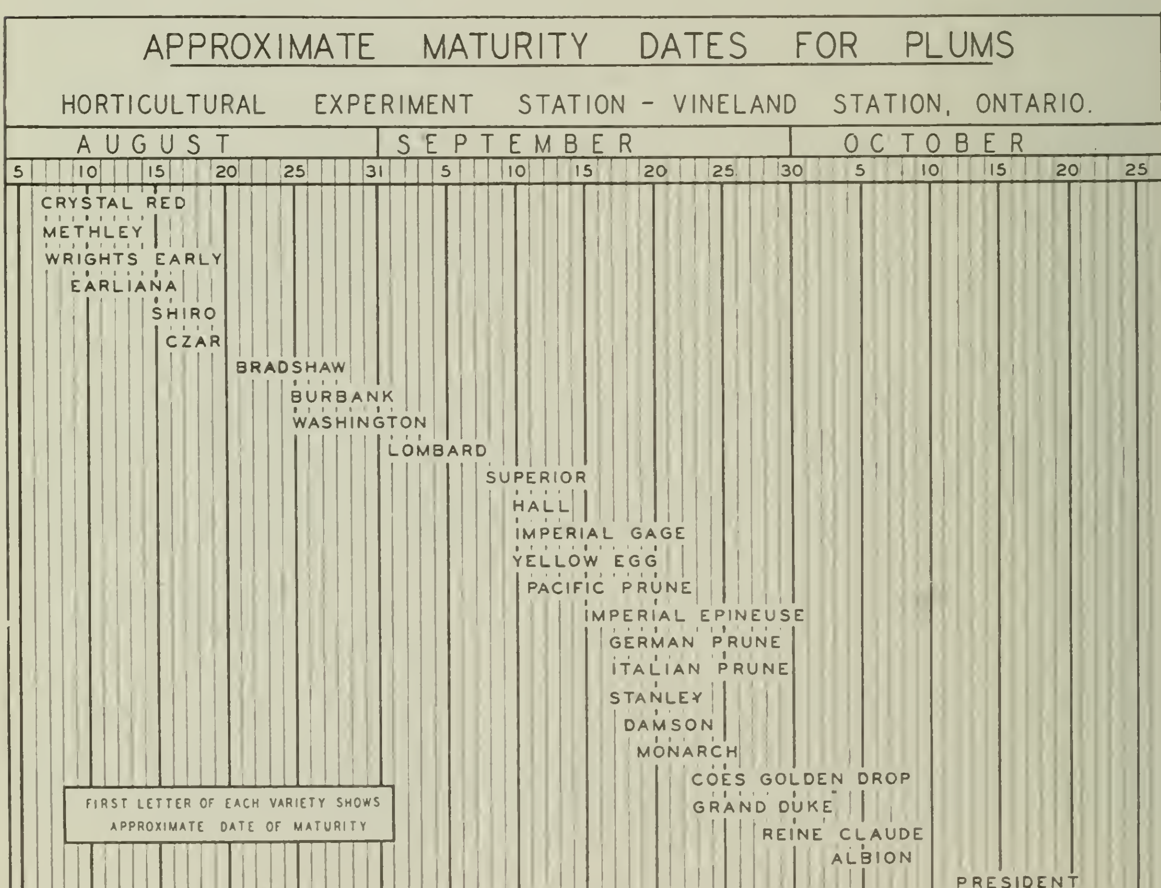
In an attempt to straighten out some of these difficulties the following charts have been prepared. It will at once be apparent that these charts have their shortcomings. First, they do not list all the varieties grown. Second, they list the order of maturity at the Horticultural Experiment Station, Vineland Station, Ontario, *only*. Throughout the fruit growing districts of the province there will be certain variations in the approximate order of maturity although they would not vary a great deal from the lists given. Proximity to large bodies of water, distance north or south of Vineland would certainly exert some influence on the ripening of some of the varieties listed. However, as a general guide to those who come in contact with the fruits in question the charts will serve as a fairly reliable index to the proper order of maturity.

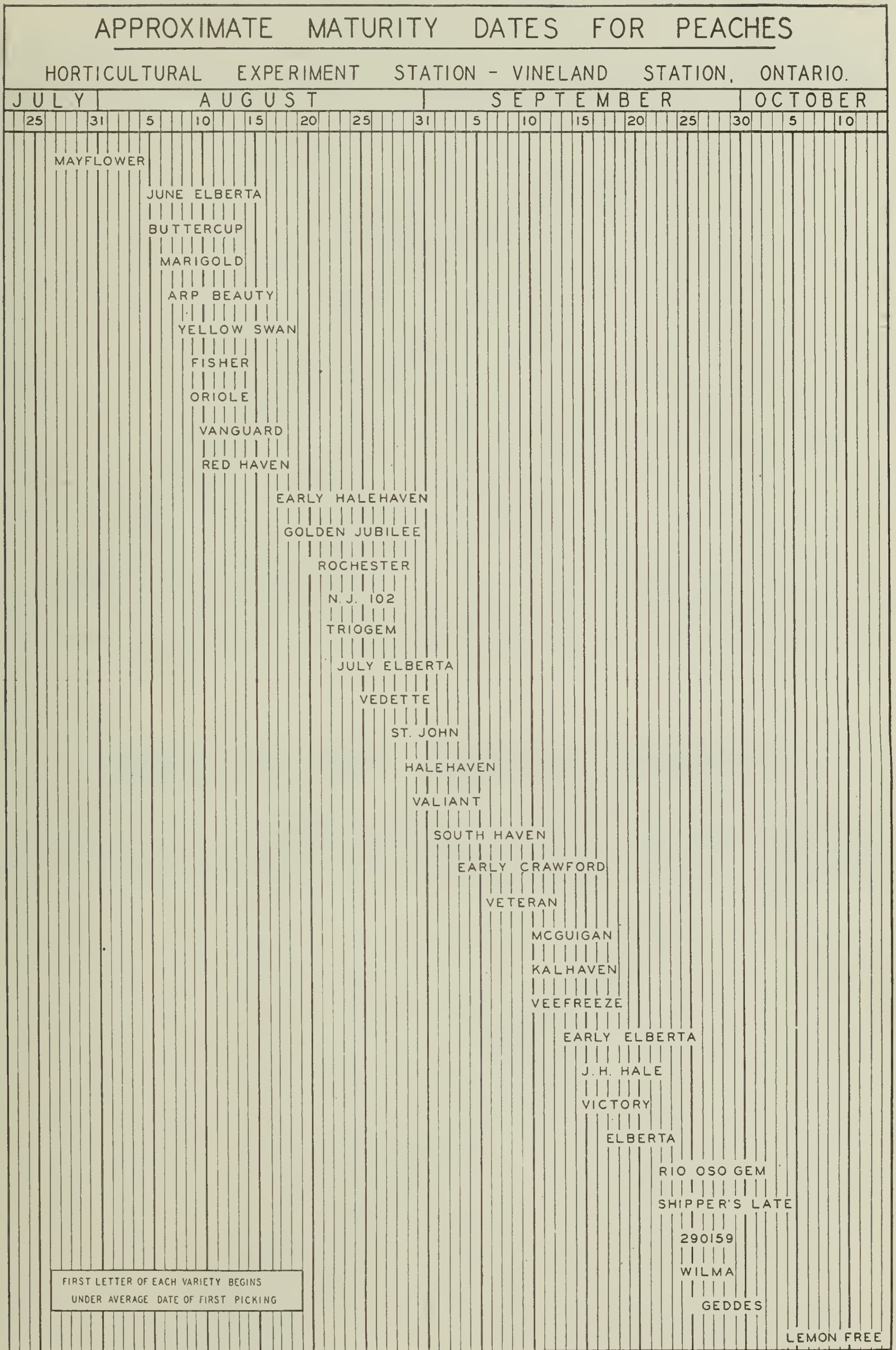
The charts themselves give the order of maturity for the varieties by indicating the date of first picking of the variety in question. The first letter of each name appears under the date line of the first picking, the extent of the lettering however being no indication of the duration of the picking season for each variety. The reason for not indicating the total picking season for each variety is obvious, since seasonal variations will shorten or lengthen the picking season, spells of hot dry weather usually shortening, and prolonged cool weather lengthening the season. Certain of the fruits, such as Plums, Cherries, and Grapes, are picked over once only in which case those charts will indicate the season of maturity of the whole crop.

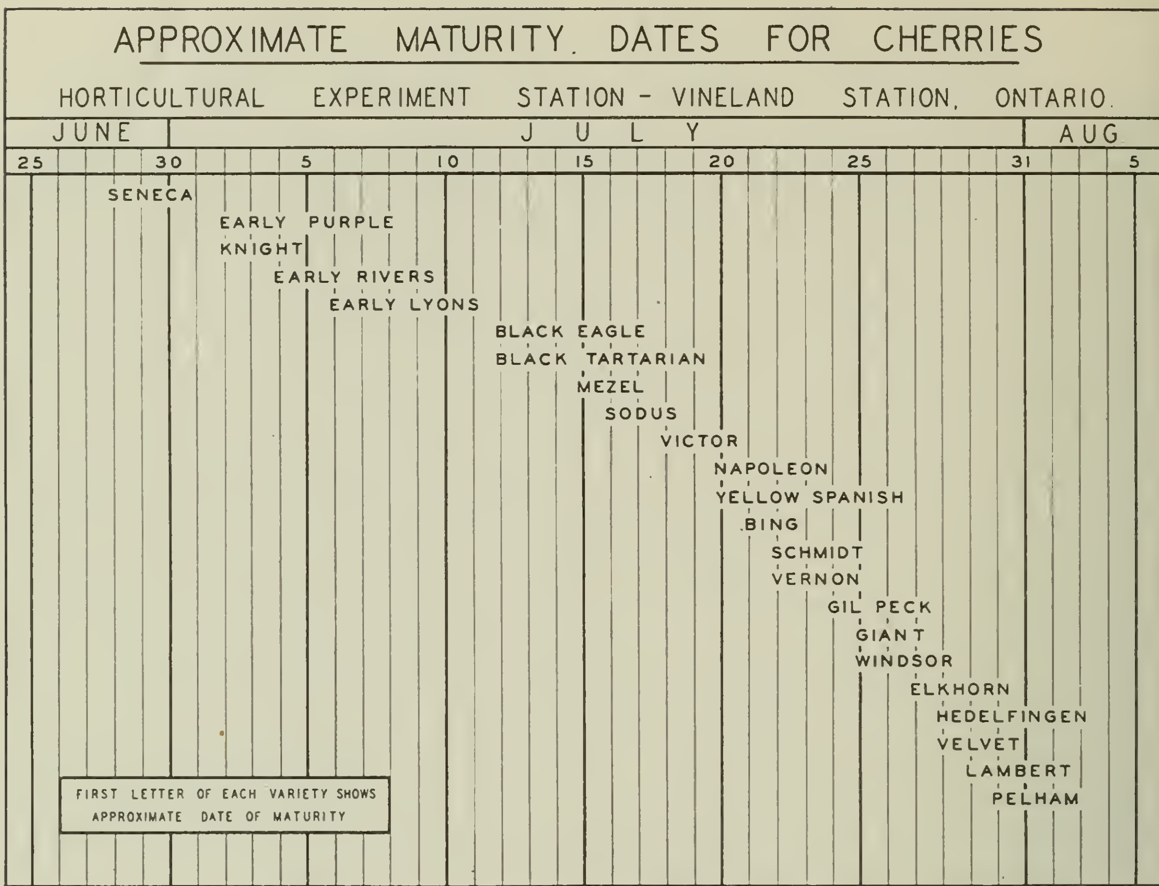
* Revised 1943.

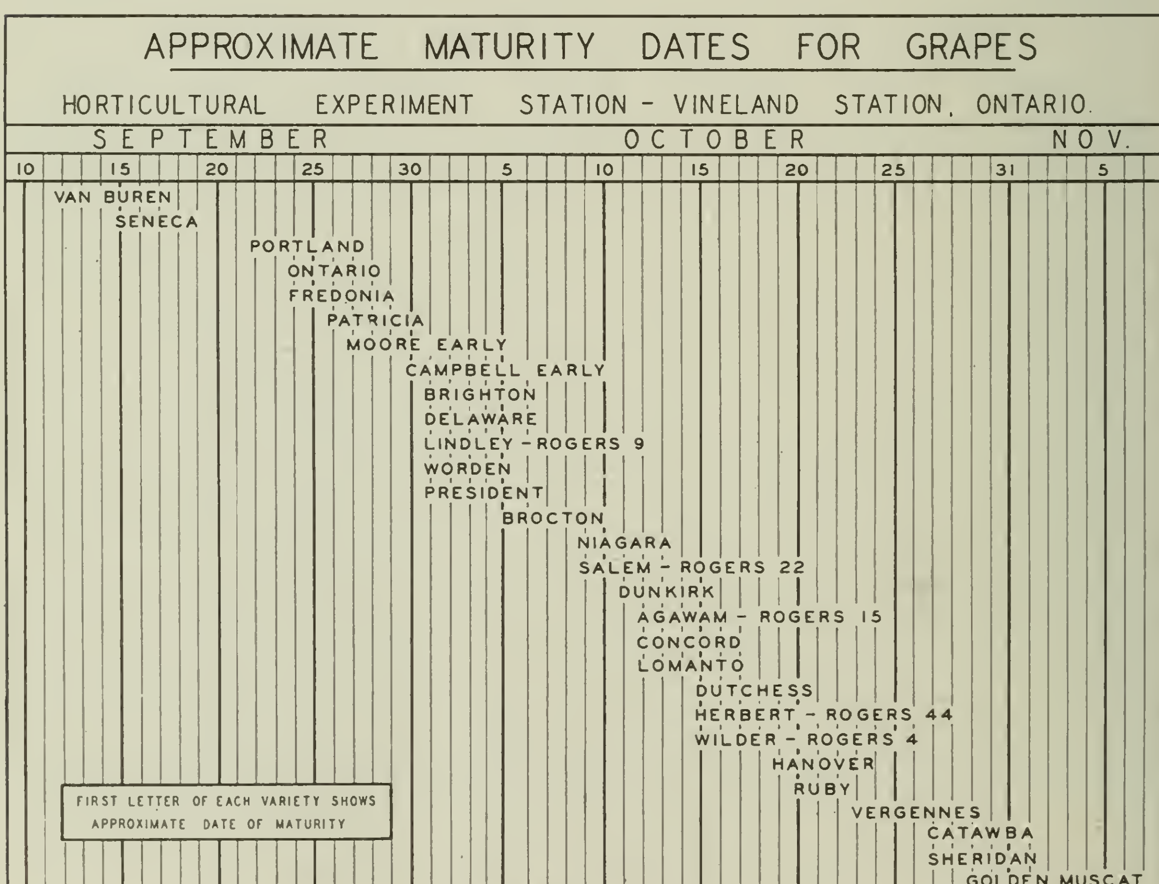

APPROXIMATE MATURITY DATES FOR APPLES
HORTICULTURAL EXPERIMENT STATION - VINELAND STATION, ONTARIO
AUGUST
SEPTEMBER
OCTOBER
NOV.
CRIMSON BEAUTY
ASTRACHAN
MARGARET PRATT
YELLOW TRANSPARENT
DUCHESS
MELBA
EARLY MCINTOSH
JOYCE
GRAVENSTEIN & SPORTS
WEALTHY
WOLF RIVER
HUME
SCARLET PIPPIN
LOBO
MCINTOSH
CORTLAND
R.I. GREENING
KENDALL
MACOUN
FAMEUSE & SPORTS
CRANBERRY
DELICIOUS & SPORTS
WAGENER
N.W. GREENING
JONATHAN
LA SALLE
SALOME
STARK
BALDWIN
ROME BEAUTY
GOLDEN DELICIOUS
GANO
BEN DAVIS
GOLDEN RUSSET
NORTHERN SPY
SECOR
FIRST LETTER OF EACH VARIETY SHOWS APPROXIMATE DATE OF MATURITY

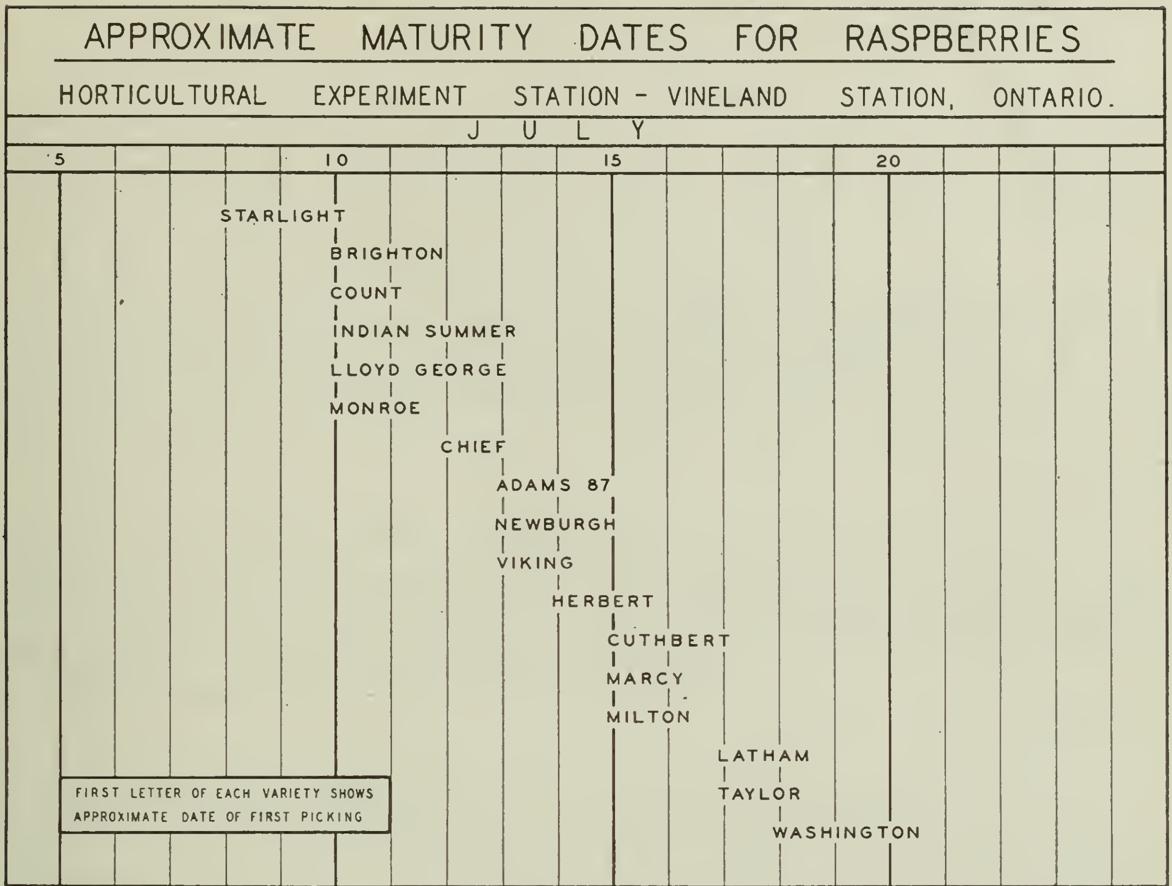

APPROXIMATE MATURITY DATES FOR PEARS
HORTICULTURAL EXPERIMENT STATION - VINELAND STATION, ONTARIO.
AUGUST
SEPTEMBER
OCTOBER
10 15 20 25 31 5 10 15 20 25 30 5 10 15 20 25 31
GIFFARD
TYSON
CLAPP
BARTLETT
RUSSET BARTLETT
FLEMISH BEAUTY
RITSON
SECKEL
BOUSSOCK
GORHAM
HOWELL
DUCHESS
CONFERENCE
SHELDON
CLAIRGEAU
VERMONT BEAUTY
ANJOU
BOSC
EASTER BEURRE
KIEFFER
FIRST LETTER OF EACH VARIETY SHOWS APPROXIMATE DATE OF MATURITY

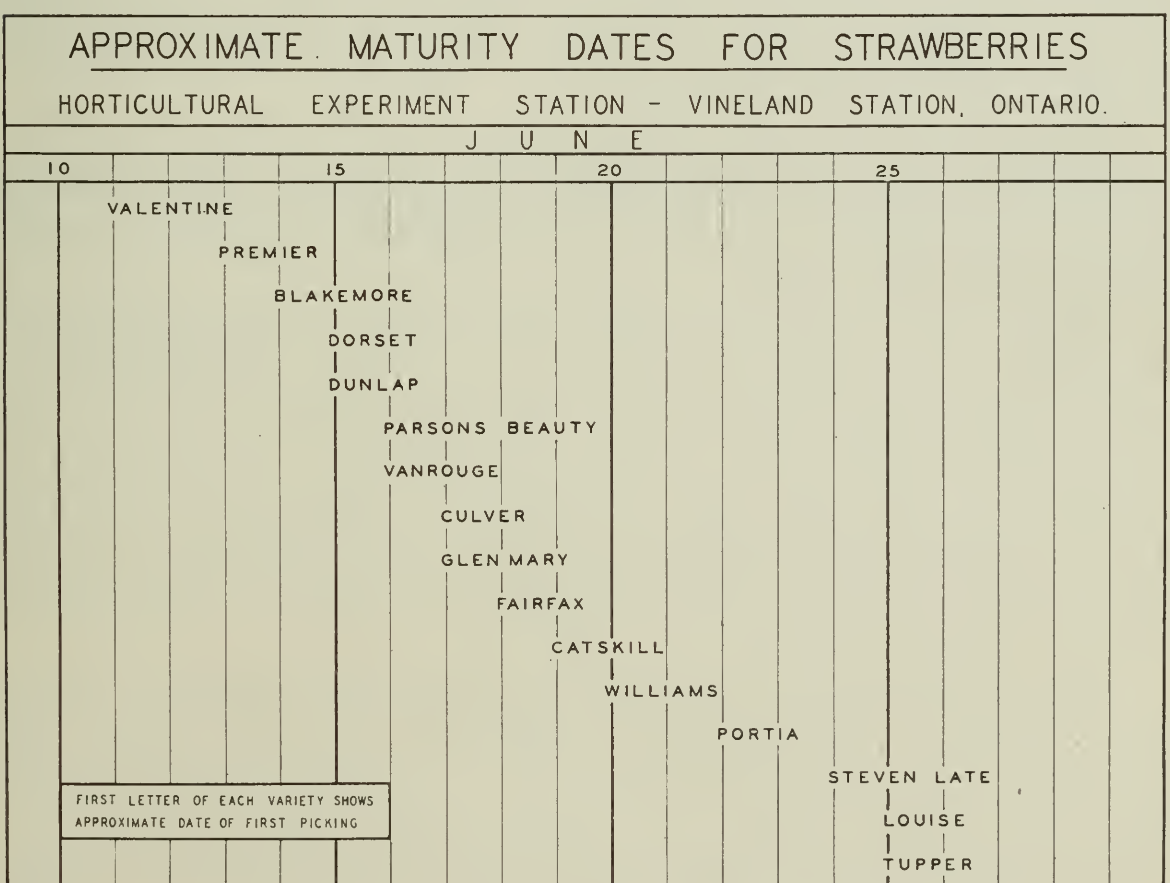

APPROXIMATE MATURITY DATES FOR PLUMS
HORTICULTURAL EXPERIMENT STATION - VINELAND STATION, ONTARIO.
AUGUST
SEPTEMBER
OCTOBER
5 10 15 20 25 31 5 10 15 20 25 30 5 10 15 20 25
CRYSTAL RED
METHLEY
WRIGHTS EARLY
EARLIANA
SHIRO
CZAR
BRADSHAW
BURBANK
WASHINGTON
LOMBARD
SUPERIOR
HALL
IMPERIAL GAGE
YELLOW EGG
PACIFIC PRUNE
IMPERIAL EPINEUSE
GERMAN PRUNE
ITALIAN PRUNE
STANLEY
DAMSON
MONARCH
COES GOLDEN DROP
GRAND DUKE
REINE CLAUDE
ALBION
PRESIDENT
FIRST LETTER OF EACH VARIETY SHOWS APPROXIMATE DATE OF MATURITY


APPROXIMATE MATURITY DATES FOR PEACHES
HORTICULTURAL EXPERIMENT STATION - VINELAND STATION, ONTARIO.
JULY
AUGUST
SEPTEMBER
OCTOBER
25
31
5
10
15
20
25
31
5
10
15
20
25
30
5
10
MAYFLOWER
JUNE ELBERTA
BUTTERCUP
MARIGOLD
ARP BEAUTY
YELLOW SWAN
FISHER
ORIOLE
VANGUARD
RED HAVEN
EARLY HALEHAVEN
GOLDEN JUBILEE
ROCHESTER
N.J. 102
TRIOGEM
JULY ELBERTA
VEDETTE
ST. JOHN
HALEHAVEN
VALIANT
SOUTH HAVEN
EARLY CRAWFORD
VETERAN
MCGUIGAN
KALHAVEN
VEEFREEZE
EARLY ELBERTA
J.H. HALE
VICTORY
ELBERTA
RIO OSO GEM
SHIPPER'S LATE
290159
WILMA
GEDDES
LEMON FREE
FIRST LETTER OF EACH VARIETY BEGINS UNDER AVERAGE DATE OF FIRST PICKING


APPROXIMATE MATURITY DATES FOR CHERRIES
HORTICULTURAL EXPERIMENT STATION - VINELAND STATION, ONTARIO.
JUNE
JULY
AUG
25
30
5
10
15
20
25
31
5
SENECA
EARLY PURPLE
KNIGHT
EARLY RIVERS
EARLY LYONS
BLACK EAGLE
BLACK TARTARIAN
MEZEL
SODUS
VICTOR
NAPOLEON
YELLOW SPANISH
BING
SCHMIDT
VERNON
GIL PECK
GIANT
WINDSOR
ELKHORN
HEDELFINGEN
VELVET
LAMBERT
PELHAM
FIRST LETTER OF EACH VARIETY SHOWS APPROXIMATE DATE OF MATURITY


APPROXIMATE MATURITY DATES FOR GRAPES
HORTICULTURAL EXPERIMENT STATION - VINELAND STATION, ONTARIO.
SEPTEMBER
OCTOBER
NOV.
10
15
20
25
30
5
10
15
20
25
31
5
VAN BUREN
SENECA
PORTLAND
ONTARIO
FREDONIA
PATRICIA
MOORE EARLY
CAMPBELL EARLY
BRIGHTON
DELAWARE
LINDLEY - ROGERS 9
WORDEN
PRESIDENT
BROCTON
NIAGARA
SALEM - ROGERS 22
DUNKIRK
AGAWAM - ROGERS 15
CONCORD
LOMANTO
DUTCHESS
HERBERT - ROGERS 44
WILDER - ROGERS 4
HANOVER
RUBY
VERGENNES
CATAWBA
SHERIDAN
GOLDEN MUSCAT
FIRST LETTER OF EACH VARIETY SHOWS APPROXIMATE DATE OF MATURITY


APPROXIMATE MATURITY DATES FOR RASPBERRIES
HORTICULTURAL EXPERIMENT STATION - VINELAND STATION, ONTARIO.
JULY
5
10
15
20
STARLIGHT
BRIGHTON
COUNT
INDIAN SUMMER
LLOYD GEORGE
MONROE
CHIEF
ADAMS 87
NEWBURGH
VIKING
HERBERT
CUTHBERT
MARCY
MILTON
LATHAM
TAYLOR
WASHINGTON
FIRST LETTER OF EACH VARIETY SHOWS APPROXIMATE DATE OF FIRST PICKING


APPROXIMATE MATURITY DATES FOR STRAWBERRIES
HORTICULTURAL EXPERIMENT STATION - VINELAND STATION, ONTARIO.
JUNE
10
15
20
25
VALENTINE
PREMIER
BLAKEMORE
DORSET
DUNLAP
PARSONS BEAUTY
VANROUGE
CULVER
GLEN MARY
FAIRFAX
CATSKILL
WILLIAMS
PORTIA
STEVEN LATE
LOUISE
TUPPER
FIRST LETTER OF EACH VARIETY SHOWS APPROXIMATE DATE OF FIRST PICKING

PART IV. THE POLLINATION PROBLEM

SOME varieties of fruits may safely be planted in solid blocks of one variety and are termed "self-fruitful". Other varieties either will not bear at all, or will not bear consistently good crops, unless pollinated with some other variety. Such varieties are termed "self-unfruitful", and when planting the orchard another suitable variety must be included to insure cross-pollination.

The honey bee is the most dependable pollen distributor. A strong colony should be able to handle 8-10 acres of apple orchard for example, until good bearing age is reached when the area should be gradually reduced until the proportion of one hive per acre of mature orchard is reached. Tree fruits other than the apple require somewhat less than the above due to the smaller size of mature trees.

Where it is necessary to plant two or more varieties for cross-pollination purposes, and where the desire may be to favor one variety over the other for commercial reasons, the **minimum** requirement is one tree of the second, or pollinating, variety for every eight of the main variety. Distributed throughout the orchard, this means every third tree in every third row. If the preference is for solid rows of a variety, every sixth or seventh row should be a pollinator. If two or more varieties of equal value are to be planted the problem is further simplified by planting two or three rows of one variety, and then a like number of the next.

In the choice of varieties to plant together, certain factors must be kept in mind. Blooming periods must overlap, good pollen must be produced, the varieties must intercross, they should have commercial value and they should preferably be annual bearers.

Apples. Under Ontario conditions, all varieties must be considered as commercially self-unfruitful. Furthermore, and having main commercial varieties in mind, McIntosh and Spy are not suitable pollinators for each other as the blooming seasons do not sufficiently overlap. R. I. Greening might be considered as a third variety to plant with McIntosh and Spy, but unfortunately it produces poor pollen. Therefore in a McIntosh-Spy-Greening orchard a fourth variety, producing good pollen and overlapping in blooming season, must be included. There are a number of suitable varieties including Wealthy, Cortland, Delicious, and Cranberry.

Pears. Commercially self-unfruitful requiring mixed plantings. With one or two exceptions any one variety is suitable as a pollinator for any other. Bartlett and Seckel are intersterile, i.e., will not pollinate each other. Kieffer is not always a good pollinator for Bartlett as pollen from the late bloom of Kieffer is sometimes aborted. In a Bartlett-Kieffer orchard therefore provision should be made for a third variety such as Anjou, Howell, or Bosc.

Cherries, Sweet. All varieties are self-unfruitful necessitating mixed plantings. Also a few varieties, Bing, Lambert and Napoleon particularly, are **inter-sterile** as well, and will not pollinate each other. Therefore an orchard planted to these three varieties, or any two of them, would still require another variety such as Black Tartarian or Windsor, for cross-pollination.

Cherries, Sour. All commercial varieties are self-fruitful. Montmorency for example, may therefore be planted in solid blocks.

Peaches. With few exceptions peach varieties are self-fruitful and may be planted in solid blocks of one variety. Three exceptions are J. H. Hale, June Elberta, and Vimy, which require interplanting with an abundant pollen producing variety.

Plums, European. With the exception of Italian Prune all European varieties (e.g., Grand Duke, Lombard, Monarch, Reine Claude, etc.) should be considered self-unfruitful requiring mixed planting for pollination. Even Italian Prune probably benefits from cross-pollination. In this case, since Italian blooms late, another late blooming variety such as Pacific or Stanley is required. Lombard, Reine Claude, etc. start blooming earlier than Italian and cannot always be relied upon for pollination.

Plums, Japanese. Burbank and Shiro, the main Japanese varieties are self-unfruitful and because they bloom earlier than most European varieties, other Japanese varieties such as Abundance and Red June need to be planted with them for pollination. Also Burbank and Shiro planted together are not satisfactory as, though Shiro will pollinate Burbank, Burbank will not pollinate Shiro. Reine Claude, an European variety is proving a satisfactory pollinator for Shiro so that an orchard consisting of Burbank, Shiro and Reine Claude would be satisfactory as regards pollination. Even so however it is better to arrange for Japanese pollinators for Japanese varieties.

Where cross-pollination is a problem in established orchards, either some of the trees should be removed and replaced with suitable pollinators or a sufficient number of the trees should be topworked to the desired pollinating variety. A temporary expedient is the introduction, during the blooming period, of "bouquets" of a pollinating variety scattered throughout the orchard. These bouquets should be placed in water to keep them fresh and hung up in the trees to make sure that bees and other pollen carrying insects work to advantage.

PART V. VARIETY COMMENTS

THE accompanying brief notes on some of the newer or otherwise noteworthy varieties of fruits are not intended to be completely descriptive. The purpose is rather to indicate the value of each variety based on its performance at Vineland or with Ontario growers who also have it under observation. Generally therefore it may be assumed that, unless otherwise indicated, a given variety is commercially satisfactory in such characters as tree growth, hardiness, cropping ability, fruit size and appearance, quality, etc. It has seemed of more importance to indicate special qualities or limitations, or some particular distinction of value to the grower in determining whether or not to plant.

Also, it should be recognized that the variety comment or appraisal applies to Ontario conditions. Performance elsewhere may well be substantially different.

APPLE DESCRIPTIVE NOTES

ASTRACHAN (Red Astrachan). This old variety still has considerable merit where hardiness, and earliness of season are required. Attractive, red, maturing over a long season. Margaret Pratt, a variety originating at Owen Sound, is very similar but is larger and therefore worth a trial where Astrachan has a place.

BALDWIN. Because of its biennial bearing habit and low market value this variety has not been planted heavily for some years. In the severe winter of 1933-34 Baldwin was almost wiped out in many districts. Where it is hardy and develops high colour it might still be considered as an export variety.

BANCROFT. Introduced by the C. E. F., Ottawa. It has not fruited at Vineland but has been described by M. B. Davis as follows: "Appears fully as hardy as McIntosh, with a strong vigorous tree. It is highly coloured, good sized, firm, of good quality and an excellent keeper."

BEN DAVIS. See Gano.

CLOSE. A Yellow Transparent seedling introduced by U.S.D.A. and maturing about with its parent. Matures over a long period, colour dull red, bruises easily, good cooker and good cropper. Probably adapted for local market use. Strong growing tree.

CORTLAND. A cross of Ben Davis x McIntosh introduced by *Geneva, as a variety to extend the McIntosh season and without McIntosh's fault of dropping. However where McIntosh can be grown to advantage in Ontario and properly stored, Cortland is not recommended. Yield is below McIntosh and it seems susceptible to rosy aphid and codling worm. May require a deep rich soil.

CRANBERRY. At Vineland it lacks in colour and quality but in some Ontario districts as in the Georgian Bay area, it is attractive and valued for export. As it blooms late it may have value where it grows well as a pollinator for Spy.

CRIMSON BEAUTY. Recently renamed Early Red Bird by a U.S. nursery with accompanying publicity and therefore renewed interest. Doubtful value unless for hardiness and very early season maturing in advance of Astrachan. Cooking variety of poor, acid quality, and short season especially when it matures during a hot spell.

DELICIOUS, and RED SPORTS. Although only introduced in 1895, there are more trees of Delicious planted in the United States than of any other variety. For optimum development of size, appearance, and quality it requires somewhat higher summer temperatures than those prevailing throughout most of Ontario. For this reason most imported Delicious are of better appearance. As the trees reach full maturity they require heavy feeding, and relatively heavy fruit thinning, due to the characteristic rather sparse foliage of the variety. Undersized Delicious are very poor in both colour and quality. It should not be planted unless the grower is prepared to give it proper attention.

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* Throughout the text "Geneva" refers to the Agricultural Experiment Station, Geneva, N.Y.

The bud sports **RICHARED, STARKING, TURNER RED,** etc. have the same weaknesses as Delicious. They have higher colour, a feature which may lead to abuse, as this may encourage too early picking and consequent lack of flavour. All Delicious types require care as to time of picking.

DUCHESS, and RED SPORTS. Duchess is a hardy, early bearing, good cooking variety maturing about mid-August. Because it is early and can be grown over a wide area it has been over-planted. Unfortunately Duchess is usually harvested quite immature, often resulting in glutted markets and consequent loss.

There are several red bud sports of Duchess but unless they are allowed to reach proper maturity they are no more attractive than ordinary Duchess, and are therefore subject to the same limitations.

EARLY McINTOSH. A Yellow Transparent x McIntosh seedling introduced by Geneva. Ripens just after or with the last picking of Melba. Colour is good, quality only fair, and in spite of heavy thinning the fruit tends to run small. For a specialized apple trade it may be useful to fill the gap between Melba and Joyce, a gap usually well supplied with peaches.

FAMEUSE. This once popular variety has been largely superseded by McIntosh. It lacks the size and bearing quality of McIntosh and because of lower market value is recommended only where a special market demand still exists.

There are several bud sports of Fameuse which are of higher colour and some also with additional size. Generally however they are of lower quality than Fameuse itself, and of doubtful value as compared with McIntosh.

GANO. A high coloured Ben Davis, of good appearance, does not show bruises, keeps well, but of poor quality. Gano may have value for export in some sections because of season and appearance, but is of little value for home markets. Where a Ben Davis type is desired, Gano is the preferred variety.

GOLDEN DELICIOUS. This once highly advertised variety fails, in Ontario, to obtain the size and attractive finish it acquires in the warmer apple regions. Nevertheless the quality is good, and is appreciated by those who buy on quality rather than appearance. The fruit shrivels badly in storage, especially if picked too early, unless extra humidity is provided. It is in demand on some markets where proper storage facilities are available.

GREENING, N. W. (Northwestern). This large roundish, handsome Greening is very hardy but because of a serious fault should only be grown where R. I. Greening is too tender. On young trees and in seasons of light crops the fruit may suffer seriously from internal breakdown. It also lacks the culinary qualities of the R. I. Greening.

GREENING, R. I. (Rhode Island). After nearly 200 years this variety retains its popularity as a cooking variety. For all round dependability of cropping and general tree characteristics it has few equals. Because of changing economic customs there is a lessening demand for a strictly culinary apple but where it can be grown and there is a market this variety is recommended. A "green" Greening is preferred and therefore it should be planted with caution on soils known to produce highly coloured apples.

JONATHAN. The home market demand is limited and Jonathan should be considered primarily for possible export market where it is favoured because of its high colour, medium size, and good quality. Jonathan requires a deep light soil and, to keep well, it must be picked at the right time. In Ontario the tree is indifferent in growth.

JOYCE. A McIntosh seedling originated by the C. E. F., Ottawa. Ripens about mid-September and seems to be gaining in popularity where a variety of this season is required. Good in quality and appearance. On young trees Joyce may be too large and unshapely but it improves later. Biennial.

JUBILEE. Originated from a cross of McIntosh x Grimes Golden at the Dominion Experimental Farm, Summerland, B.C. Not yet fruited in Ontario but from sample boxes sent from B.C., Jubilee is a very attractive red apple of good quality. Season (B.C.) March and April. It should be carefully tested in Ontario as a possible late keeping red winter apple. In order that it might be tested quickly in Ontario trees were budded at Vineland in 1942 for 1944 distribution to a few growers.

KENDALL. A Zusoff x McIntosh seedling originated at Geneva. A handsome dark red apple about McIntosh season but keeps longer. Flesh colour greenish unless allowed to remain on the tree until late. Kendall hangs better than McIntosh but not as well as Cortland. Where McIntosh colours well Kendall is of doubtful value.

LA SALLE. A late blush winter apple originating in Lachine, Quebec. Because of its season and hardiness it is being given an extended trial in the Northumberland-Durham district.

LINDA. A seedling of Langford Beauty originated by the C. E. F., Ottawa, and there described as "A very attractive apple with good keeping qualities in cold storage. It is a rather acid fruit with high flavour. Prior to Christmas it should be used as a cooker. After that it is a high class dessert. In ordinary storage it tends to shrivel but still retains its crispness and flavour and juiciness of flesh." At Vineland the fruit develops a very dark colour.

MACOUN. A McIntosh x Jersey Black seedling from Geneva, and introduced to extend the McIntosh season. It is a dark red fruit of high quality but has been slow coming into bearing at Vineland and generally not a good keeper.

MARGARET PRATT. See Astrachan.

McINTOSH, and BUD SPORTS. Because of hardiness and adaptability McIntosh is grown in all the commercial apple areas of Ontario. Nearly half the reported sales of apple trees in Ontario are McIntosh. Quality and appearance are such that the market demand has kept pace with production. The variety has several faults; it is subject to scab, drops badly at maturity, and sports freely to poorer coloured strains. By proper spraying scab can be controlled. Hormone sprays assist in controlling the drop and permit extending the harvest until the fruit is well coloured and full flavoured. Nurseries are being careful in selecting buds for propagation to eliminate the poor types.

Should the grower find himself with trees producing streaked fruit of poor appearance such trees should be marked and topworked at the earliest opportunity, using scions from trees known to produce good coloured fruit. Some red bud sports of McIntosh are FARLEY, GENEVA, HAMILTON, SMITH, and BLACKMAC.

MELBA, and RED SPORTS. Melba is a McIntosh seedling introduced by the C. E. F., Ottawa. A high quality variety maturing about mid-August, it requires careful timing at picking to get it at its best for flavour. It bruises easily and if the weather is hot at maturity it may break down rapidly.

Several high-coloured bud sports of Melba have been reported. (Lee, Pate, Platts). It is thought that these are firmer than the original and will stand handling and shipping better.

MILTON. A Yellow Transparent x McIntosh seedling originated at Geneva. A very attractive pinkish red apple of large size and good quality. Ripens throughout September, requiring several pickings. For home use or perhaps for a roadside market this might be an advantage but not in a commercial orchard.

RED GRAVENSTEIN (Geneva). A highly coloured Gravenstein sport and preferred to that variety where a good coloured culinary apple to precede McIntosh is desired. At Vineland it has been a regular annual bearer.

CRIMSON GRAVENSTEIN, as grown at Vineland, is very similar to, if not idencal with, Red Gravenstein.

RICHARED. See Delicious.

SALOME. A very hardy and long keeping winter apple of fair appearance grown to a limited extent east of Toronto. Apart from its late keeping and hardiness it has little to recommend it.

SANDOW. A Northern Spy seedling from the C. E. F., Ottawa. Much confusion exists concerning this variety. Somehow most of our nurseries have had something else instead of Sandow and thus conflicting reports have resulted. As grown in Quebec and New Brunswick the real Sandow is very attractive and warrants a trial. M. B. Davis says in part of Sandow: "While not as hardy as McIntosh it is fully as hardy as Fameuse and hardier than Spy. It bears earlier than Spy, on a strong vigorous tree. Fruit is of good size, highly coloured, well finished and very high in quality. It has the same fault as Spy in that it is subject to bitter pit." Nurseries now have true stock of Sandow.

SCARLET PIPPIN. At one time this Fameuse type apple was planted extensively in Norfolk and to a lesser extent east of Toronto. It is an attractive red apple of medium size produced on an upright tree of biennial bearing habits. Quality is only fair. It is not being considered in modern plantings.

SECOR. A Salome x Jonathan seedling from the Agr. Exp. Sta., Ames, Iowa. Much better quality than Salome and can be grown over a wider range than Jonathan. It has a tendency to overbear and must be thinned. Also, to develop colour and quality it must be left on the tree as late as possible. When well grown it is a medium sized, long keeping, attractive variety. Worth a trial where Salome has been grown.

SPILAW, SPIMIL, SPIRETTA. These Spy seedlings originated at the C. E. F., Ottawa and were selected as hardy varieties to succeed where Spy was too tender. Although they come into bearing earlier than Spy, as grown at Vineland they do not compare with that variety in other respects. Because of hardiness they may have a place in the colder areas for which they were selected.

SPY. Ranks second to McIntosh in nursery tree sales (1940 — McIntosh 93,158 trees, Spy 33,176 trees or together 126,339, out of a total of 191,628). This planting trend has continued for some years in spite of the many variety weaknesses. Spy is notoriously slow in coming into bearing (partially overcome by light pruning of the young trees). The fruit bruises easily and must be handled with special care. In light crop years the fruits become too large, are subject to bitter pit and breakdown. Spy keeps well and extends the apple season well into the spring months.

SPY SPORTS. The red sports of Spy have yet to establish themselves as the equal in all respects of the ordinary Spy. Their blush red lacks the brightness and liveliness of the streak red of the parent type, and quality seems to be below that of ordinary Spy. Also, the trade, as yet, does not fully recognize the red sports as being Northern Spys, differing only in their higher colour. Red sports of Spy under test at Vineland include FARLEY, GENEVA, LAITHWAITE, STUART and REDWIN SPY.

STARK. At one time Stark attained some importance as an export variety because of its season but in recent years it has received little attention. The variety is only moderately hardy, of inferior quality, and generally lacking in appearance. Its only claim for recognition is the late marketing season in those sections where Baldwin is not hardy.

STARKING. See Delicious.

WEALTHY. Hardy, early bearing, maturing ahead of McIntosh. When well grown it is an attractive red apple of good size, when well thinned. It has the added virtue of being a useful pollinator, blooming between McIntosh and Spy.

WOLF RIVER. An old variety valued for its hardiness in Eastern Ontario where it is grown to some extent. The very large, red apples are useful only for culinary purposes. The tree is large and vigorous.

YELLOW TRANSPARENT. Useful mainly because of earliness and hardiness. It bruises easily, and being yellow these bruises show badly. Market demand is variable.

PEAR DESCRIPTIVE NOTES

ANJOU. Anjou ranks next to Bartlett and Kieffer in commercial importance in the Niagara District. It lacks in crop dependability and the fruit drops badly before proper maturity. When well grown and properly handled Anjou is considered a good late market variety. The tree is less subject to blight than most pear varieties.

BARTLETT. Succeeds well over a wide range of soils and, except for susceptibility to blight it is a most satisfactory orchard variety. It is an early and regular bearer. The fruit is highly regarded for all purposes. To obtain full quality in the fruit it is necessary that it be well grown, and because of the fear of blight this requires careful orchard soil management. For trees making poor growth extra feeding is advised. The Bartlett pear and the Elberta peach are usually harvested about the same time and, because of the labour problem, this should be borne in mind by the grower who wishes to grow both fruits in quantity.

BOSC. For a long time, because of its susceptibility to blight, this variety was not planted. In recent years blight has not been so prevalent and Bosc is again receiving attention. When well grown it is a high quality attractive pear in good demand. On poor soils it lacks size and finish. Susceptibility to blight will still be a deterrent to general planting.

CLAIRGEAU. In appearance this is one of the most attractive pears and one which also has good tree characters and dependability of cropping. The fruit falls down badly in quality, however, being woody in texture. Nevertheless it keeps well and may have some merit as a late keeping variety.

CLAPP. Like Bosc this variety has lost in favour because of susceptibility to blight but is now regaining some prominence. Its main value lies in its size, season, and hardiness. It is a large attractive late summer variety to precede Bartlett. Another serious fault of Clapp is that it must be picked at just the right stage of maturity as picked too early it lacks flavour, and if left too long on the tree is breaks down at the core.

CONFERENCE. At one time it was hoped this popular English variety might have a place in Ontario to fill Duchess season. On the heavier soils it has proven most disappointing, lacking in size and appearance. On the lighter soils it performs much better but still falls short of the desired market qualities.

FLEMISH BEAUTY. Owing to susceptibility to scab this variety cannot be recommended for general planting. Hardiness however may earn it a place outside the main pear districts. Flemish Beauty ranks high in quality but requires careful timing of harvesting to obtain full flavour and freedom from breakdown.

GIFFARD. This is probably the only early summer pear with sufficient size and quality to warrant planting. For an early pear it keeps well if picked at the right stage. Usually ready mid-August.

GORHAM. An introduction from Geneva. It ripens about two weeks after Bartlett which it resembles in colour, shape and size, and in its juiciness and rich flavor. Unfortunately at Vineland it has been a shy bearer.

HOWELL. This early winter variety is on the recommended list as a special market sort. It is only a fair orchard performer. The fruits at picking are smooth, medium size, dark green. If stored it assumes an attractive rich lemon yellow. Owing to a nursery mixture Vermont Beauty, a small late blush variety, has been frequently confused with Howell.

KIEFFER. Ease of growing and handling, canning factory demand, and freedom from blight, all contribute to make Kieffer a leading commercial variety. However, it should be remembered that it is strictly a canning, not a dessert, variety, and should be planted accordingly, preferably in large blocks (with provision for cross-pollination). Season October and later.

OLD HOME. This variety is mentioned, not because of desirable fruit character but because of its possible usefulness as stock upon which to topwork blight susceptible varieties. In British Columbia marked success has been obtained by using Old Home as a frame upon which to topwork other varieties. Trees are now planted at Vineland for topworking tests.

RUSSET BARTLETT. A russet bud sport of Bartlett, originating with the late N. P. Moyer, Jordan Harbor, Ontario, and which may have value partly because of its attractive russet colouring, and partly for its longer edible season than Bartlett. It is Bartlett in size, shape, quality, etc., differing primarily in its russet finish. The fruit can be allowed to hang longer on the tree, and after picking and ripening it remains in edible condition longer than Bartlett. Since it is a bud sport of Bartlett, the two varieties will not cross-pollinate each other.

SECKEL. This variety has been highly rated on some markets for its quality. In Ontario it is generally regarded as a pickling pear. The fruit is small, attractive, ripening in late September and October. It should be planted only for home use, or for some special market demand.

SHELDON. A high quality russet pear of roundish shape. Useful for home use, but will not bear sufficiently to make it a profitable market variety.

SOUR CHERRY DESCRIPTIVE NOTES

MONTMORENCY is the only sour variety recommended for general planting. Many strains of this variety are offered to the trade but none of those fruited at Vineland has been outstanding. A few recent "better" strains however have yet to fruit. Montmorency responds to good care and feeding and for the present this is the best way of "improving" the variety.

SWEET CHERRY DESCRIPTIVE NOTES

BING. A popular Pacific Coast variety, regarded as too susceptible to splitting in Ontario to be recommended. Nevertheless because of its productivity, and maturing as it does about with Schmidt when cherry offerings are usually light, Bing has been planted by some growers. To avoid splitting there has been a tendency to harvest Bing too early, especially in wet seasons. The fruit is large, black, firm, and of good quality. Tree characteristics are good.

BLACK TARTARIAN. One of the two most widely grown sweet cherries in Ontario, Windsor being the other. Black Tartarian will grow over a wide range of soils but does best on the good deep "cherry" soils. It matures in early season, being perhaps the first dependable black variety. The fruit is of above medium size, good quality, somewhat soft requiring careful handling, and is of little use for canning.

EARLY LYONS. An old French variety only recently receiving grower attention on this continent. Fruit is medium to large, black, fairly firm, of good quality, maturing about a week before Black Tartarian. Its chief fault is the tree, which has long willowy branches. This, together with the long fruit stem, may result in considerable bruising of the fruit in windy seasons. Where possible it should be grown in a sheltered location.

EARLY RIVERS. Another old variety which is receiving attention. Matures before Early Lyons but is not quite so large. Tree characters are good. As with other early cherries birds are a problem but where protection can be given it is a promising early.

ELKHORN. Until recently Elkhorn and Schmidt have been confused, resulting in many conflicting opinions. Elkhorn is late ripening, the fruit is variable in size and usually runs small as the tree becomes older. It is only moderately productive. Quality is good, rich, and when canned the flavour ranks with the best.

GIANT. Giant is a real black, maturing about with Windsor and may have special value where the colour of Windsor is considered too light. Fruit size and quality are good. It is less subject to cracking than Bing. It still remains to be seen how it will compare with Windsor for hardiness, productivity and general usefulness.

GIL PECK. A new introduction from Geneva, and described as large, dark, purplish black, firm-fleshed, juicy and richly flavoured, maturing a little later than Schmidt. Not yet fruited at Vineland.

HEDELFINGEN. Recommended as a large, firm-fleshed, black cherry to follow Windsor. The fruit appears to be more resistant to cracking than most. It colours early but early colouring should not be confused with maturity. Fruit appears to hold up well after coming out of cold storage.

KNIGHT, (Knights Early Black). One of the earliest maturing cherries but unless protected, birds may destroy the crop. It is a heavy producer and the fruit may run small. Black, good quality. Good tree.

LAMBERT. Lambert, like Bing, is a popular Pacific Coast variety but as it lacks the productivity of Bing and splits even worse it is being planted only in very limited numbers in Ontario. The fruit is large, black, firm and of good quality, maturing after Windsor. The tree is quite upright in growth habit rather than spreading.

NAPOLEON. This productive variety known as Royal Anne on the Pacific Coast, is a large, firm, white cherry. It is now in demand for maraschino purposes, the future of which may depend on trade conditions after the war. Relative cost of production will likely be the determining factor.

SCHMIDT. A large, black cherry of good quality, maturing between Black Tartarian and Windsor. The tree is slow coming into bearing and is never overly productive, but this is compensated for in the large size and attractive appearance of the fruit. The tree does poorly on shallow soils, or where moisture is deficient.

SENECA. Originating at Geneva, this variety is the earliest known sweet cherry, ripening about two weeks before Black Tartarian. Because of the short period between bloom and fruit maturity it must have ideal soil conditions to bring the fruit to full size. Colours quite early and is often stripped by birds before reaching reasonable maturity. Where soil conditions are satisfactory and protection from birds is feasible, the variety is useful because of its very early season.

SODUS. A recent introduction from Geneva, and described in part: "Sodus is the best of the light coloured seedlings which have yet been originated on the grounds of the Experimental Station. It is as large as Victor which it resembles, but ripens a little earlier and is a little firmer. In quality it is one of the best. The tree is vigorous, healthy and productive." It has yet to fruit at Vineland.

VELVET, (160119). A Windsor seedling originating at Vineland and introduced in 1937. The fruit is large, black, maturing after Windsor, or with Hedelfingen. It may have special value for the quick freezing process. The trees are large and vigorous but are slightly susceptible to lime-sulphur injury resembling Schmidt in this respect. Further tests are necessary to ascertain whether Hedelfingen or Velvet will prove the better late variety over a wide range of soils and seasons.

VERNON, (160133). A Windsor seedling originating at Vineland and introduced in 1937. The fruit is large, black, very solid fleshed, maturing about with Bing but much less susceptible to cracking.

VICTOR, (160138). A Windsor seedling introduced in 1925. The fruit is large, white fleshed, firm, somewhat acid until fully ripe, then of good quality. The pit is unusually small. Victor matures slightly before Napoleon but has better crop distribution on the tree and therefore is less inclined to rot in wet seasons. Also it is more attractively coloured than Napoleon, the white ground colour being well covered with lively red. The fruit cans well.

WINDSOR. This widely grown variety originated in Windsor, Ontario, and has long been regarded as the main sweet cherry variety. It is probably as hardy and cosmopolitan as any. The tree is large, vigorous, and prolific. On some markets the colour is not considered black enough but this is not regarded as serious in Ontario.

PEACH DESCRIPTIVE NOTES

AFTERGLOW. An Elberta type but maturing 2-3 days later. Inferior to Elberta in size, colour and quality, as grown at Vineland. Rated superior to Elberta in New Jersey where it originated.

AMBERGEM. A "rubber-flesh" cling suitable only for canning. Yellow flesh with some red colour.

BONNIE. Favored in the Burlington area because of better than average hardiness. Yellow, freestone, ripening 4-5 days before Elberta.

BRACKETT. Generally Elberta type, long, flat, often pointed. Lacks colour and is otherwise unattractive. 3-4 days after Elberta. Fair quality, semi-free.

BUTTERCUP. An attractive, good quality very early variety, ripening with June Elberta. Semi-cling. Colour somewhat dull, but good appearance. **Promising.**

CANDOKA. Self-unfruitful, possessing no good pollen of its own. Also the blossoms are small, pale, and inconspicuous making cross-pollination doubtful. This is borne out by almost complete failure to bear at Vineland. What fruit there is is an attractive red and almost as smooth skinned as a nectarine.

EARLY ELBERTA. (Stark's Early Elberta). Preferred by some to Elberta which it resembles. Generally sets heavier crops than Elberta and runs smaller in size unless thinned. 3-4 days earlier.

EARLY FORTUNE. Early yellow flesh cling, maturing two days after June Elberta. Fair quality, inclined to uneven ripening, being green and hard around the pit when otherwise soft. May overbear, requiring thinning to secure sufficient size.

EARLY HALEHAVEN. Matures with or just ahead of Golden Jubilee, and may replace that variety. It originated as a limb sport of Halehaven and is apparently identical with that variety in all respects except that it ripens 10-12 days earlier. **Promising.**

ELBERTA. The dominant commercial variety and requiring little comment. Its faults are mainly mediocre quality and the too easy dropping of the fruit before full maturity. To displace Elberta any new variety must at least equal it in its good qualities,—size, appearance, shipping ability, market reputation, adaptability to varying soils and climates,—and exceed it in quality and ability to hang well to the tree.

ERLY RED FRE. Described by the Maryland introducer as a large, highly coloured, white flesh, freestone peach of fine quality, ripening about three weeks before Golden Jubilee which would probably be about June Elberta season in Ontario. Semi-free only in two years' Vineland observation.

FERTILE HALE. Supposed to be a self-fruitful "sport" of J. H. Hale and ripening with Elberta. Fruit characters are intermediate between J. H. Hale and Elberta. At Vineland Fertile Hale crops rather lightly, is semi-free only, and the fruit drops as readily as Elberta.

FISHER. A bud sport of Valiant which it closely resembles in fruit characters, although less of a freestone, but differing mainly in season being three weeks earlier. Also Fisher has apparently given rise to a further bud sport, the fruit of which is misshapen and undesirable. At its best and when free of this latter sport, Fisher is a valuable early sort ripening a few days after June Elberta.

GAGE ELBERTA. An Elberta type peach, possibly 2-3 days later in maturing, and hangs better to the tree. The tree itself is not as large or robust as Elberta, and is low and spreading in type. The fruit is no improvement over Elberta and it may not be as dependable a bearer.

GEDDES. A chance seedling from a Grimsby orchard, introduced in 1937. Fruit characters are generally satisfactory although quality is below that of Elberta, which it otherwise somewhat resembles. The main value of Geddes is in its season, ten days after Elberta.

GOLDENEAST. Well regarded in New Jersey where it originated, as a yellow flesh freestone to fill in about two weeks before Elberta or about with Valiant under Ontario conditions. At Vineland the fruit retains its greenish ground colour at maturity, an undesirable character.

GOLDEN GLOBE. A New Jersey origination of Vedette season, good appearance, yellow flesh, semi-freestone. New Jersey description rates Golden Globe as of exceptionally high quality. In the cool 1942 Ontario season it developed only fair quality on young (4 year old) trees.

GOLDEN JUBILEE. This New Jersey variety, maturing three days ahead of Rochester, has been extensively planted in Ontario, and is generally well liked by grower, canner, and consumer. The fruit is Elberta type, freestone, and peels and cans well. It is rather slow to come into bearing, (about five years) and then bears moderately, seldom requiring thinning.

HALBERTA GIANT. This variety has received considerable prominence lately. At Vineland it is self-unfruitful, the blossoms being small and without good pollen. The fruit outwardly resembles J. H. Hale but has a large hollow pit area, where decay starts. Like Hale, it is a shy bearer.

HALEHAVEN. Matures 15-18 days before Elberta (Valiant season). The fruit is highly coloured, of good quality, somewhat soft flesh, but should ship well, due to its tough skin. Inclined to overbear and therefore requires careful thinning to insure good size. Poor canner.

HARDEE. An Elberta type, maturing 2-3 days after that variety, but inferior to it in size, appearance, and quality. It is advertised as being unusually hardy in bud and wood, and may have value on that account for home planting in non-commercial areas.

HARDY ELBERTA. As grown at Vineland it is probably identical with Gage Elberta, which see.

J. H. HALE. At one time extensively planted because of its large showy fruits, J. H. Hale has lost in favour with most growers because of serious defects,—weak semi-dwarf trees, susceptibility to winter injury, and self-unfruitfulness which is only partially overcome by mixed planting.

JULY ELBERTA. Elberta style and quality, ripening just ahead of Vedette. Large size attractive fruit. **Promising.**

JUNE ELBERTA. Originally named Mikado, the name June Elberta being an improper nursery renaming now generally accepted by Ontario growers. June Elberta has been a fairly satisfactory early variety, and although self-unfruitful is readily cross-pollinated. Many of the first fruits to mature are undesirable "split pits". June Elberta may eventually be displaced by Buttercup, or Marigold, or some similar variety.

KALHAVEN. Ripens in a needed season, between Veteran and Elberta. The fruit is of Crawford rather than Elberta type, of fair to good quality, light yellow, firm flesh and should stand shipment. In Michigan, it is described as normally very productive, requiring thinning to attain good size. Five year old trees at Vineland bear this out. **Promising.**

LATE ELBERTA. As the name implies, it is an Elberta type, but later (two weeks at Vineland) in season, otherwise it has little to recommend it. Growers have sometimes confused Late Elberta with regular Elberta, owing to the loose use of the term "late" to distinguish regular Elberta from Early Elberta.

MARIGOLD. This variety is on the "Trial" list because of its early season, (with June Elberta) and attractive colouring. However it is medium to small in size requiring heavy thinning, and is semi-cling. Other varieties of approximately the same season may eventually be preferred.

McGUIGAN. Originated at Cedar Springs, Ontario. Elberta type fruit of large size, good appearance, and Elberta quality, maturing about a week before Elberta. Recommended for trial because of its desirable season.

NEW JERSEY 102. This New Jersey variety has not yet been named or introduced. 1937 planted trees at Vineland have borne good crops of medium large, globular well coloured attractive fruits of good quality, yellow flesh, freestone. Ripens 2-3 days before Vedette. **Promising.**

ORIOLE. A New Jersey introduction now planted in some quantity in Ontario. It lacks in appearance being a dull blush red. Nevertheless it is a good quality early freestone maturing with Fisher. It must be thinned heavily to produce satisfactory size and there is some evidence of fussiness as to soil and location. Fisher is perhaps a better variety in the same season unless in its present unfortunate tendency to malformed fruits.

REDELBERTA. Elberta type and quality. The colour is hardly attractive, being a dullish blush. The fruit is medium size or less, and generally the variety as it grows at Vineland is not impressive unless as a variety to fill in before Elberta. It ripens with McGuigan and Kalhaven.

REDHAVEN. Vineland trees, planted in 1941, are too young to assess. Michigan State College describes Redhaven as firm fleshed, good quality, and likely to ship better than most varieties of its season. In 1942 at Vineland it ripened a day or so after Fisher and Oriole. Michigan also notes that it sets fruit profusely and will need to be well thinned.

RIO OSO GEM. Regarded as promising as a variety to follow Elberta, though the trees may lack somewhat in vigor, resembling J. H. Hale in that regard. The fruit is attractive in size and appearance, hangs well to the tree, is firm fleshed and is fair to good in quality. **Promising.**

ROCHESTER. Not now recommended unless for exceptionally good soils and unusual care. The variety requires heavy manuring, pruning, and thinning, otherwise the fruit will be small, dull and fuzzy.

SHIPPERS LATE. There are several strains or varieties being grown under this name so that it is difficult to determine its value. Of the three strains at Vineland one is probably J. H. Hale, another very closely resembles Elberta both in fruit and in season, and the third, which somewhat resembles Elberta in appearance, ripens 4-5 days later. The latter may have value on that account although it also has Elberta's fault of dropping too readily.

ST. JOHN. Now little grown as it has been superseded by newer varieties more dependable in yield, less critical as to soil and location and better shippers. Nevertheless St. John has a delicious quality not wholly duplicated in those which have displaced it.

STRICKER. A local variety of Veteran season, and a heavy, regular cropper requiring thinning to attain satisfactory size. Even so the fruit tends to run small as the tree gets old, and may also be too dark in colour.

SUNBEAM. Recommended in the United States for quick freezing, being a "non-oxidizing" yellow flesh, i.e., the cut flesh is slow to discolour. Season is early, a week before Vedette, fruit is on the small side, rather dark in colour, good quality, almost freestone, deep yellow flesh.

TRIOGEM. Season 3-4 days after Golden Jubilee or 2-3 days before Vedette. Triogem is an attractive peach, medium size, probably requiring thinning. The yellow flesh is firm, fine grained, good quality, semi-free. The fruit hangs well to full maturity. **Promising.**

VALIANT. One of the first of the "V" peaches to be introduced (1925) and now widely planted. In season it follows Vedette, and is Elberta type though fuller, rounder, and higher quality.

VANGUARD. Introduced in 1941 and offered for trial as an early yellow flesh, semi-freestone of Fisher and Oriole season. Under test it has been a dependable bearer of good sized fruit with no tendency to misshapenness. Attractive in appearance and good in quality.

VEDETTE. With Valiant, the first of the "V" introductions (1925) and probably the most extensively planted. At the time of their introduction, Vedette and Valiant filled the need of more dependable yellow flesh, freestone peaches to take the place of the temperamental St. John. In occasional seasons Vedette may be semi-free only.

VEEFREEZE. Introduced in 1940 primarily as a quick freezing yellow flesh variety with the "non-oxidizing" quality noted for Sunbeam. In freezing tests by the Department of Horticulture, O. A. College, Veefreeze has been consistently good, being preferred to all other varieties tested. As the quick freezing industry is developed there is likely to be a demand for such varieties as Sunbeam and Veefreeze.

VETERAN. At its best Veteran fills a needed season between the earlier "V's" and Elberta. However Veteran needs better cultural conditions than Elberta for example, otherwise the fruit matures too early and lacks quality. Usually it is semi-free only. It bears well, requiring thinning, and is hardier in bud than most commercial varieties.

VICEROY. This variety was distributed under number for test purposes, but was later named as a number of growers liked it and had propagated it. It is particularly dependable as a bearer, having good crops in seasons of comparative failure in most varieties. However the fruit is semi-cling and is thin skinned, bruising rather easily, and is therefore not recommended for general planting.

VICTORY. A chance seedling originally propagated some years ago by a Beamsville grower who is introducing it in 1943 under the above name. Victory is an Elberta type peach, being very similar in every way to that variety, including season, but it hangs well to the tree until fully mature. Promising on that account.

VIMY. This is a self-unfruitful variety and it is therefore not recommended for general planting. Due to a nursery mixture it was disseminated for a time as Vedette, and as many trees had been planted in error, it was considered advisable to name it. The crop is usually light, the fruit large and showy, flesh greenish yellow and not favored by the canners.

WILMA. At one time Wilma seemed to be the most suitable variety to extend the Elberta season, even though it is tender in bud and otherwise variable as to performance. At Vineland some of the newer varieties as Rio Oso Gem, Geddes, and Station Sdlg. No. 290159, give promise of being definitely superior to Wilma as late Elberta type varieties.

YELLOW SWAN. Although an old variety, Yellow Swan still has a place as an early season sort to follow June Elberta. It may eventually be displaced by one or other more recent introductions, especially as the fruit is rather too dark and dull in colour, and the tree is short lived.

EUROPEAN PLUM DESCRIPTIVE NOTES

ALBION. A recent introduction from Geneva. The blue fruit is large, roundish in shape, firm texture, fair to good quality, ripening about a week after Reine Claude. Because of appearance and size it should be a valuable variety to extend the plum season.

DAMSON. Prolific, and a very desirable processing plum when properly mature. The much increased production which followed heavy plantings around 1920 was greatly aggravated by growers and dealers rushing the market with fruit which, though coloured, was weeks away from proper maturity, very astringent, and really unfit for use. Many trees were removed, others topworked, relieving the situation somewhat. Damsons hang well to the tree, and if left to attain full size and flavor they would undoubtedly give much better consumer satisfaction with consequent improvement in crop movement.

The "Canadian" Damson has recently been found to differ from the Shropshire Damson as grown in the Old Country. The English Shropshire is prune-shaped, less of a clingstone than the Canadian, of much better quality and superior for jam-making. In yield however, the Canadian Damson may prove superior, judging from the performance of young trees. Some Ontario nurseries are now propagating both varieties.

EARLIANA. The earliest blue European variety under test at Vineland. Earliana is of good size and quality and attractive appearance, maturing about a week before Shiro. The tree is a weak grower, especially on heavy soils and it is also susceptible to European red mite. Because of size, appearance, and season Earliana is worth a trial on the better plum soils.

GERMAN PRUNE. Originally this variety was disseminated by seed, probably accounting for the several strains most of which have only minor differences. One, the Latz German Prune, however is distinct, as it is a cling-stone, and is a plum rather than a prune. Although once heavily planted it is now rarely seen. The free-stone German prunes are smaller than the Italian. They mature with the latter, hang to the tree better, but have few if any other advantages over Italian.

GOLDEN DROP. (Coes Golden Drop). This high quality yellow variety has received little attention from the grower, possibly because it matures in a season just after Italian Prune when the fruit market is well supplied. Prior to the war it was in some demand as an export variety.

GRAND DUKE. Heretofore regarded as one of the main late blue varieties there are indications that Grand Duke may find competition from Italian Prune. Although Grand Duke matures 4-6 days after the Italian, the latter can hold over a long period and on a glutted market stored prunes will compete with the marketing of Grand Duke. This will probably have to be considered in future plantings. In other respects Grand Duke is still a desirable market plum.

HALL. This is a recent Geneva introduction from a cross of Golden Drop x Grand Duke. Hall is a very large, attractive blue plum maturing before Italian Prune. Unfortunately the flesh breaks down in cooking, hence it cannot be recommended as a general market variety. Size and appearance may earn it a place for a special trade, as roadside markets.

IMPERIAL EPINEUSE. An old French prune of excellent quality either fresh or canned. The fruit lacks an attractive finish, being a reddish purple. For home use or on a special market where the quality is recognized it may have a distinct place. It matures about with Italian Prune but is of better quality.

IMPERIAL GAGE. Opinion varies greatly concerning this variety, as it performs differently on different soils, and also many varieties have been sold under this name. The nurseries have largely corrected this latter and if heavy clays are avoided, planting only on the best (lighter) plum soils the variety is more dependable. Where a Gage plum is wanted for early September, Imperial Gage is probably the most satisfactory.

ITALIAN PRUNE. (Fellenberg). A medium sized free-stone blue prune with good keeping qualities, much in demand by fruit buyers and more recently by canners. The tree is somewhat slow coming into bearing but is eventually a dependable bearer. Because of bearing all through the tree the crop usually exceeds expectations. The fruit may drop badly when nearing maturity.

LOMBARD. An old variety useful mainly for canning. It bears heavily and for best returns should be thinned in heavy crop years. Often it is picked too immature for any purpose, fresh or processing.

MONARCH. This attractive blue plum matures just after Italian Prune. Lacking the all-round excellence of the latter, Monarch's value to the grower is now limited. The fruit is of medium size and fair quality.

PACIFIC. A large attractive blue prune and an old variety which has been receiving fresh interest because of good appearance. It matures before Italian Prune and could be useful for a fancy market trade. Pacific blooms late and is therefore useful to grow with Italian Prune for pollination. The fruit is subject to splitting in wet weather.

PRESIDENT. This, the latest maturing European variety under test at Vineland, is often only mature by Ocober 15th or shortly before. It is a large, attractive, blue-fruited variety with firm, semi-free orange flesh of fair to good quality. The fruit holds well after picking. Tree characters and cropping are good. President is considered promising as a very late variety.

REINE CLAUDE. Since 1699 Reine Claude has been considered the standard in plums. It comes into bearing early and is very prolific, frequently over-bearing, making the tree subject to winter injury. Thinning helps to overcome this weakness. Considerable variation seems to exist as to size, quality and general appearance of fruit which may be due to accidental propagation of bud sports or seedlings during the long history of the variety.

STANLEY. A hybrid of Agen and Grand Duke introduced by Geneva to precede Italian Prune. Unfortunately at Vineland, Stanley matures with Italian and for that reason meets stiff competition. It is smaller than Italian and in some seasons at least the stone is somewhat clingy. It is inclined to overbear and will require thinning. It blooms about with Italian Prune and may be useful to pollinate that variety.

WASHINGTON. This large, attractive good quality Gage plum, maturing about with Burbank was at one time quite extensively planted but, apparently proving unproductive, the variety has now almost disappeared from the nurseries. The difficulty has been that Washington and General Hand have been confused, the latter, though closely resembling Washington in appearance and season, being a notoriously shy bearer. In Vineland tests the true Washington has been a heavy and consistent yielder, and merits further trial as a commercial variety especially in view of its desirable season.

JAPANESE PLUM DESCRIPTIVE NOTES

ABUNDANCE. Perhaps the only justification for listing this variety is that in some orchards it has been observed to be a good pollinator for Shiro. It is a heavy annual bearer. It may be subject to brown rot.

BURBANK. One of the main Japanese varieties grown in Ontario and in demand for jam as well as for fresh fruit. When not allowed to overbear it develops good size and attractive appearance. Burbank will **not** pollinate Shiro.

CRYSTAL RED. This is an early August red variety of fair size and quality introduced in 1940 by a Grimsby grower. **WRIGHT'S EARLY,** a new introduction from New Zealand, is much the same in appearance and season as Crystal Red. Both deserve a trial as early season varieties.

METHLEY is another early New Zealand variety, matures with Crystal Red and Wright's Early but is of larger size, purple, red flesh, and of fair quality. The tree is vigorous. The fruit will require care in picking as the stem does not separate easily from the fruit nor is it easy to pick with the stem on. Wright's Early picks easily.

RED JUNE. Like Abundance, this variety is listed only because of the orchard evidence indicating it to be a good pollinator for Shiro. The color is a mottled garnet red with a light yellow flesh. Very clingy. Early season.

SHIRO. A yellow fruited plum, it is one of the most popular Japanese varieties because it matures when few other plums are on the market and is very attractive in appearance, **when properly mature.** Unfortunately Burbank, the other popular Japanese variety will not pollinate Shiro and therefore another Japanese variety, or the European variety Reine Claude, should be planted with it for pollination. Shiro, when properly mature (about mid-August) is good in quality. Consumer confidence in the variety is being impaired by the marketing of much too immature fruit by many growers.

SUPERIOR (Minn. #194). This recent introduction from Minnesota resembles Burbank very much in appearance and general characters but is about two weeks later. Young trees at Vineland also indicate that it will be an early and heavy bearer, and will probably require thinning. Hardy.

GRAPE DESCRIPTIVE NOTES

AGAWAM (Rogers' 15). A self-fruitful Rogers' hybrid; vigorous, usually hardy, moderately productive, subject to mildew. The fruit is red, large and attractive, foxy in flavour and with a thick skin and coarse pulp. The fruit stores well.

BRIGHTON. A self-unfruitful, red variety, suitable only for local and roadside marketing because of the thin, easily broken skin and poor keeping quality. The vine is vigorous, productive, adapted to various soils. The bunches are moderately large, attractive, and the quality of the fruit excellent.

CAMPBELL. (Campbell's Early). Satisfactory only on light, deep soils, where the vine is hardy, vigorous and productive. On such suitable soils the bunches and berries are large, attractive, and blue-black in colour. On heavy or "normal" grape soils Campbell ripens unevenly and the bunches are poorly filled and straggly. The quality is excellent when mature. It is often cut immature because it colours early, and the quality is then poor and acid.

CATAWBA. A red variety used for wine, which requires too long a season to be generally grown in the Niagara District. It has succeeded quite well on Pelee Island, the most southerly part of Ontario. In the Niagara district it ripens better back from the lakeshore and on warm well-drained soils. The foliage is subject to mildew in some seasons.

CONCORD. Adaptability to varying soils and climatic conditions have made it the most popular variety in Ontario for both wine and dessert purposes. The vines are vigorous and productive. The blue fruit does not have high quality, is foxy, but is nevertheless a popular table grape. It tends to shell badly if held some time after picking.

DELAWARE. The best of our varieties with respect to quality and, because of this, commanding a premium as a table grape on most markets. It is also widely used for wine. The bunches and berries are small and the vines lack vigour so that close planting is necessary to bring up the per acre yield. The foliage is quite susceptible to mildew. Delaware requires a deep, rich, well-drained soil, thorough cultivation, and relatively heavy pruning.

DUNKIRK. Originated by the N.Y. Agr. Exp. Station and introduced as a red variety to fill the place of Delaware. The variety is described as having vigorous, hardy, healthy, productive vines, with medium sized clusters of fruit of good to very good quality, ripening shortly before or with Concord. The skin is tough enough for shipment. Fruited at Vineland 1928-30 it was not impressive. Vines planted later, in 1939, have proven untrue-to-name.

DUTCHESS. A green grape which has been used for champagne. The vines are somewhat tender to cold, and capricious as to soil. Foliage and fruit are susceptible to mildew. When well grown the bunches are medium-sized and well filled, and the fruit of very good quality. Not adapted to heavy clay soils.

FREDONIA. A vigorous, hardy, productive, black grape. The berries and bunches are moderately large and of good quality. Foliage and fruit susceptible to mildew. Probably the best early black grape to replace Moore.

GOLDEN MUSCAT. A yellow-green variety which ripens too late for most locations in the Niagara District. The vines are vigorous, hardy, productive. The bunches and berries are very large and impressive in appearance. In a long warm season the fruit attains fair to good quality, though the flesh is somewhat stringy. The tender skin would limit it to roadside or local markets.

HERBERT (Rogers' 44). A self-unfruitful "Black Rogers", very vigorous, hardy; fruit handsome, large, of very good quality; keeps well in storage. As with all self-unfruitful varieties it must be interplanted with another variety producing good pollen. Even when this is done the bunches are frequently somewhat loose and the crop therefore not heavy.

IVES. Some years ago Ives was planted in fairly large quantity in the Niagara District on the strength of its reputation for making red wine. Under our conditions the vines proved weak and unproductive so that the variety has again fallen into obscurity.

LINDLEY (Rogers' 9). A self-unfruitful red Rogers, requires interplanting to ensure a crop. Vine vigorous, fairly hardy, somewhat susceptible to mildew. The variety is on the way out and is now chiefly found in older vineyards.

LOMANTO. A black grape suitable for wine production only and may prove quite valuable for this purpose. Vines are very vigorous, hardy and productive, equalling Concord in this respect.

MOORE (Moore's Early). Now being replaced by Fredonia. Moore prefers a rich, loose, well drained soil. The berries sometimes crack and shell badly and bunches may be loose.

NIAGARA. The most popular green grape. Vines are vigorous, only moderately hardy, when well grown more productive than Concord but more susceptible to diseases. Bunches are larger than Concord; very well filled. Quality good when properly mature. On suitable warm, dry soils Niagara acquires a rich golden finish to the berries where otherwise they are inclined to be quite green even when fully mature.

ONTARIO. Vines vigorous, productive, moderately hardy, prefers the heavier grape soils. Bunches are a little loose and the fruit, which is green, does not keep or ship any too well. Good for both dessert and wine purposes. First class for home use. Ontario ripens 3-4 days before Moore.

PATRICIA. Ripens with or just after Moore. Vines vigorous, productive, healthy. Quality only fair, flesh somewhat pulpy. Its chief value lies in its earliness combined with vigour and productiveness as compared with Moore. Fredonia is a better-all-round blue variety than either Patricia or Moore.

PORTLAND. A green variety of the same season as Ontario or a few days before Moore. It is a better market variety than Ontario and better suited to light soils although like Ontario, it does not keep or ship too well. Vines are very vigorous, hardy, productive and healthy. Quality not as good as Ontario.

RUBY. A new red variety not generally known or planted in Ontario. Vines are vigorous, hardy, productive. Ruby follows Concord in season and shows promise as an attractive red grape for market and roadside sale.

SALEM (Rogers' 22). A self-unfruitful red Rogers. Often not productive and susceptible to mildew. Bunches are medium to large, compact; berries large, quality excellent.

SENECA. A very early green grape having fruit qualities of the European type. Bunches are medium sized; flesh firm, tender, excellent quality. Attractive to birds and therefore must be watched closely as it approaches maturity. Vines vigorous, hardy, productive.

SHERIDAN. A black grape which ripens too late for most locations in the Niagara District, otherwise it would be a useful variety to extend the Concord season. The vines are vigorous, hardy and very productive. Where it ripens the quality is better than Concord.

VAN BUREN. Promising as a very early black variety for roadside markets. Clusters medium sized, berries smaller than Concord; quality good.

VERGENNES. A late red variety which benefits from being interplanted with other varieties. The vines have a straggling habit of growth which is objectionable, and are variable in vigour and hardiness with a tendency to overbear. In warm seasons and when the crop is moderate it ripens well, is attractive in appearance, and stores well. In cool seasons, or where the crop is excessive it ripens unevenly and colors poorly.

WORDEN. An old blue variety. Compared with Concord, bunches and berries are larger, it is 7-10 days earlier, not as heavy a bearer, quality better, not as adaptable to varying soils. Crop is improved when it is pollinated by another variety. Berries are apt to split in wet weather.

EUROPEAN TYPE GRAPES. The many European or vinifera type varieties which have been tested at the Station have not proved to be commercially satisfactory for our conditions. Most of the varieties require a longer and warmer summer than we have and many varieties are not winter hardy. The experience of the U.S. Department of Agriculture, quoted below, has been the same with the varieties which they have tried in the Eastern United States.

"The growing of vinifera grapes in the Eastern States should be considered purely as an experiment. All of these varieties are very susceptible to fungous diseases and require careful and repeated spraying to protect the fruit and foliage from disease." . . . "None of the varieties have been sufficiently productive to indicate the probable economic success of commercial vinifera production in the East. Results have shown that if sufficient care is taken, the amateur gardener who is willing to spend time and money in production of grapes of this type may have fair success under climatic conditions similar to those prevailing in the vicinity of Washington." (From U.S.D.A. Circular, Vinifera Grapes in the East, by J. R. Magness).

In Ontario, interested growers and home gardeners should restrict their trials to the earlier maturing varieties and must also accept the idea of much greater cultural care if good crops of satisfactory fruit are to be obtained. In commercial production this means specialized knowledge of the cultural requirements, considerably increased production costs over Concord and similar varieties, and correspondingly increased selling prices.

BLACKBERRY AND RELATED TYPES, DESCRIPTIVE NOTES

B. C. THORNLESS. This is a fairly vigorous grower and is practically free of thorns. However its fruit is too small for the commercial grower and it is mainly of interest to the plant breeder.

BOYSENBERRY. A new hybrid somewhat of the Loganberry type. It is a vigorous grower and produces long and rather slender fruiting canes which are very prickly. In Ontario it is far from being hardy as much of its fruiting wood freezes back practically every year at Vineland, hence materially reducing the crop. Its fruit is as large as a large blackberry or Loganberry and is of a deep purple colour when ripe. When really ripe it is of very nice quality being sprightly and moderately acid. However, at this stage it is too soft to ship. At the firm stage or when it is more red than purple it is very acid. For the home garden in the milder parts of Ontario it may have a place.

ELDORADO. The variety grown in Ontario under this name may not be the same as Eldorado in New York or other Eastern States. However this may be, it is, generally speaking, the most satisfactory kind in commercial production in the Niagara fruit belt. It is a vigorous grower, reasonably hardy for this district and rarely takes Orange Rust. It yields well and the fruit is large and of good quality. Ripens several days later than the Lowden.

KITTATINNY. This name is quite commonly used when speaking of blackberries in general. Actually it is a variety name and should be used only in that sense. At one time this was a very popular variety but owing to its lack of hardiness and its susceptibility to Orange Rust it has lost favor with most growers.

LOGANBERRY. One of the first hybrid brambles. A vigorous grower of long-trailing habit. Not grown in the East on account of lack of hardiness but grown extensively on the Pacific Coast. The fruit is quite large—like a large blackberry—of dull reddish purple colour when ripe. It is of good quality but rather acid.

LOWDEN. A new variety originating at Hamilton, Ontario. It is a vigorous grower and does not seem to be susceptible to Orange Rust, also it appears to be hardier than Eldorado as grown in Ontario. It yields equally as well and ripens several days earlier than that variety. The fruit is large, of excellent quality and has practically no core.

MERSEREAU. One of the newer varieties supposed to be a seedling of Snyder. It is more vigorous than that variety and the fruit is much larger and of better quality. It is hardier than the old Kittatinny variety but not equal to Eldorado. As a cropper it is medium to good and the fruit is large and of good quality. The real Mersereau is rather slow in propagation so that true-to-name stock may be scarce.

YOUNGBERRY (or Young). Of vigorous trailing habit but not hardy in Ontario. Grown in the South and on the Pacific Coast.

RED RASPBERRY DESCRIPTIVE NOTES

ADAMS 87. A vigorous grower but rather slow propagator. Does not appear to take mosaic readily. Gives good yields of large berries, which sometimes are apt to collapse. Quality is fair to good. Ripens in early mid-season.

BRIGHTON. A moderately vigorous grower and good plant maker. Somewhat susceptible to mosaic. Fruit medium or less in size, dark red and soft. Useful for earliness on local markets. Apt to suffer from red spider in dry seasons.

CHIEF. Produces a nice type of plant, vigorous and upright with plenty of suckers. It is quite hardy and appears to resist mosaic. The fruit is of medium size and of fair quality. Chief is only moderately early, being a day or two earlier than Viking. May have value in colder sections where better varieties cannot be grown.

COUNT. Very much like Brighton in plant and fruit. Reputed to do better on the heavier types of soil. Brighton and Count are still useful for first early, but should be dropped as soon as Monroe or some other early is sufficiently proven.

CUTHBERT. A good grower when free from mosaic and produces plenty of suckers. Not always hardy. It is still recommended, where disease (mosaic) free stock can be obtained, on account of its very fine quality and the demand for it for processing. First class for the "quick freezing" method of preserving.

HERBERT. Plants generally are tall and vigorous but new canes are apt to be sparse. While it does very well in some localities it has never shown up to advantage at the Horticultural Experiment Station. The fruit is medium to large, of fair quality and is apt to be soft or crumbly.

INDIAN SUMMER. This is a new introduction from Geneva, N.Y. It is a moderate grower and produces plenty of suckers. It gives an early summer crop and a late fall crop. It is probably no better for its early crop than Brighton, the fruit being rather dark and soft, and the fall crop ripens so late that it is apt to be spoiled by frost.

LATHAM. This is a vigorous grower and makes plenty of new shoots. It takes mosaic, also it mildews rather badly in some seasons. It yields good crops of large fairly attractive fruit, which is moderately firm but apt to be crumbly on the lighter soils. The quality is only fair. This is no doubt one of the hardiest of the large-fruited reds and thrives better under adverse conditions of heat, drought and cold than most other varieties.

LLOYD GEORGE. This variety has attained prominence in England and has received considerable publicity in Ontario. It is of only moderate vigor and not any too hardy. The fruit is large and long conic, bright and attractive in appearance and of good quality but acid. Its main faults in Ontario are lack of robustness and poor cropping ability. It ripens early.

MARCY. A vigorous grower, apparently resistant to mosaic, canes sturdy and fairly tall and upright. It yields well and the fruit is quite large. On the right type of soil (heavier than at Vineland) it produces a fine conical berry but on some soils it is apt to be rough and unattractive. Ripens about with Cuthbert.

MILTON. A recently named seedling from Geneva. It is a good grower and produces plenty of suckers. The fruit is medium to large, conic, light red and of fair quality. It is not any too attractive and at Vineland in 1942 it suffered more from sun scald than most varieties. It crops well and ripens in mid-season.

MONROE. A Geneva introduction. This variety is rated by the Central Experimental Farm at Ottawa as a better early variety than either Brighton or Count and is therefore included in the varieties for trial, although so far as known no growers have yet fruited it in Southern Ontario. The plant is similar to Cuthbert in appearance and the fruit ripens about six days earlier. Berries are medium to large, firm and of good quality.

NEWBURGH. Rather low growing and branchy. Reasonably hardy but freezes back rather severely in some winters. It does not take mosaic readily although sometimes it suffers from spur blight. It is a good cropper and ripens in early mid-season about with Viking. Fruit is large, roundish, firm and very meaty, of fair to good quality. Clings rather tightly until properly ripe.

NEWMAN (Newman 23). This variety has not shown up to advantage at the Horticultural Experiment Station although it is grown to some extent in the colder parts of Ontario. At Vineland it is of fair vigor, yields moderately well, and the fruit is very firm. It is a rather dry berry of only fair quality. Ripens with Cuthbert.

STARLIGHT. This variety has some merit as a first early for local markets but at Vineland the fruit has been too small and soft to be of any value. Probably better adapted for heavier soils.

TAYLOR. A vigorous grower, sturdy, upright, and forms plenty of young shoots. It is hardy but takes mosaic rather freely although the symptoms are readily seen, making rogueing easy. It is a good cropper and the fruit is large, conic, bright red and firm. In quality it is good, and it is moderately acid. Ripens rather late, with Latham or later.

VIKING. Produces plants of very good vigor and with a moderate number of suckers. It takes mosaic but the symptoms usually show up fairly clearly so that it can be readily rogued. In some localities it is apt to freeze back, more especially on poorly drained soil. It is a heavy cropper of large, bright, lively red fruit which is firm and of very good quality. For the "quick freeze" method of preserving it is first class, being one of the best, although for canning it is not quite as desirable as Cuthbert on account of its lighter color. It ripens in early mid-season, several days earlier than Cuthbert.

WASHINGTON. This is a new variety from the Western Experiment Station, Washington State. At Vineland it makes good growth with plenty of suckers and so far is free from mosaic. It produced a moderately good crop which in 1942 ripened later than any other variety. The fruit is of medium size, moderate firmness and good quality, sweet, and of medium red color. Its value for Ontario has not yet been determined.

BLACK RASPBERRY DESCRIPTIVE NOTES

BRISTOL. A strong, tall grower but suffers rather severely from Verticillium Wilt (Blue Stem). It is a good cropper and ripens early, about the same season as Plum Farmer.

CUMBERLAND. Vigorous if free from mosaic. Disease free stock of this variety may be hard to get. This is probably the best of the old established sorts in its season. Ripens a few days later than Plum Farmer.

DUNDEE. A good grower and fairly hardy. It seems to withstand virus and Blue Stem fairly well. Yields well. Ripens a few days later than Bristol and Plum Farmer.

NAPLES. Vigorous, fairly hardy and seems to withstand virus diseases and Blue Stem fairly well. Yields well. Ripens about a week later than Bristol and Plum Farmer.

PLUM FARMER. Vigorous and hardy. Fruits large and of good quality. Ripens in early midseason.

Of the above five black caps the newer ones, Bristol, Dundee and Naples may, as their merits are established by more extended trial, eventually displace Cumberland and Plum Farmer. They are worthy of extended trial.

PURPLE RASPBERRY DESCRIPTIVE NOTES

COLUMBIAN. The old standby in purple varieties but disease-free stock is difficult to obtain. It is a good grower but not any too hardy. Fruit large and of good quality. Ripens late.

MARION. A new purple from the Geneva Station. Vigorous but kills back considerably in some winters and takes Blue Stem rather readily. It is a good cropper, fruits are large, firm, of good quality and fairly acid. Ripens late.

SODUS. Another new purple from Geneva. A very vigorous grower, kills back rather badly in some winters, and is subject to Blue Stem. A good cropper, the fruit large, firm, fairly acid, ripening several days earlier than Columbian and Marion.

Marion and Sodus are probably superior to Columbian, although they lack somewhat in hardiness and disease resistance.

RED CURRANT DESCRIPTIVE NOTES

CHERRY. Vigorous, healthy, only moderately productive. Bunches are of medium size with rather short stems, making picking a bit slow. Berries are large, good quality, very juicy, of medium acidity. Ripens in early mid-season.

FAY. Of moderate vigor and rather sprawly habit. Flowers open early which may result in frost damage in some localities. Usually productive. Bunches are large with long stems, hence easy to pick. Berries also are large, good quality, moderately acid. Fruit ripens in mid-season and clings well.

PERFECTION. Of moderate vigor and hardiness. Productive. Fruit is borne on older wood than usual for red currants. Bunches are large with long stems. Berries are large, good quality, moderately acid, apt to sun-scald on the bushes. Ripens in mid-season.

PRINCE ALBERT. Vigorous, moderately productive. Clusters are of medium length, berries are large but rather sour and seedy. Prince Albert is included in the recommended list for its lateness in ripening and the ability of the fruit to hang on a long time.

RED LAKE. A new variety from the Fruit Breeding Station, Minnesota. Vigorous, hardy and productive. Fruit large, in fairly long clusters with long stems. Good quality. Ripens in mid-season to late. Well worthy of extended trial.

STEPHENS # 9. A new variety being distributed by the Central Experimental Farm, Ottawa. The vigorous, hardy and productive bushes are apt to be a bit sprawly in habit. Clusters are medium to large with fairly long stems. Fruit large, good quality, moderately sweet. Ripens in mid-season. Worthy of extended trial.

VICTORIA. Very vigorous and quite hardy. Berries apt to be small. It ripens in mid to late season. Victoria is included in the recommended list on account of its hardiness, as it can be grown where the better varieties might be too tender.

WILDER. Vigorous, moderately hardy, productive. Berries are large on long stems. Good quality, mild flavor. Ripens mid to late season and fruit clings well. Recommended for milder parts of Ontario.

BLACK CURRANT DESCRIPTIVE NOTES

BLACK VICTORIA. An old variety which is being dropped from the recommended list, chiefly on account of its unevenness in ripening.

BOSKOOP GIANT. This variety attained to some measure of popularity on account of its large fruit but owing to its uncertain cropping habit it has been removed from the recommended list.

CHAMPION. An old variety which also has been removed from the recommended list, chiefly on account of its uneven ripening and variability in size of fruit.

CLIMAX. Originated by Dr. Wm. Saunders of London, Ontario, and distributed by the C.E.F., Ottawa. Vigorous grower, good cropper.

KERRY. Another Saunders seedling, and probably one of the best black currants. Vigorous grower, heavy cropper, fruit ripens evenly.

MAGNUS. A Saunders seedling, vigorous, excellent cropper. Fruit of uniform size and ripens evenly.

NAPLES. An old standard variety, very much planted. A good grower and productive. Fruits vary considerable in size. Ripens late.

SAUNDERS. A Saunders seedling, vigorous grower, good yielder. Fruit perhaps not quite as large as Kerry or Magnus.

GOOSEBERRY DESCRIPTIVE NOTES

CHARLES. Similar type to Pearl but rated rather better than that variety by the Central Experimental Farm, Ottawa. Hardy. Very productive. Free from disease. Red when ripe.

CLARK. A large fruited English type gooseberry, thought to be a natural hybrid between English and American varieties. It is a moderately vigorous grower, generally free from mildew, good cropper and easy to pick. Hardy except perhaps in the colder parts of Ontario. Propagated by layering.

DOWNING. An old standard variety of American origin. Vigorous, hardy, healthy, very productive but the fruit is small. Propagated readily by cuttings. Downing should probably give way to such varieties as Charles and Pearl or the larger fruited sorts like Poorman and Clark.

FREDONIA. This is a new large fruited English type of gooseberry from New York State. The plants are vigorous and of open habit that makes for easy picking. The fruit is good in quality and attractive in appearance. Ripens late, is dark red when fully mature.

JOSSELYN (Red Jacket). Vigorous, healthy, productive, free from mildew. Fruit is of medium size, being larger than Pearl or Downing. The heavy foliage tends to prevent sun scalding of the fruit. Ripens early.

PEARL. Fruit much like Downing, a trifle larger, but not as large as Poorman. Vigorous, not subject to mildew. Very productive.

POORMAN. A very vigorous grower and not subject to mildew. Yields well. Fruit above medium in size but variable. Good quality, red when ripe, early mid-season. Propagated readily by cuttings. Poorman is probably the best of the American type of gooseberry, especially on the heavier soils.

SILVIA. Similar to Charles and Pearl but considered to be better than either of these by the Central Experimental Farm, Ottawa. Productive, vigorous and hardy, free from mildew, red when ripe.

WHITESMITH. This variety is thought by some to be the same as Chatauqua, particularly on the Pacific Coast. It is an old English variety. Plants are large and vigorous. Usually productive. However, it is rather susceptible to mildew and while it is the most dependable of the English varieties, it is questionable if it should be recommended at all. Clark should probably be planted in preference.

STRAWBERRY DESCRIPTIVE NOTES

ABERDEEN. This variety is receiving some publicity in New York State. At Vineland it is a sufficiently good grower and plant maker and seems to hold up fairly well under drought conditions. It is a moderate cropper and ripens in mid-season. The fruit is of medium size and rather unattractive. It is only fair in quality and is quite acid. Does not seem to have much to recommend it.

BLAKEMORE. A profuse plant maker. Susceptible to the "Yellows" disease but disease free stock is available from United States sources. Appears to be resistant to root rot. Fruit firm, light red, acid. A moderate to good cropper. Ripens soon after Premier. It has become one of the leading varieties in the South Eastern States. Suggested for trial as a jam berry.

CATSKILL. Forms sufficient plants, healthy and a good cropper. Fruit is usually large and attractive but is sometimes poorly shaped. It is moderately firm and of good quality. Ripens in mid to late season—about a week later than Premier. Worthy of trial as a dessert berry.

CULVER. A good grower, normally making plenty of plants and bearing well. Fruit is medium to large, solid red, fair to good quality though rather acid. Ripens in mid-season, slightly later than Parson's Beauty. It is rated highly for preserving by the Geneva, N.Y. Experiment Station.

DORSETT. A vigorous grower and making plenty of plants and bearing moderately well. The first few pickings give medium to large fruit but in later pickings the size is apt to fall off considerably especially on the poorer drier soils. The fruit is firm, bright red, very attractive and of excellent quality. Ripens a day or so later than Premier. Useful as a high class dessert berry for a select trade.

DUNLAP. Lacks somewhat in vigor and apt to make many rather small plants. Compared with some of the newer and better varieties it may not have much to commend it, its fruit being rather small, soft and of only fair quality. It may however have a place where the better kinds do not flourish as it is more adaptable to widely varying soils than most varieties and is included in the recommended list.

FAIRFAX. A very vigorous grower, a good plant maker and a moderate cropper. The first few pickings give some fine large fruits but the size is apt to fall off very seriously on later pickings, even more so perhaps than in Dorsett. Requires good soil, well supplied with moisture. The fruit is very firm and of exceptionally good quality. Also it is quite attractive, except when a bit overripe, when it becomes rather dark in color. Ripens about a week later than Premier. An excellent dessert berry.

LOUISE. A new seedling from the C.E.F., Ottawa. Rated as a good late variety. It is a vigorous grower and makes plenty of plants. The blossoms are imperfect, hence Louise needs to have another variety grown with it as a pollenizer.

PARSON'S BEAUTY. Vigorous, good plant maker and a good cropper on the better strawberry soils. The fruit is of medium size, fairly attractive, firm with fair quality, rather acid. Used considerably for preserving.

PATHFINDER. This is a new variety from the New Jersey Agricultural Experiment Station and it is receiving some publicity in that State and adjoining districts. It has been grown at Vineland for several years but the plants were mixed so that a true appraisal of its value for Ontario has not been possible.

PREMIER. A good plant maker under good cultural conditions although somewhat susceptible to root rot. It is a heavy cropper, with bright attractive moderately firm fruit of nice quality. Ripens early. Premier is more extensively grown commercially in Ontario than any other variety, accounting for probably 75 per cent of the crop.

TUPPER. Another new Ottawa seedling. Suggested as a pollenizer for Louise, because of its late blooming season.

VALENTINE. A recent Vineland introduction. It produces very sturdy plants and enough of them for a good row. Its roots are long and deep which helps it to withstand drought conditions. It is a good cropper, and the fruit is of fair to good quality, bright, attractive, but apt to be a bit too dark for some markets. It holds its size well over a long season. Recommended for trial because of earliness (a full picking before Premier) and firmness of fruit.

VANROUGE. First distributed several years ago by the Horticultural Experiment Station. It produces sturdy plants and sufficient for a good row but yields only moderately well. Ripens in early mid-season. The fruit is large, bright red, attractive, firm and of very good quality. For the "quick freeze" method of preserving it has been outstanding in tests at the Dept. of Horticulture, O. A. College, as it retains its flavor and color better than any other variety so far tested. Recommended for trial on this account.

PART VI. VARIETY TRIALS

When the Horticultural Experiment Station was originally constituted in 1907, the primary purpose was to facilitate and expand variety test work, under competent observation, by consolidating the many semi-private testing stations scattered over the Province. The earlier orchard plantings (1908-10) were therefore almost entirely variety orchards. Research and Plant Breeding were gradually included in the Station program, but Variety Testing still remains a major activity and in fact roughly absorbs one-third of the Station acreage and staff time, Research and Plant Breeding accounting for the other two-thirds in approximately equal proportions.

The purpose of the variety testing is to evaluate as quickly as possible the constantly increasing flood of new varieties originating as chance seedlings, bud sports, and particularly from planned plant breeding. In this latter field Alderman of Minnesota in 1936 estimated (A.S.H.S. Report 1937), 57 U.S. Stations were engaged in breeding our commonly grown, temperate zone fruits, excluding nuts and subtropical fruits. These Stations at that time had introduced to the public 541 new varieties, to which Alderman estimated 200 varieties of apples, crab apples, and plums should be added for Canadian (Dominion) Stations.

These figures give some indication of the constantly expanding variety problem, and the necessity for adequate testing at Vineland of material likely to have value for Ontario horticulture. This necessity is further indicated by the fact that of the 541 U.S. introductions only 50 have either made a place for themselves or show marked promise of coming importance. About 50 more are grown in sufficient volume to make them of significant horticultural value.

These figures are for Station introductions only and to them must be added the many hundreds of private and nursery introductions offered to the grower, often with substantial propaganda.

The variety test therefore has an important place in attempting to evaluate new varieties for commercial purposes, largely relieving the grower of this expensive task and offering guidance in what to plant and equally, what not to plant.

Of almost equal importance the presence of considerable collections of variety material on the Station grounds provides the necessary basic material for plant breeding, and permits of an intimate knowledge of the merits of the different varieties as possible parents in hybridizing. This intimate knowledge of existing material is an absolutely necessary prerequisite to intelligent plant breeding. Further, the importance of variety is being ever more sharply focused by observed varietal differences in processing value, vitamin content, etc.

In tree fruits, from three to five trees of a variety are planted for such tests. In small fruits relatively more plants are grown. Records include the source of the new variety (Nursery or Institution), year planted, seasonal notes on growth, hardiness, blooming date, fruitfulness, season of maturity, quality, value, market reaction, etc.

The lists which follow are complete for all varieties either still in test orchards, or which have been under test at some time during the period 1908-1943. Those varieties in present test orchards are indicated thus *.

Further it should be noted that the terminology used, while attempting to follow "Standardized Plant Names, 1942", has deviated on occasion to accept names commonly used and understood by the Ontario fruit grower, since primarily the bulletin is for his enlightenment rather than his confusion.

TABLE V. SUMMARY OF FRUIT VARIETY TRIALS, 1942.

Kind of Fruit	No. varieties under test, 1942	No. varieties previously tested	Total
Apples	183	202	385
Pears	79	101	180
Quinces	....	8	8
Cherries, Sweet	33	29	62
Cherries, Sour	14	26	40
Peaches	128	216	344
Nectarines	4	10	14
Apricots	46	4	50
Plums	46	124	170
Edible Nuts	28	....	28
Grapes	55	165	220
Blackberries	9	34	43
Raspberries	33	68	101
Currants	21	16	37
Gooseberries	8	38	46
Strawberries	39	226	265
Totals	726	1,267	1,993

APPLE VARIETIES

The accompanying alphabetical list notes the apple varieties which have been or are being tested at the Horticultural Experiment Station during the period 1908-1943.

*Adams Pearmain
Adonis
A. H. Culp (Sdlg.)
Alexander
*Allans Everlasting
*Allington
*Alton
Ambo
American Pippin
*Ames
*Ames 471
Arctic
Arkansas
Arkansas Black
Arobskoe
*Arthur Culp (Sdlg.)
*Ascot
*Atlas

*Baldwin
*Baldwin, Ruall
*Baldwin, Spencer
*Bancroft
Battle
Baxter
*Beacon
Ben Davis
Ben Hur
Benoni
*Bethanis
Bethel
Bietigheimer
Bingo
Bjorkman
Blackben
*Blackjon
*Blackmack
Blenheim
Blue Pearmain
Boiken
*Boskoop
Bottle Greening
*Braddocks Nonpariel
*Bramley
*Breakey
British Columbia
Brock
Brockville Beauty
Burachki

California
Calvin
Canada Baldwin
Carnival
*Casey Sdlg.
Cayuga
*Charles Ross
Chenango
Claire
Clive
*Close
Cobalt
*Collingwood
Collins
Colvert
Cooper Market
Cora
Cornish Aromatic
*Cortland
*Cox Orange
*Cranberry Pippin
*Crimson Beauty
Culp Sweet
Currie

Danville
*D'Arcy Spice
Deacon Jones
*Delicious
*Delicious Richared
*Delicious Shotwell
*Delicious Starking
*Delicious Turner
*Devonshire Quarrenden
*Diadem
*Diana
*Dolgo (Crab)
*Drumbo
Duchess
*Duchess Daniels Red
*Duchess Drummond
*Duchess Kiester
*Duchess Vanburen
*Dudenhoffer
Dudley
Dumelow

*Early McIntosh
Early Strawberry
*Easter Orange
Eastman
*Edgar
*Edgewood
*Ellison Orange
Emilia
Ensee

Fallawater
Fall Pippin
Fameuse
*Fameuse Jones Red
*Fameuse Mich. 274
*Fameuse Welland
*Flavianka Zimnia
Florence (Crab)
Forerunner
Forest
*Formac
*Franklin

*Gallia Beauty
Gano
Garden Royal
General Grant (Crab)
*George Neilson
*German King
Gideon
Glenton
*Gloria
*Godfrey
*Golden Delicious
Golden Reinette
*Golden Russet
Golden Winesap
Gravenstein
Gravenstein Banks Red
*Gravenstein Crimson (N.S.)
*Gravenstein Red (Geneva)
Greening, N.W.
*Greening, R.I.
Green Newton
*Grimes Golden
*Grover
Gypsy Girl

Haas
*Haralson
*Heusgens Reinette
*Hibernal
*Hill
Hubbardston
*Hume
Hurlbut
*Hyslop (Crab)

*Idared
Ideal
*Imms Sdlg.
*Indo

James Grieve
Jefferis
*Jonathan
*Jonathan Anderson
*Joyce
*Jubilee
*Keetosh
*Kendall
*Kenneth Tye (Sdlg.)
Keswick
King (Tompkins)
King David
Kings Acre
*Kirkland
Kitchener

Langford Beauty
La Salle
Lawfam
*Lawseed
Lawtosh
Lawver
*Lawyer
*Linda (C.E.F.)
Linda (Portugal)
Linda Donna
Linda de Inona
Linton
*Lipton
*Lobo
*Lodi
*Logsdail
Louise
*Lowbeth
Lowell
Lowland Raspberry
*Lowry
Lubsk Queen

*Macearly
*Macey
Maclaw
*Macoun
*Macross
Magog
Maiden Blush
*Manitoba
*Manitoba Spy
Mann
*Mantet
*Manton
Marengo (Crab)
*Margaret Pratt
*Margil
Marne
Marshall
*Martha (Crab)
Mavis
*McIntosh
*McIntosh Farley Red
*McIntosh Geneva Red
*McIntosh Hamilton Red

APPLE VARIETIES (Continued)

*McIntosh
Smith Red
McMahon
McSweet
*Medaille d'Or
Medford
*Medina
*Melba
*Melba Lee Red
*Melba Pate Red
*Melba Platts Red
Melvin
Mendel
Milden
*Milton
*Miltosh
Milwaukee
Minnesota (Crab)
Montreal Beauty (Crab)
Mother
Muskoka Beauty
Muskoka Champion (Crab)

Nassau
Nero
Nestor
*Newfane
Newtosh
*Niobe
*Normans Pippin
Norval
*Norvel (Ames 471)

*O.A.C. #12011
*O.A.C. #12012
*O.A.C. #17064
Oliver Red
*Ontario
Orange (Crab)
Orenco
*Orleans
*Orleans Reinette
Oswego (Farmer)
Oswego (Geneva)
*Ostem
Ottawa

Paragon
*Patricia
Peasgood
*Pedro
Peerless
Percival
Peter
Petrel
Pewaukee
Pilipok
Pinto
Piotosh (Crab)
*Pitmaston Pineapple
*Prairie Spy
Primate

Queen of the North

Radnor
Rambo
Ranier
Raynault
*Redant
*Red Astrachan
*Red Astrachan McCombs
Red Canada
*Red June
*Red King
*Red Rome
Redsauce
*Red Silver
*Redwin Spy
Rensselaer
Revet Bervomotnyi
*Richared Delicious
Rivers Peach
*Rival
Rocket
Rockland
*Rolfe
*Rome Beauty
Rosalie
Rosenhagen
Roxbury Russet
Rufus
Rupert
Russell

*St. Cecelia
*St. Lawrence
*St. Lawrence (Drummond)
*St. Lawrence (Quebec)
*Salome
*Sandow
Saratoga
Scarlet Pippin
Schenectady
Schoharie
Scott Winter
*Secor
Seek (Westfield)
*Sharon
Shiawassee
Shrouds Early Bearing Spy
Smokehouse
Sonora
*Sparta
*Spartan
*Spiana
*Spicap
*Spilaw
*Spimil
Spimore
*Spiretta
Spiro
Spitzenberg (Esopus)
*Spy, Northern
*Spy, Farley Red
*Spy, Geneva Red
*Spy, Laithwaite Red
*Spy, Laithwaite Yellow
*Spy, Stuart Red
*Spy, Redwin
Stark
*Starking Delicious
Starr
*Stayman Winesap
*Stefonia
*Stevenson
*Stirling
Stonehedge
*Sturmer Pippin
*Superb
Sutton
Sweetbough
Sweet Delicious
*Tchernoguz
Tetofski
Three Sisters
Thurso
Tolman Sweet
*Toshkee
Transcendent (Crab)
*Turley
*Turner Delicious
*20th Century

*Urbana

Vanderpool
Vandevere
*Vinnoe

Wagener
Walbridge
Waldron Beauty
Walker Beauty
*Warder
*Wealthy
*Webster
Westchester
Whitney (Crab)
*Willie Sharp
Windsor
Winesap
Winter Banana
Winter Pearmain
Winter St. Lawrence
Winterstein
Winton
Wismer Dessert
Wolf River
Woodmansee
Worcester Pearmain

Yankee
Yellow Bellflower
*Yellow Newtown
Yellow Siberian (Crab)
Yellow Transparent
York Imperial
*Young America

* Varieties still in Test Orchards, 1943.

PEAR VARIETIES

The accompanying alphabetical list notes the pear varieties which have been or are being tested at the Horticultural Experiment Station during the period 1908-1943.

*Admiral Gervais
Albertine
*Alderson
Alexandre de Russie
Amelia Baltet
*Anjou
Antoine Delfosse

*Bartlett
*Bartlett Nichol #1
Barseck
Belle Lucrative
Belle Renee
*Bergamotte Esperen
Bessemianka
Beurre Bachelier
Beurre Baltet Pere
*Beurre Bedford
Beurre Capiaumont
Beurre d'Albret
Beurre d'Amanlis
Beurre De Naghin
*Beurre Dumont
*Beurre Hardy
Beurre de Rance
*Beurre Superfin
Bon Chretien Bonnamour
Bordeaux
*Bosc (Beurre)
*Boussock (Doyenne)

Catillac
*Cayuga
*Caywood
*Chadbourne Bartlett
*Charles Ernest
*Charles Escaig
Chaumontel
*Clairgeau (Beurre)
*Clapp Favorite
Clarksville
Colonel Wilder
Columbia
*Comice (Doyenne du)
*Comte de Paris
*Conference
*Covert
Crosby Hardy

Dana Hovey
De la Forestrie
Delaville Aine
*Dempsey
De Parennes
*Diel (Beurre)
*Directeur Hardy
*Dr. Farley
Dr. Guyot
Docteur Joubert
Dorset
*Douglas
Doyenne d'Alencon
*Doyenne Georges Boucher
Doyenne Madame Tho
Doyenne Levasseur
Doyenne M. Clavier
*Duchesse d'Angouleme
*Durandeau

Early Harvest
*Easter Beurre
Emile d'Heyst
*Eureka
Eva Baltet
*Ewart

Fame
*Fin Juillet
*Flemish Beauty
*Flesherton
Fondante Thirriot
Forelle
Fox
Frederick Clapp

Gans
Gansel Bergamot
*Garber
General Stoessel
General Totleben
*Giffard (Beurre)
Gliva
Gold Nugget
Goodale
*Gorham

Hoosic
*Howell

*Japanese Sand
*Japan Golden Russet
*Jargonnelle
Jeanne d'Arc
*Josephine de Malines

*Kieffer
King Chas. of Wurtemburg
King Karl
*Koonce

Lady Clapp
La de Jule Guindon
Lamy
*Lawrence
*Lawson
*Le Conte
Le Lectier
*Lincoln
Leon Leclerc (Van Mons)
*Lincoln Coreless
Longworth
*Louise Bonne de Jersey
Louis Pasteur
Lucy Duke
Lyerle

Madame Ernest Baltet
*Madame Verte
Margaret
*Marguerite Marillat
Marie Louise
*Ming

N. E. Hansen #18
N. E. Hansen #28
N. E. Hansen #32
N. E. Hansen #34
Notaire Lepin
Nouvelle Fulvie

*Old Home
Oliver de Serres
Onondaga
*Ovid
Ozark

Passe Colmar
*Patten
*Phelps
*Phil Dick
*Philippe Chauveau
*Pitmaston
Pres. Casimir
Pres. Deviolaine
Pres. Drouard
Pres. Heron
Pres. Mas
Princess
Princess Coppie
Prof. Bazin
Prof. Grosdemange
*Pulteney

*Reeder
Reliance
Renfrew
Riehl Best
*Ritson
*Robert de Neufville
Roosevelt
*Russet Bartlett (H.E.S.)
Rutter

*Santa Claus
*Seckel
*Sheldon
Sir de Jules Gruinder
*Sir Harry Veitch
Snyder
*Souv. du Congress
Souv. de Pres. Carnot
Summer Doyenne
Sudduth
*Superb

Tonkavi
Tonkovietka
*Triomphe de Vienne
*Tyson

*Vermont Beauty
Virginia Baltet

*Waite
Wilder Early
Winter
Winter Bartlett
*Winter Nelis
Worden Seckel

* Varieties still in Test Orchards, 1943.

QUINCE VARIETIES

The accompanying alphabetical list notes the quince varieties which have been or are being tested at the Horticultural Experiment Station during the period 1908-1943.

Champion
De Bourgeat
Meech
Missouri
Orange
Pineapple
Rea
Van Deman

CHERRY VARIETIES, SWEET

The accompanying alphabetical lists note the sweet and sour cherry varieties which have been or are being tested at the Horticultural Experimental Station during the period 1908-1943.

Abundance

*Best
Bigarreau d'Italie
*Bing
Black Bigarreau
*Black Eagle
Black Heart
*Black Tartarian
*Book, J. H.
Burbank

*Carnival
Centennial
Chapman
*Clemens

*Deacon
Dikeman
Downer
Dr. Flynn

*Early Deacon
*Early Lyons
Early Purple
*Early Rivers
*Elkhorn
Elton
Emperor Francis

*Fee Early Black
Florence

*Giant
*Gil Peck
*Gold
Gov. Wood
Grosse Guigne Blanche

*Hedelfingen
Hinton

Ida

*June

Knight Early Black

*Lambert

*Mezel

*Napoleon
New Century
*Noir de Guben

Ohio Beauty

Paul
Pelham
Pickering

Republican

Rockport

*Schmidt
Schmidt Sport
*Schrecken Bigarreau
*Seneca
*Sodus
*Sweet September

Thompson

*Velvet
*Vernon
*Victor

*Waterloo Heart
White Oxheart
*Windsor

*Yellow Spanish

CHERRY VARIETIES, SOUR

*Abe Kratz

*Baldwin
Belle Magnifique
Bessarabian

*Chase
Compass
*Coronation

Double Natte
Dyehouse

*Early Richmond

Empress Eugenie
English Morello
*Fisher
Fouche Morello

Late Duke
Leib
Louis Philippe
Lutovka

May Duke
*Montmorency
*Montmorency King
*Montmorency Montgomery

*Montmorency Roszell
*Montmorency Rouse
*Montmorency Short Stem
Montmorency Sweet
Murdock Twig

*Olivet
Ontario Preserving
Ostheim

Reine Hortense
Royal Duke

*St. Medard
Suda

Terry
Timme

Vladimir

Wier
Williams Early
Wragg

* In present (1943) test orchards.

PEACH VARIETIES

The accompanying alphabetical lists note the peach varieties which have been or are being tested at the Horticultural Experiment Station during the period 1908-1943. Inclusive of supplementary lists of seedlings and sports of local origin, Illinois varieties under number, and S.P.I. introductions, some 344 varieties have been under test. Of this number 128 are still growing in Station test orchards, or in the nursery, these being starred (*).

List No. 1. Named Peach Varieties

Admiral Dewey
*Afterglow
Alexander
Alton
*Ambergem
Amsden
Anderson
*Arp
Augbert
Australian Saucer

Bailey
Banner
Belle Beausse
Belle (of Georgia)
Bequette Free
Berenice
Big Red
Billmeyer
Bilyeu
Bishop
Bokhara
Bonanza
Bonnie
Bowslaugh Late
*Brackett
Bresquilla
Brigdon
Briggs
Bronson
Bullers Late
Burke
*Buttercup

Candoka
Caprue
Captain Ede
Cardinale
Carman
Chairs
*Champion
Chaplin (Sneed)
Charles Ingouf
Chili
Chinese Cling
Cline
Columbier
Conkling
Connet
Coolidge
Cowell
Crosby
Crothers
Cumberland
Currie

*Dakota Red
Davidson (Sdlg.)
Duchess of Cornwall
Dymond

Earliest of All
Early Crawford
*Early Elberta (Stark)
*Early Fortune
*Early Halehaven
Early Rivers
Eclipse
Edgemont Beauty
Edouard Andre
*Elberta
*Elberta (Reinke)
Engle Mammoth
English Imperial
*Erly Red Fre
Exquisite

*Fair Beauty
*Farley
Fei
Fennissee Ever-bearing
Fertile Hale
*Fisher
Fitzgerald
Foster
Fox
Frances

*Gage Elberta
Galande
Geary
*Geddes
*Georgia Hale
*G. G. Patar-achia
Globe
Golddrop
*Goldeneast
*Goldenglobe
*Golden Jubilee
Golden Queen
Gold Mine
Goodman Cling
Goodman Choice
Graves
Greensboro
Gross Mignonne

Halberta Giant
*Halehaven
Hardee
Hardy Elberta (Gage Elberta?)
Hative Poullard
Hauss
Heath Cling
Heath Free
Hiley
Hodgins (Sdlg.)
Hoover
*House
Idaho Mammoth
Ideal
Illinois
Iron Mountain

*James Reid (Sdlg.)
*J. H. Hale
*July Elberta
*June Elberta
*J. W. Bartlett

Kalamazoo
*Kalhaven
Kihlkin Smock
Krummel

Lady Lindsey
Lady Palmerston
Lamont
Large York
Late Barnard
Late Champion
Late Crawford
*Late Elberta
Leader
Leamington
Lee Angle
*Leidens Late (Late Elberta)
Lemon Free
Levy
Lewis
Libbee
Liberty
Lincoln
*L. M. Bracken (Sdlg.)
Lockwood
Longhurst
Louis Grognet
Lovell
Mamie Ross
*Marigold
*Marilyn
Marion Haywood
Marshall
Mathews
Mayflower
*McGuigan
McKay Late
Michigan Beauty
*Mikado (June Elberta)
Millard
Millhiser
Millionaire
Morrisania
Morris White
Motions Cling
Motlow
Mountain Rose
Muir
Munson Free

*New American Nectar
*Newday
*New Jersey 102
*New Jersey 105
*New Jersey 111
*New Jersey 112
*New Jersey 133
New Prolific
Niagara
Noblesse
Nunnamaker (Sdlg.)

Oceana
October Elberta
Oklahoma Beauty
Oldmixon Free
Opoix
Opulent
*Oriole

Paloro
Paragon
Pattison

* Varieties still in Test Orchards, 1943.

List No. 1. Named Peach Varieties (Continued)

Peak
Pearson
Penn Hale
Peregrine
Perfection
Phillips Cling
*Pinder Early (Rochester Sport)
*Pinder Late (Rochester Sport)
Pioneer (almond)
*Platts C. (Sdlg.)
Prof. Viliare
Pullars Cling
Pure Gold
Purple Leaf

Radiance
Red Bird
*Redelberta
*Redhaven
Red Magdalen
Red River
Reeves
Rex
Richmond
*Rio Oso Gem
*Rochester
Royal George
Runyon Cling
Russell

*Salberta
Sea Eagle
Sellers Cling
Sept. Mammoth
Shipper Cling
*Shippers Late (F.P.C.) (J. H. Hale)
*Shippers Late (Mason)
*Shippers Late (Stark)
Sims
Slappey
Smithson
Smith Superb
Smock
Sneed
Snow Orange
*Southhaven
*Southern Natural
Stevens
St. John
Stearns
Strawberry
*Stricker
*Summercrest
*Summer Heath Cling
*Sunbeam
*Sunday Elberta
*Sunhigh
Susquehanna
Sutter Creek

Taylor
Thurber
Tientsin
Toronto
Townsend
*Triogem
Triumph

Tuskena

Up-to-date
Utah Orange

Vainqueur
*Valiant
*Vanguard
*Vanity
*Vaughan
*Vedette
*Veefreeze
*Veteran
*Viceroy
*Victor
*Victory
*Vimy

Waddell
Walker
*Warner
Washington
*Welcome (J. H. Hale)
Wellington
Wheatland
Wheeler Late
*White Hale
Wilder
*Wild Manchurian
Willett
Willis Heath Free
*Wilma
Wismer P. H. (Sdlg.)
Wonderful
Worth

Yellow Rareripe
Yellow St. John (see St. John)
*Yellow Swan

* Varieties still in Test Orchards, 1943.

List No. 2. Peach Seedlings and Bud Sports recently propagated by the Experiment Station, on request from the grower and for test purposes. These are now, or shortly will be in present (1943) test orchards.

*Boothman, J. (Vedette Sport, early)
*de Free, F. (Seedling, hardy)
*Fiske (G. Jubilee sport, early)
*Fluhrer (Seedling)
*Fluhrer Special (Seedling)
*Frost, A. (Seedling)
*Hunter, G. (White Seedling, Sneed?)
*Kelly Elberta
*McGill (Seedling)
*Michigan #20
*Moyer, W. H. #3 (Seedling)
*Painter, C. L. (Seedling)
*Pickett #1 (Seedling)
*Pickett #2 (Seedling)
*Ramsay Elberta (large)
*Ryckman, M. (Valiant sport, early)
*Stewart Elberta (large)
*Walker (Seedling)
*Warner (Rochester sport, early)
*Warner (Rochester sport, late)
*Wilkinson (South Haven leaf sport)
*Wismer, A. H. (Seedling)

List No. 3. New Peach Varieties received for test in 1941 and 1942 from the Illinois Agricultural Experiment Station.

*K 18
*K 43
*K 44
*K 45
*K 47
*K 48
*K 49
*K 50
*K 51
*K 52
*K 53
*K 54
*K 63
*K 73
*K 109
*46-6-5
*55-14-5
*56-15-15
*57-21-30
*58-21-13
*60-23-25
*61-23-29
*62-26-23
*64-14-16

List No. 4. Peach Varieties received for test through the Bureau of Plant Industry, U.S. Department of Agriculture. Some were sent under number only, others under both number and name. None of these are in present (1943) test orchards.

S.P.I. No's.

32374
33219 (Vainqueur)
35201
36125 (Sutter Creek)
36485
38178 (Fei)
43124 (A 1)
43127 (Ideal)
43129 (Late Champion)
43132 (Motions Cling)
43135 (Paragon)
43136 (Shipper Cling)
43137 (Up-to-date)
43569 (Bresquilla)
55563
55564
55813
55835
55836
55885
61302 (Peach x Nectarine)
63852
68352 (Pullars Cling)
68353 (Golden Queen)
68354 (Goodman Choice)

NECTARINE VARIETIES

Ansenne (S.P.I. 43139)
*Diamond Jubilee (S.P.I. 43142)
Early Newington
*Garden State
*Gold Mine (S.P.I. 43141)
Hunter
Lippiatt (S.P.I. 43142)
Muir (S.P.I. 43143)
Newboy (S.P.I. 43144)
Quetta (S.P.I. 34685)
*Rivers Orange
Surecrop (S.P.I. 43146)
S.P.I. 26503
S.P.I. 30648

APRICOT VARIETIES

*Alexis
*Blenheim
*Brookes
Budd
*Chinese
Early Newcastle
*Garden City (Montgamet?)
*Geneva
*Gibb
*Gilbert
Harris
*Hemskirke
*Henderson
*Horvath
*Hungaria (Montgamet?)
*Jap Cot
*Kaleden
*Lewis
*Montgamet
*Moorpark
*Naramata
*Perfection
*Riland
*Rittenhouse (Montgamet)
*Royal
*Scout
*Shense
*St. Ambroise
Stella
*S.P.I. 20072
*S.P.I. 32833
*S.P.I. 32834
*S.P.I. 34269
*S.P.I. 34270
*Tilton
*Wenatchee Moorpark

Number Selections from British Columbia

* 1-10
* 6-4
*22-3
*22-4
*23-4
*24-2
*24-10
*24-13
*25-1
*25-4
*25-5
*26-3
*26-5
*26-6

EDIBLE NUTS

Varieties and Species in Present Test Orchards

FILBERTS

Barcelona
Bixby
Bolwyller
Buchanan
Cosford
Daviana
Italian Red
Jones
Kentish Cob
Medium Long
White Aveline
Seedlings (200)

ENGLISH WALNUTS

Alpine
Franquette
Hall
Mayette
McDermid
Rush
Seedlings (70)

BLACK WALNUTS

McCoy
Ohio
Stabler
Thomas
Ten Eyck

MISCELLANEOUS

Butternut x Heartnut hybrid
English x Black Walnut hybrids
Chinese Chestnut (Castanea mollissima)
Pecan (Carya illinoensis)
Shagbark Hickory (Carya ovata)
Shellbark Hickory (Carya laciniosa)

* In present (1943) test orchards.

PLUM VARIETIES

The accompanying alphabetical list notes the plum varieties which have been or are being tested at the Horticultural Experiment Station during the period 1908-1943.

Agen
*Albion
*Alpha
*Amador (Erna)
America
America (Jap)
America (Starks)
Ancaster
Apple
Arch Duke (?)

Banana
Bartlett
*Beauty of Naples
Belgian Purple
Belle de Paris
Belle de Septembre
Big Mackey Damson
Bleeker
Blue Prolific
Bradshaw
*Burbank

Canada Orleans
Chabot
Cikata
Climax
Clyman
*Coates 1418
*Columbia
Conquest
*Crystal Red
*Curlew
*Czar

Daisy
Denbigh
Desoto
*Diamond
Duane Purple

*Earliana
Earliest of All
*Early Italian
Early Rivers
Early Transparent Gage
*Elephant Heart
*Ember (Minn. #83)
Emerald (Americana)
*Emerald (Domestica)

Femmonzi
Field
Formosa
French Damson

Gaviota
General Hand
Gerard
*German Prune (Baker)
*German Prune (Sherk)
Gisborne
*Glass
Gold
*Golden Drop (Coe)
Goliath
*Grand Duke
Gueii

*Hall
Hawkeye
*Honeymoon
Hudson
Hughes Sdlg.
Hulings
Hunt

Ickworth
*Imperial Epineuse
Imperial Gage
Imperial Peach
Improved Agen
Improved Lombard
*Indian Blood
*Italian Prune

*Jefferson
John A.

Kahinta
Kaga
Kaw
King of the Damsons
Kingston
Kiowa
Klondike

Large Golden Prolific
Latchford
Late Orange
Latz German Prune
Lawson
*Lombard
Lowry

*Maglio
Magnum Bonum
Mallard
Mammoth
Mammoth Gold
Mary
Mathews
Maynard
McLaughlin
*Methley
*Monarch
Monroe
Moore Arctic
Moyer

October Purple
Opata
Oriental
Oziya

*Pacific
Paragon
*Peach Plum
Pearl
Peters
Pond
Poole Pride
*President
Primate

Quackenboss
*Queenston

Raynes
*Red Ace
Red June
*Reine Claude
Reine Claude de Gabriel Combes
Riley Damson
Rockford

Santa Rosa
Sapa
Saratoga
Satsuma
Saunders
Shipper
*Shiro
*Shropshire Damson (Canada)
*Shropshire Damson (England)
Silver
Simon
Smith Orleans
Standard
*Stanley
Stanton
Stella
Sugar Prune
Sultan
*Superior (Minn. #194)
Sutton

Tennant
Thanksgiving
Toga
Tokata
Tragedy

Uncle Ben

Vesuvius
Victoria

Waneta
Warner
*Washington
Weaver
White Damson
Wickson
*Willamette
Willard
World Beater
*Wrights Early
Wyedale

*Yakima
Yellow Egg

* In present (1943) test orchards.

GRAPE VARIETIES

The accompanying alphabetical list notes the grape varieties which have been or are being tested at the Horticultural Experiment Station during the period 1908-1943.

Adobe Giant
Agawam (Rogers' 15)
Amber Queen
America
Aminia (Rogers' 39)
Armalaga
*Athens
August Giant
Augustinia
Australis
Bacchus
*Bachman's Early
Bailey
Banner
Barry (Rogers' 43)
*Beacon
Bell
Ben Hur
Berckmans
Beta
*Big Extra
Black Hamburg
Black Malvoisie
Black Morocco
Blondin
*Brennand (Forse)
*Bridgwater (Forse)
Brighton
Brilliant
*Brocton
*Bronx Seedless
*Buffalo
Caco
*Campbell
Canadaigua
Captivator
Carman
*Catawba
Catawba-Concord
*Cenzo
Champagne
*Champanel
Charlton
Chasselas avec Royal
Chasselas Besson
Chasselas de Fontainbleau
*Chasselas Rose
Chasselas Vibert
Clinton
*Cloeta
Colerain
Collier
Columbia
*Concord
*Concord Seedless
Cornichon
Cottage
Craig
Creveling
Csalia
Cynthiana
Dattier
*Delaware
Delicious
*Demand
Diana
Diamond
Dog Ridge
Dracut Amber
*Dunkirk
*Dutchess
Early Daisy
Early Ohio
Early Victor
Eaton
Eclipse
*Eden
Ellen Scott
Elvira
Emperor
Empire State
Erickson
Escol
Esther
Etta
Eumelan
Feher Szagos
Fern Munson
Flame Tokay
*Fredonia
Frenturies
Gaertner (Rogers' 14)
Gamay
Geneva
Goff
Gold Coin
*Golden Chasselas
Golden Drop
*Golden Muscat
Golden Queen
Green Mountain
Green Early
Gros Colman
*Hanover
Hartford
Hayes
Headlight
*Hector
Herbemont
*Herbert (Rogers' 44)
Hermann Jaeger
Hernito
Hicks
Hubbard
*Iona
Isabella
Italian (Walker)
*Ives
Janesville
Jefferson
Jessica
*Kendaia
*Kerimoff
*Kerimoff Early
*Keuka
King
King Philip
Lady
Lady Downes
Lady Finger
Lady Hutt
Lady Washington
Last Rose
Lignan Blanc
Lincoln
Lindley (Rogers' 9)
*Lomanto
Lucile
Lukfata
Lutie
Malaga
Manito
Martha
Mary
Massasoit (Rogers' 3)
Mathilde
McPike
Mericadel
Merrimac (Rogers' 19)
Miller's Burgundy
Mission
Missouri Riesling
Moore
Morocco
Moyer
Muench
Muscat
Muscat Blanc
Muscat Hamburg
Muscat of Alexandria
*Niagara
Nitodal
Norton
*Oberlin
*Ontario
*Paschke
Patricia
*Pearl of Csaba
Pense Malaga
Perkins
Petit Syrah
Pierce
Philippi
Pinot Gris
Pinot Noir
Pocklington
*Portland
Prentiss
*President
Regal
Requa (Rogers' 28)
Ripley
Rogers' 24
Rogers' 36
Rockwood
*Rose Hamburg
Rommel
*Ruby
R. W. Munson
Sabal Kanski
Salamander
Salem (Rogers' 22)
Sauvignon
*Seneca
*Sheridan
*Stout Seedless
Sultanina
Sweet Water
Telegraph
Thompson Seedless
Ulster Prolific
Urbana
Valhallah
*Van Buren
Vergennes
Vibert
*Violante Early
*Violante Special
Walker
*Watkins
*Wayne
*Westfield
Wilder (Rogers' 4)
Wills (J. H.) Sdlg.
Winchell
Wine King
Woodruff Red
*Worden
Wyoming
Xlnta
*Yates
Zante

* In present (1943) test vineyards.

BLACKBERRY AND DEWBERRY VARIETIES, AND HYBRIDS

The accompanying alphabetical list notes the varieties which have been or are being tested at the Horticultural Experiment Station during the period 1908-1943.

Agawam
Albro
Ancient Briton
Austin

*B.C. Thornless
Blower
*Boysenberry

Chico #1
Chico #2
*Chico #4
Chico #6
Crandall

Early Harvest
Early King

*Eldorado
Evergreen Thornless

*Gainor

Himalaya
Humboldt

Iceberg

Joy

*Kittatinny
Loganberry
*Lowden

Lucretia

Mammoth
McDonald
*Mersereau
Phenomenal
Premo
Primus

Rubus species canadensis
Rubus species fructicosus
Rubus species illecebrosus

Rubus species innominatus

*Snyder
Spineless Diffuse

Taylor

Veitchberry

Wachussett
Wilson
Wineberry

Youngberry

RASPBERRY VARIETIES, RED, PURPLE AND BLACK

The accompanying alphabetical list notes the varieties which have been or are being tested at the Horticultural Experiment Station during the period 1908-1943.

The letter following name indicates color of the fruit — black, purple, yellow. All others are red.

Adams 34
Adams 87
Adams 101
Adams 170
Arnold

Belle de Fontenay
Black Diamond (B)
Brant (P)
*Brighton
*Bristol (B)
Buckeye

Cardinal (P)
Cayuga
*Chief
Columbia
Columbian (P)
Conrath (B)
Count
Cumberland (B)
*Cuthbert

Devon
Donboro
*Dundee (B)

Eaton
Erskine

Fillbasket
French River, Sdlg.

Geneva, N.Y. 5357
*Geneva, N.Y. 5548
*Geneva, N.Y. 5670
*Geneva, N.Y. 5671
Geneva, N.Y. 8111
Geneva, N.Y. 8123
Geneva, N.Y. 8475
Gold Drop (Y)
Golden Queen (Y)
Gregg (B)

Hailsham
*Herbert
Hilborn (B)
Hornet

*Indiansummer

June

Kansas (B)
King

Lafrance
*Latham
*Lloyd George
Lowden

MacDiarmid
*Marcy
*Marion (P)
Marlboro

Miller
*Milton
*Morrow

*Naples (B)
*Newburgh
Newman 6
Newman 20
*Newman 23

Ohta
Older (B)
Ontario
*Ottawa C.E.F. 0-201
*Ottawa C.E.F. 0-262
*Ottawa C.E.F. 0-263
*Ottawa C.E.F. 0-264
*Ottawa C.E.F. 0-271
*Ottawa C.E.F. 0-272
*Ottawa C.E.F. 0-273
*Ottawa C.E.F. 0-275
*Ottawa C.E.F. 0-276
*Ottawa C.E.F. 0-277
Owasco

Park Lane
Perfection (B)
Phoenix
Plum Farmer (B)
Profusion

Ranere
Reliance
Royal Purple (P)
Rubus occidentalis (B)
Rubus strigosus

Seneca
Shaffer (P)
Sir John
Smith Giant (B)
*Sodus (P)
Starlight
Sunbeam
Superlative

*Tahoma
*Taylor
Turner

Van Fleet
Victory
*Viking

Washington
Wisbeach Perfection

* In present (1943) test plantations.

CURRANT VARIETIES, RED, WHITE AND BLACK

The accompanying alphabetical list notes the varieties which have been or are being tested at the Horticultural Experiment Station during the period 1908-1943.

The letter following name indicates color of the fruit — Red, White, Black.

*Baldwin (B)
*Black Victoria (B)
*Boskoop Giant (B)
Buddenborg (B)

*Champion (B)
*Cherry (R)
*Climax (B)
Clipper (B)
Collins Prolific (B)

Diploma (R)

Eagle (B)

*Fay (R)
Franco German (R)

Greenfield (R)

*Kerry (B)

Lee (B)
London Market (R)
Long Bunch Holland (R)

*Magnus (B)

*Naples (B)

*Ontario (B)

*Perfection (R)
*Pomona (R)
Prince Albert (R)

*Red Cross (R)
Red Dutch (R)
*Red Lake (R)

*Saunders (B)
Seabrook (B)
*Stephens #4 (R)
*Stephens #9 (R)

*Topsy (B)

Versailles (R)
*Victoria (R)

White Grape (W)
White Imperial (W)
*Wilder (R)

* In present (1943) test plantations.

GOOSEBERRY VARIETIES

The accompanying alphabetical list notes the varieties which have been or are being tested at the Horticultural Experiment Station during the period 1908-1943.

Angler
Broom Girl

Careless
Carrie
Chatauqua
*Clark
Columbus
Crown Bob

Downing

Favourite
Freedom
*Fredonia

Golden Drop
Green Gage

Houghton
Husbandman

Industry

*Josselyn

*Keen Seedling
Keepsake

Lancashire Lad
Leader

Mabel
May Duke

Nailor

Ostrich
Overall

*Pearl
Pilot
*Poorman
Prince Regent

Ribes cynosbati
Ribes hirtellum
Ross

*Silvia
Smith Improved
Speedwell
Spinefree

Topsy
Triumph

Victoria
Viper

Warrington Red
Wellington Glory
Whitesmith
*Worcester

* In present (1943) test plantations.

STRAWBERRY VARIETIES

The accompanying alphabetical list notes the varieties which have been or are being tested at the Horticultural Experiment Station during the period 1908-1943.

Abbot
*Aberdeen
Admiral
Americus
Anana de Griemiel
Arizona
Aroma
August Luther

Beacon
Beauty
Beaver
Bederarena
Bellmar
Bennett
Big Late
Billy Sunday
*Blakemore

Bliss
Bouquet
*Borden
Brandywine
British Sovereign
Bubach
Bun Special
Bushel Basket

Buster

Caledonia
Camden
Campbell
Cardinal
Carl
Cassandra
Caro

STRAWBERRY VARIETIES (Continued)

*Catskill
Champion
Charles
Chesapeake
Clare
Claribel
Clark
Clermont
Climax
Clyde
Cobalt
Commonwealth
Confederation
Cordelia
Corsican
Corvallis
Crescent
*Culver

Delecto
Desdemona
Dick
Dornan
*Dorsett
Dr. Burrill
Dr. Moiere
*Dresden
Duffin
*Dunlap
Dutch Evern

Early Bird
Early Ozark
Edward
Elgin
Empire Allred
Enhance
Enormous
Ettersburg 80
Ettersburg 84
Ettersburg 89
Ettersburg 121
Ettersburg 412
Eurisko
Everbearing
Excelsior

*Fairfax
Fendall
Fendalemo
Florence
Forward
Fragaria califor-
nica
*Fragaria chilo-
ensis
Fragaria moschata
Fragaria vesca
*Fragaria virgin-
iana

*Gandy
Gale
Gem
Geneva, N.Y. 4294
Geneva, N.Y. 4433
Geneva, N.Y. 4792
*Geneva, N.Y. 7225
*Geneva, N.Y. 7821
*Geneva, N.Y. 8929
*Geneva, N.Y. 9245
George
Glen Mary
Golden Palace
Golden Prize
Goodell
Green Mountain

Hanham
Harvest King
Haverland
Helen Davis
Hericort de Thury
Heritage
Highland
Horace
Howard Supreme
Howard 25
*Howe
Hundred Dollars

Island King

Jerome
Jessica
Jewell
Jocunda
John
John H. Cook
Joe
Jim
Julia

Kellko
Kellogg
King
King Edward
King George
King Wealthy
Kitty Rice
Klondike

Laurier
Lavergne
Laxton Latest
Little Scarlet
Longfellow
*Louise
Louis Gauthier
Lovett
Lucky Boy
Lupton

*Mackenzie
Magic Gem
Magoon
Marechal Foch
Mariana
Marshall
Mastodon
McGowan
Meighen
Merveille de
France
Michel
Minnesota #3
Minnesota #935
Missionary
Molena
Monarch
Moore
Morningstar
Morse

Narcissa
Nettie
Neverfail
New Oregon
*New Jersey 225
*New Jersey 303
*New Jersey 311
*New Jersey 312
*New Jersey 347
New York
Nick Ohmer
Nor-J
Northfield
*North Star

O.A.C. Early
Ohio Boy
Olga Petrova
Ophelia
Oregon
Orem
Ossie
*Ottawa C.E.F.
0-261
*Ottawa C.E.F.
0-271
*Ottawa C.E.F.
0-291
*Ottawa C.E.F.
0-294

Panama
Parisienne
Patagonia
*Parsons Beauty
*Pathfinder
*Pearl
Peerless
Pineapple
Pitchers Overland
Pocomoke
Portia
*Premier
Pride of Michigan
Progressive
Prolific

Ralph
Robert
Rockhill
Royal Sovereign
Ruby
Rumark

Sample
Santiago de
Chile
Schauber
Senator Wilson
Sharpless
*Simcoe
Sionilli
Splendid
Staples
Stevens Late
St. Louis Prize
Superb

Tennessee
Texas
The Best
The Queen
Thompson
Thompsons Sdlg.
Three W's
Tid Bit
Trebla
*Tupper

Uncle Jim
U.S.D.A. #1
U.S.D.A. #2
U.S.D.A. #3
U.S.D.A. #4
U.S.D.A. #5
U.S.D.A. #6
U.S.D.A. #7
*U.S.D.A. #8
U.S.D.A. #9
U.S.D.A. #10
U.S.D.A. #11
U.S.D.A. #12
U.S.D.A. #13
U.S.D.A. #14
U.S.D.A. #15
U.S.D.A. #16
U.S.D.A. #17
U.S.D.A. #18
U.S.D.A. #19
U.S.D.A. #20
U.S.D.A. #21

*Valentine
Vandyke
*Vanguard
*Vanrouge
Victoria

Wait
Walter
Warfield
Whataflavor
William Belt
Williams
Woolverton

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Ontario Department of Agriculture

Statistics and Publications Branch

TORONTO, ONTARIO

"DESTRUCTIVE PEST ANIMALS"

The Rat and the Mouse

Figure 1.—Traps properly baited and placed at wall openings where rats travel, will yield good returns.

The work of hundreds of men and women is lost each year in producing and handling foods that are eventually eaten or destroyed by rats and mice.

BY

Lionel Stevenson, Provincial Zoologist,

ONTARIO VETERINARY COLLEGE

GUELPH, ONTARIO.

FOREWORD

Rats and mice are the most destructive mammalian pests that the Ontario farmer has to compete with. The livestock farmer sees his feed bins raided and the stable walls undermined. The grain grower takes his loss in grain eaten or otherwise destroyed and in damage to grain holding equipment. The poultry farmer takes his loss from the raiding rats and mice in grain feeds taken and young birds killed. (A raiding rat has killed as many as 200 baby chicks in a single night). The fruit and vegetable growers take a loss on their crops in storage while awaiting marketing as well as extensive injury in the field. These losses that embrace every branch of farming when coupled with the losses on foods being handled or stored in urban centers or during transportation to markets make up a staggering total loss. Hundreds of tons of feed grains are eaten or polluted each year by rats and mice in store houses, mills, stables, piggeries, poultry houses, and other places where feed grains are kept awaiting use. Vegetables, fruits, meats, dairy products and other foods too often are lost to the rats and mice after such reach the home. The extent of these unnecessary losses is difficult to estimate. Careful observation at various points where food production, processing, storage, distribution and utilization indicate that the total loss in food stuffs is far greater than the public realize. Some well-informed observers say the annual loss in foods taken or destroyed amounts to more than $20,000,000.00. This loss, coupled with the menace to public health caused by rats and mice, indicates that these costly and destructive pests should be more fully controlled.

Rats and mice are filthy animals that haunt manure piles, open privies, sewers, and garbage dumps to wallow in filth, and then in their nightly tours contaminate food stuffs in the feed bins, feed hoppers, house basements, kitchens and pantries. In this way, germs of such diseases, as bubonic plague, tularaemia, murine typhus, brucellosis, rat bite fever, foot and mouth disease, rat typhoid, trichinosis, distemper, ringworm, mange, and many others are spread. A rat may visit a sewer or a tank where sick room discards have been dumped, or a stable where diseased animals are kept, to pick up on its hairy body and feet a load of disease-producing bacteria, then raid a basement, food-storage, or a pantry and contaminate everything it touches.

Rats and mice while now controlled to some extent on many premises can be more fully controlled if all persons having to do with food supplies would inaugurate a more persistent and vigorous execution of well-laid plans against these food-destroying and disease-distributing pests. A persistent and vigorous action is necessary due to the rapid multiplication of rats and mice.

REPRODUCTION POSSIBILITIES

Rats and mice will reproduce at a great rate if the food supply and shelter are satisfactory to their needs. The common female brown rat will under favourable conditions bring forth three or more litters a year (15 are possible). The gestation period is but 21 or 22 days. The litters will average six. From every pregnant female rat that finds a suitable home on a farm, in a food market or in a storage warehouse, enough young rats will come to overrun the premises within a year. Rats become sexually mature at about 85 days. Field mice and house mice reach breeding age, if well fed, at 48 days. The gestation period for mice of the various species is 20 to 21 days. As with rats, breeding is confined to periods of favourable temperature, food abundance and shelter. Seventeen litters of young are possible from a female mouse under favourable conditions. The unfavourable conditions to reproduction in rats and mice, imposed by our nothern climate greatly limits the numbers of new generations. However, the yearly increase from one pair of rats or mice will under favourable conditions exceed 500, if all young lived and bred. This rapid increase will indicate that our food crops are always in peril, even with but few visible rats and mice around.

Rats travel long distances in search of congenial living conditions. The field mice usually find congenial quarters in any house or barn. The common house rat (mus rattus) is a native of India. The brown or Norway rat (mus Norvegicus) is a native of Central Asia. The house rat reached Western Europe during the thirteenth century. The brown rat reached Europe during the Eighteenth century. The brown or Norway rat has very largely displaced the common house rat.

Both species of rats came to America on ships transporting colonists and their effects.

MEASURES TO DESTROY RATS AND MICE

Trapping - Traps are a very useful device in controlling rats and mice, if used by people that understand how to use them. The small spring or "Break back" traps are quite efficient, if kept set and freshly baited with baits that these animals like. Stale baits will not attract rats or mice if there is a better quality of food available to them. The "tilting top" barrel trap is very effective, and once in position does not require very much attention other than removing the drowned victims and renewing the bait on the tilting barrel top. Rats or mice that jump on the tilting barrel top are precipitated into the barrel of water to drown. The wire box type of trap is effective and keeps on taking rats as long as bait is provided. The spring door traps are successful and have a decided advantage in that such can be set with both end doors wide open, permitting an all clear view likely to deceive the wily old rats.

BAITING RAT TRAPS

Pieces of food substance that the rats are known to take in their foraging can be cut into suitable shape to suit the trap being used. Pieces of raw meat, raw fish, buttered bread, dried fruit (peach or prune), fresh fruit (apple), vegetables (carrot, tomato), buttered sweetened pop corn, doughnut, rolled oats, nut meats, etc. Baits must be kept fresh, changed every twenty-four hours, as rats will shy away from stale bait, if there is anything fresh and sweet in the neighbourhood that they can reach.

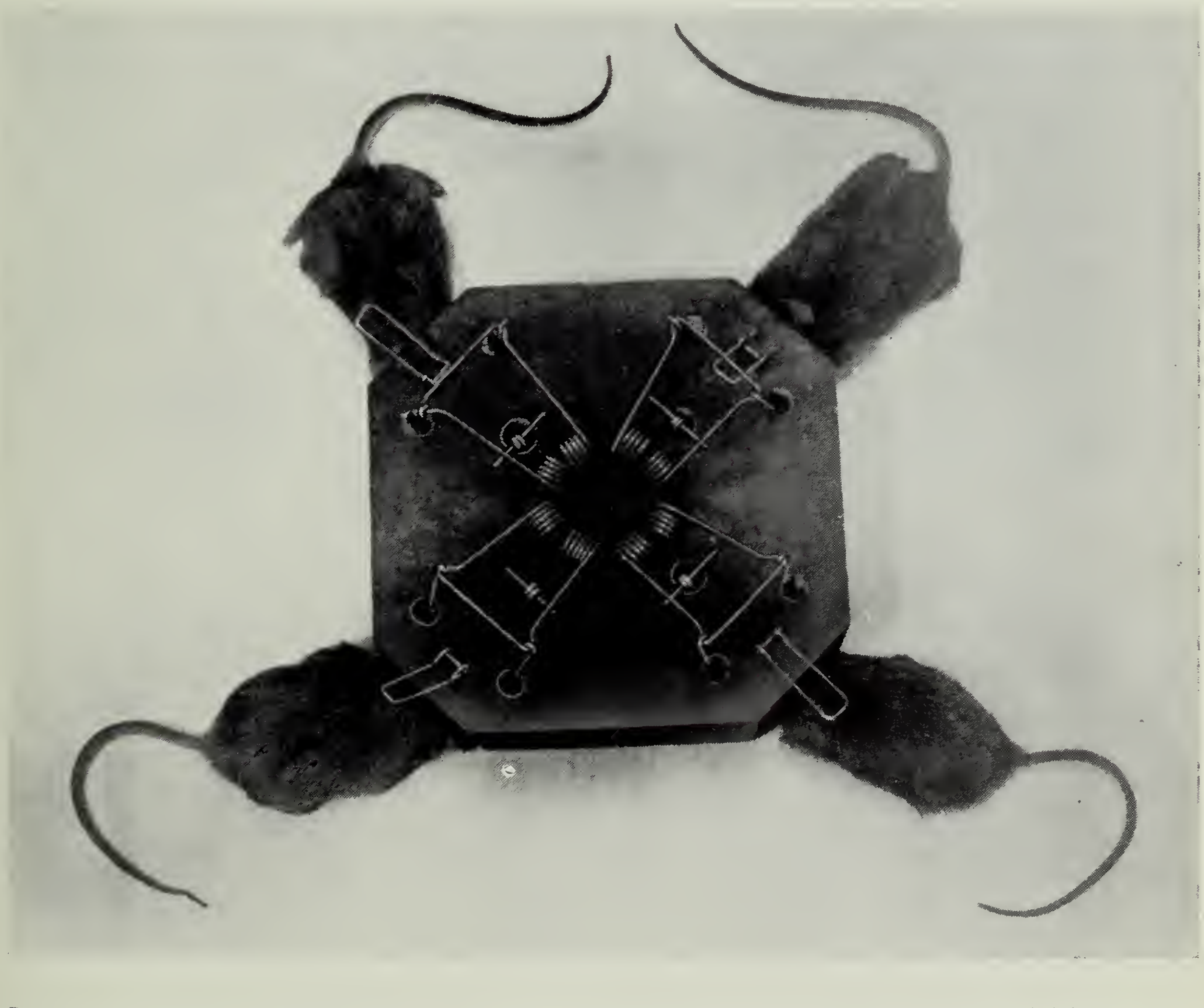

Figure 2.—Traps of this type, baited with raisins, will take many mice during a year. Welcome mice with a baited trap, one will attract others.

BAITING MOUSE TRAPS

Sultana or other raisins soaked soft enough to be easily attached to the trigger of a trap make excellent bait for mice. Other dessicated, preserved or fresh fruit cut or shaped into suitable size, do very well, but the raisin is more durable and will remain in good condition for many days. Cheese baits are very attractive to mice. Sweetened pop corn balls, oatmeal balls, buttered bread, cooked meat, suet and other fat will also attract mice to the traps.

LOCATIONS FOR TRAPS

Both rats and mice prefer to stick close to shelter of some sort. Sacks, boxes or boards can be so placed along a wall to form a suitable shelter or a run for either rats or mice, if a shelter or dark corner does not alreay exist. Traps should be set on or near the present feeding areas, or along the runways, the entrance places, in places offering seclusion and known to be frequented by the animals. Baits with an odour attractive to rats will draw them for considerable distance and to places that they usually do not visit. If food is abundant, it should be put out of reach of the rats, otherwise the rats will not go to the traps. Trapping is difficult where there is an abundance of food within easy reach of the rats. If there are many rats on the premises, it is well to use as many traps as possible so as to get results quickly and before the rats get wise to the danger of a trap. Change the baits, keep the traps clean, free from rust, and in perfect working order, otherwise little success will attend a weak or half-hearted effort. The mature rat is wise to much that is going on around him and may be difficult to trap; if you can not get him with one kind of trap and bait, try others. There are many combinations, one of which will outwit the most wary rat.

POISONING

Mild, slow-acting poisons, such as red squill or barium carbonate are to be preferred in making baits. Baits should be made up fresh of foods that rats and mice are fond of; otherwise, these animals will not touch them unless very hungry.

The following foods have proven useful in poison baits. Cereals, as rolled oats, corn meal, and whole wheat bread. Meats, as freshly ground beef, canned or fresh fish and eggs. Fruits, as apples, tomatoes, and raisins. Food materials not already in an acceptable form, may be put through a food chopper and reduced to a fineness that will permit easy mixing in of the poison substance used.

Red squill poison baits are made as follows:

(a) Mix one ounce of powdered red squill with a little water to form a thin paste, then add this thin red paste to one pound of freshly-ground meat or one-half pound of corn meal. A teaspoonful of this mixture is ample for one bait.

(b) Spread an ounce of a standard red squill extract over two ounces of dry whole wheat bread that has been cut into small squares. One square is ample for one bait. The red squill baits should be placed on squares of heavy paper and set in the most likely rat or mouse runs. Red Squill while acceptable to rats and mice if hungry, is not acceptable to other animals due to its flavor. The risk of poisoning chickens, dogs or pigs is very much reduced when red squill is used.

Barium carbonate poison baits are made as follows:

Mix one part of barium carbonate to six parts of ground meat or six parts of oatmeal. Water is added to make a stiff paste. A teaspoonful of either mixture is ample for one bait. Barium carbonate baits are placed on squares of heavy paper in places frequented by rats and mice during the evening. All barium carbonate baits not eaten over night should be gathered up and burned. Stale baits are not attractive. Fresh baits should be placed one night each week until it is evident that a clean up has been made. Where rats are wise in the ways of man, it is sometimes necessary to gain their confidence by feeding baits that are free from poison for a time or two, then following with the same kind of bait food with poison added. Barium carbonate is slow-acting poison and must be kept out of the reach of children and domestic animals. The barium carbonate container should be labelled **POISON**. If barium carbonate is taken in mistake, give the victim either mustard or salt dissolved in warm water to induce vomiting. Call the family physician.

The use of phosphorus, arsenic, strychnine, or thallium for the poisoning of rats or mice should be restricted to the most careful and cautious persons. The use of suitable containers in which poison baits may be placed will reduce the possibility of animals larger than rats or mice getting the poison bait. Unwanted glass ware such as old marmalade jars or other jars with an opening large enough to permit the entry of a rat or mouse and small enough to keep out a cat, dog or chicken can be baited and placed with relative safety. Small land tile can be used also in which to expose to rats and mice the poison bait.

Figure 3.—Baits are protected if placed in glass bottles, land tiles, sections of eave troughing pipe or specially made boxes. Animals other than mice or rats are not likely to reach the protected bait.

GAS WARFARE ON RATS

In locations where a concentration of gas can be obtained sufficient to kill rats, the fumigation methods may be used to advantage. Rat burrows and other rat harbors around sheds, old walls, rubbish piles, garbage dumps and corn cribs are relatively easily dealt with. Flour mills, packing houses, abattoirs, and other large buildings, can be fumigated with poison gas, only by experienced men at a time when the building can be given up for a day to allow the work to be done.

All life, excepting rats, mice and insects should be removed from buildings before fumigation is undertaken.

CALCIUM CYANIDE

Crude calcium cyanide dust is a compound which on exposure to the air will give off an extremely poisonous gas, called hydrocyanic acid or prussic acid. This gas, if sufficiently confined or concentrated that rats or other animals must breathe it, is destructive to life. Calcium cyanide dust is used by forcing it into the rat burrow by means of a dust blower or dust pump. A few blasts of air behind the light dust will force enough through the burrow to create an air condition very unfavorable to the rats or any other animals forced to breathe the resulting hydrocyanic acid gas. If there are numerous holes such should be plugged to prevent escape or dilution of the gas too quickly. Fumigation of corn cribs, lumber piles, walls, rubbish dumps and such like places is more difficult to undertake than the fumigation of a rat burrow, due to inability to secure sufficient concentration of gas without greatly increasing the quantity of calcium cyanide used. Fumigation generally should be carried out in still air, otherwise the poison gas will be carried away from the spot where it is intended that it should function. Calcium cyanide when exposed to the air leaves a non-poisonous residue, the gas created is soon dissipated in the surrounding air, so such feeds as ear corn and hay are not rendered poisonous by its use, if well exposed to the air for two days, following the use of calcium cyanide.

CARBON MONOXIDE GAS

The exhaust gas from a gasoline motor can be piped to rat burrows by means of iron and rubber tubing. The gasoline motor (car, tractor or portable engine) should be adjusted to operate on a "rich" gasoline and air mixture and be run at moderate speed for ten minutes to create sufficient carbon monoxide gas for each burrow and its connecting runs and chambers.

All exit holes should be blocked with moist soil to prevent dissipation of the gas.

CARBON DISULPHIDE GAS

Carbon disulphide is quite effective as a killing agent for rats, while they are enclosed in their burrows. It may be used indoors or outside, wherever there is a well-defined burrow that can be easily plugged to retain concentration of the poison gas. The dampness of the soil in which the rat burrow is located is an aid in concentrating the poison gas. Carbon disulphide is best used by pouring one ounce of this evil smelling liquid on a wad of absorbent cotton, that is held in a long forceps until it is placed well down into the rat burrow. The forceps or tongs should then be quickly withdrawn and the burrow entrance closed by a spadeful of moist soil. Examine the area closely and cover all possible exit holes to prevent the escape of gas. Carbon disulphide is highly inflammable and therefore should be kept away from all fire.

FLOODING

In places where adequate water under pressure is available, rat and mice can be drowned out, providing the layout of the premises will permit such practice. This method of combating these pests can be carried out around market buildings and transportation buildings where stocks of merchandise are frequently moved or can be arranged to suit such practice.

VIRUSES

Are not recommended for rat destruction by the author of this circular as little or no success has followed the use of such to date.

USEFUL ANIMALS AID IN CONTROLLING RATS

The rat seeks the shelter of buildings or building materials and does not forage very far afield, except under special conditions.

Owls and weasels frequenting barns will prey on rats and take many. The terrier type of dog can be trained to hunt rats, destroy many and drive others away. The fox terrier and the scotch terrier seem best adapted for rat hunting and will, if encouraged, keep a farm free from the rat pest. Cats as a class are of some value as rat catchers. Ferrets under the control of experienced men will drive rats from their hiding places out into the open where they can be destroyed. The weasel will hunt rats with vigor, killing or driving them away, but has the undesirable trait of being so blood thirsty that it will attack any bird or animal. If the weasel would confine its activities to rats and mice, it would be welcomed on every farm, but being a destroyer of poultry it is not generally wanted. Hawks will take a few rats during the summer and early autumn in districts where wheat and corn are extensively grown. Rats will leave the buildings and forage in nearby grain fields at harvest time if feed is scarce elsewhere. Vast numbers of field mice are taken by foxes, mink, skunks, hawks, owls and shrikes.

MEASURES TO PREVENT RATS GAINING ACCESS TO FOOD

To live, rats and mice must eat. Scarcity of food means weakness, poverty and no reproduction. Starve rats and mice by keeping all materials that they could use for nourishment out of reach.

1. Waste food should not be left in open spaces such as garbage dumps, vacant lots, orchards, gardens, or grain fields where rats and mice can feed unmolested.

2. Garbage cans should be rat and mouse tight and provided with a cover that can be kept in place. Neglected garbage cans with no lids or poorly fitting lids are an aid to rat and mouse breeding. Whole colonies of rats will depend on and get most of their nourishment from carelessly exposed, lidless garbage containers. Garbage cans that are constructed with a hinged top and foot tread for easy opening are best for protecting kitchen garbage while it is being accumulated and awaiting collections.

Figure 4.—People too careless or indolent to keep the cover on the garbage can are an aid to rat welfare. All garbage should be covered or burned at once. The treadle top opening garbage can, if properly adjusted and operated will keep food away from rats.

3. Bulk foods are best kept in containers that are rat and mouse proof. Cement, sheet metal, wire cloth, and glass are proof against the teeth of rodents. Large bins for grain, fruit, and vegetables can be constructed of cement concrete and provided with tops and doors protected by thin sheet metal. Medium size food containers can be made entirely of sheet metal. Small containers are best made of light sheet metal or of glass. Wire mesh or hardware cloth should have spacing of not more than one-half inch.

4. In the planning of new buildings or the repair of old buildings full consideration should be given to structural materials and design, as will prevent the entry of rats and mice. Food warehouses, markets, elevators, freight sheds, cattle stables, pig pens, chicken houses and other buildings where edible substances are stored, held or used can be constructed in part of masonry. Cement concrete, stone, brick and cinders make tough chewing for the invading rat. Foundations should be of cement concrete. Floors can be of cement concrete or asphalt. Walls can be entirely of masonry or only partly so, providing that ample cement concrete is used in and around all sills, studs, joists, and baseboards to prevent rats and mice gnawing their way into the building.

5. Counters in stores and markets where food stuffs are displayed are best constructed of hard smooth materials that rats and mice can not climb. Wire mesh covers should be provided for all exposed over night food materials that can not be otherwise protected in rat-infested premises.

6. **Rat and mouse deterrents** - Rats and mice object the odour of a number of substances and also to the presence of some substances that have little or no odour. Package goods, as seed grains in sacks, held in barns or warehouses can be protected by the liberal use of flake naphthalene scattered on the floor and over the grain or seed sacks. The bottom sacks should be slightly raised above the floor to permit circulation. The naphthalene odour will in time disappear so it must be renewed in the long term holding of sacked grain. Coal tar derivatives have an objectionable odour to the rat and may be used instead of naphthalene, for protecting sacked seed grain. Of the non-odourous substances, useful for protecting sacked grain or package goods, powdered sulphur, lime, lye, or copperas can be used.

DEODORANTS

Rats and mice sometimes die in out-of-reach places, as within walls, where it is difficult to remove them without breaking the wall. Obnoxious odours from putrefying bodies can be neutralized by deodorizing compounds. Lysol can be used as a deodorant, without tearing out a section of wall, simply by boring a small hole through lath and plaster and pouring in by means of a syringe or funnel and hose two or three tablespoonfuls. The hole in the wall is plugged as soon as the lysol has been placed. It may be necessary to place lysol in a number of locations in an attempt to find the unseen source of the odour.

MEASURES TO REMOVE RATS' HARBOURS

1. Destroy by burning all unwanted small quantities of materials that could be used by rats and mice for nourishment or nest making.

2. Clean up all garbage that could shelter rats or mice,—stone piles wood piles, old lumber piles, old straw stacks and brush piles frequently shelter rats and mice so should be burned or put in order.

3. Provide suitable cement concrete foundations and floors for all buildings. Drive rats out of the holes they make under foundations and floors by the use of gas or a ferret, then cement over the area to prevent further digging. Use cement concrete between studs, joists, along the sills and in the walls wherever rats and mice might try to make an entry.

4. Old unused buildings on farms and in town are generally rat harbours so should be torn down and the area cleaned up to destroy all possible rat shelters. Rats must have suitable shelters to increase so reduce the shelters to prevent rats breeding.

5. Destroy by burning all old corn stalks in shocks or piles as such are very attractive to rats and mice so should be removed.

6. In rat proofing buildings, attention should be given to all openings as drains, windows, ventilators, and doors. All drain outlets or sewer inlets should be fitted with a tight fitting grating of suitable size to keep out rats and mice. All windows, especially basement windows should be fitted with wire mesh screens. All ventilator intakes and exits, should be screened. All doors or other openings should be furnished with screen doors so hung as to swing shut and stay shut, except when in actual use. The unprotected sewer opening, the open basement window, the open ventilator intake and the open door are welcome signs to wandering rats looking for a home and feed. Cement concrete or metal will if properly placed discourage rats and mice.

7. Buildings such as colony houses, corn cribs, and granaries that it is not practical to put on permanent masonry foundations, should be elevated above the ground at least six inches. This space should be kept clear at all times and the buildings moved frequently to prevent rats making use of such protection.

8. All stored boxed goods or sacked grain should be piled in such a way as to frustrate as much as possible any attempt by rats or mice to make use of same as a shelter. A wide, clear space between sacked goods and the floor of the storage building is helpful in that it permits the entry of a cat, a ferret, or a small dog.

Figure 5.—This rat worked hard gnawing a hole over one inch deep in the door and casing, trying to get into a meat storage room.

RAT AND MOUSE PROOFING BUILDING

This is the most important of all undertakings in the control of rats and mice. Keeping food and shelter away from these animals will do more to reduce pest numbers than any other one of the various control factors.

Rat proofing of farm buildings presents many small problems due to the conditions peculiar to the farm business. Modern buildings in which cement concrete, sheet metal and structural steel form the greater part of the structure are not inviting to rats and mice, but the old wooden farm buildings usually present everything that the pest animals need in a safe home or shelter. The rat and mouse breeding places in buildings on the farm are usually beneath wooden floors in poultry houses, barns, stables, granaries and corn cribs. Piles of wood, lumber, building materials, hay, straw, and refuse also offer shelter. Cement concrete foundations that go down at least two feet below ground level are necessary to all permanent buildings.

Old permanent buildings can be jacked up and suitable cement concrete foundations built for them, cement concrete floors should be put in and generous use made of a non-chewable cement concrete around the sills, and between the studding. Steel lath and plaster on both sides of the first two feet of old wooden wall is an improvement and will keep rats and mice from chewing their way into the building. All grain bins should be lined with thin sheet metal. The corn in the corn crib can be protected by placing wire netting entirely around the structure. A strip of smooth sheet iron not less than eight inches wide should be placed around the top of the wire netting to prevent rats and mice climbing in. A concrete foundation and floor for the corn crib will also save corn. The protection of poultry houses offers more difficult problems than the other live stock buildings. When planning and constructing poultry buildings, the following should be avoided,—wooden floors or floors close to the ground, double walls, and the placing of fixtures in such a way as to shelter rats and mice. Hollow walls or spaces between studs are very apt to be used as shelters by rats and mice so should be avoided in structures. Portable poultry buildings should be elevated two feet above the ground. All interior fixtures should be placed well above the floor of the poultry house in such a way that no shelter is offered to rats or mice. Outside storage cellars, walls, and floors should be made entirely of cement concrete, the ventilators covered with wire netting and the doors sheeted over with metal. All buildings should be carefully checked over for possible places of entry such as openings in cement concrete walls left for steam pipes, water pipes, and drain pipes. If found such opening should be closed preferably with cement. If cement is not practical, then use wire netting folded and shaped so as to form an effective removable plug for such an opening.

Old buildings in town can be made proof against rats and mice, just the same as farm buildings can, if the owners have the will to do it.

New buildings in town are now generally constructed according to architects' plans and specifications that call for the liberal use of indestructible and noncombustible materials as concrete and steel. Rats and mice therefore find it hard to get into the modern city building, unless they find one where the people are so careless as to leave doors and windows unguarded or open. Modern market buildings are built entirely of masonry and steel so offer a real problem to the rat seeking shelter.

A few sign boards "Swat the Rat and the Mouse" will remind workers that the problem of controlling these pests requires constant attention.

COMMUNITY EFFORT

The farmer should for his own profit, prevent rats and mice breeding on his farm. The urban dweller should protect his own property and the health of his family against rats and mice. Those persons that allow rats and mice to increase on their property until such become a menace to the neighbourhood are neglecting their duty to the community. The town refuse or municipal garbage dump should be handled in such a way as will prevent rats and mice breeding and feeding there, to spread over the district. The removal of rats from a community can only be accomplished by the organized efforts of all those occupying premises that harbour rats. Such co-operative efforts against rats are best undertaken by the local Municipal Council, or such organization as a Board of Trade or a Farmers' Club.

THE FIELD MOUSE

Field mice of several species cause very serious losses in orchards, shrubberies, gardens and fields every winter and need close attention to prevent or minimize loss. Girdled trees wither and die. Ornamental trees and shrubs are frequently ruined by bark-eating mice. Lawns and meadows are severely damaged by mice feeding on grass, grass roots, bulbs and corms. Evidence of destruction is to be seen on every hand with the disappearance of the snow in March. The meadow mouse (Microtus), the pine mouse (Pitymys) and the white-footed mouse (Peromyscus) are the principal offenders. The common short-tailed meadow mouse is by far the most abundant of these species in Ontario. The meadow mouse feeds above the ground on any available green bark or other vegetation. The pine mouse feeds largely below the surface on the roots of trees, shrubs, and grasses principally, but other vegetation may be eaten when living conditions are hard. The pine mouse may cause considerable damage working below the surface on tree roots before its presence is suspected.

FIELD MOUSE CONTROL

Clean cultivation if practical for the area, spading around the trees and shrubs, the covering up or removing of all debris or other vegetation likely to give shelter to mice, the covering the bole of the tree or shrub with an application of a lime-sulphur and glue mixture, or with several layers of tar paper or with a layer of wire mesh, are methods that will aid materially in reducing mouse damage. The practice of partly pruning the orchard trees in December and leaving the prunings near the bole of the tree until spring is a good one as it gives the mice something to satisfy their hunger. With their hunger satisfied, they are less likely to damage the trees. Green prunings can thus serve a good purpose over winter if scattered about on the ground where mouse damage is likely to occur. Poisoned grain placed in hollow land tiles, long cans, or old glass jars or old marmalade bottles can be spotted about the orchard in the tree rows as poison stations for mice. The entrance to the tile or jar should be small enough to keep game birds or small fur-bearing animals from reaching the poisoned grain or other form of bait. Spring traps can be set in runways at the entrance of burrows. Sultana raisins or large grains of corn fastened to the spring trap trigger make excellent baits. Traps require close attention and must be kept baited and set in likely places to be successful. Traps require a daily examination. The use of poison bait is the most satisfactory way of controlling field mice in orchards and gardens. Danger to other animals should be kept in mind when poisons are used. Poisons are safe in the hands of careful people. Fortunately, pheasants, quail, partridge, and chickens are highly resistant to strychnine, and will not be injured by poison grain if such is carefully placed in poison station containers, or dropped into mouse burrows out of the reach of birds. Grain bait for mice is prepared as follows: mix one tablespoon of gloss starch into two ounces of cold water, and stir into twelve ounces of boiling water to make a thin starch paste. Mix one ounce of powdered strychnine with one ounce of sodium bicarbonate, and then stir this mixture into the thin starch paste, then add four ounces of heavy corn syrup and one tablespoon of petrolatum. Stir well to make a smooth, free-from-lumps mixture. This mixture can then be added to 12 pounds of crushed oats. To use, a teaspoonful of the poisoned crushed oats can be placed in each mouse burrow or in the mouse poison station during the spring, the summer and the autumn. The effectiveness of this method after snow has covered the ground is limited. The practice of keeping the snow tramped down hard around small orchard trees or shrubs will aid in keeping meadow mice away as they follow the path of least resistance when moving about under the snow in search of food. The most effective work in controlling field mice is done during the spring, summer, and autumn. Neglect during these seasons will result in the difficult problem of trying to combat a pest that is protected by frozen ground and snow covering. Plan to destroy field mice during the seasons when they are easy to reach. Disturb their nests. Trap them. Poison them. Encourage and protect natural enemies of field mice.

USEFUL ANIMALS AID IN CONTROLLING MICE

Of the various carnivora preying on field mice the fox, the mink, and weasel are of the greatest importance in Ontario. In areas where the coyote abounds, the mouse forms a very important part of its food. Wolves, bears, lynx, fisher, and skunk also feed on mice and are of importance in keeping down the numbers. The animals preying on the field mouse varieties do not increase beyond one animal or one small litter each year; hence, their numbers should not be materially reduced by hunting. It is a big mistake to shoot or trap all the foxes out of a district. Such practice is usually followed by heavy losses due to field mice destroying grasslands, field crops, and orchards. All hawks and owls prey on the various species of field and woodland mice. These birds are working in the interest of the farmer, continually hunting and destroying mice. An active mouse-hunting hawk or owl will destroy 1,500 or more mice during the season April to November. Fifteen hundred mice will destroy a lot of crop. The wise farmer will protect the hawks and owls because he knows that they aid in the control of his numerous but small, unseen enemies. These birds work for their living and pay their way many times over, even if they do take a chicken occasionally.

SUMMARY ON RAT AND MOUSE CONTROL

1. Plan and construct all buildings in such a manner as will discourage the entrance of rats and mice.

2. Rats and mice will enter open doors of the so-called rat proof buildings. Keep doors closed when not in use.

3. Clean up, if possible, all materials useful or otherwise, that offer shelter to rats and mice. Wood piles, scrap lumber piles, rubbish piles, stone piles, brush piles, hay and grain stacks, pit-silos, tumble down buildings, and manure piles all offer shelter to rats and mice.

4. Arrange for the safe burning of all garbage from day to day.

5. Use traps continually. See that such are attractively baited and set at all times. Use poison baits, if traps fail.

6. Use the fumigation method where it can be applied, and traps are not efficient as around corn cribs or other places where there is a great abundance of a food preferred by the rat.

7. Do not be hard on the natural enemies of the rat and mouse. The fox, the hawk and the owl deserve a measure of tolerance and protection for their part in keeping rats and mice in control.

8. Keep a dog of the type that likes to hunt rats and mice. It will kill many and drive many away.

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Statistics and Publications Branch
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THE HOME VEGETABLE GARDEN

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Nutritionists have stressed the importance of a variety of fresh vegetables for an adequate supply of minerals and vitamins in our diet. The home vegetable garden can supply all or part of the vegetable supply, depending on the size and management of the garden area. A well managed vegetable garden may be a place of pleasure and profit whether one lives on a farm or in a village or has a small lot in a backyard in a town or city.

WHERE TO MAKE A GARDEN

If there is any choice of location the best soil is mellow and loamy in texture, free from rubbish and stones, fairly level and well drained.

The garden should be near the house for convenience in caring for and harvesting the vegetables. This is of special importance on the farm where the work in the garden is often done by the women.

Shaded areas near buildings should be avoided. The combination of shade and competition with tree roots spoil areas under or near large trees. For best growth a garden should have at least six hours sunlight in the middle of the day.

WHEN TO PLANT

Since the climate varies greatly in different parts of Ontario it is difficult to state the time of planting of the first out-of-door vegetables. The table of planting information gives the approximate planting dates for the Guelph district.

WHAT TO PLANT

In the choice of the kinds and varieties of vegetables consideration should be given to family preference and the size of the garden area. The former, though important, should still allow a variety of crops. Nutrition studies indicate that a wide choice of vegetables is desirable. Therefore, small quantities of vegetables not now commonly used by the family might be grown to encourage a wider preference by the members of the family.

The large farm garden may contain as many as 45 kinds of vegetables—an appetizing, healthful and varied vegetable diet. Those vegetables which can be canned and stored should be produced in quantities sufficient to provide most of the winter's supply for the family.

In the smaller town or village garden the space consuming crops such as squash, melons, cucumbers and potatoes should be avoided. In spite of the space required crops such as peas, corn and asparagus may be planted by those who appreciate their high quality when freshly harvested.

The small garden will contain those crops such as lettuce, radish, spinach, onions, leeks and kale which require a minimum of space. Tomatoes will also be grown. Enough beets and carrots would be grown for immediate use. Concentrate on those crops which respond to intensive cultivation and which will provide sufficient variety.

THE GARDEN PLAN

A carefully thought out plan put on paper is essential if one is to garden efficiently. An intimate knowledge of the various crops is essential in order to make the best plan. Each year it is wise to preserve the plan and suggested improvements in order to improve succeeding plans and gain useful information. By constantly referring to the planting table (page 9) and the following suggestions, even the most amateur gardener can prepare a plan suited to his needs.

(1) Long straight rows are to be preferred to several short rows or beds for ease in planting and cultivation and to avoid needless waste space for paths. When only small quantities are needed more than one kind of vegetable may be planted in one row.

(2) Where possible, to avoid shading, rows should run north and south rather than east and west.

(3) If the garden is on a fairly steep slope it is much better to have the rows run across the slope rather than up and down.

(4) Perennial crops such as small fruits, asparagus, rhubarb and horseradish should be planted at one side of the garden in order that they will not interfere with the spring preparation of soil.

(5) If the rows are arranged according to date of planting just enough soil would have to be prepared as needed for each planting.

(6) Early crops such as lettuce, radish and spinach should be grouped together so that they may be cleared away and other fall crops planted in the space.

(7) Crops such as tomatoes, onions, peppers, eggplant, parsnip, salsify and parsley which remain in one place throughout the entire season should be planted together where they will not be disturbed.

(8) Tall crops such as corn and pole beans which shade other crops, and crops such as squash, cucumber and melons which may overrun smaller crops should be placed at one side of the garden where they will not interfere with other smaller crops.

(9) Do NOT crowd plants.

(10) Plan to have a variety of crops ready for harvest at all times.

(11) Plan for a succession of crops, which may be done in two ways. Follow early crops such as lettuce, radish and spinach with such crops as late beets, carrots, or cabbage. Similarly carrots, beets or cabbage harvested early may be followed by lettuce, radish, spinach, kohlrabi, winter radish and similar crops. Crops such as corn, radish, spinach, lettuce and peas which when mature remain in good condition for only a short time can either have several successive seedings or else, especially for corn, sow at the same time several varieties which mature at different dates.

(12) Intercropping or companion cropping is the growing of two or more crops on the same area at one time. Seed of radish may be planted with slow germinating parsnip seed to both mark the row and provide a supply of radishes. Quickly maturing crops such as lettuce, radish and spinach may be planted between rows of tomatoes, eggplant, melons, cucumbers and other crops which are widely spaced and occupy the ground during the entire season.

SEED FOR THE GARDEN

Good vegetable seed is free from dirt and foreign matter, capable of a high percentage of germination, free from seed borne diseases and true to varietal name.

Cheap seed is quite often poor seed either because of poor germination or not being true to name. Buy seed from the better seed companies located in the general region of the grower.

PREPARATION OF THE SOIL

Garden soils respond well to applications of manure of 20 to 25 tons per acre or 100 pounds per 100 square feet. If manure is not available commercial fertilizers may be substituted but organic matter must be added in some form such as green manure. Winter rye sown in September and turned under in the spring is a good source of organic matter.

A mixed fertilizer of a 4-8-10 or 4-8-6 analysis at a rate of 1,000 to 1,500 pounds per acre or 2 to 4 pounds per 100 square feet would be expected to give satisfactory results on most garden soils. Fertilizer may be applied broadcast and worked into the soil or in bands 2 to 4 inches from the rows at planting time.

Soil should not be worked in the spring when it is so wet that a handful will not crumple after being compressed.

For a good seed bed soil should be well worked, pulverized and smoothed level as seed germinates poorly in coarse lumpy soil.

SOWING AND TRANSPLANTING IN THE GARDEN

Seed should be sown in straight rows or shallow trenches soon after the soil is prepared. For depth of planting and distance between rows consult the planting table. When the soil is extremely dry it is good practice to plant the seeds deeper to get them into moist soil. This is especially recommended for large seeds such as beans, corn, cucumbers and squash. If care is taken not to sow seed too thickly much seed may be saved and thining of seedlings may not be necessary later.

Since many of our vegetable plants such as tomatoes, peppers, egg-plant, celery, cabbage, cauliflower and related plants are usually started indoors and later transplanted to the garden, it is well to heed certain suggestions regarding transplanting.

(1) Water the plants well before disturbing.

(2) Disturb the roots as little as possible, for best results.

(3) If possible avoid transplanting during hot dry weather but, if it must be done, plant late in the afternoon, water well and shade the plants from the sun for several days.

(4) Plants started indoors may be hardened by exposure to favourable outdoor temperatures during the day for several days before transplanting or by giving them only sufficient water to keep them from wilting.

THINNING AND CULTIVATION

Thin plants when they have become well established but before they have become crowded. Consult the planting table for thinning distances. Small carrots, onions and beets thinned from the home garden may be used on the table. The tops of thinned beets and turnips make excellent greens.

The principal reasons for cultivation are weed control and aeration of the soil. Cultivation should be shallow and only frequent enough to control weeds. For most effective weed control the soil must be stirred while the weeds are still small seedlings. Heavy soil should not be cultivated when wet.

Small gardens can be easily cultivated with the hand hoe and garden rake. For larger gardens the wheel hoe is a time and labour saving implement worth possessing. The farm garden is of such size and so arranged that cultivation may be done by horse or tractor implements.

DISEASES AND INSECTS

For information regarding diseases and insects attacking vegetables write to the Departments of Botany and Entomology, respectively, of the Ontario Agricultural College, Guelph.

SUGGESTED LIST OF VARIETIES OF VEGETABLES FOR THE HOME GARDEN

Asparagus:		Mary Washington.
Bean:	Snap, green-podded bush:	—Bountiful, Plentiful, Tendergreen, Stringless Green Pod.
	Snap, wax-podded bush:	—Sure Crop, Pencil Pod, Round Pod Kidney Wax.
	Lima, bush:	—Fordhook Bush Lima, Henderson.
	Lima, pole:	—Leviathan.
Beet:		Crosby Egyptian, Detroit Dark Red.
Broccoli:		Italian Green Sprouting.
Cabbage:	Early	—Golden Acre, Early Copenhagen.
	Midseason	—Glory, Succession.
	Late	—Danish Ballhead (short stem).
	Red	—Red Rock.
	Savoy	—Drumhead Savoy.
Carrot:		Red Core Chantenay, Nantes.
Cauliflower:		Snowball or Erfurt.
Celery:		Golden Self-Blanching, Golden Plume, Utah and Salt Lake.
Cucumber:		Early Fortune, A and C, Straight Eight.
Eggplant:		Black Beauty, New Hampshire Hybrid.
Lettuce:	Butter Head	—Big Boston.
	Crisp Head	—New York.
	Cos	—Paris White.
	Leaf	—Grand Rapids.
Muskmelon:		Hearts of Gold, Honey Rock.
Onion:		Yellow Globe Danvers, Prizetaker, Riverside Sweet Spanish (transplanted).
Parsnip:		Hollow Crown.
Peas:		Laxton's Progress, Thomas Laxton, World Record.
Pepper:		Harris' Earliest, Harris' Early Giant.
Potato:	Early	—Irish Cobbler, Chippewa, Warba.
	Late	—Katahdin.
Pumpkin:		Small Sugar or Pie.
Radish:		Scarlet Globe, Scarlet Turnip White Tip.
Rhubarb:		Macdonald, Valentine.
Rutabaga or Swede Turnip:		Canadian Gem, Perfect Model.
Spinach:		Long Standing Bloomsdale, Summer Savoy.

Squash:	Summer—Yellow Straightneck, Italian Marrow or Cocozelle, Zucchini. Winter—Warted Hubbard, Golden Hubbard, Delicious, Kitchenette, Table Queen.
Sweet Corn:	Marcross 6.13, Spancross 4.13, Golden Bantam, Golden Cross Bantam.
Tomato:	Bounty, Bonny Best, John Baer, Stokesdale, Rutgers.
Turnip:	Purple Top.
Watermelon:	Honey Cream, Early Canada, Stone Mountain, Winter Queen.

PLANTING TABLE

Vegetable	Feet of row per person	Seed or plants per 100 feet of row	Depth to sow seed, inches	Distance between rows: Horse cultivation	Distance between rows: Hand cultivation	Distance between plants in rows, inches	Time of planting in open soil	Days to harvest
Asparagus	5-10	50-60	6-10	6 ft.	3 ft.	18-24	April	2 years
Beans, Bush	10-15*	1 lb.	1-2	2½-3 ft.	1½-2 ft.	2	May 15	50-70
" Pole	5-10	½ lb.	1-2	3-3½ ft.	1½-2 ft.	12	May 15	60-70
Beet	10-15*	1 oz.	½	2-2½ ft.	1-1½ ft.	2-3	Apr. 1-July 10	55-70
Broccoli, Early	5-10	65	plants	2½-3 ft.	1½-2 ft.	18	Apr. 1-15	10-60
" Late	5-10	65	"	2½-3 ft.	1½-2 ft.	18	June 15-July 10	10-60
Brussels Sprouts	5-10	65	"	2½-3 ft.	1½-2 ft.	18	May 15-June 15	70
Cabbage, Early	5-10	65	"	2½-3 ft.	1½-2 ft.	18	Apr. 1-15	70
" Late	10-15	50-65	½	2½-3 ft.	1½-2 ft.	18-24	June 15-July 10	110
Carrot	10-20*	¼ oz.	½	2-2½ ft.	1-1½ ft.	2-3	Apr. 1-July 10	65-75
Cauliflower, Early	5-10	65	plants	2½-3 ft.	1½-2 ft.	18	Apr. 1-15	60-70
" Late	5-10	65	"	2½-3 ft.	1½-2 ft.	18	June 15-July 10	60-70
Celery, Early	5-10	200	"	2½-3 ft.	1½-2 ft.	6	Apr. 20-May 15	
" Late	10-15	200	"	2½-3 ft.	1½-2 ft.	6	July 1-15	
Chard	2-5	1 oz.	1	1½-2 ft.	1-1½ ft.	6	Apr. 1-May 1	55
Corn	15-50*	¼ lb.	2-2½	3-3½ ft.	2-3 ft.	18-36	May 10-July 1	70-90
Cucumber	5-10	½ oz.	1-2	4-6 ft.	4-5 ft.	12-48	June 1-July 1	60-70
Eggplant	2-6	50-60	plants	2½-3 ft.	2 ft.	18-24	June 1	70-80
Endive	2-5	1 pkt.	½	2-2½ ft.	1½ ft.	8	Apr. 1-15	90
Horseradish	1-2	100	plants	2½-3 ft.	2 ft.	12	Apr. 1-15	1 year
Kale	3-6	2 pkt.	½	2-3½ ft.	1½-2 ft.	8	July 15-Aug. 1	55-60
Kohlrabi	3-6*	2 pkt.	1	2-2½ ft.	1½-2 ft.	2-4	Apr. 1-July 15	60
Leek	1-2	2 pkt.	1	2-2½ ft.	1-1½ ft.	2-3	Apr. 1-15	

Note: *Amount at each sowing.

PLANTING TABLE—Continued

Vegetable	Feet of row per person	Seed or plants per 100 feet of row	Depth to sow seed, inches	Distance between rows: Horse cultivation	Distance between rows: Hand cultivation	Distance between plants in rows, inches	Time of planting in open soil	Days to harvest
Lettuce	5-10*	2 pkt.	½	2-2½ ft.	1-1½ ft.	8-12	Apr. 1-Aug. 1	45-80
Muskmelon	10-15	¼ oz.	1-2	4-6 ft.	4-5 ft.	12-48	June 1	80-100
Onion (seed)	5-10	½ oz.	seed, ½	2-3 ft.	1-1½ ft.	2-4	Apr. 15	
" (transplants)	5-10	600	plants 2-3	2-3 ft.	1-1½ ft.	3-4	Apr. 1-15	115-135
Parsley	1-2	2 pkt.	½	2-3 ft.	1-1½ ft.	6	Apr. 1-Aug. 1	80
Parsnip	5-10	2 pkt.	¼	2½-3 ft.	1½-2 ft.	3-4	Apr. 15-30	110
Peas	10-30*	1 lb.	1-2	2½-3 ft.	1½-2 ft.	2	Apr. 1-30	60-85
Pepper	3-6	60-100	plants	2½-3 ft.	1½-2 ft.	12-18	June 1	65-75
Potato	.75-200	5-10 lbs.	2-4	2½-3 ft.	2-2½ ft.	12-14	Apr. and May	
Pumpkin	5-10	¼ oz.	1-2	6-10 ft.	6 ft.	72	June 1	110
Radish	3-6	2 pkt.	½	2-2½ ft.	1-1½ ft.	2	Apr.-Aug.	28-35
Rhubarb	1-2	35-50	plants	3-5 ft.	3 ft.	24-36	April	
Rutabaga or Swede Turnip	5-10	2 pkt.	½	2½-3 ft.	1½-2 ft.	4-6	June 15-30	100
Salsify	3-6	2 pkt.	½	2-2½ ft.	1-1½ ft.	2	Apr. 15-30	
Spinach	10-30	1 oz.	½	2-2½ ft.	1-1½ ft.	3	Apr. and Aug.	40-45
N.Z. Spinach	5-10	1 oz.	½	2-2½ ft.	1½-2 ft.	18	Apr. 15	
Squash	5-10	½ oz.	1	6-8	6	6	June 1	
Tomato	10-30	33	plants	3-4	3	36	May 25-June 1	75
Tomato (staked)	15-30	50-75	plants	3-4	2-2½ ft.	12-18	May 25-June 1	75
Turnip	5-10	2 pkt.	½	2-2½ ft.	1-1½ ft.	3-4	Apr.-Aug.	50
Watermelon	3-6	½ oz.	1	6-8	6	6	June 1	75-85

Note: *Amount at each sowing.

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Ontario Department of Agriculture

Statistics and Publications Branch

TORONTO, ONTARIO

ESTABLISHING THE YOUNG ORCHARD

by

W. H. UPSHALL

HORTICULTURAL EXPERIMENT STATION

VINELAND STATION, ONTARIO

Young peach orchard. Proper eare is necessary to establish sound, vigorous profitable trees.

ESTABLISHING THE YOUNG ORCHARD

W. H. Upshall

HORTICULTURAL EXPERIMENT STATION

Vineland Station, Ontario

AN ORCHARD should be a long-time investment and consequently deserves very careful planning. Many orchard men will freely admit that they made mistakes in selection of site, soil, distance of planting, varieties, etc.—mistakes which have reduced and are continuing to reduce the returns on the investment. It seems wise therefore to investigate thoroughly all orcharding factors before the new orchard is finally placed and planted, to seek and weigh advice from experienced orchardists, fruit dealers, and professional horticulturists.

LOCATION

As a rule the safest procedure is to start a new orchard in a recognized fruit district. Here one has the advantage of the collective experience of the neighbours as a guide, ready access to co-operative or private sales channels, to sources of orchard supplies and to cold storage facilities. There are however some very successful isolated orchards, particularly adjacent to good local markets where a high proportion of the sales are made at the orchard, all of which reduces the cost of marketing. Another advantage held by the isolated orchard is the absence of nearby orchards in which insects and disease may not be well controlled. Wherever the orchard is situated there should be ready access to good highways and probably also to railroads. With spraying such an essential factor in orcharding, a plentiful and constant supply of water is of the utmost importance.

It is not within the power of the orchardist to change the weather; therefore it is important to locate in a district in which temperature and moisture conditions favour the development of regular crops of good quality fruit. For instance, in Ontario one cannot count on regular crops of peaches outside of the Niagara district and a narrow fringe of land along Lake Erie, the southern portion of Lake Huron and the western portion of Lake Ontario. In other areas winter injury of the wood or spring frost injury to the blossom buds comes too frequently to make peach growing a profitable commercial venture.

SITE

Good water drainage is an important consideration in the selection of a site for the orchard. Tile drainage, important as it is, cannot take the place of good natural drainage. Areas on which water lies on unfrozen soil for more than a few hours after a rain should be avoided. Tree roots must breathe or die, and cannot long survive without an adequate supply of air which, of course, is cut off under conditions of submergence in water.

The direction of the immediate slope of the land is not of vital importance. Steep slopes should be avoided if possible, because of the danger of loss of top soil through erosion to lower levels. Young orchards are nearly always cultivated during the early season, and even in older sod orchards it is often necessary to break up the sod occasionally. Any such cultivation opens the way to a loss of top soil from steep or even moderate slopes.

Air drainage is almost as important as water drainage. Cold air drifts downward to low areas, eventually coming to a "pocket" where it accumulates. This is known as a "frost pocket" and is an unsuitable site for fruit trees because of the added danger of injury during the winter and early spring. Woods or very dense windbreaks on one or more sides of the orchard are not desirable because they hinder the free air movement so important in the checking of disease and insect injury.

SOIL

In the selection of a suitable orchard soil the physical characteristics, particularly texture and depth, are of first importance. A soil texture which allows for rapid intake of water is a valuable asset. The rainfall which runs off the land is of no benefit whatever to the crop; but a plentiful supply of water, naturally held in the soil, is the best kind of insurance for healthy

FIG. 1. Soil erosion. To eliminate the loss of rich top soil a gully should be left continuously in sod, the land on each side being treated as a separate field or orchard.

and productive trees. There should be at least four feet of soil above the basal rock or clay, better six feet, and this should be soil in which roots will penetrate freely. It is easy to see that a soil six feet deep will have about twice the water reserve for the roots that the soil three feet deep will have. The available nutrient supply will also be much greater under the former conditions. Ground water coming up to within three feet of the soil surface and remaining there for more than a few hours during the growing season acts like rock or hard clay in reducing the possible root area, for death of the water-soaked roots is the result. Post holes or trenches four feet deep as observation posts during the growing season will give very valuable information on water levels. As a rule a subsoil of mottled brown colours indicates poor internal drainage and should be avoided for orchard purposes.

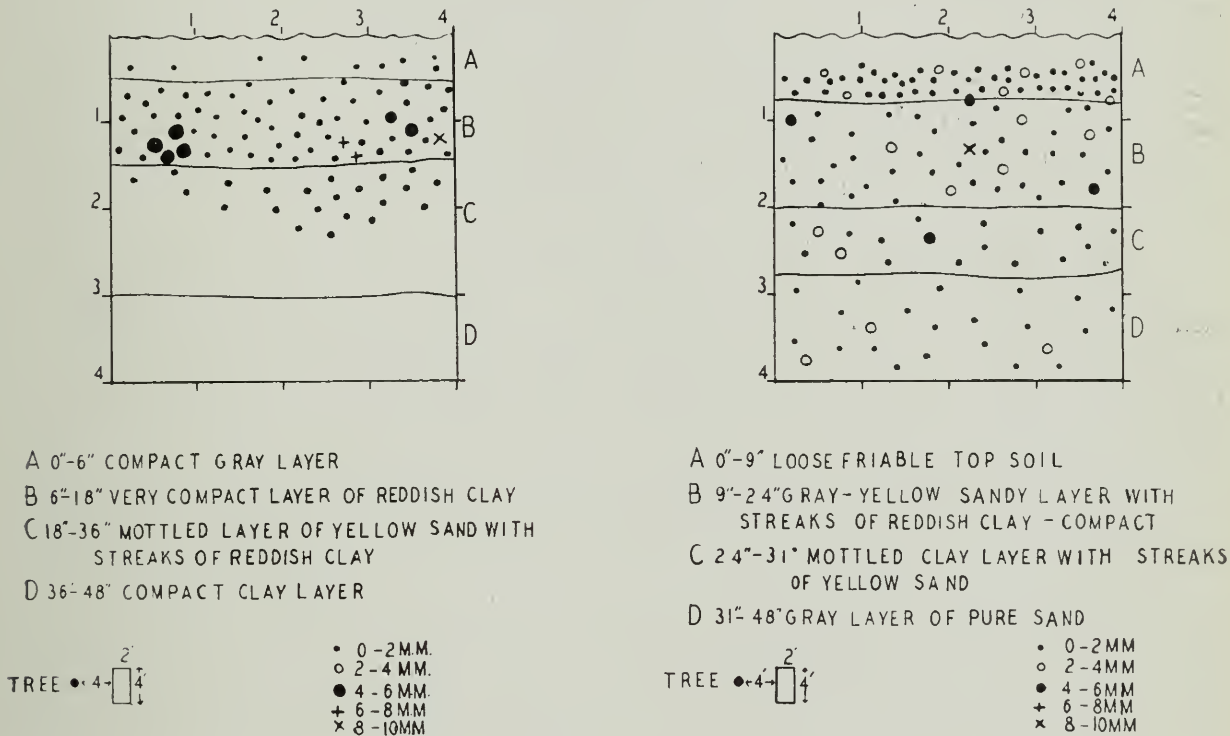

FIG. 2. Depth of rooting determines size and productivity of the tree. The above illustrations show (*left*) depth of rooting in a shallow soil and (*right*) in a deep soil, the symbols representing root positions and diameters along trenches dug adjacent to trees of the same age. The shallow soil trees were weak growing; the deep soil trees strong and vigorous, about three times the size of the former.

Given good drainage, apple trees do well on a wide range of soil types light sandy loam to clay loam. Pear and plum do well on clay loam soils, even on those on which water intake is rather slow. Peach and cherry prefer very deep gravelly or sandy loams, and both are particularly susceptible to injury under conditions of poor drainage.

PLAN OF ORCHARD

Having selected a suitable piece of land for the orchard, measurements should be taken and a plan drawn to scale. There are two main systems of orchard planting being used in Ontario: (1) Square or Rectangle, and (2) Diagonal or Quincunx. The latter is used only in apple orchards and is derived from the former by the placement of a "semi-permanent" tree (O) in the centre of each square (or rectangle) of permanent trees (X). The semi-

X X

O

X X

permanent tree would probably be removed in fifteen to twenty years, leaving an orchard on the Square or Rectangle system. In apple orchards some growers have used a complete system of "fillers," one tree of a quick-cropping variety between each two permanent trees in both directions. Others have used fillers in one direction only, leaving wide spaces between tree rows in which to grow intercrops. However, it is now quite generally agreed that these filler trees do not yield large enough crops to pay their way and for their removal, and often are left in so long that the permanent trees are injured by them.

For rolling land the new Contour method of planting is being used to some extent. Trees are not planted in straight lines but in curving rows running as far as possible at right angles to the slopes. All cultivating and hauling is done this one way, the idea being to reduce the loss of top soil by the elimination of the normal furrowing and ridging of cultivation in the way the water flows naturally.

The danger of spray injury of one kind of fruit tree when spraying another kind is so great that it is inadvisable to have a "mixed" orchard—apples with peaches, pears with plums, etc.

Varieties should be carefully selected and arranged in the orchard so that pollination requirements are met. With the exception of peaches and sour cherries, it is inadvisable to plant solid blocks of single varieties of the tree fruits. For detailed information see Ontario Department of Agriculture Bulletins on "Pollination in Relation to Orchard Planning" (424) and "Fruit Varieties" (430).

The planting distances now favoured by observant growers for permanent trees of the various kinds of fruit are as follows:

Apple	40′ x 40′
Pear, Plum, Sour Cherry	20′ x 20′
Sweet Cherry—on usual or "peach" soils	25′ x 25′
on real deep "cherry" soils	30′ x 30′
Peach	22′ x 22′

Having in mind the difficulty of getting through a mature orchard with a spray outfit and fruit-hauling equipment during the harvesting season, some growers prefer to have a wide spacing in one direction. They would, for instance, choose 18′ x 22′ in preference to a 20′ x 20′ spacing.

NURSERY STOCK

Source. As in other lines of merchandise there are good ones and poor ones among nursery trees. For a grower contemplating any large order of fruit trees it would pay to "shop around" a bit, i.e., to see the trees available in the nurseries and to compare qualities and prices. This should be done well in advance of the required delivery time, otherwise the grower may not be able to get the varieties and grades that he wishes. When trees are ordered from an agent, preference should be given to those who represent well-known firms, otherwise investigation of the company's standing should be made.

Rootstock. All fruit trees are budded or grafted, usually on seedlings, in the nursery. In recent years many new rootstocks have been coming into the trade. Some of these are desirable additions and others are proving to be undesirable, at least under certain conditions. Therefore, unless a grower has some special assurance about a new rootstock, he should keep to the following standard rootstocks:

Apple	French Crab or Domestic apple
Pear	French pear or Bartlett seedlings
Plum	Myrobalan
Cherry	Mahaleb—on deep soils
	Mazzard—on shallower soils
Peach	Southern Natural or Elberta seedlings

Age. Trees with tops from one to five years of age are available. Often the older trees have had the digger run under them but have been left in the row. A year or two later they are sold as "root-pruned" trees. Sometimes the tops have also been heavily pruned, but not always. Growers being offered such trees should see them in the nursery that they may judge for themselves their suitability for the purpose. The claim for root-pruned trees that they come into bearing earlier than the normal two-year trees has not often been justified.

In peaches and sweet cherries one-year trees are most satisfactory and deserve preference over older trees. In apples, pears, plums and sour cherries it is hard to beat No. 1 two-year trees. On these there are usually plenty of good strong buds from which a satisfactory top may be built.

Grade. Fruit trees are commonly graded as No. 1, 2 and 3, according to height and to diameter of trunk two inches above the bud union. For standard apple, pear and plum (two-year and older) the grades are as follows:

No. 1—$\frac{11}{16}$ to 1 inch in diameter and 5 feet and up in height
No. 2—$\frac{9}{16}$ " $\frac{11}{16}$ " " " " 4 " " " " "
No. 3—$\frac{7}{16}$ " $\frac{9}{16}$ " " " " $3\frac{1}{2}$ " " " " "

For peaches and cherries the height requirements are less than for the other fruits and most nurserymen consider $\frac{9}{16}$ to $\frac{11}{16}$-inch size as No. 1 grade in peaches. The above grades have been established by the nurserymen themselves, not by law.

Time of planting. In the Niagara district, except for peaches, very good results have been obtained from plantings made about mid-November, from the 10th to the 20th. In other districts growers should be guided by local experience. One-year apple, pear and plum, being slow to mature in the nursery, may suffer winter injury when planted in the fall, but this is not true for sweet cherry, for which fall planting is favoured. Where jack rabbits are a problem it would be wise to delay planting until spring. In the spring, planting should be done as soon as the soil is fit to work. Delay means reduced stand or growth of trees, sometimes both. In this connection the buyer should be very definite to the nurseryman about the time of delivery of his trees. When they arrive he should look them over carefully and, if dissatisfied with them, should immediately get in touch with the nursery. Bundles should be opened and the trees heeled in the soil until planting time. All roots should be in close contact with the soil, and this can be attained only by careful packing and tramping around the roots.

LAYING OUT THE ORCHARD

The first step in laying out the orchard is the location of a base line. This should run parallel to a road, fence or adjacent orchard, and it can be on any side or end of the new orchard. At one end of this base line a corner tree should be located, leaving room for turning with implements even after the tree is mature. A stake is driven in at this point. A 100-foot cloth or steel tape is useful for measuring, but a light pliable wire 100 to 150 feet in length and marked with paint where required is quite satisfactory.

To have the orchard imposed squarely on the base line so that even on the diagonal the trees will be in line, it is necessary to have an exact right angle at both ends of the base line. This is easily attained by measuring 30 feet along the base line from the corner stake. Then the intersection of a

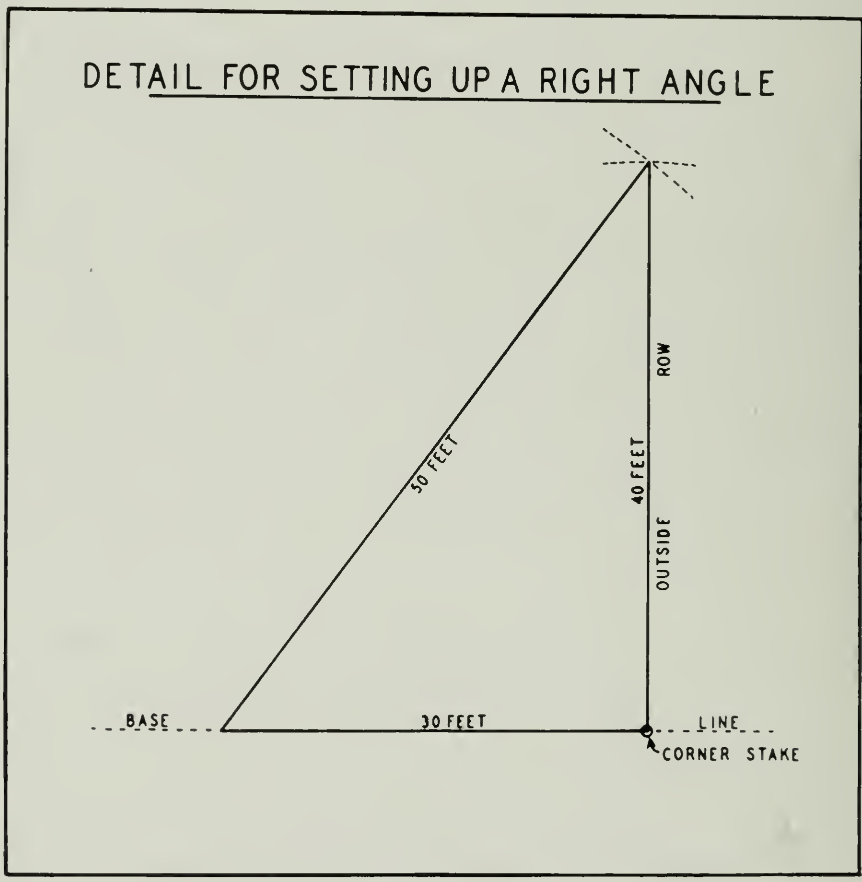

FIG. 3. Trees should be planted in straight rows and on the square. A true right angle at the starting point, as indicated in the diagram, will insure a proper beginning.

50-foot arc from this point and a 40-foot arc from the corner stake will give the right angle, establishing one of the outside rows of stakes (see Fig. 3). This method is merely an extension of the carpenter's 3, 4, 5-foot system of getting a right angle. Measuring from the corner stake, other stakes are used to mark tree locations along the base line, and when the last stake is in another right angle is obtained in the way just described. Then stakes are placed in their proper places all around the outside of the field. The interior stakes may be sighted into place from two directions, but the work is done more quickly and perhaps more accurately by using the measuring tape or wire for the whole job. If the orchard is to be a large one and on rolling land the help of a surveyor may be advisable and is almost imperative if the orchard is to be planted on contour lines.

TRANSPLANTING

So much care having been taken to get the area properly staked, it is very important that the trees be planted exactly where the stakes stood. Use of the planting board is the best insurance that this will be done (see Figs. 4, 5 and 6). The planting board is usually five feet long, four inches wide and one inch thick, with a notch in the centre and a hole near each end

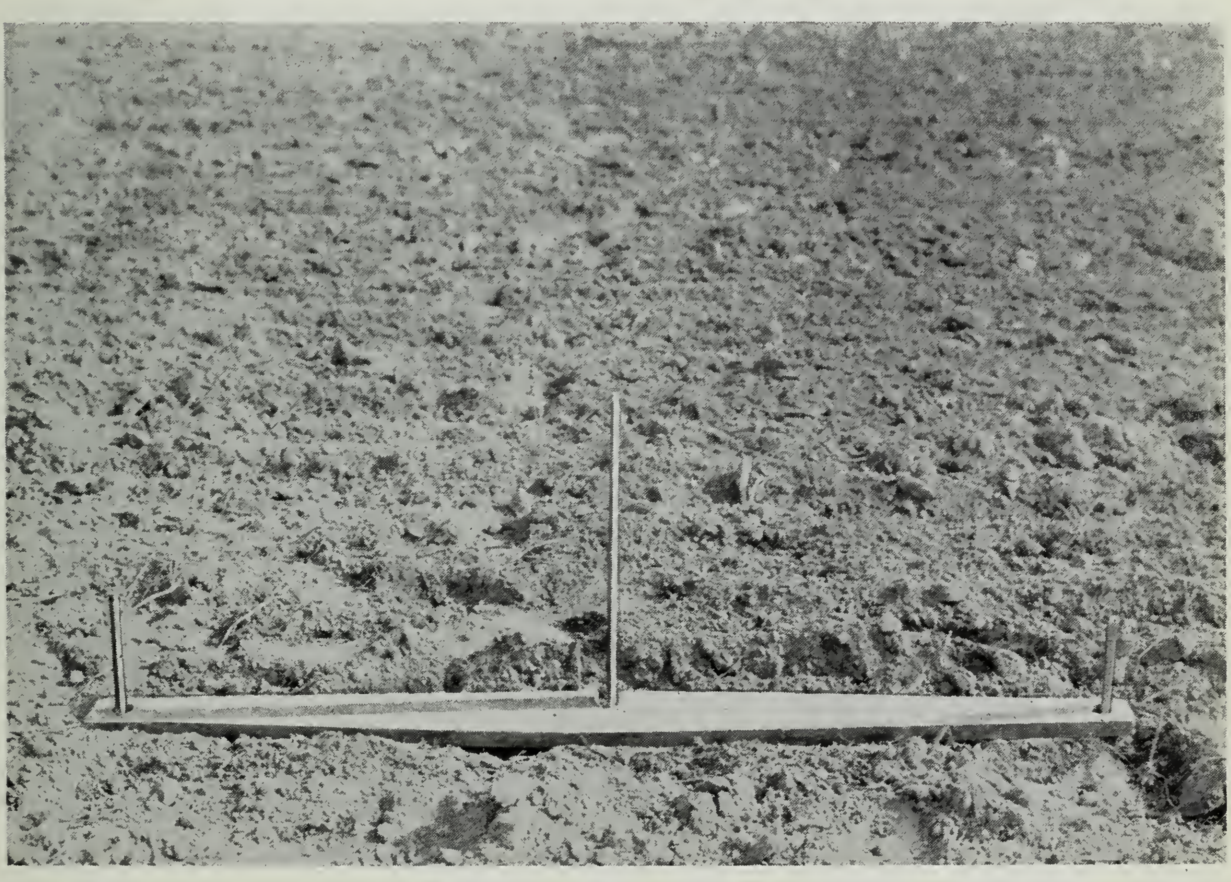

FIG. 4. The planting board in place. It is lifted straight up and put out of the way while the hole is being dug.

in line with the centre notch. The planting board is placed so the tree-marker stake is snugly in the notch, and then small end stakes are shoved into the soil through the end holes. The board is lifted straight up over these end stakes and a hole about eighteen inches in diameter is dug around the original marker stake, after which the planting board is put back into place over the two end stakes. The tree is put in the hole and into the notch in the board;

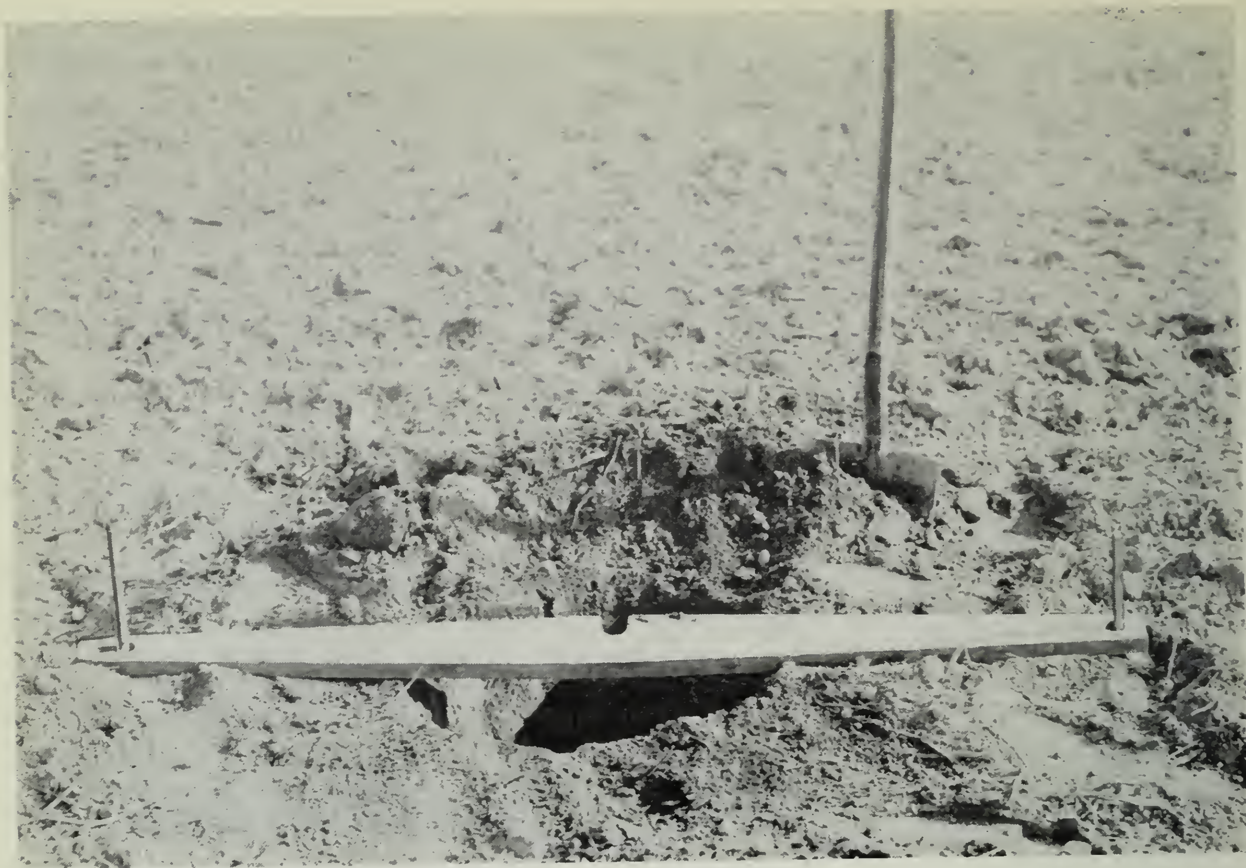

FIG. 5. After the hole has been dug the planting board is placed in its original position.

FIG. 6. The tree is placed in the hole in such a position that the trunk fits snugly into the centre notch. As soon as the tree is held firmly in position by soil tramped around the roots, the planting board may be removed.

the hole is partially filled with soil and tramped so the tree will hold its position. Then the board is removed, the balance of the soil filled in around the tree and tramped thoroughly. The soil mound around the tree should be two to three inches high and the last shovelful should not be tramped.

In digging the holes it is desirable to keep top soil separate from the subsoil, and put the former in the hole first. This allows the new roots to grow out into the richer top soil and may give the tree a better start. Holes should not be dug far in advance of planting because of the undesirable drying of the soil. The trees themselves should not be left exposed very long before planting, but carrying them around in tubs of water is quite unnecessary.

In transplanting trees two men work together, one placing and holding the tree and tramping the soil as the other man shovels it into the hole. Trees should be placed with the heavily branched side towards the prevailing wind, usually southwest, and with a slight slant also in the same direction.

Trees should not be planted more than two inches deeper than they stood in the nursery. This will bring the bud union at or just above ground level. It is almost impossible to get permanently deep-rooted trees by deep planting, as they are very likely to develop a second root system above the old one when the latter is put down into the strata of infertile and poorly aerated subsoil.

There have been so many losses from applying manure and chemical fertilizers in the holes at planting time that it is generally considered unwise to do so. Moist peat moss, about twelve quarts per tree, mixed with the soil at planting time, has given good results on heavy clay soils, but has not been profitable on any of the lighter soil types.

PROTECTION FROM MICE AND RABBITS

Sometime before the first winter in the orchard, wire guards should be placed around each tree as a protection against mouse injury. They are made from quarter-inch mesh galvanized wire, eighteen inches wide, cut to a length to give room for several years' growth after a slight overlapping of the ends (see Fig. 7). The guards are sunk in the ground two or three inches to hold them firm. Each fall they should be examined and reset if required.

In some districts rabbits, particularly jack rabbits, do a great deal of damage to fruit trees by eating and tearing the bark of branches and trunk. Shooting and poisoning will help to keep down the amount of injury, but often it will have assumed considerable proportions before the grower is aware of it. In these districts it is advisable to wrap young trees with burlap as high as the rabbits are likely to reach from snow banks, or cover with resin-alcohol repellent to the same height. To make this repellent add slowly and with constant stirring twelve pounds of finely broken **lump** resin to one gallon of **cold** antifreeze alcohol, which is ethyl alcohol denatured with a small quantity of wood alcohol. This solution should be applied with a brush in the late fall. The bark must be thoroughly dry at the time, as the solution will not adhere to a moist surface. Unused solution should be kept in a closed container to prevent evaporation of the alcohol. This repellent has not been injurious to apple or pear trees, but there is no available data on its effects on plum, peach or cherry trees.

FIG. 7. Tree guard in place around a young tree, the best kind of insurance against damage by mice.

For information on mouse and rabbit poisons or further directions on repellents the reader is invited to write to the Horticultural Experiment Station at Vineland Station.

PRUNING

At planting. Newly planted trees, both fall and spring planting, should be pruned as soon as possible after the planting operation. A reduction of the top lessens loss of water and wind effects and compensates for the loss of a high proportion of the root system in lifting the trees from the nursery row.

The central leader system with various modifications is now the favoured method of training all fruit trees. Unfortunately the normal two-year and older nursery tree is not well adapted to this method. The branching system is too low and too crowded, and often there are narrow-angled crotches which are inherently weak and subject to breakage in later years. The wise procedure therefore is to remove all laterals except one with a good angle, which is cut to a short stub with terminal bud on the **under** side (see Fig. 8). This stub should be about twenty-seven inches from the ground level and will develop into the lowest branch of the tree. If the leader is more than four and a half feet in height it should be headed at this point. From this leader other branches will arise during the first or second year in the orchard. With well-branched peach trees it may be necessary to leave a few two-bud stubs along the trunk

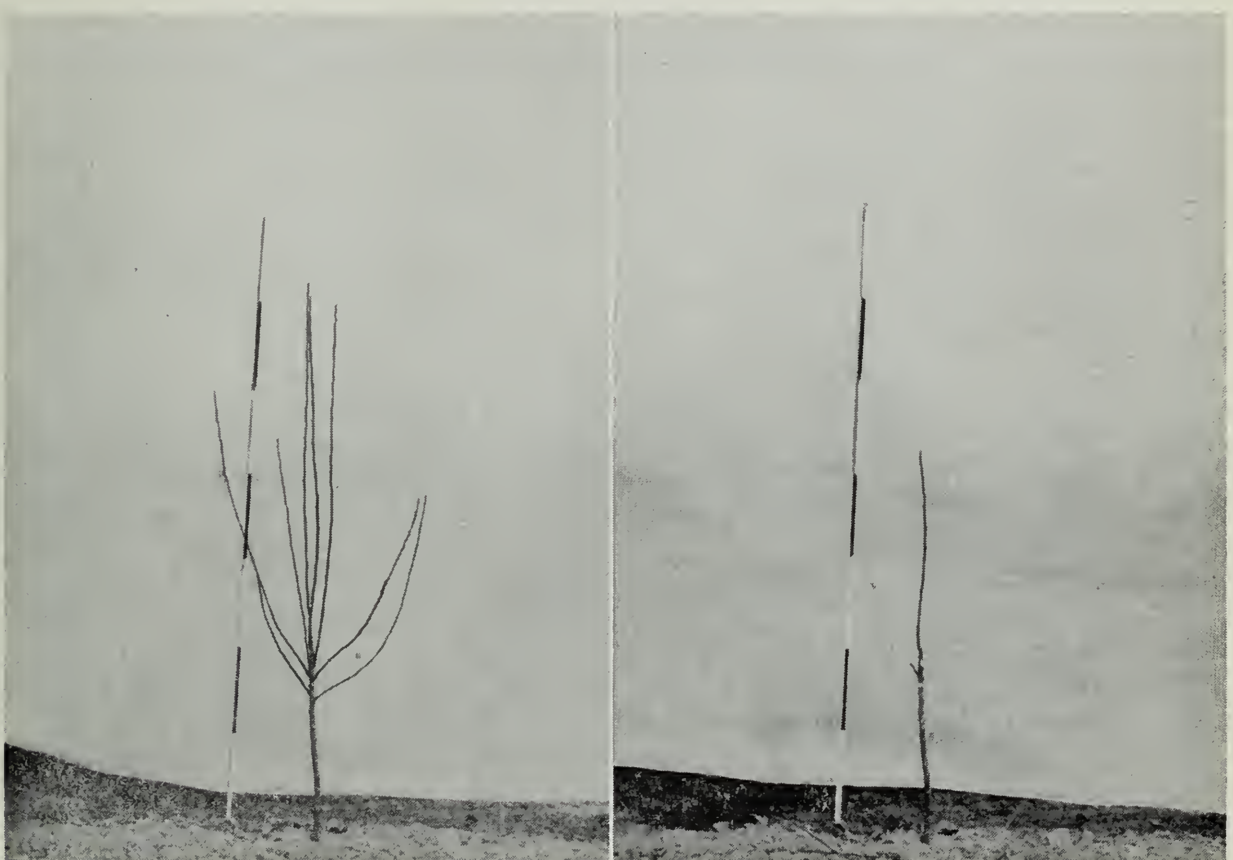

FIG. 8. Typical two-year apple tree, newly planted, before pruning (*left*) and after pruning (*right*). Note crowding of branches and narrow angles on the unpruned tree, both of which are contributory factors to tree breakage in later life. For this reason it is necessary to practically start with a whip and establish a new and strong head from well-spaced branches.

so there may be sufficient choice of branches a year later. For peach trees the lowest branch may be twenty inches from the ground and the topmost one forty-two to forty-eight inches. Peach trees do not naturally maintain a leader, so it is in order to remove the leader at planting time or a year later.

After the first year in the orchard. The pruning given at planting time is not appreciably dwarfing in its effects, probably due to the relatively greater shock of the transplanting itself. However, the removal of live branches from an established orchard tree is definitely and decidedly a dwarfing process. Not only does it reduce the bearing area of the tree, but it also tends to keep the tree in a juvenile condition, growing rapidly, but slow in coming into bearing. Therefore it is obvious that pruning in the early years should be very light—only sufficient to build the tree to a shape that will give good support and light conditions for the heavy crops to come.

After the first year's growth it will be possible to select the branches that are to be the permanent ones. Three or four branches and a leader are sufficient to give a well-balanced tree. More than this number results in a tree with too many crossing and interlocking laterals. All excess branches or spurs should be cut off clean at the trunk. The selected branches should be six to nine inches apart and arranged spirally around the trunk. Sometimes in the first summer only short branches or spurs develop from the buds (see Fig. 9). In the training process these are just as useful as branches, for they grow out into branches the following year (see Fig. 10). Both with spurs and branches it is important that crotches with angles sharper than thirty-five degrees be eliminated, selection of permanent branches being confined solely to those with strong crotches.

FIG. 9. Apple tree after one year's growth in the orchard before pruning (*left*) and after pruning (*right*). This tree was not headed at four and a half feet when planted, as recommended in the text, thus making the cut necessary at this time. Only branches, spurs or buds useful for the permanent framework were retained. Owing to drouth conditions growth of all trees in this orchard was poor during the first summer. Figs. 9, 10, 11 and 12 are pictures of the same tree, but different to the one shown in Fig. 8, no picture of the former tree at planting time having been taken.

After the second, third and fourth year. Very light pruning is required. It consists largely in the removal of laterals running into the centre of the tree, thinning out where they are crowding together, and the removal of one side of a narrow-angled crotch (see Figs. 10, 11 and 12). No branch or leader should be allowed to become much larger than the others, use being made of the dwarfing effect of pruning to keep large branches from getting too far in the lead over others to give a balanced tree. Strong-growing branches

FIG. 10. Apple tree after two years' growth in the orchard before pruning (*left*) and after pruning (*right*). Ordinarily, no heading and only very light branch thinning is required at this age and until the tree comes into bearing.

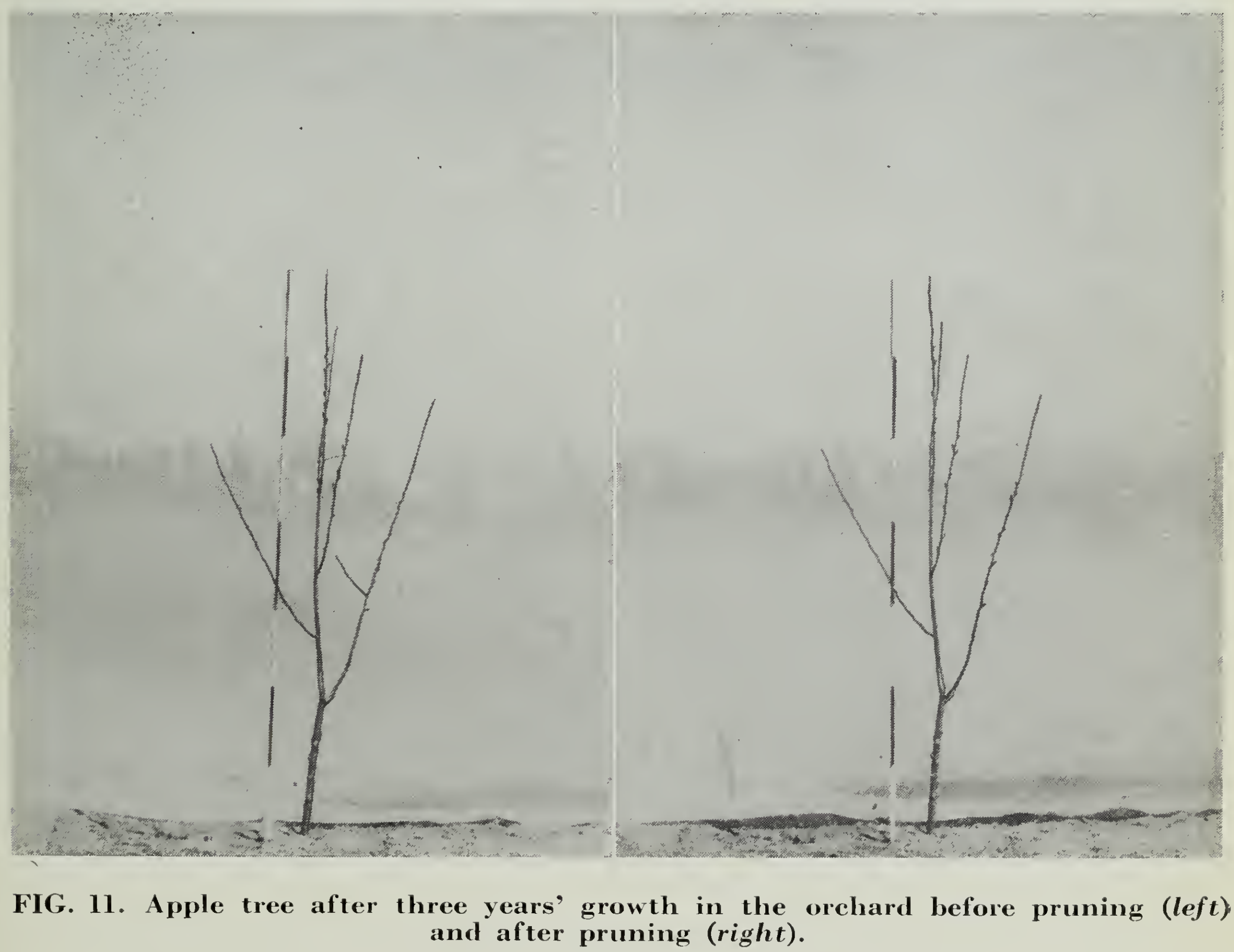

FIG. 11. Apple tree after three years' growth in the orchard before pruning (*left*) and after pruning (*right*).

FIG. 12. Apple tree after four years' growth in the orchard before pruning (*left*) and after pruning (*right*). Note the numerous spurs bearing blossom buds.

throw more laterals than weaker ones, and the removal of a few of these laterals will bring the growth of the strong branches into proper relation with the weaker ones.

For a more complete discussion of training and pruning see Ontario Department of Agriculture Bulletin 392, "Pruning the Tree Fruits."

SOIL MANAGEMENT

Methods. Unless the land is very rolling in nature it is usually advisable to cultivate the young orchard during the first three or four years. Up to this time the trees are comparatively shallow rooted and may suffer severely from sod or weed competition. However, cultivation should be stopped about July 1st, and a green manure crop such as buckwheat, millet, soybeans or oats should be sown. If weeds come well they are a satisfactory cover, though some growers object to them for appearance sake. If a prolonged drouth occurs in late July or August it may help the trees materially if the green manure crop is mowed. After rough discing in early September, rye may be sown, but, if this is not to be done, the summer crop should be left standing as a barrier against the washing of the soil with fall and winter rains and to hold the snow in the orchard. In the spring, as soon as the soil is dry enough, or where rye is present about mid-May, the land should be disced or plowed, and there should be just sufficient subsequent cultivations to keep weed growth under control until about July 1st.

Fertilization. If it is known that the land is "run down" or if growth is unsatisfactory, applications of barnyard manure in the early spring of one or more years would be well worth while. For increasing the organic content of the soil there is no cheaper form than the product of the land itself, i.e., green manure crops grown thereon. Manure will give increases in this crop, and commercial fertilizers may also show results. A soil test will tell what elements are lacking in the soil and what fertilizer is most likely to give a paying response. For method of taking soil samples and information on fertilizers and soil management see Ontario Department of Agriculture booklet, "Recommendations for Soil Management and Use of Fertilizers."

Intercrops. It is fairly common practice to grow vegetables or small fruit crops between the tree rows in the young orchard. There can be no objection to this practice provided fertilization takes care of both intercrop and tree crop and that cultivation ceases about July 1st. However, in stone fruit orchards there is added danger of infection by Verticillium Wilt when potatoes, tomatoes and raspberries are grown among the trees. The intercrop should be kept beyond the spread of the branches, otherwise the trees may be adversely affected by the competition.

SPRAYING

Diseases and insects attack leaves as well as fruit, and thus there is need for protection of foliage if it is to be maintained in a healthy condition. Any injury, be it either insect or disease, which destroys all or a part of the green leaf tissue, dwarfs the tree, delays fruit bearing, and renders the tree more susceptible to winter injury. A grower should find out from a study of "The Spray Calendar for Non-bearing Orchards"* and by consulting the local spray service men what spray or sprays are necessary in his district to ensure a healthy foliage throughout the whole season.

*For this publication write to Dominion Entomological Laboratory, Vineland Station, Ontario.

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Ontario Department of Agriculture

Statistics and Publications Branch

TORONTO, ONTARIO

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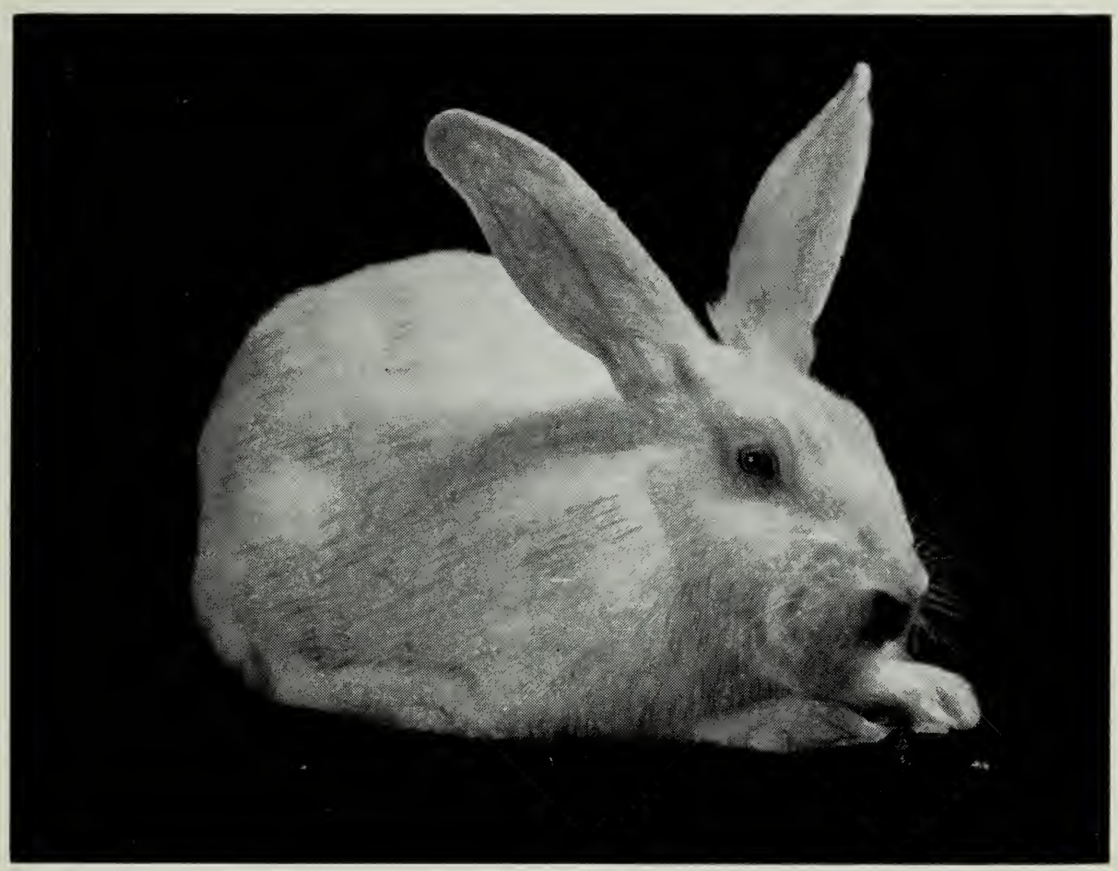

by

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THE DOMESTIC RABBIT

FOREWORD

DOMESTIC RABBITS grown under conditions that favour rapid body development are an excellent source of tender, delicately flavoured, white and nutritious meat. Domestic hutch-reared rabbit meat is in the same class as chicken and is far superior to, and quite different from, the meat of wild rabbits.

During periods of war, the meat foods obtained from cattle, swine, sheep and poultry are higher in price than during periods of peace. The meat of the domestic rabbit, if available, can very well take the place of other meats, at least on one day of each week throughout the year.

Rabbit meat can be produced on any farm or village lot, just as successfully as poultry can. A few rabbits bred on many farms or kept on many town lots will supplement the nation's food supply just as much as will the increase in other meat-producing animals. Small meat-producing animals like the rabbit can be maintained successfully by many people where large animals could not be kept.

Good rabbit skins are needed at all times in providing items of clothing needed by the human race; particularly necessary during a war period when imports are uncertain. Hutch-raised domestic rabbits are marketed or used at home when eight to ten weeks of age, at a weight of four pounds.

Domestic rabbits are used extensively in Great Britain and all other European countries as a source of meat. Those desiring to produce rabbits in a large way should locate near a large marketing centre and make arrangements with the retail meat trade to sell the production of the rabbit ranch.

The housing cost for rabbits can be somewhat less than for poultry.

RABBIT MEAT

Analyses of rabbit meat prove definitely that it contains approximately twenty per cent protein, which compares favourably with the protein content of other lean meat. The fuel value of rabbit meat is quite equal to that of other meats, averaging 850 calories per pound. Rabbits in good condition will dress fifty-five per cent or more of their live weight, and over eighty per cent of the dressed weight is edible meat. The liver, which is just as edible as calf liver, makes up five per cent of the dressed weight. It has the same high value as calf liver.

RABBIT SKINS

Rabbit skins are extensively used in garments, trimmings, linings, felt and glue. Rabbit skins that have passed through the hands of fur dressers and fur dyers are sold under suitable trade names and used in a large way to replace the more costly furs. Most of the rabbit skins used in the Ontario fur manufacturing industry have to be imported from countries where rabbit breeding is an important part of the animal husbandry.

The sale of pelts plus the sale of meat will, under good management, yield profits comparable to any other line of animal husbandry. For those undertaking the production of rabbits beyond the needs of the family, a location near a large consuming population where surplus rabbit meat may be sold is of the utmost importance. Rabbit skins are durable, and if properly prepared can be shipped to distant markets or held for long periods if necessary. Rabbit pelts supply half the fur garment material used. With the exception of sheep the rabbit is doing more to keep humanity warm than any other animal. Rabbit skins when dressed, dyed and made up in garments are sold under any of the following "trade names":

Arctic seal	Bluerette	French sable	Nutriette
Australian seal	Coast seal	French seal	Polar seal
Baltic lion	Castorette	Fox hair	Red River seal
Baltic white fox	Chipchillas	Glo seal	Roman seal
Baltic fox	Chinchillette	Imitation ermine	Russian leopard
Baltic leopard	Cony mole	Lapin	Russian seal
Baltic tiger	Cony leopard	Meskin beaver	Sealette
Baltic seal	Cony (French)	Minkony	Sealine seal
Bay seal	Electric beaver	Moline	Sable hair
Baby beaver	Electric seal	Muskratine	Siberian seal
Baffin seal	Ermiline	Mendoza beaver	Squirrellette
Beaverette	Erminette	Northern seal	Squirreline
Belgian beaver	French beaver	Nordic seal	Super seal
Belgian lynx	French chinchilla	Near seal	Twin beaver
Black hare	French leopard	Nubian seal	Visonette

NUMBER OF BREEDERS REQUIRED

Four female rabbits and one male of any of the medium-sized or large breeds will, if properly cared for, produce enough young rabbits to supply the rabbit meat that a family of four people are likely to use. One male rabbit for each ten females is the usual ratio in the large rabbitries.

CHOOSING A BREED OF RABBITS

All breeds of domestic rabbits, if properly kept, are capable of producing satisfactory meat for home use. The New Zealand White, the Chinchilla and the Flemish Giant are the varieties most commonly kept in Ontario. These are suitable to the production of a satisfactory carcass and pelt. Other varieties such as the French Silver and Beveren are also quite popular. White pelts will as a rule sell better than coloured pelts.

SELECTING BREEDING STOCK

Time can be saved by purchasing pregnant female rabbits. A non-related male can be secured when needed. If a start is made with young rabbits, it is necessary to wait until such are seven or eight months old before any increase can be expected. The following facts should be kept in mind when selecting breeding stock: (1) Rabbits must be healthy, vigorous and of early maturing strain. (2) Rabbits must produce a good quality of white, fine-grained and delicately flavoured meat. (3) Rabbit carcasses should be compact and well covered. (4) Rabbits should belong to a breed that produces a type of pelt most desired by the fur markets. (5) Female rabbits must be good enough to produce and rear six or more, true-to-type, vigorous young three times a year. (6) Rabbits that are deficient in vitality, poor feeders, or have poor teeth cannot produce profitably.

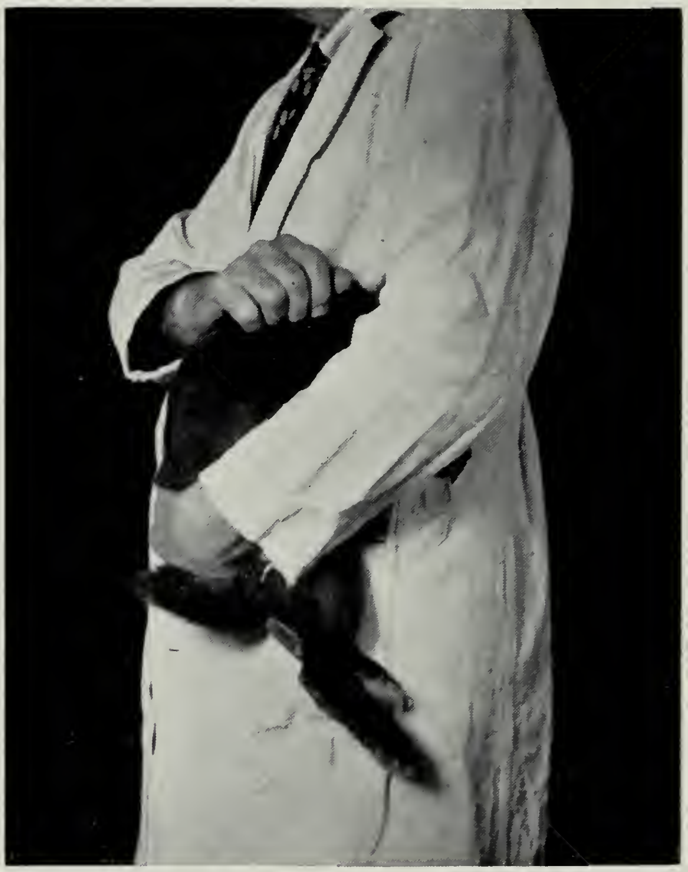
RABBIT BREEDING

The small breeds of rabbits will, if well developed, be ready to mate when five to six months of age. The medium-sized breeds should be ready to mate when seven months old. The large or giant breeds require from nine to twelve months to reach mating maturity. Under ideal conditions, it is possible for the female rabbit to produce four litters of young in a twelve-month period. The pregnancy period is but thirty-one or thirty-two days, and the nursing period fifty to fifty-six days. To attain four litters a year, it is necessary to remate the female as soon as the young are weaned. Breeding females should be in proper physical condition before mating. Thin females are not likely to do very well, so should be given a rest. Many thin females do not conceive. Some individuals reproduce well until five or six years of age, but as a rule three years is the breeding age limit for many female rabbits. Spring matings are usually the most productive. Factors such as sore hocks, disease, injuries, moulting, poor physical condition, old age, and ranch disturbances, presence of dogs and children interfere seriously with reproduction.

The female rabbit has no regularly recurring oestrus period, but shows by behaviour when mating is possible. Female rabbits that show restlessness or nervousness as indicated by their trying to escape from the pen and join other rabbits, or acting in any other unusual manner, such as rubbing the chin on feed manger or water device, should be taken to the hutch of the male for attention. If mating takes place, the female should be returned to her hutch at once. Careful watch should be kept while rabbits are together, otherwise a serious fight may occur. Assistance is sometimes necessary to bring about a successful mating act. Test matings should be tried to determine if conception has taken place. The test matings are made eighteen to twenty-two days after the known mating. When the female proves to be pregnant, a nest box with suitable bedding material should be placed in the hutch twenty-seven days following the known mating date. The female rabbit nearing the parturition date will make her own nest, so should not be disturbed, but left quiet and as comfortable as possible. She will as a rule go through the parturition act without needing any assistance. When the young are two days old, it is well to examine them and remove any surplus or weaklings. Too frequent disturbance of the nest or newborn will result in loss, so leave them alone until they are large enough to leave the nest. Keep strangers, other rabbits, dogs and cats away.

Young rabbits can be lifted by the flank without causing injury or pain.

This is a comfortable position, leave the ears alone, as lifting by the ears is painful and injurious.



A large rabbit can be carried comfortably if held as illustrated.

HANDLING RABBITS

If it is necessary to handle a rabbit, do not lift it by the ears or legs as such may cause injury. Try having someone lift you by the ears, and see how you like it. Very small rabbits may be lifted without injury or pain by carefully grasping the loin region with the thumb of your right hand on the left flank of the rabbit and your fingers on the right flank. Rabbits of medium weight may be lifted and carried by grasping with your right hand the fold of skin over the shoulders, the back of the rabbit being toward your body; your left hand is placed under the rabbit in a position to support its weight. Heavy rabbits are best carried under your left arm, being supported by your left hand.

Rabbits should be given special attention during unseasonable weather, as they suffer from heat and also from exposure during cold weather. Provide shade and cooling factors, if possible, when needed. Protect rabbits from drafts during cold weather. The more comfortable a rabbit is kept, the better the weight increase and welfare.

THE RABBITRY

When rabbit keeping is planned to supply meat for one family only, not very much equipment is required, as four female rabbits and one male rabbit will produce enough young rabbits to supply all the rabbit meat that an average-size family will use. This small number of rabbits can usually be housed in buildings already available on most village and country premises. An unused one or two-car garage, a poultry house, a colony house, a small barn or shed can be used if available. When it is planned to produce rabbit meat and fur for sale, adequate buildings with equipment are required of a size and design to suit the numbers. Such buildings, which are usually small structures, should be so planned that the animals can be handled with a minimum of labour. Animals must be fed, kept clean and comfortable, so provision should be made for light, ventilation, easy cleaning, freedom from draft or extreme temperature changes. The doors should be amply wide to permit the carrying of hutches in or out, as during the mild part of the year the hutches can be placed under trees or in open sheds.

Breeder rabbits must be provided with individual hutches of a size to suit. Breeder rabbits of the small breeds require a floor space of not less than 7½ square feet and head room of at least 2 feet. This is obtained in a hutch 2½ feet deep, 2 feet high and 3 feet long, inside measurements. Medium-weight breeds of rabbits require 10 square feet of floor space, or a hutch 2½ feet deep, 2 feet high and 4 feet long. Giant breeds of rabbits require 15 square feet of floor space per rabbit. Hutches should be well built of good materials, in one, two, or three-tier units, if many rabbits are kept. When only a few rabbits are kept, makeshift hutches constructed from packing cases or scrap materials may be satisfactory, but it is generally advised that well-designed and constructed hutches be used, as such can be kept more sanitary and are easier to work with.

The most satisfactory type of hutch for Ontario climate is the semi-closed hutch, constructed with the ends, top and back of wood; the front of inch-mesh wire; the roof made so as to project for protection. When shed or house space is available, all-metal hutches can be used to advantage if obtainable. Galvanized sheet metal, wire grids (muskrat wire) and mesh wire when obtainable make excellent rabbit hutches, feed racks and self-feed hoppers. The wooden frame wire hutches are not as durable as the all-metal hutch, but if well constructed with the wood frame protected by the wire will give good satisfaction, as they are more sanitary than the nearly all-wood hutch.

NEST BOXES

The nest box, used in the hutch to accommodate the female and her litter at any season and to accommodate breeding rabbits during cold weather, can be made of wood, in box form, 12 inches by 16 inches by 9 inches, or a nail keg can be used. The box type of nest box is made to facilitate easy cleaning; the top and bottom can be removed. Ordinary nail kegs with metal end hoops will make a very satisfactory nest box for small or medium-weight breeds. The nail keg nest box must be provided with a front board 4 inches high to keep it in place and prevent its rolling; also to keep the nest material in place.

FEED HOLDERS

The hay manger should be large enough to hold a twenty-four-hour supply, and be of such a design and structure as will prevent waste. The hay manger and grain trough can be combined equipment when dry mash or grain is used, but not when the mash is dampened. If dampened foods are used a stone crock or cement basin of suitable design can be used to advantage. Wooden mangers and feed boxes are likely to be damaged, so if possible all such structures should be made of substances that the rabbit cannot gnaw.

SELF-FEEDERS

The self-feeding system is not recommended for the feeding of breeding stock, other than the breeding doe and her litter. It is well adapted to the feeding of butcher stock where high condition is required. When a mixed ration is used in a self-feeder, waste may follow, due to the rabbits picking out the parts most palatable to them. Rations made up into the pellet or cube form are best suited to self-feeders. When used in feeding butcher rabbits the self-feeder system has a number of advantages—as saving of feed and labour—quicker gains are made, and better finish. A very good self-feeder can be made from a five-gallon light metal oil or gasoline can and some light box lumber by any man handy with tools.

FEEDS AND FEEDING

The rabbit is made from the food substances that it eats. Proper body development, health and reproduction are founded on the use of suitable, abundant and wholesome feeds being supplied to rabbits under conditions suited to their well-being. The rabbit is a very clean feeder and must not be forced to eat such unwholesome feeds as mildewed, mouldy or dusty vegetation or grain of any kind. The cleanest of feeds for the rabbits should be the aim of the rabbit breeder. Some variety in feed is appreciated by the rabbit, but any change in ration used should be made gradually unless it is known that injurious substances are being included.

HAY FOR RABBITS

Well-cured, fine-quality alfalfa, red clover or clean, fine, mixed grass and clover hay is preferred for rabbits. Reject coarse stems, old crop, weather-damaged, poor-coloured or mouldy fodder of any kind. Bright, green-coloured, fine-stemmed third cutting of alfalfa that is harvested during dry, bright weather is most desirable. The feeding of long hay has objections in dust, contamination and waste, so it is desirable that all hay be cut into lengths of two to four inches before being placed in the hay rack. A hand saw or a hand axe or a hay knife can be used in preparing hay for feeding.

GREEN FEEDS AND ROOTS FOR RABBITS

Rabbits that have a chance to pick their own feed in the wild will eat a great variety of green plants, but show preference for field or lawn grasses, young clover, lettuce, young peas, turnip and mangle tops, young carrots, young cabbage, and young soy beans, peas or corn. All these plants can be supplied in moderate quantity to hutch-raised rabbits. With the advance of the season apples, cabbage, turnips, carrots and mangles are taken, along with the dry grasses or clovers. With the coming of winter, dry grasses, young autumn-sown wheat and the bark of various shrubs and trees form the greater part of the feed taken by the free rabbits. All of such feeds may be used by domestic hutch-raised rabbits to supplement the basic hay and grain ration. Green or succulent plants and roots are usually the best source of necessary vitamins and mineral required by the rabbit, so should be used throughout the year. Hutch-raised rabbits that have to depend entirely on dry feeds do not do as well as those receiving a basic hay and grain ration that is supplemented by green vegetation or clean, juicy roots to a reasonable extent (best not to exceed forty per cent). There is danger in feeding roots showing dry rot or mould of any type. Hand pick, clean and wash all roots used for rabbits.

GRAINS FOR RABBITS

Rabbits prefer whole grain. Clean oats and wheat are the most desirable cereals. Barley, buckwheat, flax and corn can be used in rations if made into meal. Feeds in the form of meal should be fresh, as all grains lose their natural flavour and decrease somewhat in nutritive value if stored in the meal form. Clean, bright whole wheat and oats, free from all evidence of smut, fungus or mould are available in all districts, and should be sought for by the rabbit feeder. Use your nose and eyes on all grain samples before purchasing. Loose smut, stinking smut, blue, pink, green and black mould or fungus growth can generally be detected by appearance or odour. Mixed grain meals of doubtful quality can be stirred up in a glass of water as an aid to detecting the make-up of a mixture. The following rations do very well in Ontario:

For Breeding Rabbits

GRAIN:	2 parts clean, plump whole wheat. 2 parts clean, plump whole oats. 1 part linseed or soy bean meal (parts by weight).
ROUGHAGE:	Clean, fine clover or alfalfa hay. Green feed in season. Roots in season.

Feed the grain portion of this ration once a day in quantity that the rabbits will clean up in one-half hour. Hay should be available at all times in a quantity that is cleaned up daily. Green feeds and roots should be removed if uneaten within an hour.

For Females Nursing Young

GRAIN:	2 parts clean, plump whole wheat. 2 parts clean, plump whole oats. 2 parts linseed or soy bean meal (parts by weight).
ROUGHAGE:	Clean, fine clover or alfalfa hay. Green feed in season. Roots in season.

Feed all the grain portion of the above ration that the mother and her young will clean up without waste each twenty-four hours. Hay should be available at all times. Any green feed or roots not eaten within one-half hour should be removed.

If the ration is used in meal form it should be dampened slightly before being placed before the rabbits.

Iodized white salt may be fed in the form of a "salt block" that is always available in a corner of the feed rack.

A supply of clean drinking water must be kept in reach of the rabbits at all times. After a litter is weaned it can be carried on the same ration that it is used to. The female, after the weaning of her litter, must be built up in preparation for her next pregnancy period, so requires attention in keeping with her condition.

Complete rations that are finely ground up and pressed into small pellets are giving satisfactory results and are desirable in many ways. Pelleted feeds can be used in self-feeders with economy of time and feed cost. The self-feeder is of great value in feeding the doe and her litter, and also the litter after the doe is removed. Special types of pellet holders are available.

ANGORA WOOL RABBITS

The hair of Angora rabbit, usually spoken of as Angora wool, has been in use in garment making for over two hundred years. It is only recently that the value of Angora wool in warmth and lightness in garment making has been appreciated by a worth-while percentage of our citizens. Formerly Angora wool was used principally for infants' garments, but at the beginning of World War II we find Angora wool in great demand for army and airmen's garments. Germany and Japan learned to appreciate the value of Angora wool in airmen's garments long before the opening of World War II. People living in districts where low winter temperatures are common now generally recognize Angora wool garments as being the warmest and lightest winter garments obtainable. This spread in the knowledge of the value of Angora rabbit wool should result in an ever increasing demand that can be supplied only by profitable production.

The pioneer Angora rabbit breeders passed through rather trying times of low profits and indifferent markets, but from 1940 the outlook for the Angora rabbit breeder has greatly improved. Canadian spinners now are using (1943) more Angora wool that Canadian Angora breeders can provide at a very satisfactory price. Disruption in the usual commercial activities of France and other European countries since 1939 has cut off European supplies of Angora yarns to Canada. This has created the large demand for Angora wool production in Canada and the United States. If and when France returns to the production and export of Angora yarns some interference may be expected in the excellent Canadian and United States markets now existing in 1943.

Angora rabbits, of which there are many colours, are not considered as hardy and prolific as the short-hair, meat-producing rabbits. The Angora rabbits are special-purpose rabbits, developed to grow an abundant crop of fine wool suitable for use in garment making. These rabbits can also be used for meat and pelt production. The amount of wool produced by the Angora will vary with age, size and living conditions. Young rabbits, ten to sixteen weeks old, will produce but little wool at the time of the first plucking. The increase will be attained as the rabbit reaches maturity, when the yield will average twelve ounces per year. The hair on rabbits over four months of age is best removed by plucking. Shearing can be practised, but the advantage of a higher price for plucked wool indicates its desirability. Careful people that are gentle by nature can pluck the hair from a rabbit's body without any apparent discomfort to the rabbit. Rough, careless people should not keep Angora or other rabbits. As the hair is removed from the rabbit body, it should be placed in separate receptacles in accordance with its quality. Any mixing in of inferior hair (as shorts, cots, matts or soiled) will result in a low price for all. There are five grades, with prices ranging from 50c. to $7.70 per pound (1943) for plucked wool. Plucking or shearing is undertaken when the hair is "ripe" or comes out easily, usually once every three or four months.

The feed rack and the feed used should be such as will reduce the amount of dust and chaff to a minimum, as it is necessary to keep the hair clean. Brushing or blowing the hair is practised frequently to keep the hair free from dirt, cotts and tags. High grade, clean wool alone commands a market at good prices. The breeding, feeding, general care and records for Angora rabbits are practically the same as with the short-hair, meat-producing rabbits.

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The Angora Rabbit, by R. E. Hodgson.

RABBIT SANITATION

Equipment, shelters, houses and their surroundings must be kept in a highly sanitary condition if health is to be maintained and satisfactory reproduction secured. Caged animals cannot get away from their own faecal matter as can an animal in the wild. Faeces, soiled bedding and unused feed and water should be removed daily a sufficient distance from the hutches that gases and odours cannot contaminate the air surrounding the rabbits. Rabbits that are forced to breathe foul air coming from faecal matter will sooner or later go into the unprofitable class. Feed troughs and water bowls should be examined daily and changed or cleaned at once if necessary. It is a good practice to scald and disinfect equipment every week. Feed troughs and water bowls can easily carry a load of disease germs, so the utmost care should be exercised in keeping equipment in a satisfactory, sanitary condition. The distribution of possible disease carriers about the rabbit premises by careless or ignorant people must be watched for by the management. Hands contaminated while handling sick rabbits are a frequent means of carrying trouble to the other rabbits. Soiled footwear, dirty, contaminated clothing, contaminated ranch equipment, fungus spores on the feed or bedding are common sources from which trouble may start. Dogs and cats are best kept away from the premises occupied by rabbits. Rats and mice are carriers of trouble and must be fully controlled. Rats can and do sometimes steal baby rabbits from the nest of a placid mother rabbit. Flies are filthy in their habits, always loaded with bacteria and fungus spores which they can deposit on water bowls or in feed mangers. All hutches and nest boxes should be cleaned and disinfected frequently if the health of the rabbits is to be maintained. Tools used for cleaning, as hoes, scrapers, shovels and brooms, are likely to carry disease germs about a ranch unless great care is exercised in keeping them clean.

KILLING AND SKINNING

A humane way to kill a rabbit is by the dislocation of its neck. This is done by holding the hind legs with the left hand, and with the right hand grasp the head with the thumb, pressing on the neck vertebrae. Give the head a pull and a quick upward snap. When the vertebrae is snapped, suspend the carcass on hook by a hind leg and then cut off the head to permit immediate bleeding out. A short, stout stick such as a piece of broom handle can be used to stun rabbits if the operator cannot bring about neck dislocation. The head is removed at once following stunning. The skin is opened with the point of a sharp knife, just below the hock of the suspended leg, and a cut made to the base of the tail and on along the inside of the other leg. When this cut from hock to hock has been made the skin can be broken free from its attachment and pulled down over the carcass, the knife being used very little or not at all.

When the pelt is off, the carcass should be rinsed in cold, clean water to remove any blood or hair. The rinsing process is quickly done. The carcass is then hung up and the viscera removed. The heart, liver and kidneys are good food and should be saved. When the carcass has cooled out, it can be cut up into sections of a size suitable to the roasting pan. Rabbit carcasses that are intended for the market should be cut into eight pieces, placed in a suitable wax-paper-lined (9″ x 4″ x 2½″) box or on a cardboard picnic plate, and then wrapped in cellophane for protection. Such wrapping can be made very attractive; a sprig of parsley or other green leaf adds to the appearance, and will help make sales to prospective customers who have not yet learned to appreciate rabbit meat. Do not expose the entire rabbit carcass for sale. They are unattractive to most people and unsaleable. Cut up the carcass ready for the pan and display in an attractive manner if you desire quick sale.

Dislocating the vertebrae before bleeding.

The rabbit skin when freshly removed should be placed on a wire stretcher or a wood stretching board. All surplus fat and other loose tissue should be removed; and the pelt, on its stretcher of suitable size, flesh side out, is hung up in a cool room to dry. A piece of No. 9 galvanized wire, five feet long, bent in the form of a bow, makes a very good stretcher on which to place a rabbit skin. The hide should not be stretched to a size any larger than it was when on the living rabbit. The back fur is most valuable, so arrange the pelt on the stretcher so that all legs are on the same side. Examine the pelts at the end of twenty-four hours and straighten the edges or any part such as the front legs requiring attention. Rabbit skins should not be dried in a warm room or out in the sun. Hang in a cool room where there is good circulation of air. Do not use salt on rabbit skins.

When pelts are thoroughly dry, and free from all grease, dirt or fat, they can be packed for shipment. Flaked naphthalene should be sprinkled on each layer of pelts during packing for the purpose of keeping out insects. Each bale of rabbit skins should be wrapped in heavy paper and burlap, well tied and properly marked as to ownership, number of skins, colour and destination. Where a large number of skins are to be offered, such should be carefully sorted over and graded for quality, colour and size. Poor quality, unprime skins of various colours and sizes should not be mixed when offered for sale. Every class, grade, colour and size of skin should be kept separate, otherwise low prices can be expected. Fur buyers want prime, full-furred pelts, as such alone can be sold to manufacturers. The poorer grades of rabbit skins provide the hair required in the manufacture of felt hats. First-grade pelts are large, full furred and free from fat, dark spots, streaks or cuts. The denser the under fur the more valuable the pelt. First-grade pelts are dry, clean, and in good shape. Second-grade pelts are somewhat lacking in the foregoing qualities. Third-grade pelts include those with short hair, thin under fur, poorly stretched and dried. The first two grades can be used by the furrier and the third grade by the felt manufacturer.

GOOD PRACTICES FOR THE RABBIT BREEDER

1. Purchase stock from breeders that are known to be reliable.
2. A beginner in rabbit breeding should confine his efforts to one breed.
3. Locate hutches where such will be free from drafts, easy to keep dry and clean.
4. Take advantage of sun's rays when locating hutches.
5. Let young rabbits reach maturity before mating. Do not breed until seven to ten months old.
6. Plan to have adult females produce three or four litters a year.
7. Cull out all rabbits that do not reach a desired standard. Breed for the best.
8. Be regular in feeding, cleaning, and other work about the rabbitry.
9. Use a complete and well-balanced, economical ration. Grow as much rabbit feed as you can on your own land.
10. Market surplus breeding stock, meat, rabbits and pelts in a business-like way. Produce to supply your customers each week.
11. Keep records of the breeding stock.
12. Keep records of operation costs, including overhead equipment, feed and labour.
13. Avoid sudden changes in rations.
14. Do not use musty hay or smutty grain.
15. Study the disease section of this bulletin.

References on Meat and Fur-Producing Rabbits

Rabbit Raising. U.S. Dept. of the Interior, Conservation Bulletin 25.

Rabbit Parasites and Diseases. U.S. Dept. of Agriculture, Farmers' Bulletin 1568.

Rabbit Recipes—U.S. Dept. of Agriculture, Leaflet No. 66.

Home Tanning of Leather and Small Skins. U.S. Dept. of Agriculture Farmers' Bulletin No. 1334.

The above listed publications may be obtained only by purchase (priced at 10c. each) from the Supt. of Documents, Government Printing Office, Washington, D.C., U.S.A.

Rabbits in Colonies.
The Chinchilla and Chinrex Rabbits.
The Rex Rabbit.
Fur Producing Rabbits.
Marketing Rabbit Flesh.
How to Feed Rabbits.
Raising Fur Rabbits.
Green Foods for Rabbits.
Stud Register and Account Book.

The above listed publications may be obtained by purchase from the Fur Trade Journal, Box 31, Toronto 2, or other publishers dealing in publications relating to fur animal breeding.

THE RABBIT IN HEALTH AND DISEASE

All healthy rabbits have brightness of the eye, rhythmical and symmetrical movement of the nostrils, a well-covered muscular back, a clean skin and bright fur. A well-nourished body with ample covering of well-developed muscle and fat indicates thrift and freedom from disease. Thinness in cases where the feeding and general care are apparently satisfactory is often an indication of parasitism. The healthy adult rabbit while at rest breathes through the nostrils at the rate of twenty-five to thirty respirations per minute. The respirations should be quiet. To be healthy a rabbit must have sound teeth. The teeth should be examined before a purchase is made. The faecal matter or droppings of a healthy rabbit will be in the form of hard, round pellets, the colour of which will vary from dark brown to light brown, depending upon the feeds consumed. Skin diseases, scurf or eruptions of any kind are not found on healthy rabbits. Moult is not necessarily a sign of ill health, as perfectly healthy rabbits may show moulting in an aggravated form.

THE SPECIFIC DISEASES OF THE RABBIT

(a) Disease due to bacteria.
(b) Disease due to protozoa.
(c) Disease due to fungi.
(d) Disease due to metazoan parasites.

(a) Bacterial Infections

(1) Tuberculosis. The rabbit is susceptible to the bovine, the avian, and the human strains of the tubercle bacillus. The bovine strain is the most common.

Symptoms: In the chronic form there is a progressive loss of weight; diarrhoea may be evident; weakness, emaciation and rapid breathing are manifest towards the end of the course of this disease, which ends fatally in four to eight weeks. In the acute miliary form of tuberculosis in the rabbit the animal will die within three or four days of the first symptoms of distress or illness being manifest. Laboured breathing and sleepiness are the most obvious changes noted.

Post-mortem appearance: In the chronic form of tuberculosis in the rabbit the lungs are usually consolidated in some degree with gray-white areas of caseation. In the miliary form of tuberculosis in the rabbit, multiple small yellowish-white granules are found in the lungs, liver, spleen and kidneys.

Tuberculosis may occur through the practice of feeding milk from tuberculous cows. Once in a rabbitry, it can spread quickly from mother to young.

There is no treatment. Diseased animals must be removed from the premises and a thorough disinfection carried out. Scrub the hutches with hot water and washing soda. Then follow with a five per cent carbolic solution or its equivalent.

(2) Pseudo-tuberculosis. This infectious disease is caused by *Pasteurella pseudo-tuberculosis rodentium.* Pseudo-tuberculosis usually kills the rabbit within three or four weeks. The symptoms are loss of appetite, progressive weakness, emaciation, laboured breathing and disinclination to move.

The post-mortem examination of a rabbit, dead due to pseudo-tuberculosis, will show small, white, cheesy nodules in the lungs. The liver, spleen and intestinal tract may be spotted also with small nodules.

There is no treatment. Sick animals should be removed at once. This disease may be introduced with new breeding stock or stored vegetables or other feeds that have been contaminated by diseased animals.

(3) Contagious Catarrh or Snuffles. *Bacillus bronchisepticus* and *Pasteurella lepisepticum* are the two organisms associated with snuffles, causing an inflammation of the mucous membrane of the nasal passages and sinuses of the head.

Symptoms of snuffles: A persistent, white, sticky nasal discharge, continued sneezing and apparent nasal obstruction. The rabbit will rub its nose on its paws, causing the hair to become soiled and matted. The rabbit becomes thin, weak, and usually dies. No treatment is of value in contagious catarrh. The diseased rabbits should be removed. Protect the rabbitry by isolating new breeding stock for two weeks, having them cared for by another attendant. Maintain the rabbits in best possible manner. Well-fed stock kept under a high standard of hygienic conditions are not affected by contagious catarrh.

(4) The Common Cold. This condition of mild inflammation of the nasal mucosa with a slight discharge is often mistaken for snuffles. Rabbits with common cold should be isolated in dry, well-ventilated, free-from-draught, well-lighted hutches, and given the most nutritious feeds. A drop of ephradine in each nostril is a help. Chlorodine at the rate of three drops in a teaspoonful of warm water is useful also.

(5) Necrobacillosis. This infectious disease is caused by *Fusiformis necrophorus*, an organism that gains entrance to the body of the rabbit through small wounds, usually about the lips or face.

The symptoms of necrobacillosis are a painful swelling which gradually spreads and may involve the entire face or the chest and throat region. The surface of the wound becomes a dirty, grayish-white in appearance. In some cases, the wounds or abscesses may appear on the legs or flanks. Rabbits with necrobacillosis have difficulty in eating, gradually starve and die after an illness of two or three weeks. The condition, if generalized, does not respond to treatment. Prevent by removing all diseased animals, a thorough clean-up and disinfection of the hutches and utensils.

(6) Strangles. Abscesses of variable size develop in the region of the lower jaw. They are caused by a streptococcus infection and may involve quite large areas of bone and tissue. These abscesses are firm and do not tend to

rupture spontaneously, but must be opened by lancing in order that the thick, grayish-yellow pus can be removed and the wound washed out. Neglected abscesses of this type may involve vital structures and cause the death of the rabbit. Abscesses should be opened early and hygienic measures applied; otherwise the infection will spread and become difficult to control.

(7) Haemorrhagic Septicemia. *Pasteurella cuniculicida* is the organism causing haemorrhagic septicemia in rabbits. This disease develops quickly, killing the rabbit in twenty-four to thirty-six hours. The disease is difficult to detect, as but little evidence of illness may be manifested to attract notice. There is a high temperature, listlessness, inappetence and diarrhoea, followed by coma and death. Diagnosis should be made by bacteriological examination, as the post-mortem findings in many cases are very limited and may show nothing more than a congestion of the abdominal visceral organs and engorgement of the blood vessels. In some instances an autopsy will show a marked congestion of the lung tissue and numerous small haemorrhages in the heart muscle. Haemorrhagic areas may be frequently noted on the surface of the lungs, the heart sac, the intestines, and on the lining membrane of the pleural and abdominal cavities in some cases. Affected rabbits should be removed and a thorough disinfection of the premises made immediately a definite diagnosis has been made. Treatment of the sick is of little value, but preventive treatment by the use of vaccines is of some value.

(8) Salmonella Infection. Two organisms, widespread in nature, *Salmonella aertrycke* and *Salmonella enteritidis*, are the cause of heavy losses in young rabbits. Most outbreaks originate in food, water and bedding contaminated by the excreta of infected rats and mice. Young rabbits are the most susceptible. The symptoms, if noted, are dullness, high temperature, diarrhoea and coma. Post-mortem lesions are very indefinite, and a diagnosis must be based on a laboratory examination of tissue. Control by destroying rats, mice and flies, the chief spreaders of salmonella. Use clean feed and bedding. Treatment of Salmonella infections is not very successful. Intestinal disinfectants may be used.

(9) Vent Disease or Rabbit Syphilis. This venereal disease is caused by *Treponema caniculi*, an organism found in the sores of the affected organs. This disease is transmitted during mating, and appears as small scaly sores on the genital organs. This disease responds to local treatment with mercurial ointment. Control by close examination of all breeding stock, isolation of all suspected cases, destroying all contaminated bedding, and thoroughly disinfecting the premises.

(10) Mastitis. The condition of inflammation of the mammary gland may cause the female to neglect her young shortly after they are born. Mastitis is caused by bacteria gaining entrance to the teat canal and then spreading throughout the glandular tissue. The infected gland is enlarged. There is fever and soreness. Abscess formation may follow. Treat by frequent, hot applications (not over 118 degrees F.), massage gently, milk out frequently, reduce feed, apply camphorated oil to the surface of the glands.

(11) Puerperal Septicaemia. This condition of septic infection after the birth of the young follows incomplete evacuation of the placenta, the retention of a dead foetus, or wounds acquired during parturition. Bacteria are always present and may enter and grow wherever conditions are favourable to them. Symptoms noted are a sudden illness developing within three days following parturition. The mother rabbit is dull, refuses to eat, feverish, has quickened respirations, and neglects her young. Treatment as irrigation of the uterus with saline solution, followed by bland antiseptic oil.

(12) Tularemia. A specific infectious bacterial disease due to *bacterium tularense*. This disease is not seen in domestic rabbits that are kept in hutches and not exposed to the wood tick, the rabbit tick, the deer fly or the rabbit louse. Symptoms as seen on post-mortem are as follows: Necrotic spots in liver and spleen; the lymph glands of the abdomen and groin are swollen, inflamed and sometimes contain pus. Treatment is of no avail.

(b) Diseases Due to Protozoa

Coccidiosis is the commonest and most serious disease of rabbits. There are two forms of coccidiosis in rabbits: (1) the hepatic or spotted liver form caused by *Eimeria stiedae*, (2) the inflamed intestine form caused by *Eimeria perforans*. The parasite in both forms undergoes a complicated life cycle. part of which is spent in the rabbit and part on the ground. Oocysts are formed in the tissue of the liver or intestine of infected rabbits. These pass out by way of the rectum to the ground with the faeces, where they mature and reach a state capable of infecting another rabbit. When the matured oocysts enter the intestine of a rabbit, they are composed of two or four spores, each of which is capable of producing numerous merozoites. The merozoites enter and injure seriously the epithelial cells. The symptoms of coccidiosis are diarrhoea, progressive emaciation, the rabbit becomes dull and listless, with gradual weakness of hind legs, coma or convulsions immediately before death.

The post-mortem of a rabbit dead due to coccidiosis of the hepatic form will show the liver to be slightly enlarged and spotted with white areas; in the intestinal form the epithelium of the intestine will show a thickening and a catarrhal inflammation. There is no treatment of known value for cocciosis in rabbits. Since the faecal matter of infected rabbits carry the oocysts, everything should be done to keep rabbits away from rabbit faeces. This is best done by the use of slatted or wire-bottom pens, so constructed that faecal matter will fall out of reach. Hutches should be well scrubbed frequently with washing soda and disinfected with a ten per cent solution of household ammonia. Food and water bowls must be kept very clean and the litter changed at least twice a week. No feed from areas where rabbit manure has been spread can be used with safety.

(c) Rabbit Diseases Caused by Fungi

Two diseases caused by fungi, favus and ringworm, are troublesome at times with young rabbits. The fungus causing favus is known as *Achorian* *schonleini.* It attacks the surface of the skin, usually on the legs, head and ears, but may extend. Brownish-yellow and gray scabs form on the affected areas. Treatment for favus: All rabbits should be carefully examined for scabbing and, when found, isolated and treated. The scabs can be removed and the areas saturated daily with two per cent tincture of iodine until the fungus is destroyed. The scabs removed should be burned. Favus is transmissible to human hands. Ringworm will respond to the same treatment recommended for favus. Ringworm is caused by a species of *Trichophyton,* and is characterized by round, hairless areas or gray bald spots on the skin of the rabbit.

(d) Diseases Due to Metazoon Parasites

(1) The external parasites of rabbits include mange mites, fleas and lice. Ear mange or ear canker may be caused by either *Psoroptes communis cuniculi* or by *Chorioptes cuniculi.* These mites produce a catarrhal condition of the external ear with an evil-smelling, brownish discharge. Ulceration and scab formation follow. Rabbits with ear canker flap their ears and scratch the irritated parts; the head may be held twisted to one side. Treatment consists of cleansing the ear, using hydrogen peroxide; wipe dry and apply daily for ten days a mixture consisting of olive oil twenty parts and one part carbolic acid. The hutches should be thoroughly scrubbed and then sprayed with a hot coal-tar dip solution. Skin mange in rabbits may be caused by either of two species of mange mites. The symptoms are the same, as the mites of both species burrow under the skin, causing irritation and an exudate; the hair falls out; open sores or gray-yellow crusts appear. Skin mange spreads rapidly and may be serious enough to kill rabbits in three or four weeks. Treatment is not advised. All mange-infected rabbits should be killed and burned. Control by a clean-up, burning all the litter and scrubbing the hutches with hot coal-tar dip solution.

Lice and fleas are found on rabbits that are poorly cared for. If rabbits rub and scratch, look for lice or fleas. Preparations containing powdered derris root are most effective against external parasites. The hutches should be scrubbed out with a hot coal-tar dip solution. Powdered derris root compounds may be sprinkled over the floor cracks, in nest boxes and pens to reach the young or larva form of the flea.

(2) Internal parasites are found in poorly cared for rabbits. Round worm, tapeworm and bladder worm infestations are the three types of internal parasitism encountered. Round worms may be found in the stomach and intestine. These are very small, white and thread-like worms capable of causing enteritis and diarrhoea if present in large numbers. Round worms are removed by the use of 0.05 c.c. of tetrachlorethylene given in a capsule. The bladder worm or larval tapeworm is very common in rabbits. There are two forms, one of which, the *Cysticercus pisiformis,* is a single-headed bladder worm occurring in the abdominal cavity on the liver or mesentry as small, white watery blebs. It is not harmful to the rabbit in this stage. The other form of bladder worm

occurs between the muscles and under the skin, where they may interfere with movement of the muscles. Both forms of bladder worm found in the rabbit are an intermediate stage of the tapeworms infesting the dog. The control of tapeworm and bladder worms in rabbits consists in keeping dogs away from premises where rabbits are kept and protecting the food used by rabbits. In cases where adult tapeworms occur in rabbits, such can be removed from the rabbit's intestine by adding freshly ground areca nut to the feed. The dose is one-quarter to one gram, depending on the weight of the rabbit. The presence of adult tapeworm infestation is indicated by the proglottids of tapeworm appearing with the faeces.

INDIGESTION IN RABBITS

Digestive disorders in rabbits are generally the result of poor management. Causes: Poorly ventilated hutches and insanitary conditions in and around the premises tend to cause rabbits to be more susceptible to digestion troubles. Poor management of the feeding, as an overabundance of succulent greens following a period of dry feeding. The use of feed contaminated by bacteria and other low forms of life is responsible for much intestinal trouble.

Symptoms: A rabbit with indigestion has no appetite. It is restless and troubled by frequent colic and diarrhoea. There is frequently an excessive salivary flow that is sufficient to wet the mouth and jaw area.

Treatment: Stop all feed for forty-eight hours. Water alone may be given. Clear the bowel with calomel, using a half-grain tablet. After bowel has been cleared, aromatic syrup of rhubarb, five to ten drops, may be given. Start feeding gradually, after forty-eight hours of fast, using clean, mixed grass and clover hay, along with grain and carrots in moderate quantities.

CONSTIPATION IN RABBITS

This condition in rabbits is generally due to exclusive use of concentrated feeds, little or no green feed being used, the presence of hair in the tract. Exposure to cold may suppress the muscular activity of the bowel and thereby cause constipation.

Symptoms: The rabbit in a constipated condition is dull and without appetite and will sit huddled up in the corner of the hutch. The faeces, if any, are small, hard pellets, usually mucus covered and adhering in strings.

Treatment: Change the feed to provide green feed or roots of a succulent nature. Use good, leafy clover and also some bran and oil-cake. Administer one-quarter to one-half teaspoonful of Epsom salts dissolved in water, or one-half teaspoonful of castor oil. Watch faeces carefully and adjust feed to suit, avoiding use of drugs.

STOMATITIS

Inflammation of the mouth of the rabbit occurs as the result of injury by sharp parts of plants. Abnormal teeth, injuring the mouth, are a cause also.

Symptoms: Increased thirst; animal refuses to eat hay or other dry feed. In severe cases the tongue may be swollen and ulcers may form on gums and lips. Glands on underside of the jaw may be enlarged. The flow of saliva is increased. There may be a disagreeable smell from the mouth.

Treatment: Provide clean bedding, and food that is easily masticated. Grind the dry feed. Rinse the mouth with normal saline solution or potassium permanganate solution. Clean affected parts and paint with a two per cent solution of silver nitrate.

GASTRITIS IN THE RABBIT

Inflammation of the stomach in the rabbit may be caused by any of the following: Mouldy, decaying and fermented food of any kind, as well as foul, stagnant water, may give rise to the most acute form of gastritis. The most common cause is food. Irregularity in feeding also is a cause in that it brings on greedy feeding with engorgement at times.

Symptoms: Diminished appetite; dull, heavy appearance; indifference to surroundings; abdomen may be bloated and tender to pressure; bowel movements irregular, constipation alternating with diarrhoea.

Treatment: Rest the stomach for a few days. Milk is useful if the rabbit will take it. Some green feed in small quantity, fine oatmeal and flaxseed are useful in bringing rabbit back to normal.

INTESTINAL CATARRH

A common condition in rabbits, in which there is increased peristalsis, increased secretions into the intestines, and diarrhoea.

Symptoms: The affected rabbit shows listlessness and lack of appetite. The faeces are fluid and thin and may contain blood and portions of undigested food. Intestinal sounds more lively than normal. The urine is diminished and dark coloured. If the condition persists for ten or more days, death usually follows.

Treatment: Regulate the diet and establish favourable hygienic environment. The sick rabbit should be kept in a warm place. Feed clover hay; withhold all juicy, green feeds. Castor oil, five to ten drops, or calomel, one-half grain, used with excellent results to clear intestine of irritants. Astringents as oak bark, tannin, subnitrate of bismuth, chalk or calcium lactate may be given. A teaspoon of sodium hyposulphite in four ounces of warm water is useful in the early stages of this condition. A return to normal diet should not be made until the intestinal movements are normal and there is no longer any sign of diarrhoea.

HAIR SWALLOWING OR OBSTRUCTION

The swallowing of hair by Angoras and other rabbits frequently causes serious trouble. The licking of the hair will dislodge much at moulting time. The fibres are taken into the mouth and swallowed. The long hair tends to bunch and form plugs likely to block the intestine.

Symptoms of hair swallowing: Hair may be seen in the faeces. Gradually the rabbit will stop eating and present a dejected appearance. Constipation with intestinal fermentation, giving rise to toxic symptoms, followed by death in three or four days.

Treatment: Drastic drenching. In most cases, one-half grain of calomel will yield results. A little Epsom salts once weekly in the mash is useful to keep the intestine free from accumulating hair.

BULLETIN 435 NOVEMBER, 1943

Ontario Department of Agriculture

Statistics and Publications Branch

TORONTO, ONTARIO

CONTROL OF RABBITS

by

R. W. Thompson, Provincial Entomologist

ONTARIO AGRICULTURAL COLLEGE

GUELPH, ONTARIO

10M-11-43
(C2269)

CONTROL OF RABBITS

The European hare, commonly known as the "Jack Rabbit", has increased in numbers in Ontario until in many orchard areas the animal has become a serious menace. This species, and to a lesser extent the smaller "cotton-tail" rabbit, in the past few years, have caused considerable injury to plantings of young fruit trees and also to ornamental trees and shrubs. As a result of present war conditions of man-power shortage and scarcity of shot-gun ammunition, rabbit drives have become less common, thus allowing the rabbits to increase more rapidly.

Injury by rabbits is generally more severe during winters when snow is deep and vegetation is therefore inaccessible to these animals.

All varieties of fruit trees and many ornamental trees and shrubs seem to be susceptible to attack by rabbits, but in some localities certain apple varieties appear more attractive than others. Throughout the province generally, however, it appears that any variety of apple may be attacked and therefore all require protection from rabbits.

Fig. I(a) Fig. I(b) Fig. II

CONTROLS AND REPELLENTS

1. SHOOTING. Hundreds of rabbits formerly were destroyed by organized drives.

2. WRAPPING YOUNG TREES WITH BURLAP. For trees up to three or four years of age burlap strips, about 3 inches wide, should be cut. Starting at the ground the first lap should be double, and continuing in a spiral should cover the trunk right up to the branches. The branches may be wrapped by folding inwards and covering completely with wide pieces of burlap joined together. Such wrappings should be securely fastened in place. (See Fig. I, a and b).

3. **WIRE-NETTING CRIBS OR GUARDS.** Trees up to ten years of age may be successfully protected by surrounding them with chicken-netting cribs or guards. To construct these, three posts are driven into the ground in the form of a triangle and wire netting, of sufficient height to exclude rabbits at the greatest height of snow, fastened to these. For smaller trees, two posts will often suffice, since the chicken wire can be fastend in the form of an oval without danger to the limbs from rubbing, provided adequate size is furnished. (See Fig. II.)

4. **WOODEN CRIBS.** Some orchardists have been consistently successful in preventing rabbit injury to trees by the use of triangular cribs made from split cedar rails. Each side of the triangle is constructed separately and then the completed crib erected by tying the three frames together. While such cribs are reasonably rigid, it is wise to anchor each with a post to prevent them from blowing over in the event of unusually strong winds. The cedar rails are split into pieces about 1 inch by 1 inch by 3 to 5 feet. These are then nailed to end pieces in the form of a rack, of sufficient size to exclude rabbits at the greatest height of snow. The horizontal slats need be no closer together than 6 inches because rabbits apparently will not enter these guards even though they could do so easily. (See Fig. III.)

5. **REPELLENTS.** Various materials have been used in efforts to repel rabbits from young trees. **The most effective is the resin-alcohol solution.** This is prepared from the following formula, which gives about 2 gallons:

Lump resin (finely broken)	12 lb.
Cheap alcohol (anti-freeze type)	1 gal.

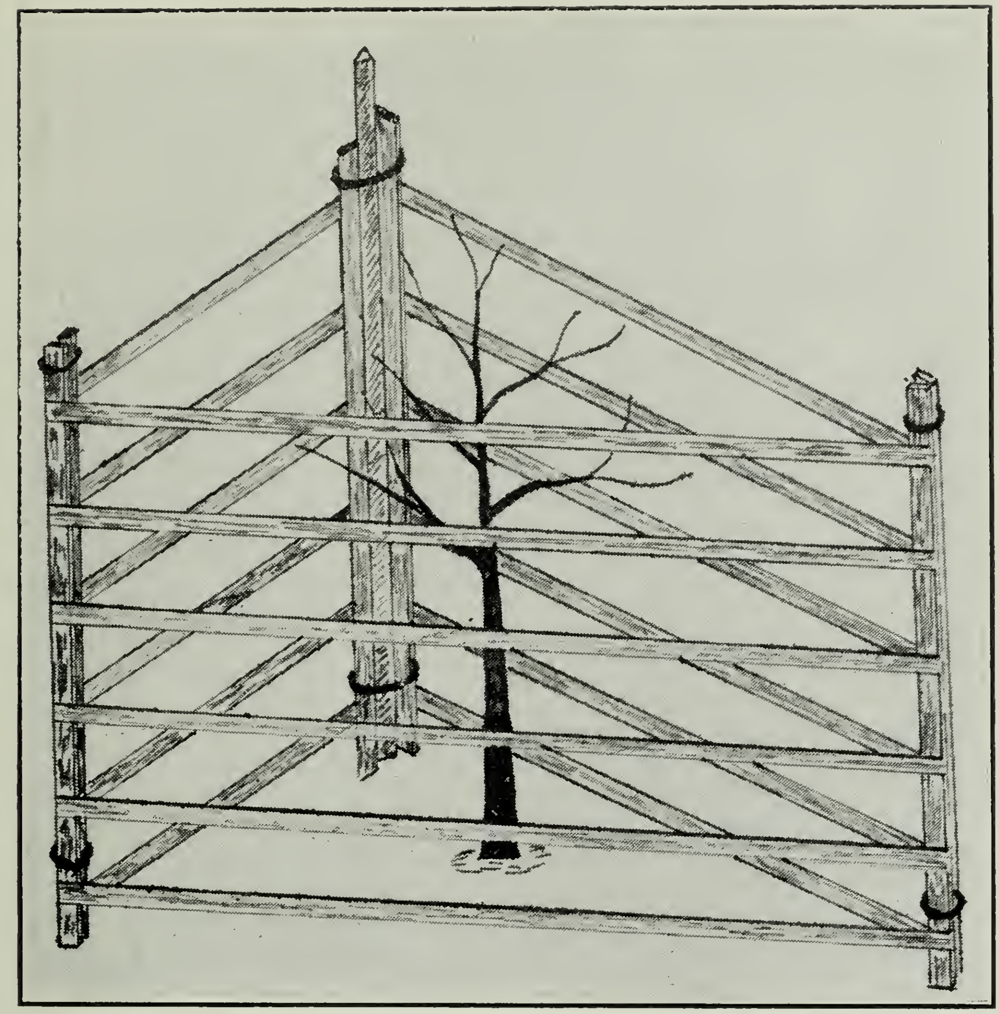

Fig. III

Be sure the alcohol contains no glycerine or other material which will affect its solvent properties. If this explanation is made to the dealer, disappointing results may be largely avoided. Use **lump resin,** not powdered resin. The latter contains a substance which prevents complete solution in alcohol. Crush the resin by placing in a sack and either beating with a mallet, or rolling with a piece of iron pipe 1½ or 2 inches in diameter. Sifting through fly screen will remove all uncrushed lumps. Place alcohol in a large container and stir in the resin, very slowly, until it is all dissolved. The container in which the solution is to be stored should be dry and clean and should, when filled, be tightly closed to prevent evaporation of the alcohol. **Keep the solution away from fire because it is quite inflammable.** Pour a small amount into a small container, such as a tin can, for immediate use.

Apply with a small paint brush, in late fall, but before rabbit injury is likely to occur and while the bark is still dry. Moisture on the bark from rain, snow, or even fog, will cause the solution to dry white and flake off in a short time. The solution in the small can may thicken while being used but may be kept workable by the addition of a little alcohol.

Small trees may be covered completely with the solution, including the terminal buds, since experiments have shown that the solution does not injure the buds. Any unpainted bud or bark is likely to be eaten. Large trees should have the trunks and limbs painted to the height to which rabbits can reach from the top of the deepest snow.

Commercial repellents resembling the above are on the market but, while more expensive than the home-made product, are no more effective.

6. **POISON BAITS.** Make up small bundles (about 6 inches in diameter) of leafy alfalfa or of red clover hay. Dip these into a pail containing the following poison:

> One ounce strychnine sulphate dissolved by stirring in 1½ gal. of boiling water. Add to this 1 pint of corn syrup and stir well.

Before setting out such baits, distribute single forkfuls of unpoisoned alfalfa or red clover hay through the orchard. When tracks show that the rabbits are attracted to these, substitute the poisoned alfalfa. The latter should, however, be tied to the trunks of the trees, the crotches, or even to stakes. The latter is the preferable method since these can be moved up or down most easily to suit the level of the snow. Baits should be numerous enough to kill rabbits rapidly before damage is done to the trees.

CAUTION (a) Do not use bait unless the orchard is securely fenced and all gates fastened to keep out livestock.

(b) Remember strychnine is very poisonous, hence be sure that all vessels are washed thoroughly and that the strychnine powder is labelled POISON and put where children cannot reach it. Since strychnine can poison through the skin, baits should not be handled with the bare hands.

(c) Search frequently through the orchard for dead rabbits. Remove these and destroy them.

(d) When baits are no longer needed, gather all remnants and destroy by burning.

Orchardists and those with ornamental trees and shrubs are invited to write in, giving their experience with any of the above described methods of rabbit control. Suggestions regarding any other successful methods of control would also be welcomed.

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Ontario Department of Agriculture
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TORONTO, ONTARIO

MOUSE CONTROL IN ORCHARDS

by

R. W. Thompson, Provincial Entomologist
ONTARIO AGRICULTURAL COLLEGE
GUELPH, ONTARIO

10M-11-43
(C2270)

MOUSE CONTROL IN ORCHARDS

The common meadow mouse is the only one which causes serious damage in orchards in Ontario. Young shade trees and ornamental shrubs are also seriously injured in some seasons. Orchards of almost any age growing in grass or sod-strip are more liable to injury than those under clean cultivation. Injury may occur, however, in autumn, even in cultivated orchards where there is good cover. There is usually more injury in years when deep snow occurs.

METHODS OF CONTROL

1. **REMOVE LITTER FROM AROUND BASE OF TREE.** Suckers, which often grow in profusion around the base of the tree, should be removed. This destroys attractive food material for the mice and also makes removal of litter and grass from the base of the tree much easier. **No matter what other methods of protection are followed the first essential is to eliminate all possible harbours for mice near the tree base.** A circle three feet in diameter should be cleared around the trunk. The earth should then be mounded up around the base of the tree to provide drainage and to lessen the depth of snow around the tree trunk. This mounded earth should be pressed firm so that it will freeze quickly and thus be impervious to burrowing. Moreover, firming the earth will also prevent to a great extent the formation of a funnel caused by the tree being blown about by the wind. In such funnels water collects, subsequently forming a block of ice about the trunk. If ice does not form in such funnels, rubbing of the bark on the frozen edges may result. Staking the young trees will largely prevent this.

2. **CINDERS OR CRUSHED STONE.** Fine coal cinders or fine crushed stone, packed firmly to a depth of about 4 inches around the base of the tree, are effective in preventing burrowing by mice under the guards mentioned in (4.) below. It is doubtful whether either of these materials alone would completely prevent mouse injury, especially if there is a snow cover.

3. **TRAMPED SNOW.** For smaller plantings tramping snow firmly around the trunk, after each snow storm, is effective as it prevents mice from working in from beneath the snow.

4. **GUARDS.** For young trees most growers use guards around the trunk. These may be of wire netting, wood veneer, or asbestos building paper.

(a) **WIRE.** This should be fairly coarse, have a quarter-inch mesh, and be galvanized. The common size of guard is 18 inches wide by 18 inches high. These dimensions permit the continued use of the guards until the trees are 7 to 8 years of age. For larger trees a strip 18 inches high and as long as necessary may be cut. Guards may be cut and rolled over a pipe to form a cylinder and the lap-joint finally secured with wire. Shaping of the guards can be done, with bare hands, indoors, much better than outdoors. The cut edge of the wire forming the bottom of the cylinder should be inserted 3 inches into the mounded soil, cinders or crushed stone, about the base of the trunk. This prevents mice from burrowing beneath the guard. (See Fig. I.)

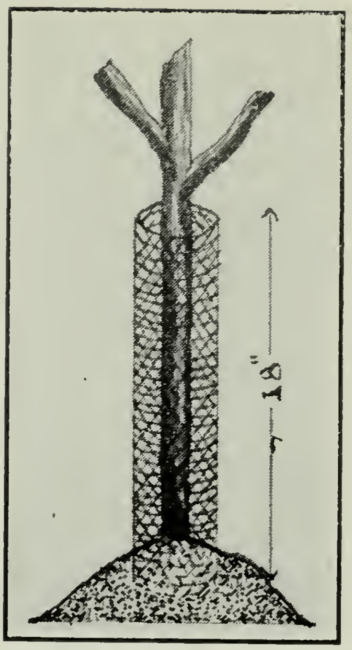

Fig. I

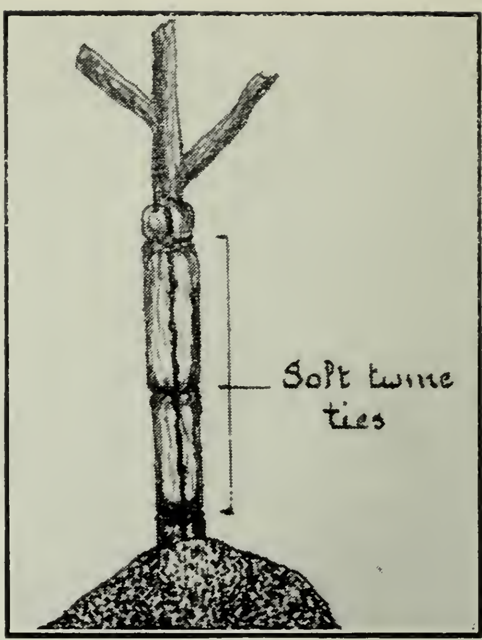

Fig. II

(b) WOOD VENEER. Guards made from such material should be about the same size as wire guards and should be similarly inserted into the soil, cinders or crushed stone. Both types should be examined in fall and again in spring to see that they have not been displaced. Wire particularly may injure the bark by rubbing, if displaced. Wood veneer and also asbestos paper guards (c. below) should be removed in the spring and put on in the fall late enough to miss codling moth larvae that often spin up in them in the warmer parts of the Province.

(c) ASBESTOS PAPER. This material should be used as a reasonably tightly wrapped guard, using several laps, and securing with soft twine. A loose wrapper will be torn by wind and thus be easily entered by mice. (See Fig. II.)

5. REPELLENTS. These are not recommended for mice because it is necessary to apply them below the soil level as well as above. The damp bark encountered beneath the soil level causes the repellents to disintegrate. Resin-alcohol solution, or similar materials, such as are applied for repelling rabbits, are unsuitable since they flake off shortly after application because of contact with soil water.

6. POISON BAITS. These are excellent for use against mice, but it is wise also to use guards as added insurance against mouse injury. In many orchards fallen apples are not completely removed and thus baits prepared from apples are not very attractive. This is also true when the temperature is below freezing.

Under such circumstances grain baits are likely to prove more attractive. The poisons used in poison baits are either strychnine, white arsenic or zinc phosphide. The zinc phosphide may be purchased as a commercial mouse poison. For information on sources where this may be secured consult your local co-operative or spray dealer.

(a) STRYCHNINE-GRAIN BAIT. Mix 1 level tablespoonful of laundry starch in 1/4 teacupful of cold water. Stir this into 3/4 pint of boiling water to make a clear paste. Mix 1 ounce of strychnine sulphate with 1 ounce of baking soda and stir this into the hot starch paste to make a smooth, creamy mixture, free from lumps. Then stir in 1/4 pint of heavy corn syrup and 1 tablespoonful of glycerine or liquid petrolatum. When thoroughly mixed, pour this over 8 quarts of rolled feed oats (porridge type does not mix as well) or wheat, and stir so as to coat thoroughly each grain.

(b) STRYCHNINE-APPLE BAIT. Cut sound apples into 3/4 inch or 1 inch cubes. To 1 quart of cubes (100 to 125 pieces) add 1 level teaspoonful of powdered strychnine alkaloid and saccharine equivalent to half the size of a bean. Dust part over part of the cubes, mix, add more cubes, dust again, and thus continue until all are mixed.

(c) WHITE ARSENIC-APPLE BAIT. Use 1 teaspoonful of powdered white arsenic (purchased from druggist) to each quart of apple cubes and mix in the same way as in (b). (Neither lead arsenate nor calcium arsenate may be substituted satisfactorily for white arsenic.)

TIME AND METHODS OF APPLYING BAITS

Choose the forenoon of a warm, dry day in late October or in November. If a mouse runway is present beneath a tree, drop in a cube, using a piece of wire to handle the cubes individually. If no runway, no mice are present and no bait is needed. Pass on to next tree. Where rolled oats or wheat are used, handle the bait with a teaspoon, placing a teaspoonful in each runway. All baits should be covered with a large handful of mulch or straw. (See Fig. IV.) This makes more favourable conditions for the mice to feed and also hides the bait from other animals and birds. It is safer to place the required amount of bait in cleansed, quart, lubricating oil cans, such as may be obtained at some gas stations, or in small-sized field tile. The oil cans should have also a hole punched in the opposite end. (See Fig. III.)

Fig. III

Later in the season it is sometimes difficult to find runways and then cans or small-sized field tile are very useful as "feeding stations". These containers should be so placed that water will not run in. Cover all such devices with mulch or straw. Place a few "feeding stations" along the orchard fences. If sod adjoins the orchard, place also a few "stations" several yards from the orchard fence in such sod.

NOTE. All the above baits are very poisonous, hence the utmost care is necessary in cleaning all mixing utensils. Any baits that are left over should be destroyed promptly, preferably by burning. The poison itself should be stored in bottles away from children and irresponsible persons and plainly marked "POISON." Baits should not be touched with the bare hands since poisoning may occur through the skin.

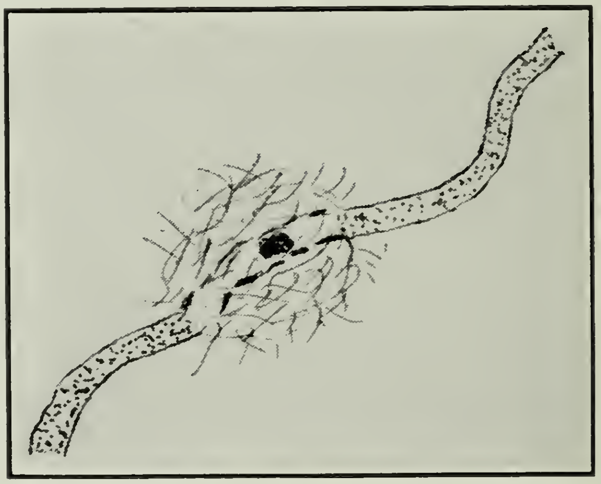

Fig. IV

ORCHARD SOIL MANAGEMENT

By E. F. PALMER and J. R. VAN HAARLEM

HORTICULTURAL EXPERIMENT STATION

VINELAND STATION, ONTARIO

THE SOD MULCH IN APPLE ORCHARDING, A SYSTEM OF SOIL MANAGEMENT WHICH IS NOW WIDELY FAVOURED.

ONTARIO DEPARTMENT of AGRICULTURE

STATISTICS AND PUBLICATIONS BRANCH, TORONTO, ONTARIO

BULLETIN 437 • JANUARY, 1944

INDEX

THE GOOD EARTH

If you would maintain its productive capacity for orchard purposes, observe these fundamentals,—

Know what soil is, and understand its relationship to the plants that grow on it.

Study the particular soil requirements of the fruits you intend to grow avoiding the use of unsuitable or marginal soils.

Crop production is directly related to the maintenance of soil organic matter. Guard what you have, and if possible, add to it by reducing cultivation, retaining crop refuse, using cover and green-manure crops, adding manure, straw, old hay.

Cultivation destroys organic matter. Some tree fruits, as for example, peaches, probably require cultivation even under the most favourable conditions. Even so, less cultivation than now commonly given may be sufficient. The apple and pear can often be successfully grown under a permanent sod-mulch system or, at the least, a greatly reduced program of cultivation. Study your soil and your fruits with the thought in mind of reducing cultivation to the minimum consistent with maintaining satisfactory production.

An actual deficiency in nitrogen, phosphorus, or potassium, or an improper balance of these plant foods, may be the cause of unsatisfactory conditions of growth and fruitfulness. Or "trace" elements may occasionally be responsible. Soil and leaf diagnoses should reveal the cause and indicate the remedy. This service is at the grower's disposal.

ORCHARD SOIL MANAGEMENT

E. F. Palmer and J. R. van Haarlem

Ontario fruit growers are increasingly conscious of the limitations of cultivation and correspondingly interested in soil management methods which will maintain unimpaired the productive capacity of orchard soils. The purpose of this bulletin is to present such methods together with supporting evidence but necessarily leaving to the grower the adoption of the particular management program best suited to his requirements.

The effectiveness of any soil management practice should not be measured alone by immediate response, particularly of yield, but rather by the performance of the orchard over the entire time that it occupies the land. Additionally, orchard practices should be such that, when the trees are eventually removed, the soil will not have been so impoverished as to be unsuited for further orchard purposes or other agricultural crops. It should be possible by intelligent management to continue orcharding permanently on a given piece of land.

This is hardly the case at present, speaking broadly, and acknowledging that individual growers are handling their soils faultlessly. The problem is to make the exception the rule and thus ensure that present fruit areas continue indefinitely as such. It may be accepted as fact that orchard soils in the older established fruit areas of southern Ontario are now definitely less fertile and generally less suitable for orchard purposes than they were 20 to 30 years ago. Certainly they are less suitable than when first planted as virgin soils.

> **"The fertility of an orchard soil is more than its plant food constituent. It involves the nature of the soil, its depth and topography, its previous treatment, the use of fertilizers and manures, the nature of the cultivation, and the covers or sods grown." (Penn. Bull. 294.)**

In the preparation of the accompanying material many authorities have been freely consulted and quoted in order to give substance to the ideas and opinions expressed, to fully develop the varying effects of the factors noted above, and to indicate practices which will favourably influence soils for orchard purposes.

SOILS, THEIR ORIGIN AND NATURE

An adequate knowledge of the nature and composition of soil is necessary to an intelligent understanding of its management.

Soil as a whole is simply a mixture of solids, liquids, and gases or air. The solid portion consists of broken down rock (inorganic) plus organic material derived from living things such as roots and plant parts generally, and soil organisms. In this solid portion particles range in size from stones and gravel, through sand and silt, to clay. "Texture" of soil is determined by the proportion of particles of different sizes.

These particles cling together in groups and it is the sizes and shapes of these groups, and their resistance to breaking down which make the "structure" of the soil. This in turn affects soil productivity since it determines the ease of root penetration, the rate of absorption and movement of water, and aeration. A satisfactory "granular" soil structure is as important in plant growth as proper chemical balance of plant foods. In fact nutritional deficiencies are in general easily remedied but fundamental soil characteristics, once disturbed, are repaired with difficulty.

Soils vary in colour depending upon the amount of organic matter present and the accumulation of certain chemical compounds. The darker soils are considered the most fertile ranging through to the yellow, gray, and white which are the least fertile.

Clay, which has the smallest particles of any solid material in the soil, deserves special mention. These very fine particles, most of which cannot be seen even under a microscope, are called colloids. They represent the last stage in the break-down of larger pieces. Some are made from organic matter, some from mineral matter. The clay particles or colloids are the pantry in which plant foods are kept, the storage place where chemicals are held, to be gradually released to nourish plants. The kind and amount of the clay or colloid portion of a soil is therefore extremely important in determining its fertility.

But before the nutrients can be actually absorbed by roots, they must be transferred to the liquid portion of the soil, the soil solution. This might be roughly likened to a thin chemical soup, made of minerals dissolved in water, which occupies the pore spaces between the solid particles of soil. That is, the soil solution shares these pore spaces with air. Air in the soil supplies plant roots with oxygen, and it is important to maintain the supply by proper drainage.

We live in a moist world, and of all chemical compounds water is the most wonderful and universally useful. A severe drought emphasizes the value of a soil with good moisture-holding capacity. Water is constantly moving in the soil, pulled downward by gravity, and creeping upward, downward, and sidewise in the tiny cavities or pores through the operation of capillary forces—the same forces that pull ink up in a blotter. How water is retained in the soil and how it moves is an interesting but complex subject for study, closely tied up with laws of physics. The vital point is what is called the available water—the amount that is left after all excess has been drained away by gravity, but before so much has been removed by evaporation and transpiration that plants wilt. This available water is capillary water; it is held by capillary attraction in the minute pore spaces. Since structure determines the size and shape of the pore spaces, it is most important in determining the capacity of a soil for holding a large amount of available water. (From Soils and Men.)

SOIL AND PLANT RELATIONSHIPS

Soils and Men, the 1938 Yearbook of the United States Department of Agriculture clearly states the fundamental relationship of soils and plants in the following words,—

> In all soil management, the important point obviously is the relationship between the soil and the plants that grow in it. With due regard for economic factors such as accessibility to markets, good management consists (1) in selecting the right plants for a given soil, or in choosing the right soil for a given plant; (2) in maintaining the soil so that it remains suitable for the plant; or (3) in modifying it so that it is more suitable.
>
> If a soil is to be favorable for the growth of crops, it must meet six fundamental conditions, some of which can be brought about to a considerable extent by management practices:
>
> (1) It must be suited to the use of efficient cultural implements.
>
> (2) It must offer effective resistance to destructive erosion or depletion under a desirable cropping system. Certain silt loams and very fine sandy loams, for example, are excellent for plants but so subject to erosion that they cannot be used for certain crops for any length of time.
>
> (3) It must be capable of storing enough moisture to meet crop requirements under normal rainfall or irrigation. Texture, structure, and depth to the water table are important factors. The first two, at least, can be modified by proper management.
>
> (4) There must be adequate aeration to permit the development of a good root system. Where this is lacking it can often be provided by drainage; but in heavy, impervious soils or where the water table is near the surface, satisfactory drainage may be impossible.
>
> (5) There must be a supply of plant nutrients sufficient for profitable yields. Here management can be profoundly effective in altering infertile soils by the use of fertilizers, cover crops, and manures.
>
> (6) The soil must be free of unfavorable chemical conditions such as excessive acidity or alkalinity, harmful concentrations of salts, or excesses of certain elements that create an unbalanced condition for plants. Here also good management may often correct defects, as by the use of lime to bring about the most favorable soil reaction.
>
> Most of these points, it will be noticed, have to do with the needs of the plant for water, oxygen, and nutrients. The success attained in growing plants in water cultures, without any soil whatever, shows that these are the three things on which attention must be centered.

FIG. 1. Organic matter is the basis of soil fertility. Return crop residues to the soil. Don't burn them.

ORGANIC MATTER AND HUMUS

Again in **Soils and Men** we read as follows:—

The scientific study of the soil takes in not only physics and chemistry but biology. All living things supported by the soil return to it in the end, to be broken down by untold numbers of micro-organisms and become the complex substance called humus. This humus is in effect a storehouse of plant nutrients that are gradually released as it is still further decomposed into simple mineral salts, carbon dioxide, and water. But humus represents more than stored plant nutrients; intimately mixed with soil, it has a great deal to do with creating and maintaining good soil structure.

There is no true soil without organic matter. The quantity of humus, however, depends primarily on climate and vegetation. Climate determines the rate and time of decomposition; vegetation determines the amount and kind of organic substance added to the soil each year. In grassland, for example, the quantity of humus in the soil is large; additions each year are not great, but they have been gradually built up because climatic conditions have made the rate of decomposition slow. Eventually all soils under natural conditions reach a state of balance, when the additions of humus from native vegetation equal the removal by decomposition. . . .

When man clears away or plows up the native vegetation, he disturbs or destroys this balance. He may or may not damage the soil, but he must provide for an adequate supply of humus in one way or another if productivity is to be maintained.

The living microscopic organisms that swarm in the soil are the agencies that break down raw organic material into humus, and this again into simpler elements. They do this in the process of getting food for themselves and building up their own bodies. They in turn die, by uncounted billions, to add to the soil organic matter.

FIG. 2. Cover and green-manure crops help in maintaining organic matter. Start when the orchard is young.

Nature and Purpose of Soil Organic Matter and Humus. The terms "soil organic matter" and "soil humus" are not easily defined or indeed capable of exact definition. However, soil organic matter may briefly be regarded as including such plant material (the main source) as dead roots, leaves, fruits, and stems of plants; carcasses of insects, worms and animals; live and dead soil micro-organisms; and various products of decomposition of the dead residues. Chemically it consists of proteins, carbohydrates, fats, resins, waxes, and similar compounds.

Soil humus represents an **advanced stage** in the decomposition by micro-organisms of soil organic matter and is a mixture of many different compounds of no definite chemical composition. It is dark in colour and practically odourless. Organic residues whether fresh or in process of decomposition as well as those in an advanced stage of decomposition, which however still resemble the parent material in structure, are not considered a part of soil humus, but are organic matter. Normally the content of soil organic matter, and particularly humus, will be greater near the surface of the soil and will decrease with depth until it disappears entirely.

Some authorities hold that the term "humus" should be used to designate the organic matter of the soil as a whole, irrespective of its stage of decomposition but at present the weight of evidence seems to be in favour of the above separation and definition of organic matter and humus. In this bulletin for fruit growers, to avoid confusion, the term "organic matter" will have preference as an all inclusive one, "humus" being used only where it definitely refers to the well decomposed, more or less stable part of the organic matter of the soil.

The functions of organic matter are to act as a conserver of nitrogen and mineral plant nutrients, to regulate their liberation for the use of growing plants, and to modify certain physical and mechanical properties of the soil such as structure, colour, consistence, and moisture-holding capacity. As an example, the formation of the granular structure most

FIG. 3. Growth of Sudan grass, an orchard green-manure crop, as affected by soil organic matter. Plot 19A on the left has had mineral fertilizers only and no nitrogen during 30 years of cropping. Plot 18A has been treated annually with cow manure and complete fertilizer. (Photo courtesy New Jersey Agr. Exp. Station.)

favourable for plant growth is governed by the organic matter content of the soil. In its role as conserver and regulator of plant nutrients organic matter is invaluable. It may be likened to a governor or balance wheel which maintains soil fertility since it is the natural storehouse of moisture, of nitrogen, and of much of the minerals.

Active organic matter, in process of decomposition, supplies food and energy for micro-organisms whose activities are essential to make a soil productive. In a general way therefore soils best supplied with organic matter are the most productive and as organic matter is depleted, ability to produce crops declines. Here it should be understood that a **rich** soil is not necessarily a **fertile** soil, fertility depending upon the availability to the growing plant of the foods present. Thus we see that chemical fertilizers alone may correct nitrogen or mineral deficiencies but fertility and therefore crop response depend upon the presence of adequate amounts of organic matter. Soils low in organic matter may sometimes produce good crops, given very favourable seasonal conditions and perhaps careful use of chemical fertilizers, but such productivity is neither natural nor lasting.

Ohio authorities, noting the effects of loss of organic matter, report an increase of 16.5 pounds in weight per cubic foot of soil, a decrease of 9.3 per cent in porosity, and a loss in organic matter of 4,000 pounds per acre, in a soil cropped for 40 years, as compared with a virgin soil. In other words the loss of organic matter has made the soil definitely more compact in character and correspondingly less suited to plant growth.

Organic Matter and Water Relationships. The importance of water in crop production is self-evident. The part that organic matter plays in the moisture-holding capacity of a soil and in facilitating absorption and movement of water cannot be over-emphasized.

A soil's capacity to retain moisture is in direct proportion to the fineness of the soil particles. The finer the particles the greater the water-holding capacity so that a clay for example is much more effective than a sand or sandy loam. Decomposed organic matter (humus) is even finer than clay and its water-holding capacity is several times greater thus indicating its importance in even the finest textured soils. In the coarser soils, since their inherent or unaided water-holding capacity is proportionately less the coarser they are, humus content is correspondingly important.

Expressed in percentage, increased water-holding capacity due to humus increase may seem small, but an increase of 1½ per cent (a very conservative one) in available water in the top six inches of soil represents, according to New York workers, 3,750 gallons per acre, or with 50 trees (apple) to the acre, 75 gallons per tree. This is an increase in **capacity, not amount,** so that after every good rain there could be this much more water available in the top six inches of soil; thus in the course of a season several times 75 gallons might be available for each tree.

This increased water-holding capacity is of prime importance in smoothing out seasonal distribution of rainfall. Too often summer droughts, even of short duration, are held responsible for partial crop failure when in actual fact faulty soil management and low humus content are responsible. The soil must take rain when it comes, holding it in anticipation of later crop needs, its capacity to do this depending, as we have seen, on its humus content.

SOURCES OF ORGANIC MATTER UNDER ORCHARD CONDITIONS

The trees themselves will supply some organic matter chiefly in the form of leaves, especially where they do not easily blow away as under sod conditions or where fall plowing is **not** practised. Substantial amounts of organic matter must, however, come from other sources, cover and green-manure crops, weeds, farm manure, sod, straw, old hay.

Cover and Green-manure Crops. Green manuring, either alone or in conjunction with the use of farm manure, must be a continuous process to maintain soil organic matter as there is no very large addition from the turning under of a single crop. In fact the objective in green manuring is to maintain rather than increase organic matter. Actual increase where needed will have to come either from a change in cultural practice or from additional material brought in.

In green manuring the maturity of the crop determines the amount of organic matter added to the soil. Young succulent material decomposes readily, and quickly releases plant nutrients for fruit tree use, but it has little effect on the total soil organic matter. On the other hand, plants allowed to mature before being returned to the soil decompose more slowly and are of much greater value as sources of organic matter.

Green-manure crops, planted in **late** summer and plowed or disked early the following year therefore add little organic matter, but do release plant nutrients when the trees can make good use of them for early, vigorous growth. Green-manure crops planted in **early** summer, as where minimum cultural practices are followed, (See page 27) will mature by fall, and will therefore add very considerable amounts of organic matter. The individual grower will vary his practice to suit the needs of particular soils and fruit crops.

Cover (over-wintering) and green-manure crops may be divided into two classes, leguminous and non-leguminous. The **leguminous** crops, represented by members of the pea and bean family, have the ability to store nitrogen from the air through the activity of the bacteria living in nodules on their roots. When the plant dies, or is turned under, nitrogen is liberated sufficient for its own decomposition plus a surplus for following crops. In orcharding, more particularly apple orcharding, legumes have the same fault as farm manure, slow release of nitrogen, which may unduly prolong tree growth and delay fruit maturity to the detriment of both tree and fruit.

If a soil has not previously grown legume crops it is best to inoculate the seed with a culture of bacteria peculiar to that crop so that the production of the nodules on the roots is stimulated. These cultures are obtainable from Agricultural Representatives, the Ontario Agricultural College and most seed houses. After the first crop is grown the soil will be sufficiently inoculated for succeeding crops of the same kind.

The **non-leguminous** crops are represented by the cereal grains such as rye, buckwheat, millet. These crops have not the ability to store free nitrogen and, for abundant growth, must be supplied with nitrogen from fertilizers or other sources. Also, these crops when turned under need considerable nitrogen for the bacterial decomposition of the plant material.

FIG. 4. Soil erosion. In cultivated orchards loss of rich top soil is often serious. Gullies should be left continuously in sod as in Fig. 6, the land on either side being treated as separate orchards.

The millets and rye are heavy consumers of nitrogen during their growing period and the following period of decomposition. If the extra nitrogen is not supplied they will compete with the trees for nitrogen, often to the disadvantage of the trees. Thus we sometimes find that when a heavy crop of rye or millet is plowed under without additional nitrogen, a nitrogen deficiency in the tree will be indicated by pale foliage colour.

Cover and green-manure crops may also be classified as deep or shallow rooted. The deep-rooted crops, such as alfalfa and sweet clover, penetrate well into the subsoil from which they obtain not only plant food but also large quantities of soil moisture. This may sometimes work against the tree, robbing it of needed moisture during hot weather. These deep-rooted crops, by penetrating into the subsoil, help to open it up so that tree roots can penetrate more freely and tap the available soil minerals in the subsoil. Young orchards however are particularly susceptible to the competition of these deep-rooted crops which, when sown, should therefore be kept well away from the trees.

Cover crops can be a valuable aid in holding winter snows and preventing soil erosion. Any crop that stands stiff and straight throughout the winter will hold snow and prevent drifting. The snow cover not only adds soil moisture but also prevents the deep penetration of frosts. During the spring, in orchards where run-off occurs, a remaining cover crop will prevent the rich topsoil from flowing down the ditches. Erosion is an insidious thing, very often not appreciated until serious results are in evidence and it is too late to hold or restore the rich topsoil. It is far better to make use of cover-crop residues as blockades to soil erosion.

FIG. 5. Apple tree under clean cultivation showing effect of soil erosion. Such shallow roots are more subject to injury by cultural equipment and low winter temperatures. (Photo courtesy Michigan State College.)

With cover and green-manure crops it is often good practice to apply a low nitrogen complete fertilizer (such as a 2-12-6), just previous to planting to stimulate growth. Having the crop take up some minerals during the summer season is an indirect means of fertilizing the tree with minerals in an organic form, for on decomposition these plant residues give up these minerals in a readily available form. Fertilizers for this eventual use should not be put on in heavy amounts as it is not desirable to overstimulate the trees at that time of year. An application of 125-250 pounds per acre of a mixed fertilizer would be considered ample.

The listed crops are being used as green manures but some are not suited to Ontario conditions and others remain to be tested. Those known to have value for Ontario orchards are discussed in the accompanying paragraphs.

Legumes

- Alfalfa
- Clover—
  - Alyce
  - Burr
  - Kent White
  - Ladino
  - Red
  - Sweet
- Crotalaria
- Kudzu
- Lespedeza
- Peas—
  - Cow
  - Winter
- Soybeans—
  - Field
  - Garden
- Vetch—
  - Crown
  - Hairy

Non-Legumes

- Barley—
  - Fall
- Buckwheat
- Millet—
  - Common
  - Crown
  - Empire
  - Hog
  - Hungarian
  - Japanese
  - Red Turghai
  - Siberian
- Oats
- Mixed Grains
- Rape
- Rye
- Rye Grass—
  - Italian
- Sudan Grass

FIG. 6. Permanent sod along watercourses or gullies reduces erosion in cultivated orchards.

Alfalfa—Alfalfa does not make a good green-manure crop because of insufficient spring growth by the time it should be turned under, but makes a good permanent sod and is widely used for this purpose. (See page 34).

Soybeans—Soybeans have not been used extensively in Ontario as a green-manure crop probably because it has been difficult to obtain a good stand. Fresh one-year seed should be used and inoculated with the correct type of bacteria if it is the first time the soil has grown soybeans. For best results the land should be rolled after seeding. At Vineland there is some indication that the garden type, or edible soybean, germinates and grows better than the field type. At present the cost of edible soybeans is high but this may be reduced if they come into more general use. Soybeans appear to be our best leguminous green-manure crop.

Sweet Clover—Sweet clover is a biennial crop, dying out completely the second season after planting unless it becomes self-seeded or is reseeded by hand. As a green-manure crop, planted late one season and turned down early the next spring, sweet clover has not given entire satisfaction because of insufficient growth by the time it should be turned under. However, as a semi-permanent sod, as for instance in the alternate strip method of cultivation (see page 39), it is a very useful crop, penetrating and opening up the subsoil, adding considerable nitrogen and a fair amount of organic matter. To obtain its greatest usefulness as a cover or green-manure crop it should be planted with a buckwheat nurse crop (which can be mowed when necessary during the season), allowed to grow late the next spring and then turned under before the growth becomes woody. Handled in this way, in orchards that would fit such a program, sweet clover will yield a fair tonnage of organic matter and add considerable nitrogen to the soil.

FIG. 7. Millet as a green-manure crop planted in late May following a very short cultivation period.

Buckwheat —Buckwheat has been used extensively as a green-manure crop for orchards. The seed is cheap, germinates well, and when thickly sown gives a good ground cover and smothers weeds. The dry weight of a single buckwheat crop is not as great as with some other materials. When sown about July 1st, the first seeds will mature in about eight weeks and a light disking at this time will thresh out enough seed for a good volunteer crop the same season, thus greatly increasing the weight of straw produced in one year. Buckwheat straw decomposes easily so there is little danger of a heavy nitrogen drain where it is used.

Millets —Millet varieties are divided into two types, hay and grain, the hay type being leafy and the grain type non-leafy. The hay or leafy type belongs to the foxtail group, has slender stems which grow 2½ to 5 feet in height, broad flat leaves and bears seed in dense cylindrical heads. The very leafy varieties of this type provide dense ground cover and draw great quantities of moisture from the soil, which in wet seasons is a good point but in dry years is a detriment to the orchard. However, in orchards that are generally too wet, these would be good crops to take up the excess moisture. Varieties in this group are — Common, Empire, Hungarian, Japanese and Siberian.

The grain or non-leafy type comes in the proso millet group and is characterized by having pannicle heads with large seed. The stems are coarser, except the variety "Crown", grow 2 to 5 feet in height and bear fewer, narrower leaves. They have a shallow root system and in dry weather practically stop active growth. This type does not use the quantities of soil moisture that the leafy type does and therefore will not compete with the trees during dry weather to the same extent. Varieties in this group are—Crown, Hog, and Red Turghai.

FIG. 8. Millet cut and let lie, to facilitate apple harvesting. Late fall tractor disking will partly incorporate this cut material in the top soil; or it may be left undisturbed until spring.

In general, and more particularly the leafy type, millets draw heavily on the available soil nitrates, very often at the expense of the trees. The effect on the orchard, or on a following green-manure crop, is therefore a nitrogen deficiency. Thus a millet crop sown about July 1st followed by rye in late fall will result in a poor stand and growth of rye. To partially overcome this effect an application of 125-250 pounds of 2-12-6 just previous to sowing these crops will avoid nitrogen competition with the trees, and the minerals will in addition be of immediate benefit to the green-manure crops and ultimate benefit to the fruit trees.

Mixed Grains—Mixed grains, sown July 1st, can be used as a green-manure crop if cut when reaching a height of about 18 inches to prevent seed formation. The crop is shallow rooted and will not draw too much upon soil moisture. A heavy weight of easily decomposed plant material is possible. It is a good smother crop for weeds.

Rape—Some years ago rape was used extensively as a green-manure crop but growers have found it too wet during harvesting operations due to slow drying after heavy dews. Rape is easily grown and provides a thick ground cover but does not add much organic matter to the soil. Also it is very subject to aphis attack.

Rye—Rye has been used for many years as an orchard cover crop, sometimes at the expense of the orchard. It is a particularly heavy nitrogen feeder during its rapid spring growth and if the weather then is too wet to plow rye down there is a serious nitrogen drain which adversely affects the trees. Frequently rye is in head and three to four feet high before soil

TABLE I.—COVER AND GREEN-MANURE CROPS

	Rate of Seeding	Time of Seeding	Method of Sowing	How Managed	Nitrogen When Turning Under
Legumes	(Per Acre)				
Soybeans	1½ — 2 bus.	Summer	1 year seed only, roll after seeding.	Left over Winter or lightly disked	No
Sweet Clover	15 — 20 lbs.	Late spring	With nurse crop	Left over Winter	No
Vetch	1 bus.	Late spring	With nurse crop	Left over Winter	No
Non-Legumes					
Millet	20 — 30 lbs.	Summer	Without nurse crop	Lightly Fall disked	Yes
Sudan Grass	25 — 30 lbs.	Summer	Without nurse crop	Lightly Fall disked	Yes
Buckwheat	1 — 1½ bus.	Summer	Without nurse crop	Left over Winter	No
Mixed Grain	1½ — 2 bus.	Summer	Without nurse crop	Left over Winter	No
Rape	6 lbs.	Summer	Without nurse crop	Left over Winter	No
Rye	1½ — 2 bus.	Fall	Without nurse crop	Left over Winter	Yes
Weeds	——	——	——	Left over Winter	Yes
Permanent Sod					
Alfalfa	15 — 20 lbs.	Spring	With nurse crop	Cut as required	No
Bluegrass (Canada)	25 — 30 lbs.	Spring	Without nurse crop	Cut as required	No
Orchard Grass	15 — 18 lbs.	Spring	Without nurse crop	Cut as required	No
Pasture Grass Mixtures	16 — 24 lbs.	Spring	Without nurse crop	Cut as required	No

conditions are such that it can be turned under. A further nitrogen drain then occurs when this large volume of maturing material is plowed under and decomposition gets under way. The competition for available nitrogen has been the cause of severe damage to trees in wet springs. On the other hand, in good seasons of normal spring weather, rye is an ideal cover crop. Before plowing down in any season a light application of nitrogen should be made to hasten decomposition and lessen competition.

Sudan Grass —This grass belongs to the sorghum family and grows best in good "corn weather", germinating well in hot weather and growing three to four feet high in the orchard. It forms a thick ground cover and is a good smother crop for weeds. Because of the thick cover it should be lightly disked in the fall to prevent the harbouring of mice during the winter. Before plowing down Sudan grass in the spring a light nitrogen application should be made to promote decomposition. At Vineland, Sudan grass has not given as high yields of dry matter as Crown, Empire, and Japanese millets.

Weeds—Failing the planting of any other green-manure crop a good stand of weeds will yield large quantities of plant material to turn under. Many growers object to the untidy appearance of the orchard and the tall stiff stems left standing during the picking season. Mow the weeds once or twice during the season as they reach a height of 18-20 inches. When finally turning the crop under, a very light application of nitrogen should be given to stimulate breakdown and prevent a nitrogen drain on the orchard. Handled in this way weeds can be a satisfactory source of organic matter. Incidentally weed growth in an orchard is usually a fair index of soil fertility. Soils which won't grow weeds won't grow green-manure crops either, and eventually won't grow satisfactory fruit trees or crops unless and until fertility is restored by building up the soil organic matter.

Farm Manure—In general farming putting manure back on the land is the natural means of returning to the soil as much as possible of the fertility removed in crops. In orcharding it is usually the case that manure is not produced in sufficient quantity to supply the need and must therefore be brought in from near-by general farms or from city stables and stock yards. Even then it will be the case, more often than not, that there is insufficient manure for all orchard demands, and other materials and methods as discussed in this bulletin, will have to be substituted.

Manure varies in the amount of plant food which it supplies, i.e., nitrogen and minerals, but even though low in these elements it is a dependable source of valuable organic matter. In fact this is probably its chief value rather than the actual plant food present. The benefits are largely indirect being accomplished by improvement in physical condition of the soil, water-holding capacity, aeration, favourable effect on soil organisms, etc. Reference should also be made to organic substances variously termed "plant growth substances", "accessory growth factors", "vitamins", and concerning which very little is yet known. Farm manure however has long been known to strikingly increase plant growth more than can be accounted for by the actual plant food it contains. This extra value may be due to the presence of plant-growth chemicals which stimulate root development or otherwise assist the plant.

In orcharding, manure should be used with caution, especially for apples, as it supplies slowly available nitrogen which may delay tree maturity and adversely affect fruit colour, quality, and storage life.

Paunch manure—This partly digested fodder taken from the stomachs of animals killed in the abattoirs is sometimes used for manuring, although

FIG. 9. A mulch of old hay as a valuable source of needed organic matter in a clean cultivated pear orchard.

it is not the equal of farm manure. Paunch manure is acid in reaction and, because it is only partly digested, is fibrous in nature. Especially if used as a mulch therefore, lime should be added to correct acidity, and nitrogen to aid decomposition. Even where used in moderate amount as a manure substitute it is as well to add lime and nitrogen.

Sawdust, shavings, peat—These materials are sometimes used for stable bedding where they absorb the liquid portion of the manure in which there is enough nitrogen to promote decomposition. Moderate applications of such farm manures can be an excellent source of organic matter. However if sawdust and shavings are used directly from the planing mill, or peat directly from the bog, their low nitrogen content and high acidity may produce adverse effects on soil and crop. These adverse effects may be minimized by a light application of nitrogen to aid decomposition, and of lime to counteract acidity.

Sod as a Source of Organic Matter—Left to itself, as for example in grassland, a soil slowly enriches in organic matter, finally reaching a state of balance where the additions from the grass or other vegetation equal the removal by decomposition. Under orchard sod conditions therefore the organic matter problem solves itself, it nevertheless being necessary to provide that the fruit tree does not suffer from competition for food and moisture. This may be accomplished, as later discussion suggests, by the use of mulch, and commercial fertilizers where needed.

Loss of organic matter, accumulated under sod conditions, begins with cultivation, and the longer it is continued other things being equal, the greater the loss. This is not **necessarily** to be deplored as the decrease is in large part the necessary accompaniment of making the organic matter useful to the tree. But if allowed to go too far, unaccompanied by replenishment, the eventual result will be declining growth and lowered yields. Soil management should be so planned as to provide for a level of cropping which can be maintained without impoverishment of the soil itself.

Hay and Straw—With the scarcity of manure in fruit districts it has been difficult to find suitable substitutes for the manure usually applied. Straw and hay offer such a substitute, in fact as a source of organic matter alone the substitute may be cheaper than manure itself. An average manure contains from 75% to 80% water so that in a ton the dry matter amounts to about 500 pounds only. Dry straw and hay, on the other hand, have upwards of 1,700 pounds of dry matter per ton. As to fertility an average manure contains 10 pounds of nitrogen, 5 pounds of phosphoric acid and 10 pounds of potash per ton. A glance at Table II. is convincing evidence of the fertility value of straw and hay as compared with manure, although manure has other values as already suggested.

Hay or straw is put on the orchard in late fall at the rate of two tons per acre, and lightly disked to partly break it up and incorporate it. If legume hays are used no nitrogen supplement to aid decomposition is needed since these hays already have a high nitrogen content. The non-legume hays and straws need about 150 pounds per ton of some form of nitrogen to hasten decomposition and prevent competition with the tree. One-half of this amount is broadcast over the material when applied and both are lightly disked. Early the next spring previous to the regular spring operations the remaining half of the nitrogen should be applied. Treated in this way two tons of straw or hay are the equivalent in organic matter of about seven tons of manure.

Growers using straw or hay should be careful not to apply more than a maximum of three tons per acre. Also when using pea straw, with its high nitrogen content, and rapid decomposition, care must be taken not to apply it too deeply around the tree as a mulch, as this has sometimes resulted in injury due to late growth.

TABLE II.—MANURE VALUE OF FARM RESIDUES*

Crop	Approximate Pounds Per Ton			
	Nitrogen N.	Phosphorus P_2O_5	Potash K_2O	Dry Matter
Wheat straw	10.0	3.0	12.0	1808
Rye straw	11.2	5.1	18.1	1858
Oat straw	12.8	4.0	24.9	1816
Barley straw	16.7	5.6	30.7	1716
Pea straw—from viner	20.8	7.0	19.8	1700
Pea straw—threshed	28.6	7.8	20.2	1778
Bean straw—threshed	38.0	7.8	25.6	1790
Alfalfa straw—threshed	43.8	10.2	33.6	1840
Clover straw—threshed	42.6	11.0	28.2	1838
Alfalfa hay	49.0	10.0	42.0	1832
Clover hay	42.0	10.0	40.0	1742
Soybean hay	46.0	14.0	22.0	1828
Timothy hay	25.0	11.0	20.0	1816
Buckwheat	13.0	7.1	24.2	1802
Millet	14.0	3.6	34.0	1730
Marsh grass	17.2	10.6	54.0	1720
Leaves, mixed	15.0	3.2	6.0	1832
Cow manure, fresh	6.8	3.2	8.0	460
Horse manure, fresh	11.6	5.6	10.6	600
Sheep manure, fresh	16.6	4.6	13.4	720
Hog manure, fresh	9.0	3.8	12.0	540
Hen manure, fresh	32.6	30.8	17.0	880
Mixed stable manure, fresh	10.0	5.2	12.6	482

*Compiled from various sources.

While there will always be exceptional cases in which the so-called minor elements are of importance, yet nitrogen, phosphorus and potassium are the three elements most likely to worry the fruit grower. (Growers may prefer to think of phosphorus as phosphoric acid or superphosphate, and potassium as potash.)

Nitrogen-Mineral Balance—Fruit trees require a roughly balanced food supply. That is to say, while they may tolerate a wide range of nutrient proportions, yet when one of the nutrients, as for example potassium, becomes excessively low in relation to nitrogen, further applications of nitrogen to "improve" growth simply make matters worse. This happens all too frequently in practice, as growers, noting a lack of vigour and good foliage colour assume that nitrogen is needed whereas in fact its application may do harm. The constant use of nitrogen alone, as practised by many growers, **may** throw both soil and tree out of balance as to their needs for potassium and phosphorus, with ultimate adverse results.

Nitrogen—This ever-changing, fluctuating element is absolutely essential to the maintenance of soil fertility, for without it plant growth would cease. It exists in relatively small amounts in most soils, accumulates very slowly under even the best systems of soil management, and is easily lost through leaching, erosion and crop removal. It is extremely difficult under any cropping system involving cultivation to maintain or build up the soil's supply. Also the cost of fertilizer nitrogen is relatively high so that, all in all, it is easily the most important element with which the fruit grower has to deal.

Phosphorus—While indispensable, like nitrogen, for plant growth, phosphorus is of less practical importance to the fruit grower. Most soils are as low in phosphorus as in nitrogen, but less of it is removed by crops, and very little is lost by leaching. The main problem is to keep the orchard soil in suitable physical condition, well supplied with organic matter, and approximately neutral in reaction, so that enough phosphorus will become available as needed for the trees. Actual deficiencies can be corrected at reasonable cost by the use of chemical fertilizers.

Potassium—This element is present in most orchard soils, unless the very light types, in considerably larger amounts than nitrogen or phosphorus. The crop removes a large amount and there is also considerable loss from leaching although small compared with that of nitrogen. Next to nitrogen, potassium deficiency, especially as its ratio to nitrogen is important, is likely to be a cause of impaired tree vigour and fruitfulness. In fact general health and vigour seem to be particularly dependent on this element and it is claimed that plants well fed with potassium have greater disease resistance.

Lime (Calcium)—Soil fertility is often regarded as primarily a matter of nitrogen, phosphorus, and potassium supply, overlooking calcium which performs many indispensable functions in plant growth and in modifying soil conditions. Liming has beneficial effects on the soil's "life", its microbiological processes, and on its chemical and physical nature, improving its structure. The value of liming in correcting acidity of orchard soils is perhaps primarily to promote the growth of cover and green-manure crops (legumes especially) as fruit trees themselves are mostly quite tolerant of slightly acid conditions. Also, though lime is not a substitute for manure or fertilizers, yet when needed, its application increases their effectiveness.

Trace Elements—The role of trace elements such as magnesium, manganese, iron, boron, zinc and copper is still undergoing investigation. For the most part, Ontario soils appear to be well supplied. In fairly acid soils the availability of these elements is increased and deficiency is seldom found, but in the more alkaline soils light applications of fertilizers containing trace elements may become necessary. In some restricted areas deficiencies of magnesium and boron have been found and supplements of these materials have become necessary.

SUITABLE ORCHARD SOILS AND SITES

There is ample good orchard soil in any of the recognized commercial fruit areas of Ontario, and orchards need not and should not be set out on "marginal" lands in which there are serious limiting factors of topography, soil type, drainage, or natural fertility. The problems and difficulties of fruit growing are quite sufficient without these added handicaps and soil management in particular should not be complicated by unsuitable soil or location.

The broad fundamental requirements (for detail see Ontario Bull. 433, **Establishing the Young Orchard**), are good air and water drainage, sufficient depth of soil, open texture to permit of rapid intake of water and free root penetration, a range in soil types from light, sandy loam to clay loam but avoiding the **very** light, sandy loams, the too coarse, leachy soils, and the too heavy, compact clays. Within these limitations there is ample choice for the particular requirements of the kinds of tree fruits to be grown, whether apple, pear, cherry, peach, or plum.

These general soil requirements in relation to specific fruits are well and briefly stated in **Fundamentals of Soil Science** (Millar and Turk) as follows:—

> **Apple**—Apple trees require a large available water supply and are therefore well adapted to the well-drained, porous loam and silt loam soils. Sandy soils and sandy loams with clay at a depth of 6 to 8 feet are usually satisfactory. Deep, dry sandy soils and wet or poorly drained soils are to be avoided.
>
> **Pears**—They are similar to apples in water requirements, but can withstand greater extremes with respect to moisture supply. They are better adapted to somewhat heavier soils than other fruit trees and grow well on well-drained clay loam soils. It is important that the soil be of suitable depth for extensive root development. Good drainage and aeration are important. Excessive fertility, particularly with respect to nitrogen, should be avoided from the standpoint of increased susceptibility to fire blight and winter injury.
>
> **Peach**—Peach trees do not require so much moisture as apple and pear trees and can therefore be grown on lighter soils, although sandy loams and even silt loams, where the surface horizons are deep, are also suitable for peaches, within their climatic limitations. The soils must be well-drained; the heavy, compact clay soils are least desirable. Peaches are usually most successful on soils of moderate fertility since they are more subject to winter injury and some diseases when the trees are extremely vegetative.
>
> **Plum**—The soil requirements for plums are about the same as those for pears. They appear somewhat better adapted to heavier soils than other trees with the exception of pears.
>
> **Cherry**—The water requirement of cherry trees is less than for apples, and consequently they are adapted to soils somewhat lighter in texture. Deep, dry sandy soils, however, are objectionable. The soil requirements of cherries are similar to those of peaches in that they are very susceptible to defective drainage.

Aeration and Drainage—Some of the fundamental requirements of a satisfactory orchard soil as already noted, are good surface drainage, a texture which ensures good root aeration, and a subsoil which allows excess water to drain away. Aeration and drainage are closely interrelated as well-drained soils usually are well-aerated soils, and compact, impervious soils are poorly aerated. In these latter soils it is especially important to avoid practices which increase compaction, and in fact underdrainage may often be necessary to reasonably fit them for orchard purposes. Underdrainage however should not be expected to so improve **too** heavy and compact soils as to make them suitable for orcharding.

Waterlogging, a condition in which the soil air spaces are completely filled with water, is due to water entering the soil faster than it can drain away naturally. Fruit tree roots require large amounts of air in the soil so that even partial waterlogging may greatly interfere with normal root activity. Provided other conditions are satisfactory, underdrainage will usually correct the trouble.

Most of the sandy loam peach soils of the Niagara District tend to be shallow, the open-textured sandy loam being underlaid by an impervious clay at a depth of 3 to 4 feet. Usually these soils are greatly benefited by underdrainage, which may be complete, or may follow the depressions only. The effect of underdrainage is especially notable in seasons of unusually heavy spring and fall rains as in the fall of 1942 and spring of 1943.

SYSTEMS OF HANDLING ORCHARD SOILS

For apple and pear orchards particularly, the trend of the past 12-15 years has been away from clean cultivation towards other systems notably sods and mulches. Even young trees succeed under sod if properly handled although there may be advantages in cultivating the young orchard until it reaches bearing age. (See Table IV.)

In tree fruits other than the apple and pear the disposition is to reduce cultivation from the excessive and unprofitable "summer fallowing" of recent years, although not to the point of sod culture which is perhaps too extreme for the stone fruits,—peaches, plums, and sour cherries. For sweet cherries, if soil conditions otherwise are right, sod is quite feasible.

Reporting on 20- to 30-year-old walnut and filbert orchards in Oregon, Stephenson and Schuster (**Soil Science**, Nov. 1942) concluded as follows:

> Some cultivated orchard soils in Western Oregon contain from one fifth to two fifths less organic matter than do similar uncultivated soils.
>
> Availability of phosphorus based upon chemical methods may be reduced as a result of long-continued cultivation, partly through nutrient and organic matter depletion and the unfavorable biotic changes that have taken place.
>
> An appreciable change in soil structure is associated with tillage and organic matter depletion.
>
> Tillage pans that interfere with water penetration and with proper functioning of the soil are common in cultivated orchards. The immediate soil surface may become dispersed and run together until water cannot penetrate.
>
> Many soils are more spongy and porous a few inches below the depth disturbed by tillage than in any other part of the profile. This layer is full of large, easily visible cavities, probably the result of undisturbed insect and other animal life in the soil.

Pennsylvania Bulletin 373, **Orchard Soil Management**, reporting on a survey of representative orchards and vineyards has this to say,—

The findings show clearly for residual soils in particular, where moisture shortage is a frequent limitation to yield and vigor of tree, that clean-cultivation leads to soil depletion, manifesting itself in the form of decreased organic matter and nitrogen and diminished permeability. Condemnation of clean-culture as a system of orchard management appears inconsistent with the fact that many clean-cultivated orchards are profitable, but these profits are obtained at the expense of the soils' destruction. Clean-cultivation must eventually lead to premature abandonment of the particular site. Several peach and grape growers whose soils are included in this study have agreed that their clean-cultivated blocks are being "run down". This depletion has been caused by sheet and gully erosion which was commonly encountered on clean-cultivated sites. Orchards which were cover-cropped annually suffered less loss in soil and water while not a single permanently sodded site was encountered on which the subsoil was exposed or on which gullies were to be found.

It is believed that these findings demonstrate what has taken place in the past and point the way to what must eventually take place in the future. Soil structure and permeability must be maintained, because if not maintained, the lack of them, eventually though slowly, will lead to increased runoff and erosion. The loss of water at critical periods and the loss of top soil will eventually lead to decreased vigor of tree and yield, and premature abandonment of the site. Those soil conditions which tend to preserve the permeability and fertility of the soil are shown to be present when permanent sod or rotated sod occupies the ground. Such systems introduce new problems in orchard management, such as moisture and nutrient uptake by the cover, rodent injury, greater fertilizer requirement, and others, but it seems best to find solutions for such problems than to be forced to cope with the more difficult one of a depleted soil.

In reporting on the relation between soil organic matter and available moisture under different orchard cultural systems which had been in effect for 25 years, Ohio workers comment that the total amount of soil organic matter was less under cultivation, even though cover crops had been used, than under the mulch and sod treatments; and these differences in organic matter resulted in significant differences in available moisture.

The effects of organic matter losses through cultivation, if not compensated for by replacement, become evident in the burnt out, droughty condition of sandy soils and the lack of good tilth and poor physical condition of heavier soils. Sooner or later, as indicated in the Pennsylvania quotation, and depending on the kind of soil, the original organic matter content, the climate as regards temperature and moisture, and the extent of cultivation, the organic matter may become so low that a permanent agriculture can no longer be maintained. It is perhaps unfortunate that these adverse effects are less quickly evident with the deeply rooted tree fruits than with shallow rooted field crops, as otherwise the fruit grower would be more alert to the problem.

The problem is general. In New York Agr. Exp. Station Bulletin 632, for example, R. C. Collison writes as follows:

It is the feeling of fruit growers that many orchards in New York are fast approaching the (above described) conditions as evidenced by the poor physical condition of heavy soils and a gradual decrease in yields. Many such orchards have been given a new lease of life by the application of nitrogenous fertilizers, but it is a question as to how long the fertilizer effects will continue if, at the same time, no provision is made for additional organic matter.

Nevertheless sod, or even reduced cultivation, may not suit the requirements of individual growers for any tree fruit. A practice which is profitable in one locality may be less profitable or actually useless in another having different climatic or soil conditions. Consideration of the advantages and effects of each of these major systems (with modifications), upon the soil and the crop will assist the grower in choosing the soil management program best fitted to his needs.

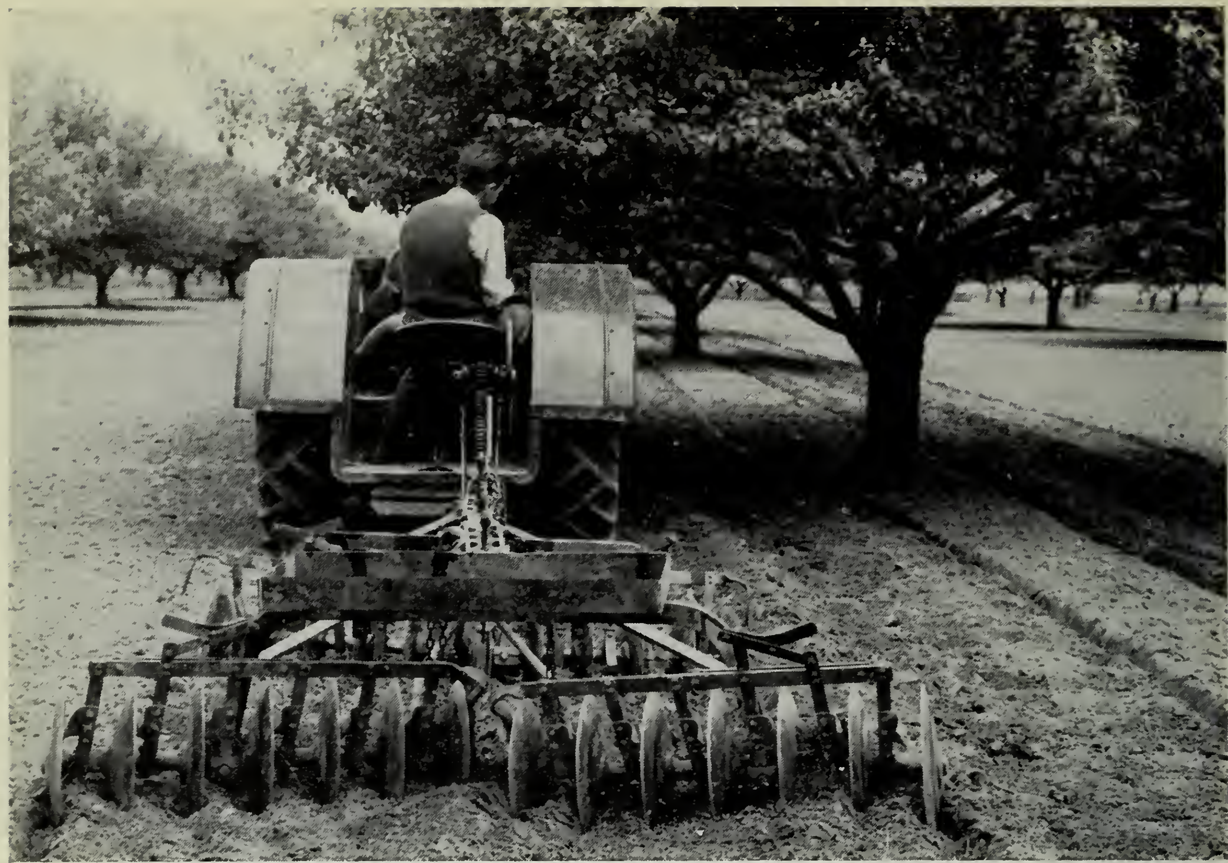

FIG. 10. In tilled orchards cultivation should be shallow. Don't use a plow if the disk will serve the purpose. Complete burying of crop debris is neither necessary nor advisable.

CLEAN CULTIVATION AND COVER CROPS

A system of clean cultivation which does not include maintenance of organic matter is just as much a system of neglect as a sod system which neglects mulching, manuring, rodent control, and the like. Both are horticulturally unsound. In this discussion therefore it is assumed that clean cultivation as practised is rational and includes some or all of the following, —cover and green-manure cron, farm manure, weeds, hay, straw, or other sources of organic material. In the absence of these, clean cultivation is simply asking for trouble.

What Cultivation Does—It removes noxious weeds; prevents weed competition for food and moisture during the most active vegetative period of the fruit tree; incorporates manures, including green crops, in the soil; prepares a seed bed for the next green-manure crop; and aids in the control of certain insect pests and mice.

Cultivation speeds up the decay of organic matter necessitating a strong replacement policy if the soil's productive capacity is to be maintained.

In many soils cultivation tends to the formation of a plow-sole, the compacting of the layer of soil just below tillage depth. That is most pronounced where the soil is cultivated while still too wet. In the early spring or after heavy rains cultivation might better be a day late rather than a day too early to reduce plow-sole troubles. Where a plow-sole condition already exists, deep tillage with a subsoiler (See Figs. 20 and 21), can often be done to advantage more especially in young orchards of re-

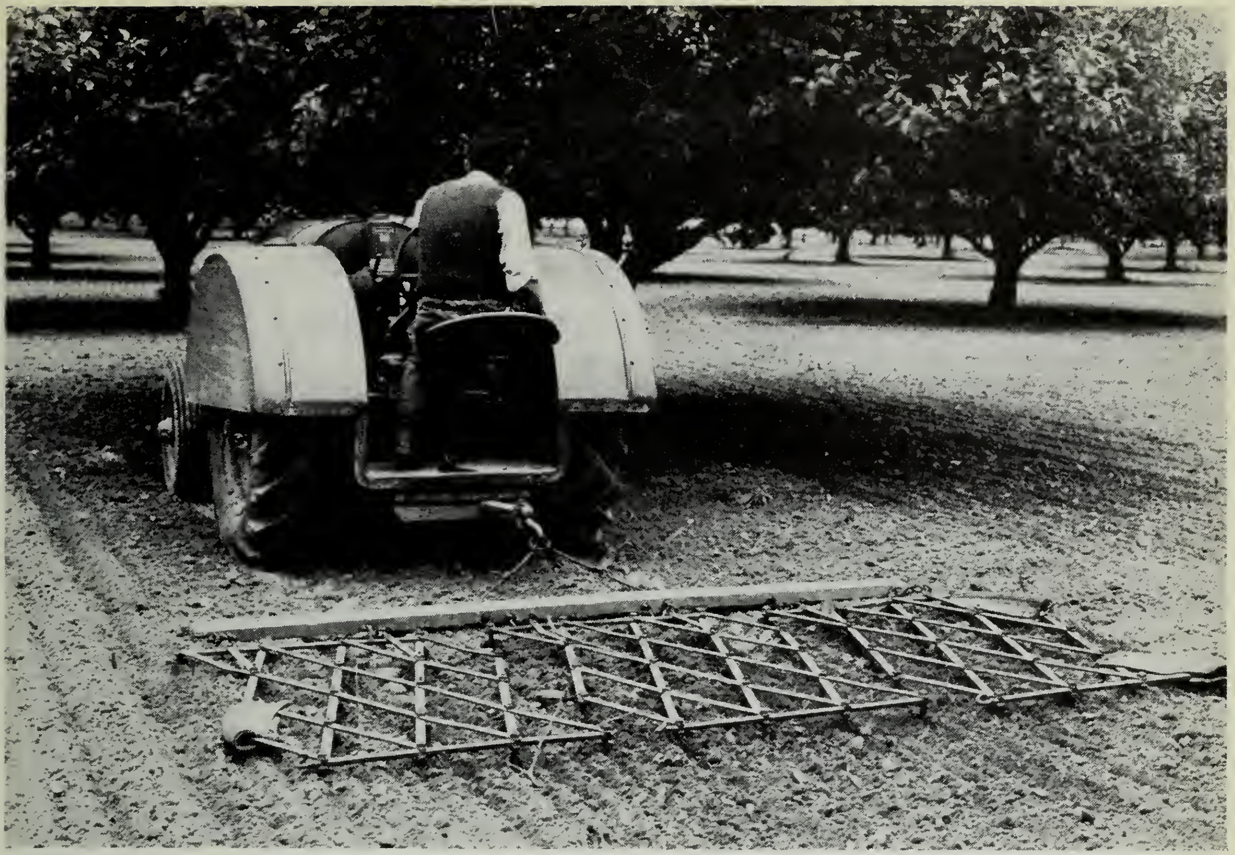

FIG. 11. Following the initial plowing and disking, or disking only, later cultivations need be only sufficient in depth and frequency to destroy weeds and prevent surface baking. Cultivation should be entirely discontinued as early as the individual grower's conditions permit.

stricted root range, or on land being prepared for planting. Plow-sole condition may correct itself if the land is left untilled as in sod.

Cultivation conserves moisture only in so far as it removes competing weeds or cover crops. The cultivation of a weed- or plant-free soil does not conserve moisture in any appreciable degree, contrary to general belief. Nor does it promote the upward movement of water from the subsoil, or distribution sideways. Frequent and deep stirring of soil may in fact speed up water losses by exposing fresh amounts of moist soil.

As to soil aeration, necessary in the release of plant food and in root development, the evidence indicates that sufficient aeration ordinarily takes place in orchard soils regardless of whether or not they are cultivated.

Time and Amount of Cultivation—As already noted, cultivation speeds up the decomposition of organic matter and the liberation of plant food. This speeding up of soil processes may be desirable for some conditions and crops, as for example vegetables, and undesirable or at least unnecessary and therefore wasteful for other crops and conditions. The grower should aim at the **minimum** cultivation which will serve his purpose thus lightening the burden of organic matter maintenance. An additional advantage of shortening the tillage period is that two green-manure crops, as for example buckwheat twice, or buckwheat followed by rye, can be grown each season with corresponding increase of soil organic matter. This does not apply to young non-bearing trees which benefit from a longer tillage period since it prevents the competition of weeds or too-early-seeded cover crops. The older established, deep-rooted trees do not suffer from competition.

FIG. 12. Cultivation destroys organic matter. The longer it is continued the greater the loss. In this orchard the trees on the right receive only 2 weeks' cultivation, those on the left the usual 6-8 weeks. Yield has been maintained under reduced cultivation, the soil is steadily improving in texture, fruit is higher in colour, tree and fruit mature earlier as compared with normal cultivation, and cultivation and organic matter replacement costs have been reduced.

At Vineland an experiment was started in 1928 in an eight-year-old apple orchard to determine whether or not cultivation could economically be reduced from the usual 2-3 months' period. The reduced or minimum cultivation consisted of simply plowing the land (fall or spring) followed by enough spring cultivation to prepare a seed bed. The green-manure crop was then sown, the whole operation usually being complete by May 15th. Normal cultivation was given to comparable plots which were seeded down about July 15th. Results for the fifteen-year period, 1928-42, are given in Table III.

TABLE III.—A COMPARISON OF NORMAL AND MINIMUM ORCHARD CULTIVATION

(Accumulated yield in pounds per tree, 1928-42)

Variety	Normal Cultivation	Minimum Cultivation
McIntosh	2,356 (21)*	2,681 (19)
Baldwin	1,386 (24)	1,384 (18)
Northern Spy	2,087 (18)	1,787 (21)
Average —	1,943 (63)	1,951 (58)

* The number of trees for each variety and treatment is shown in brackets after the yield figures.

The McIntosh minimum plots outyielded the normal plots by about 14 per cent, Baldwin plots have been equal, while Northern Spy normal plots have outyielded the minimum by 17 per cent. These Spy minimum plots happen to be partly on eroded soil with consequent reduced vigour of some trees. Averaging all plots and varieties the two treatments have thus far been almost exactly equal (1943 and 1951 lbs.) in yield, indicating that there has been no advantage from the longer cutlivation. Against it must be set the higher cultivation and organic matter replacement costs.

As to time and amount of cultivation we may therefore conclude:

Start cultivation as early as soil conditions permit to encourage a vigorous, early growth period. For Southern Ontario this may be as early as mid-April, and correspondingly later as one goes north. Discontinue early, even to the point in apple orchards of simply preparing for, and immediately seeding, a cover or green-manure crop. In any event discontinue after perhaps six weeks of cultivation, or not later than the middle of June (later farther north). A **light** late cultivation even as late as September, may be necessary to prepare for a late-seeded cover crop. For stone fruits, as peaches, cultivation may also be discontinued by mid-June or may safely and profitably be extended to the end of the month, the actual time varying with rainfall, crop development or other seasonal conditions. As previously noted, young non-bearing trees benefit from proportionately longer cultivation.

Depth of Cultivation—This involves plowing, disking, harrowing. We have been brought up to believe that plowing is an almost indispensable soil treatment possessing many virtues. More recent opinion strongly suggests that we have been doing much unnecessary work, even actually harmful in its effects on both soil and tree. Without attempting to analyze the varying opinions it may be said that real virtue lies in the shallowest cultivation which will accomplish the desired result. If soil type and the amount and nature of the manuring material to be incorporated in the soil permit of disking rather than plowing, then disking it should be. If later cultivations can be satisfactorily done with shallower implements than the disk, then they should be used. Don't worry if some trash is left on the surface or only partially buried. While it may offend the eye it will please the tree. It's just another case of minimum rather than maximum cultivation. Most Niagara Peninsula orchards, so-called peach soils, could be handled without ever using a plow, and would likely be the better for it.

Contour Cultivation—Soil erosion is an increasingly serious orchard problem, even on only moderately rolling land. The grower should then consider contour furrowing, or plowing and planting land across the slope instead of in straight rows regardless of slope. Terracing is a type of contour cultivation. The essential consideration is to set up natural controls so that water will be conducted off at low velocity thus greatly reducing or entirely preventing erosion. In planting an orchard on the contour plan, the contour of the land, including all its irregularities, must be followed closely so that there is not more than 2 per cent deviation in any 100 feet. This may need a land surveyor in staking out the orchard site.

Intercropping—During the early years of the young orchard, it is common practice to intercrop. The ultimate well-being of the orchard must however be the first consideration, and intercrops should therefore be chosen carefully and discontinued early. Preference should be given to crops requiring early summer cultivation such as peas, beans, tomatoes, early potatoes, strawberries. Bush fruits are likely to be left too long for

FIG. 13. A South Carolina peach orchard planted on the contour to prevent erosion and loss of soil fertility. (Photo, courtesy South Carolina Extension Service.)

the good of the orchard. Whatever the crop, special care should be taken to avoid undue competition with the orchard by leaving a crop-free area around each tree, enlarging this area as the trees increase in size.

Rotation in the Use of Manures, Green Crops, and Fertilizers— Orchard needs may call for annual applications of both manure and fertilizers, plus the growing of green-manure crops. The severe winter freeze of 1942-43 was a good, if costly demonstration of the importance of good fertility, as for example peach orchards well fertilized and well supplied with organic matter, whether annually or in rotation, came through with less tree injury and greater crops than neighbouring orchards.

However, whether from financial or other reasons, the grower may not always be able to make annual and substantial applications of manure and fertilizers. He will be inclined to make a little fertilizer go a long way spreading it thinly over a large acreage when it should perhaps be concentrated on a smaller acreage under a system of rotating applications over a period of years.

Mineral fertilizers applied in small amounts are ineffective because soil fixation ties up too much of the light application in an unavailable form, leaving insufficient for the trees. Also manure applied in too light amounts (5-6 tons per acre) does not benefit the trees as much as when put on in moderate applications of 10-15 tons annually or in rotation as suggested. An economical rotation is to apply manure one year, minerals the next, and hay or straw supplements the third, with a green-manure crop every year. Such a rotation would assure adequate applications.

FIG. 14. Young Bartlett pear tree in alfalfa sod mulch. Note the cut material mulched well beyond the tree, and the wire guard around the trunk for mouse protection.

A soil analysis should first be made to determine the present level of fertility so that the program to be instituted will meet any immediate need and then take care of future requirements. It is not necessary, for example, to repeat the application of mineral fertilizers every year. Once the deficiency has been met the organic matter will absorb the soluble surplus and hold it for future use.

SOD CULTURE

As compared with clean cultivation a well-managed sod culture or mulch system for apple orcharding has been shown by grower experience and experimental evidence to accomplish certain results. In the early years tree growth and yield under sod mulch will lag somewhat, but will catch up in 10-15 years and will eventually surpass clean-cultivated trees. Fruit size, under sod mulch, will be equal or superior to clean cultivation, colour will be better, date of maturity will be earlier, "drops" will suffer less injury from bruising, soil fertility will be superior, orchard operations as pruning, spraying, harvesting will be facilitated due to firmer footing at all times. Supporting evidence is given for these statements.

Note the term "sod culture". Sod "neglect" has no place in successful orchard management, but unfortunately it was the neglected sod orchard which formerly brought sod into disrepute. The sod was simply evidence of lack of grower interest. Mostly the orchards were small and a bit of a nuisance. Then there were revival meetings throughout Ontario and growers were encouraged to prune, spray, fertilize, **and cultivate.** This cultivation,—breaking up of long-established sods—released unusual quantities of plant food which, with heavy pruning, caused a sudden surge of growth and fruitfulness. Seemingly the superiority of cultivation over sod was established, but the early treatment had been sod neglect not sod culture; and in any event continued cultivation, unless accompanied by manuring, would soon deplete the storehouse of organic matter which had accumulated under sod conditions. Growth and fruitfulness must eventually decline.

A permanent sod-culture system, in the light of present knowledge, is suited only to apples, pears, and perhaps sweet cherries. Accompanying discussion therefore concerns these fruits, and more particularly the apple itself. In many apple producing areas in Canada as elsewhere sod culture has come into wide favour due to its demonstrated advantages.

When to Start Sod—Some growers prefer to till the young orchard until bearing age is reached and then seed down, and this may have advantages where erosion is not a problem but certain insects are, as for example the Buffalo Tree Hopper. This insect can be quite troublesome.

Michigan authorities, (Special Bulletin 313), reporting on an experiment at their Graham (Grand Rapids) Station, comment as follows:

> Commercial apple growers, almost exclusively, follow the practice of maintaining their newly set orchards under the cultivation-cover-crop system of soil management, until such time that it appears the trees are sufficiently well established to withstand the competitive influence of a grass sod. Opinions of these growers however, differ as to when this period has been reached. Some hesitate to change over to the sod-mulch system before the trees reach the age of 20 or 25 years, while others seed their orchard to grass at an earlier age. In view of the data presented on the growth and yield of the trees in this experiment, it appears entirely feasible that the sod can be established at a much earlier stage than was formerly thought advisable, without appreciably changing the rate of tree growth and fruit production. It is believed that the value of the somewhat greater growth and yields obtained in the young orchard under the clean culture system, by delaying the change-over to the sod-mulch system, will not equal the value of the additional soil and fertility lost during the same period by erosion, particularly on erosive soils and steep slopes. Tree growth can be increased, in a large measure, by applications of the necessary fertilizer elements, but the cost of replacing the lost soil with its humus and fertility in the orchard, will much exceed the value of any extra fruit produced. The more erosive the soil type and the steeper the slope, the earlier is the date at which the cultivated orchard should be seeded down to grass.

At Vineland, our own experience with a 4½ acre block of McIntosh has been that with necessary attention to mulching (including additional material if needed) and fertility, sod may be started at the time the orchard is planted, or within a year or two. However, growers may prefer to cultivate and intercrop for a period of years before seeding down.

The results in this McIntosh orchard are given in Table IV. The orchard was planted in 1922, the initial sod plots were seeded in 1923 and the delayed sod plots in 1928.

FIG. 15. The "mulch" is an essential part of sod culture. It should extend to, or beyond the spread of the branches, and should be sufficient in amount to smother growth of the sod material throughout most of the season.

TABLE IV.—McINTOSH YIELDS UNDER DIFFERENT SOIL TREATMENTS

Plot Group	Treatment	Number of trees	Accumulated Yield per tree 1922-1940
1.	Cultivation and cover crops throughout, 1922-1940*	15	1,966 lbs.
2.	Grass sod mulch throughout, with nitrogen as required, 1923-40	19	1,998 lbs.
3.	Alfalfa sod mulch throughout, 1923-1940	30	2,287 lbs.
4.	Cultivation 6 years (to 1927) then grass sod mulch 1928-40	15	2,329 lbs.
5.	Cultivation 6 years (to 1927) then alfalfa sod mulch 1928-40	30	2,293 lbs.

*Sown July 15th.

Grass and alfalfa sod mulches throughout the life of the orchard have equalled in yield cultivation throughout for the fifteen crop years, and in the light of other evidence (Michigan, Pennsylvania), may be expected to eventually outyield cultivation. Delaying the establishment of the sod for six years has given some increased yield for a grass sod, but none in the case of alfalfa.

The "Mulch" in Sod Culture—Sod culture normally implies that the sod material, grass or alfalfa, will be cut as necessary, perhaps two or three times during the growing season, the cut material either being left where it falls or concentrated as a mulch under the tree. Nothing is removed from the orchard. It is not a hayfield. The mulch in fact is an integral part of the system. Additional material, strawy manure, straw, old hay, or other crop refuse may be drawn in to supplement this mulch and build it

FIG. 16. Alfalfa sod mulch in an apple orchard. The alfalfa will be mowed twice during the season, the cut material being mulched under the trees, and supplemented if necessary.

up sufficiently to practically smother growth under the trees. If tree growth and fruitfulness fall short of requirements, farm manure or fertilizers, or both may be added as needed.

Michigan investigators have estimated the annual cost of maintaining the mulch system at $4.50 per acre, this figure including the expense of mowing, raking, and spreading under the trees. Where additional material, calculated at two tons per acre, is needed to supplement the sod cuttings the cost rises to $10.25 per acre. This compares with $10.60 as the estimated cost of cultivation-cover-crop management.

As noted, during the active tree-growing period the grass or alfalfa sod should be cut, usually twice, to minimize moisture competition with the tree at a critical period. When the cut material is used as a mulch it should be spread under the trees immediately, starting a foot or two from the trunk (as a measure in mouse control) and extending to, or somewhat beyond the spread of the branches. The amount of mulch, whether or not supplemented by additional material should be sufficient so that, while fairly well decomposed by the latter part of the season it is still heavy enough to retard most grass or other growth under the trees.

Suitable Sod-Mulch Crops—Choice is pretty well limited to alfalfa, and grasses. The latter should preferably be planted in mixture as for example, bluegrass 6 lbs., red top 4 lbs., timothy 4 lbs., orchard grass 3 lbs., making 17 lbs. in all to the acre. Alfalfa, being a legume, gathers nitrogen, and may sometimes gather too much or at least release it too late in the season for the good of the tree. Deep rooting, with consequent opening up of the subsoil, is another valuable characteristic of alfalfa. Due to its own

FIG. 17. Grass sod mulch in an apple orchard. The grass will be cut twice, mulched, and if necessary supplemented with additional material such as straw or old hay.

needs for nitrogen alfalfa may have a temporary adverse effect on tree growth for two or three years, or until it is well established and the mulch under the trees has become effective both in releasing nitrogen and minerals and in conserving moisture.

Supplementary Mulch Materials—Use may be made of almost any plant material including straw, old or spoiled hay, corn stover (chopped), ordinary crop refuse or debris. The last named should not include canning factory refuse, grape pomace, or pea vines. Factory refuse is all right as a thin application but, due to its high acidity, will do harm if applied in the quantity necessary for a mulch. Grape pomace is woody in composition due to its seed content and very slow to decompose. Pea vines are too high in nitrogen and stimulate late, soft growth.

Effect of Mulch on Soil Fertility—One effect of decaying organic matter is well illustrated by some Ohio results reported in **Science** (December 10, 1937) under the title, **The Potassium Content of Soil Beneath a Straw Mulch.** In the Experiment Station Orchards at Wooster, it was found that, on the whole, potassium was very low. When potassic salts were applied, the potassium was "fixed" in the surface soil and failed to move downward into the root zone even after ten years of treatment. Part of their orchards were under a mulch system of management and they were interested to know to what extent potassium had accumulated under this mulch from the decomposing straw. Their findings were as follows:

> These quantitative results show conclusively that potassium is very high to a depth of from 24 to 32 inches and sometimes to 40 inches beneath the 38 year old mulch. This is highly significant in the light of the characteristic fixation of potash salts in the surface inch and a half to two inches of surface soil. In no case was potash fertilizer applied to the mulch trees.

Samples of soil taken from the grass area between the trees showed no such accumulation of available potassium. Those taken from an adjacent unfertilized plot which has been in a three-year rotation of potatoes, wheat and clover showed a very low potassium content even in the first few inches of topsoil.

Another orchard nearby which has been in different systems for twenty-two years shows similar results. The soil under the mulched trees has a high available potassium content to the depth of the rooting area of the trees, while the soil under the trees kept in the tillage-cover crop system is very low in this element. For example, the soil beneath two trees in the mulch system has a content of 1,000 pounds per acre of available potassium at the depth of 24 inches, while the soil beneath a tree 40 feet away in cultivation contained less than 175 pounds at the same depth.

In a later (1943) report on this Ohio orchard it was found that all the elements investigated (potassium, calcium, magnesium, phosphorus, boron) had been increased in the soil beneath a heavy mulch as compared with adjacent land under cultivation. Potassium was considerably increased under mulch at all depths sampled. A smaller effect was noted on calcium and magnesium. The increases in phosphorus, boron, and organic matter were confined to the area just beneath the mulch.

Similar evidence was secured from a block of apples at Vineland, planted in 1924, seeded to alfalfa in 1932 and the cut alfalfa mulched under the trees thereafter. Analysis of soil samples taken in July 1936, (a very dry summer), both from under the mulch and from adjacent areas of growing alfalfa between the trees, gave the following nutrient levels.

TABLE V.—NUTRIENT LEVELS UNDER ALFALFA MULCH AND IN THE OPEN

Under Mulch	Potassium	Phosphorus	Nitrate	Per Cent Moisture
0-6″ depth	50 p.p.m.*	High	313 p.p.m.	10.9
6-12″ depth	20 p.p.m.	High +	137 p.p.m.	8.8
12-18″ depth	20 p.p.m.	Very High	95 p.p.m.	4.9
Between Trees				
0-6″ depth	15 p.p.m.	High	55 p.p.m.	5.7
6-12″ depth	5 p.p.m.	High +	28 p.p.m.	6.8
12-18 depth	5 p.p.m.	Very High	22 p.p.m.	4.5

* p.p.m. is simply "parts per million", the way in which the soil chemist expresses the amount present of a given plant food.

Potassium, nitrate, and moisture are considerably higher under this **alfalfa** mulch than in the adjacent area between trees, while phosphorus did not vary. Nutrient levels, nitrogen particularly, would not be so high under a non-legume mulch, or in seasons of heavier rainfall.

Effect of Mulch on Soil Moisture—Table V. indicates (last column) that at Vineland soil moisture was higher under mulch than in adjacent unmulched sod areas. Also workers in Ohio, Pennsylvania, Massachusetts and Michigan report an increase of soil moisture under sod mulch as compared with clean cultivation. Michigan results for example show that in a Duchess-Northern Spy orchard the average soil moisture content during August, September and October was 47 per cent higher for the sod mulch. In commenting on this in Michigan Special Bulletin 313, the author writes:

The greater soil moisture in the sod mulch plots can partially be attributed to the two soil coverings—namely, sod and mulch. These naturally slow down any movement of surface water, thereby increasing the time during which the water may penetrate the surface soil. Further, the soil under sod and protective mulches, is much more porous, which accelerates the movement of rain or snow water into the soil. In contrast, the clean-cultivated soil offers little or no resistance to the escape of precipitation water. Its less porous condition, brought about by a lower humus content, compacting by heavy orchard equipment, and the beating down and puddling of the surface by dashing rains greatly retards the free penetration of snow and rain water. Also, it has been observed that the soil in the cultivated plots froze at an earlier date and to a greater depth than it did under the protective covers of sod growth or mulch. Consequently, the longer period of frost in the soil of the cultivated plots would retard the free downward movement of water over a longer period of time than the less frozen soil in the sod-mulch plots.

The Effect of Sod and Mulch on the Fruit (Apple)—It is common observation that sod (unmulched) apples are of higher colour and firmer, crisper texture than cultivated ones. Where the sod becomes a proper mulch system, the fruit tends to become more like cultivated fruit, depending upon the nature, amount, and continuity of the mulch, but is still superior in colour and firmness, unless an over-abundant legume mulch is maintained. Sod-mulch fruit matures earlier than cultivated, yet nevertheless, holds better to the tree, especially noticeable in McIntosh. Early dropping of McIntosh is associated with nitrogen availability, being less severe where there is comparative nitrogen starvation in the latter part of the season as under a moderate to light mulch, or reduced cultivation, or sod "neglect".

In recording the relative effects of sod mulch and cultivation on fruit size (apple) a Michigan investigation previously referred to notes the following results over an eight-year period for four varieties, Duchess, Grimes Golden, Baldwin, Stayman Winesap.

TABLE VI.—COMPARATIVE SIZE OF CULTIVATED AND SOD-MULCH APPLES

Soil Treatment	Grade Sizes	Average Yield Apples for all 4 varieties
Cultivated	2½" up	47.1 per cent
	2¼" — 2½"	36.9 per cent
	2 " — 2¼"	15.9 per cent
Sod Mulch	2½" up	84.2 per cent
	2¼" — 2½"	13.7 per cent
	2 " — 2¼"	2.0 per cent

Contrary to general belief the sod-mulch apples averaged larger than the cultivated ones. This is not uncommon where a proper mulch system is followed, and in fact oversize fruit may **sometimes** become a problem due to exceptionally favourable moisture and nutrient conditions induced by the decomposing mulch. In such event the grower should, temporarily at least, discontinue mulching under the trees, but cut the alfalfa or grass as required and let it remain where it falls.

Sod-Mulch Effect on Yield—Table IV. (page 33), used in the discussion on the time of establishing the sod, shows also that total yield is not adversely affected by the sod mulch. In fact these Vineland sod plots whether established when the orchard was planted, or six years later, either equalled or surpassed the yield of the cultivated plots. Michigan results were similar as indicated in this quotation from Special Bulletin 313.

> . . . the trees under clean cultivation . . . showed a greater yield for the first 10-year period than the trees growing in sod-mulch plots. However, by the end of the 15-year period the total production for all (five) varieties in the sod-mulch plots, except Duchess, was greater per acre than for the trees in the cultivated plots. This was also true of the 20-year period when all of the trees grown in sod, including Duchess, showed heavier total production of fruit than the cultivated trees.

FIG. 18. Under sod conditions protection from mice is very necessary. The wire guard, kept properly adjusted, gives permanent protection.

On a percentage basis, the increased sod yields (over cultivation) for the 20-year period were, Duchess 7.4, Grimes Golden 15, Baldwin 42, Stayman 32, Northern Spy 86.

Mulch and Mice—A mulch under trees provides ideal conditions for meadow mice. Since they prefer not to feed or travel in the open, a circle about three feet in diameter should be kept bare of mulching or other material. Quarter-inch mesh galvanized wire guards provide an economical permanent protection against mice. In addition poison bait should be set out every fall to eradicate any mice that may have become established during the summer. Consult Ontario Bulletin 436, **Mouse Control in Orchards.**

INTERMEDIATE SYSTEMS OF SOIL MANAGEMENT

Sod Strip—As the name implies a strip of sod, perhaps 12-15 feet wide, is left along each row of trees, the remaining area being cultivated. The method is used in Ontario to a limited extent for apples and more extensively for pears where it has been considered helpful in blight control.

Sod Square—A square of sod is left around each tree with the remaining area receiving ordinary cultivation. Growers using this method usually plow crosswise in alternate years.

FIG. 19. The Alternate Strip method of orchard soil management, suitable for apples and pears. The new cover crop on the land to the left is just nicely started and will be left to grow the following season. The old cover crop on the right land will be plowed or disked under in the fall or following spring and kept cultivated until time to seed the new cover crop.

Both sod strip and sod square are helpful to the extent that they reduce cultivation costs and soil losses, and permit of low headed trees in an otherwise cultivated orchard. Mulching is not ordinarily a part of these methods, therefore the effects of cultivation in releasing plant food, and the growing of cover and green-manure crops to maintain organic matter, are needed; otherwise these systems would tend towards sod neglect. They present, too, the same problems of insect and mouse control as complete sod mulch. Nevertheless, as modifications of complete clean cultivation, sod strip and sod square may be of value under some conditions, the orchard owner being the best judge. If these same conditions satisfy the requirements of complete sod mulch then that system is considered preferable.

Alternate Sod Strip—Intermediate in character between sod and clean cultivation, this system has advantages of its own and should receive careful consideration by the grower whose conditions do not justify sod mulch, but who is not fully satisfied with clean cultivation. Every other land is left seeded down, usually to clover, for a full season, and is cut and let lie two or three times during the season. The remaining or alternate lands are given ordinary cultivation and then seeded down to the cover crop which will be grown throughout the **following** season. Those lands which are in cover crop one season are cultivated the next. This alternation of treatment is kept up indefinitely. Costs of cultivation and cover-crop seed are reduced, organic matter content is favourably influenced, erosion is reduced or stopped, insect and mouse control are easier than in sod mulch.

RELATIVE SUITABILITY OF CLEAN CULTIVATION AND SOD MULCH FOR VARIOUS FRUITS

From the discussion thus far, it may be accepted that while a given system of soil management may be the most suitable for reducing water run-off and erosion, and maintaining fertility, yet it may not be entirely satisfactory for certain fruits. Thus sod mulch succeeds well with apples where soil and climatic conditions are favourable but has yet to be proven equally suitable for peaches, plums, or sour cherries. For these fruits the answer may lie in restricting plantings to favourable soils and locations, growing cover and green-manure crops, and practising shallow and short-time cultivation so that much of the plant material remains on or near the surface.

The recommendation then, is to consider sod mulch, or certainly reduced cultivation, for apples, pears, sweet cherries, not only on rolling land subject to erosion, but wherever conditions seem to warrant. For the stone fruits, peaches, plums, sour cherries, continue clean cultivation and green manuring, plus farm manure if available, but reduce the kind and amount of cultivation to the minimum which the individual grower finds from experience will sufficiently maintain growth and yield under his conditions and leave his soil unimpaired or even improved. No rule of thumb can be given as no two fields are entirely alike due to differences in treatment and cropping of earlier years. Factors which must be considered are, amount and distribution of rainfall, soil type and present fertility, the price of manure or substitutes and the ease with which they may be secured, the value of the fruit crop, etc. The grower, too, must be susceptible to new ideas.

It is worth while at this point to record the results of a survey of grower experience and experimental evidence relating to modified cultural practices for peach orchards, made by Bregger and Musser of South Carolina. They conclude as follows,—

> In spite of the almost universal acceptance of the traditional cultivation systems for peach orchards, evidence has been piling up which indicates that certain conservation practices, including continuous vegetative and mulch covers, modified sod, or simply a short annual period of cultivation, are both practical and successful. The authors of this paper are presenting the experiences of various growers, especially pertaining to orchard soil management practices which completely or largely eliminate cultivation. These changes in practice toward the adoption of unorthodox measures have often been brought about by grim necessity, due to severe erosion with an accompanied low state of tree vigor.
>
> The "cover" practices which are being used to replace the traditional clean-cultivation with or without planted cover crops may be divided roughly into two groups: (1) continuous grass or legume sods, either solid or broken into strips, and (2) mulches. Other modifications include curtailment of the intensity or length of the cultivation period, the use of "trashy cultivation" where cover crop residues are left on the surface, and even the reseeding of cover crops without cultivation.
>
> Solid sod covers have been quite successful in several Michigan and Pennsylvania peach orchards where planting was done on deep soils. Harry Skinner and Clayton Miller, well known orchardists, near Chambersburg, Pa., have for many years used sweet clover as a peach orchard cover crop with only early spring cultivation, being careful to mow the cover crop at other critical periods. In a field test near York. Pa., peach trees were also seen making a good growth in mixed covers of orchard grass, clover, and Korean lespedeza.

SOIL TESTING AND FERTILIZER NEEDS

Information from soil tests, carefully made and properly interpreted provide the grower with a statement of his soil's fertility and indicates what, if anything, is needed to balance the plant food already present and maintain the soil in a high state of fertility. The grower is then better able to regulate his system of soil management by more intelligent use of fertilizers, manures, and green crops.

Soil chemistry has now reached the point where it is possible to make rapid soil tests with reasonable accuracy. If the samples are carefully taken, and enough of them are mixed in a composite sample to accurately represent the orchard condition, the rapid soil test will give a fairly reliable picture of the soil's fertility. The tests usually made comprise acidity (pH), nitrate, phosphate, potash, and lime.

Soil acidity can play a very important part in the behaviour of the orchard. Too great an acidity or too much alkalinity will interfere with the nutrient intake of the tree and cause poor growth and fruitfulness. The tree fruits respond well in a soil having an acidity of around pH 6.0-6.5 but may begin to show nutritional troubles above and below this point. The lime or calcium test gives an accurate picture of the available calcium in the soil. Even in an acid soil available calcium is necessary, not only to lessen acidity, but to feed the plant. Nevertheless, the **indiscriminate** application of lime to an orchard soil should be discouraged, as harm may be done if the soil is already at, or above, the neutral point.

The nitrate test is significant only for the particular time of sampling since soil nitrates fluctuate from season to season and even from day to day depending on moisture, temperature, and growing conditions of the tree. A more accurate indication of the need for nitrates (nitrogen) is the colour of the foliage and bark on the tree, and the length of the terminal growth.

The phosphorus and potash levels shown by the rapid tests are an indication of the available phosphorus and potash supplies in the soil. A low test indicates a deficiency which can usually be corrected by appropriate fertilizer applications. For detail recommendations as to kind, amount, and manner of application of commercial fertilizers (based on normal peace time supplies) the grower is referred to Ontario Department of Agriculture Pamphlet, **"Recommendations for Soil Management and Use of Fertilizers"**.

To be of value in diagnosing crop needs, the soil samples submitted for analysis must be representative of the orchard and must therefore be carefully collected and prepared. To this end detailed instructions, available on request, may be secured either from the Horticultural Experiment Station, Vineland, or the Department of Horticulture, O. A. College, Guelph.

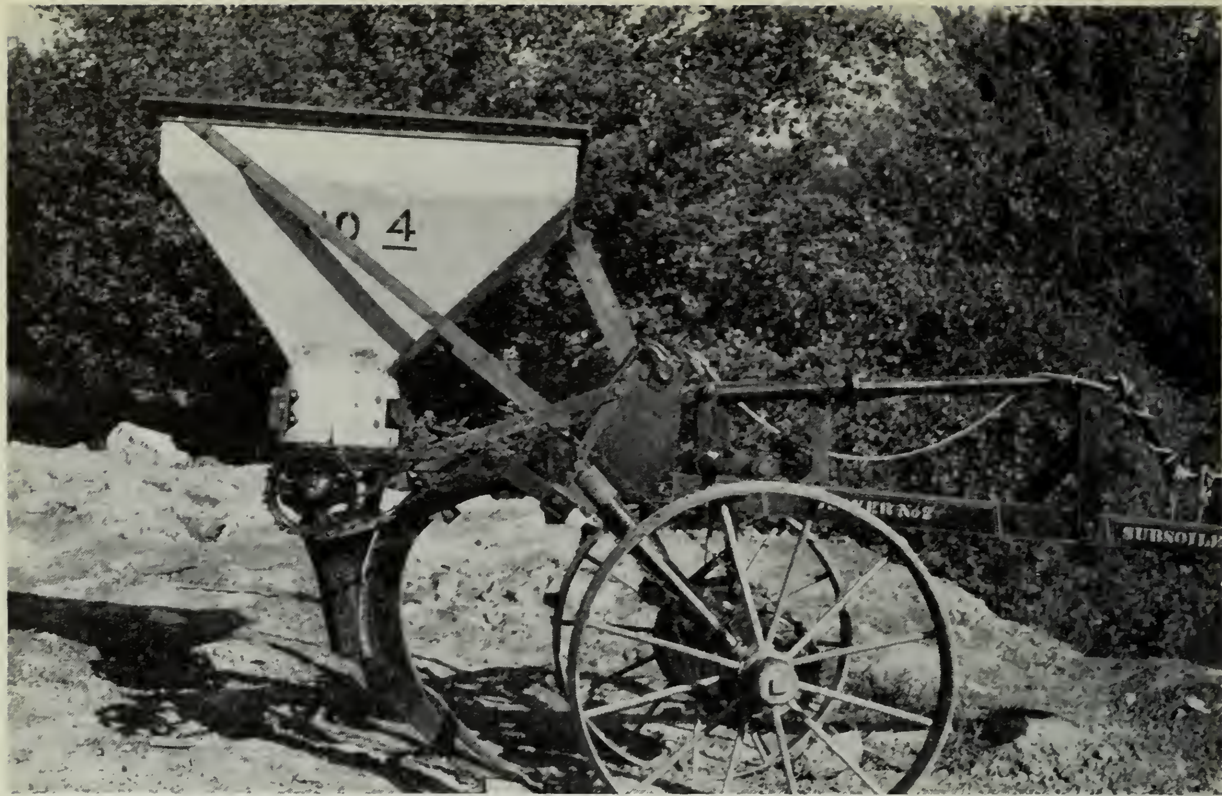

FIG. 20. The subsoiler is a valuable implement for breaking up a plow-sole or compacted soil. It may be fitted as shown with a hopper attachment for deep placement of fertilizers.

Deep Placement of Fertilizer—Methods of fertilizing orchards have undergone considerable change in the last few years. Broadcasting of fertilizers previous to plowing and disking, and to orchards in sod, has been the accepted custom for many years. While this method is useful for shallow-rooted fruit crops such as berries yet it has its limitations for tree fruits. One limitation is the inability of the mineral fertilizers to percolate through the soil to sufficient depth to reach the main root area; also most Ontario soils have a high fixation factor which ties up in a non-available form too much of the minerals applied broadcast.

A recent development for overcoming these difficulties is the deep placement of mineral fertilizers by machines designed to sow the fertilizer in a continuous ribbon at any desired depth between two and eighteen inches. These machines are a combination of a sub-soiling plow plus a modification of the seed drill. The fertilizer tube is placed behind the chisel tooth of the sub-soiler and the fertilizer flows from a hopper placed above.

The deep placement of mineral fertilizers in this manner assures their reaching the depth of greatest root concentration, and in a narrow band or ribbon which reduces soil fixation to a minimum by reducing the free dispersal of fertilizer throughout a large volume of soil. Another favourable result is the breaking up of plow-sole and heavy subsoil layers by the subsoiling action of the plow. This opens up the subsoil for better drainage and aeration and allows the roots to penetrate farther into subsoil often rich in minerals.

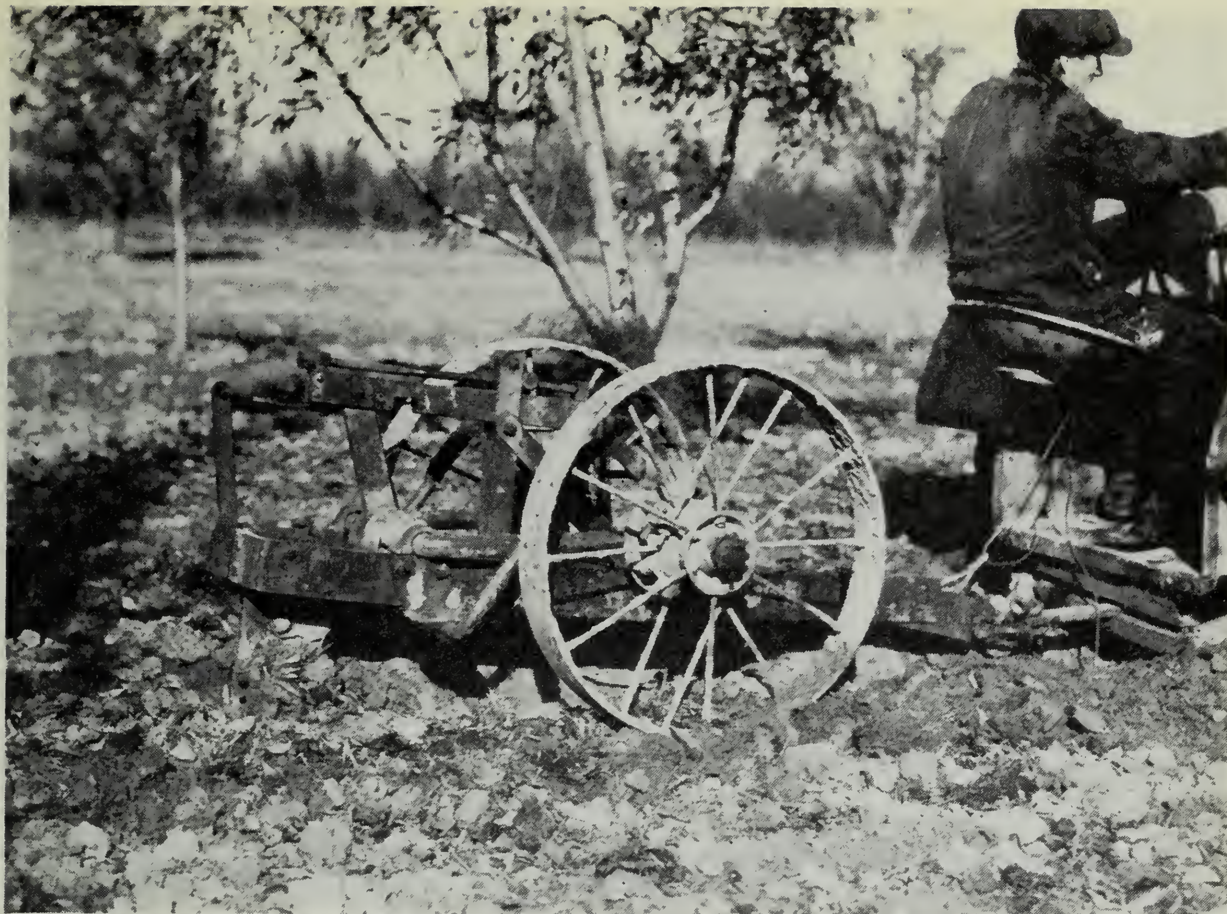

FIG. 21. A subsoiler (without deep-placement fertilizer attachment) in operation. The work should be done in late fall, and under dry soil conditions, to minimize the effects of root injury to trees, and to secure the maximum shatter-effect on the subsoil.

Cases of mineral deficiencies have shown immediate benefit from the deep placement of minerals in zones occupied by feeding roots, and in some cases where drainage was a problem, the opening up of the subsoil has greatly relieved the condition. These machines have been used in apple, pear, peach, plum and cherry orchards, vineyards and berry plantations. Experimental data are lacking on the results of deep placement in tree fruits but there is much evidence of its beneficial effect on truck crops, where the fertilizer is placed below and to the side of the seed rows. On the basis of orchard observation alone, it appears a worth-while method of applying mineral fertilizers.

In applying fertilizers by deep placement care should be taken to keep well away from the tree to avoid unnecessary cutting of roots. As a rough guide the machine should be run just outside of the outer branches, or in cases of large trees meeting at the centre, once down the centre of each tree space. Also it is most important that deep placement be carried out in the fall **only,** well after growth has ceased, to avoid a possible check to the tree by the cutting of active feeding roots. In late fall when the tree is dormant the loss of a few roots will not seriously affect growth the following spring, but if carried out in the spring this root cutting may seriously upset the feeding ability of the tree at a time when the demand for nutrients is great.

FOLIAR (Leaf) DIAGNOSIS OF NUTRITIONAL NEEDS

It is possible to diagnose some nutritional ailments of fruit crops by foliage symptoms. Where only a single nutritional disorder is responsible it is comparatively easy to make such a diagnosis but where two or more elements are lacking at the same time the symptoms are hard to diagnose and are often confusing, the element of greatest deficiency sometimes masking the appearance of the others. It becomes a matter of experience and observation to enable one to diagnose deficiencies under orchard conditions. The following very brief descriptions cover the more commonly encountered deficiencies. For a more detailed discourse on deficiency symptoms see Publication 714, **Apple Nutrition,** by M. B. Davis and H. Hill, Division of Horticulture, Experimental Farms Service, Ottawa.

Nitrogen Deficiency—Most growers already know the appearance of this deficiency symptom since they know that a light foliage colour is usually tied up with low nitrogen supply. The first indication of a nitrogen deficiency is the pale green colour of the leaves instead of the dark green colour characteristic of healthy trees. The leaves will usually be smaller than normal, the twigs will be spindly and short. Another symptom in advanced stages is the reddish colour of the bark on the main framework of the tree. Apple leaves turn from the pale green colour to yellow and will fall off in the yellow stage. Peach leaves turn from pale green to yellow and develop reddish spots, the centres of which may fall out. Leaves on the ground have these red spots.

Phosphorus Deficiency—Phosphorus deficiency alone is seldom encountered in the orchard, usually being accompanied by some additional deficiency. On peaches, phosphorus deficiency symptoms develop as a yellow blotched or mottled appearance between the veins of the leaves, with the older leaves falling off readily. On other fruits the leaves will be somewhat smaller than normal and at first will have a dull dark green colour followed by a paler green overlaid with a reddish bronze appearance.

Potassium Deficiency—For the most part all fruits react in much the same way and marked symptoms develop where there is a deficiency. The leaves first show reddish dots or large blotches **along the margins**; in later stages these reddish areas will join together to form a brown margin around the leaf which finally turns a grey or "cigar-ash" colour. At this stage the leaves will tear or tatter as the wind breaks out the crisp dead areas. On peach foliage this grey colour seldom develops. At the brown stage the peach leaf will form a layer of abscission cells around the affected parts, which then drop off, giving the margin of the leaf a scalloped appearance. With potassium deficiency the entire leaf seldom drops off.

SOME BOOKS AND BULLETINS CONTAINING INFORMATION ON ORCHARD SOIL MANAGEMENT

BOOKS

Modern Fruit Production, by Gourley and Howlett. (Macmillan.)

Fundamentals of Fruit Production, by Gardner, Bradford and Hooker (McGraw Hill.)

Fruit Crops, by Talbert and Murneek. (Lea and Febiger.)

Deciduous Orchards, by W. H. Chandler. (Lea and Febiger.)

Soils and Men, U.S.D.A. Yearbook of Agriculture. 1938.

Fundamentals of Soil Science, by Millar and Turk. (John Wiley & Sons.)

The Nature and Properties of Soils, by Lyon and Buckman. (Macmillan.)

BULLETINS

Recommendations for Soil Management and Use of Fertilizers. Ontario Dept. of Agr.

Establishing the Young Orchard. Ontario Bull. 433.

A Guide to the Production of Norfolk Brand Apples. Norfolk Fruit Growers' Assn.

Twenty-Five Years of Orchard Soil Fertility Experiments. Penn. Bull. 294 (State College, Penn.)

The First Twenty Years' Results in a Michigan Apple Orchard. Mich. Sp. Bull. 313. (Agr. Exp. Sta., East Lansing.)

Heavy Mulching in Bearing Apple Orchards. Mass. Bull. 328 (Agr. Exp. Sta., Amherst.)

Relations Between Orchard Soils and Cover Crops. New York Bull. 632. (Agr. Exp. Sta., Geneva.)

Experiments in Orchard Soil Management, Fertilizers, Mulches and Cover Crops. New York Bull. 691. (Agr. Exp. Sta., Geneva.)

Some Facts About Soil Management in a New York Orchard, New York Bull. 629. (Agr. Exp. Sta., Geneva.)

Orchard Terracing. South Carolina Bull. 97. (Clemson Agr. College, Clemson.)

In the preparation of this bulletin the authors have made extensive use of many of the books and bulletins listed above. This help is gratefully acknowledged. Growers who may wish for further and more detailed information on orchard soil management will find the list of value although not all the publications noted may now be available.

THE GRAPE IN ONTARIO

By C. B. KELLY

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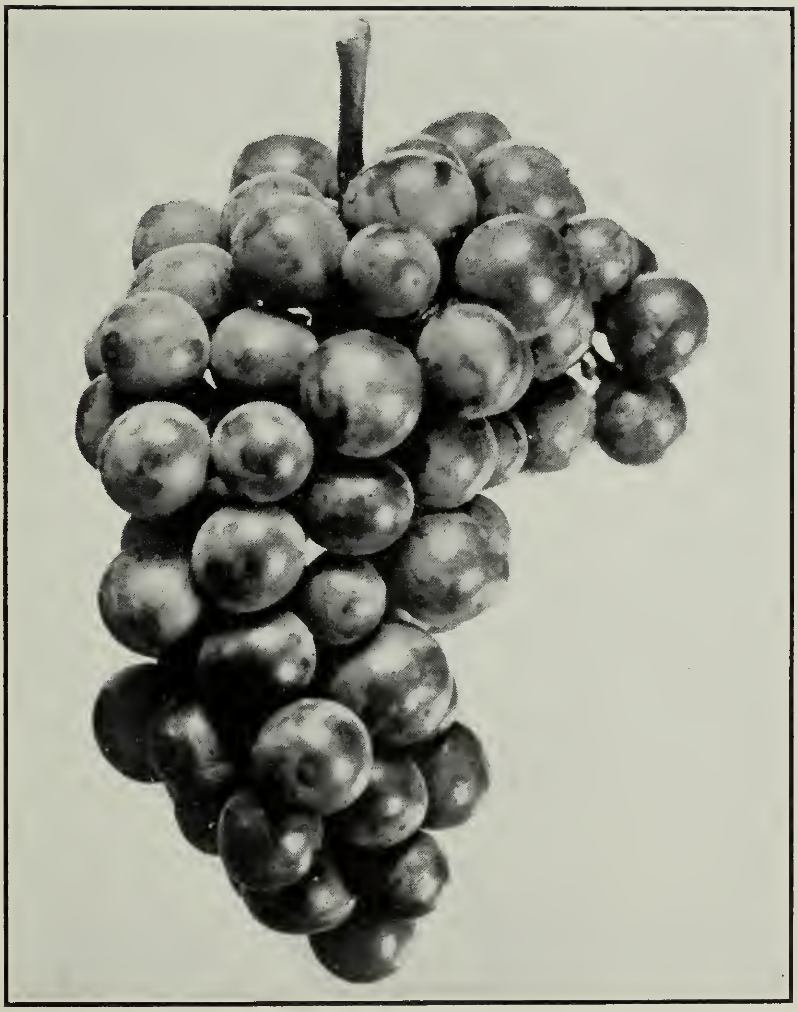

ONTARIO DEPARTMENT of AGRICULTURE

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CONTENTS

THE GRAPE IN ONTARIO

C. B. Kelly

The grape is an important fruit crop in Ontario, being second in value to the apple. During the past few years there has been increased interest in this fruit stimulated by wartime prices, and the present bulletin has been prepared to present the most recent information on grape culture as adapted to Ontario conditions. Many of the cultural operations are radically different from those used in growing tree and small fruits and therefore are not adequately covered in the general bulletins on pruning, pollination, care of the young orchard, and orchard soil management. There is also the problem of what varieties to plant, having in mind constantly improved information on old and new varieties for wine-making purposes.

LOCATION, SITE AND SOIL

LOCATION. Grapes thrive fairly well without winter protection throughout most of southwestern Ontario. However, the most favourable areas are those where the winter temperatures are moderated by the influence of Lakes Erie and Ontario and summer temperatures are high. The grape likes heat.

The general location for grapes is of great importance. In the Niagara peninsula, where most of the grapes are grown, the general aspect is north, facing Lake Ontario, with the escarpment or "mountain" in the rear. Here the crop varies from season to season, but is never a complete failure. The most favoured locations are back from the lake shore, just below and on the first rise of the escarpment where, depending somewhat on the direction and force of air currents, spring and summer temperatures are often several degrees higher than close to the lake. In some seasons the fruit fails to fully mature in lake-shore vineyards where the cooling effect of the water delays the start of spring growth and tempers the heat of summer. On the other hand, the lake influence sometimes prevents injury from late spring and early fall frosts, vineyards above the escarpment being especially subject to such injury. Delayed maturity becomes a matter of utmost concern in seasons such as 1926 when even the most favourably situated vineyards barely matured their crops.

Only the earlier maturing varieties should be planted in locations where the growing season is consistently short. In such locations, cultivation should be stopped early and a cover crop planted or weeds permitted to grow to hasten the maturity of fruit and cane.

SITE. The site for a vineyard should be chosen with particular regard to air circulation and soil drainage. Good air circulation will aid the grower in his fight against mildew and rot. The danger of frost injury in the spring and fall often depends largely on site. Low-lying, flat land suffers first as cold air tends to settle there, flowing down from higher ground.

As to soil drainage, a slight slope is sufficient to carry away surface water. Too great a slope is a disadvantage in that erosion of the soil may be severe, and on such sites the grape rows should, if possible, run across the general slope, not up and down. While this may be contrary to the accepted north-south direction of the rows, the prevention of erosion with its tragic loss of topsoil is of utmost importance. It is perhaps better not to plant grapes at all on easily eroded slopes.

Internal drainage of the soil will depend on its nature, the heavier the soil the poorer the natural drainage, particularly where the subsoil also is heavy. Since many of the best grape soils are clays, underdrains are often advisable.

SOILS. Grapes are grown successfully in a commercial way on a great variety of soils. Good vineyards are found on the clays of Vinemount, Beamsville, and St. Catharines; the mountain wash of Winona; the black soils of Homer; the sandy soils of Jordan, Vineland, and Port Dalhousie; the sand of Fonthill; and the gravel in the Burlington district. However there are general soil preferences, and individual varieties show preferences noted in the variety discussion.

The site has been mentioned as influencing maturity of the fruit. A cold soil also delays ripening, the coldness being due largely to an excess of water in the subsoil. Grapes thrive best on the drier, warmer soils where the fruit matures early, with relatively high sugar content and therefore improved quality. Underdrains will make cool sands warmer, but the undertaking may not be advisable where these soils are more valuable when planted to other crops. It is better to plant at the start, on the heavier, harder clays, except perhaps those few varieties which prefer a sandy soil.

Two types of soil give large crops of high quality grapes. These are the silty soils found below the escarpment in the Niagara peninsula, and the soils of the first ledge of the escarpment mapped in the soil survey work as Dunkirk clay loam. The former is a gray or black colour and from six to nine inches deep, underlaid with a heavy subsoil of bluish or drab-coloured clay. Where the proportion of organic matter is greatest, the soil is darkest and most open and friable. This type of soil is derived from glacial lake deposits and occupies low-lying areas. The Dunkirk soil is dark brown to grayish brown clay and clay loam, about eight inches in depth, somewhat hard and cracks on drying. Owing to its nature it usually drains easily as the grit and gravel, well mixed with the greater part of the soil, tend to keep it loose and open. The subsoil however is hard and impervious to water. The exception to these two types of grape soils is found in the warm, dry sands as in the Fonthill district and scattered in various other parts of the grape-growing areas.

SELECTION OF VARIETIES

In discussing varieties, the ultimate use of the fruit, whether for wine, table, grape juice, or preserving, should be considered. It is estimated that sixty-eight per cent of the grape crop from 1937 to 1941 was used by the recognized commercial wineries in Ontario, while a further ten per cent, possibly more, was eventually made into wine. The grower therefore cannot disregard the fact that the bulk of our grape crop is used for wine and that other outlets, while important, nevertheless constitute a relatively smaller market.

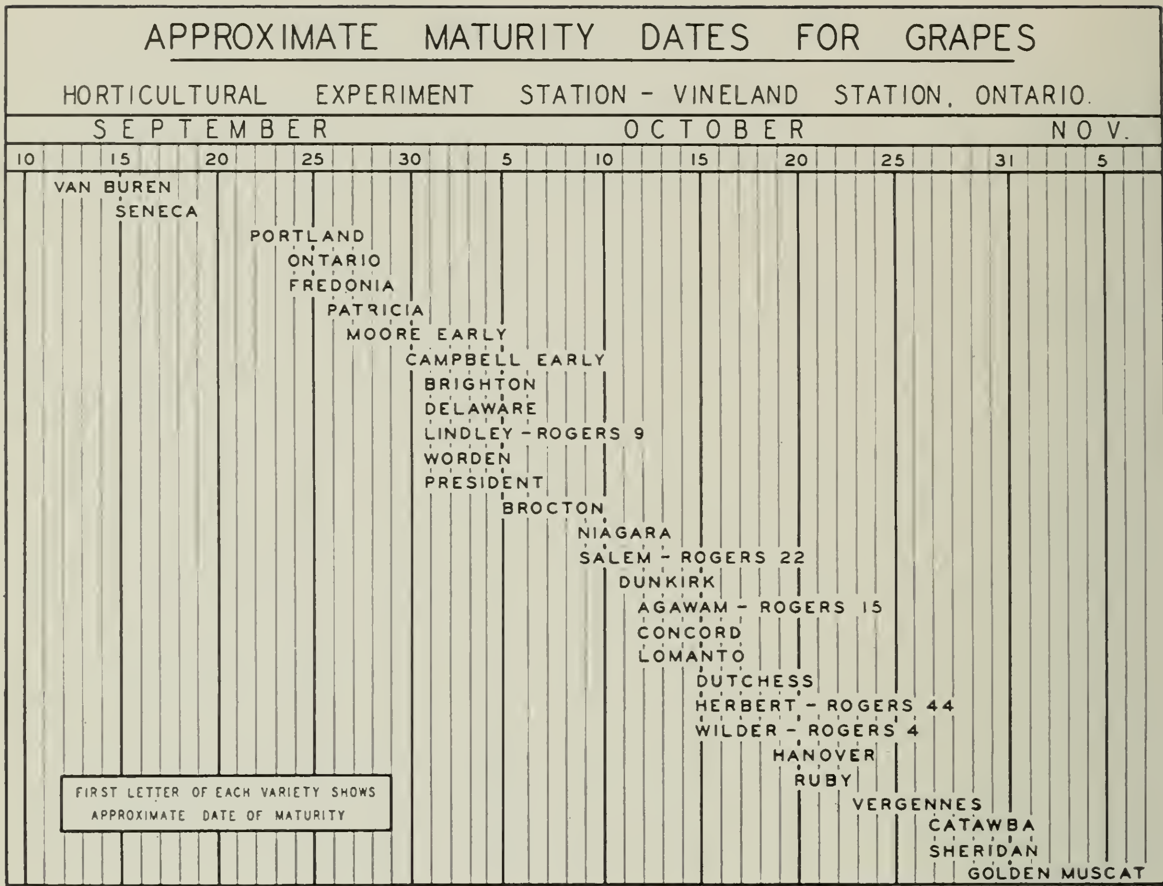
The history of grape growing in the Niagara district shows that grapes originally were grown primarily for table use, and that wine production came later. Most of our varieties, therefore, still have a dual purpose which is an advantage to the grower in the event that one or the other outlet fails temporarily. However Concord, the principal dual purpose variety, does not make wine with as high quality as can be made from some other varieties which, however, have little or no value as table grapes.

In recent years wine makers interested in producing higher quality native wines have been retesting the older American wine varieties such as Catawba, Delaware, Dutchess, and are testing newer sorts including Lomanto, President, and unnamed seedlings. Unfortunately good wine-making qualities are not always accompanied by desirable vine characteristics such as productiveness, hardiness, adaptability to varying soils, ease of propagation, all of which are of paramount importance from the grower's standpoint. Delaware is an excellent variety for making wine, but is not popular with the grower because of high production costs due to lack of vigour in the vine and low per acre yield. Catawba ripens too late to succeed generally in the Niagara district, though it was once successfully grown on Pelee Island. It may nevertheless be a useful wine grape even though low in sugar content.

TABLE I. QUANTITY OF EACH VARIETY OF GRAPEVINES SOLD BY NURSERIES IN ONTARIO DURING THE YEARS 1931–1940

Variety	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940
Agawam	1,506	1,036	1,110	1,783	1,601	8,696	11,019	12,242	6,721	4,807
Brighton	1,486	733	1,446	1,080	1,495	1,796	514	851	1,416	1,012
Campbell	4,040	1,874	4,462	8,523	3,690	3,872	3,849	3,865	3,658	2,031
Concord	315,823	84,447	40,932	71,921	66,235	37,073	68,416	70,114	75,531	65,651
Delaware	649	9,198	1,353	401	2,213	211	619	301	592	267
Fredonia	....	....	....	....	....	2,857	4,634	7,083	22,379	26,065
Lindley	1,584	1,121	1,362	1,210	832	1,146	1,252	1,651	1,402	430
Moore	11,697	7,731	14,257	12,810	7,929	8,427	2,660	4,969	5,361	5,302
Niagara	101,984	76,903	49,266	62,947	44,898	32,828	50,338	26,569	36,252	29,400
Ontario	....	....	....	....	....	1,798	787	5,415	2,179	1,812
Patricia	....	....	....	....	15,540	7,808	10,605	10,362	8,351	6,070
Portland	....	....	....	....	5,739	1,411	3,550	6,042	10,835	7,792
Worden	24,135	8,503	13,094	18,231	9,400	8,126	6,438	7,672	10,011	11,292
Miscellaneous	18,586	10,694	12,982	28,593	5,571	6,054	6,470	5,462	3,631	4,403
Totals	481,490	202,240	140,264	207,499	165,143	122,103	171,151	162,688	188,319	166,334

(From Dominion Bureau of Statistics, Ottawa)



Some years ago Concord was estimated to constitute about sixty-five per cent of the grape acreage. That the situation is changing is shown by Table I which gives the numbers of vines of each variety sold by nurserymen in Ontario. However these figures do not include large numbers of vines that are propagated by growers themselves for their own use.

While figures for the number of vines of each variety in the vineyards of the Province are not available, the following summary from Table I shows the trend in plantings during the period 1936–40. The relatively new varieties, Fredonia, Portland and Patricia, have been heavily planted while Concord has declined from an estimated sixty-five per cent to thirty-nine per cent.

Concord	39.1%
Niagara	21.6
Fredonia	7.8
Worden	5.4
Agawam	5.4
Patricia	5.3
Portland	3.6
Moore	3.3
Campbell	2.1
Others	6.4
	100 0%

(Fig. 2) Proper interplanting of the self-sterile varieties with any good pollinating variety increases the size of the crop. (Right) Flower cluster from a self-sterile variety completely failing to set fruit through lack of pollination. (Centre) The result of partial pollination. (Left) The result of good pollination.

Also, in selecting varieties, roadside stands and local markets should be considered. A variety such as Brighton for example is of doubtful value where shipment to a distant market is necessary. For local sale, as from a roadside stand however, its thin, easily broken skin would not affect its sale, and its quality is such as to commend it to the most critical.

Summarizing then, the grower, in selecting suitable varieties to plant, should consider the various factors noted previously, and particularly must have regard for the newer varieties of possible value for wine purposes. A recommended list for 1944 will quite possibly be out of date within a year or two. The accompanying list, therefore, is not so much a *recommended* list as a list of wine and market varieties some of which are already widely grown and others just coming into prominence. They are listed in order of maturity.

WINE— Delaware, President, Niagara, Concord, Lomanto, Dutchess, Catawba.

MARKET—Van Buren, Seneca, Fredonia, Ontario, Brighton (roadside only), Niagara, Salem, Agawam, Concord, Herbert, Ruby.

POLLINATION. In the market list there are three varieties that are often called Rogers' Hybrids. These are Agawam (Rogers' 15), Herbert (Rogers' 44) and Salem (Rogers' 22). Of these three, Agawam is self-fertile or self-fruitful, so that it may be planted without reference to cross-pollination. Herbert and Salem, however, and also Brighton, are *self-unfruitful.* Therefore in planting, provision must be made to include with them good pollinators such as Concord and Niagara, or in fact any of the other varieties listed, all of which, with the exceptions noted, are self-fruitful and good pollinators. Brighton apparently is easily cross-pollinated as it almost invariably sets good crops of large, well-filled bunches. Herbert is not so easily pollinated as, even where ample provision has been made for cross-pollination, the bunches are apt to be straggly and the yield light. When including a self-unfruitful variety in the vineyard at least every third row should be a good pollinating variety.

VARIETY DESCRIPTIVE NOTES

The accompanying brief notes on some of the newer or otherwise noteworthy varieties of grapes are not intended to be completely descriptive. The purpose is rather to indicate the value of each variety based on its performance at Vineland or with Ontario growers who also have it under observation. Generally, therefore, it may be assumed that, unless otherwise indicated, a given variety is commercially satisfactory in such characteristics as hardiness, vigour, cropping ability, fruit size and appearance, quality, etc. It has seemed of more importance to indicate special qualities or limitations, or some particular distinction of value to the grower in determining whether or not to plant.

Also, it should be recognized that the variety comment or appraisal applies to Ontario conditions. Performance elsewhere may well be substantially different.

Agawam (Rogers' 15). A self-fruitful Rogers' hybrid; vigorous, usually hardy, moderately productive, subject to mildew. The fruit is red, large and attractive, foxy in flavour and with a thick skin and coarse pulp. The fruit stores well.

Brighton. A *self-unfruitful,* red variety, suitable only for local and roadside marketing because of the thin, easily broken skin and poor keeping quality. The vine is vigorous, productive, adapted to various soils. The bunches are moderately large, attractive, and the quality of the fruit excellent.

Campbell (Campbell's Early). Satisfactory only on light, deep soils, where the vine is hardy, vigorous and productive. On such suitable soils the bunches and berries are large, attractive, and blue-black in colour. On heavy or "normal" grape soils Campbell ripens unevenly and the bunches are poorly filled and straggly. The quality is excellent when mature. It is often cut immature because it colours early, and the quality is then poor and acid.

Catawba. A red variety used for wine, which requires too long a season to be generally grown in the Niagara district. It has succeeded quite well on Pelee Island, the most southerly part of Ontario. In the Niagara district it ripens better back from the lake shore and on warm, well-drained soils.

The foliage is subject to mildew in some seasons. There appears to be a steady though limited demand from wineries for Catawba, even in seasons when it does not mature well and is low in sugar.

Concord. Adaptability to varying soils and climatic conditions have made it the most popular variety in Ontario for both wine and dessert purposes. The vines are vigorous and productive. The blue fruit does not have high quality, is foxy, but is nevertheless a popular table grape. It tends to shell badly if held some time after picking.

Delaware. The best of our varieties with respect to quality and, because of this, commanding a premium as a table grape on most markets. It is also widely used for wine. The bunches and berries are small and the vines lack vigour so that close planting is necessary to bring up the per acre yield. The foliage is quite susceptible to mildew. Delaware requires a deep, rich, well-drained soil, thorough cultivation, and relatively heavy pruning.

Dunkirk. Originated by the N.Y. Agr. Exp. Station and introduced as a red variety to fill the place of Delaware. The variety is described as having vigorous, hardy, healthy, productive vines, with medium sized clusters of fruit of good to very good quality, ripening shortly before or with Concord. The skin is tough enough for shipment. Fruited at Vineland 1928–30 it was not impressive. Vines planted later are not yet fruiting (1943).

Dutchess. A green grape which has been used for champagne. The vines are somewhat tender to cold and capricious as to soil. Foliage and fruit are susceptible to mildew. When well grown the bunches are medium sized and well filled, and the fruit of very good quality. Not adapted to heavy clay soils.

Fredonia. A vigorous, hardy, productive, black grape. The berries and bunches are moderately large and of good quality. Foliage and fruit susceptible to mildew. Probably the best early black grape to replace Moore. A good shipper.

Golden Muscat. A yellow-green variety which ripens too late for most locations in the Niagara district. The vines are vigorous, hardy, productive. The bunches and berries are very large and impressive in appearance. In a long warm season the fruit attains fair to good quality, though the flesh is somewhat stringy. The tender skin would limit it to roadside or local markets.

Herbert (Rogers' 44). A *self-unfruitful* "Black Rogers," very vigorous, hardy; fruit handsome, large, of very good quality; keeps well in storage. As with all self-unfruitful varieties it must be interplanted with another variety producing good pollen. Even when this is done the bunches are frequently somewhat loose and the crop therefore not heavy.

Ives. Some years ago Ives was planted in fairly large quantity in the Niagara district on the strength of its reputation for making red wine. Under our conditions the vines proved weak and unproductive so that the variety has again fallen into obscurity.

Lindley (Rogers' 9). A *self-unfruitful* red Rogers, requires interplanting to ensure a crop. Vine very vigorous, fairly hardy, somewhat susceptible to mildew. The variety is on the way out and is now chiefly found in older vineyards. Not sufficiently productive for commercial planting. Dessert quality very good.

Lomanto. A black grape suitable for wine production only and may prove quite valuable for this purpose. Vines are vigorous, hardy and productive, equalling Concord in yield.

Moore (Moore's Early). Now being replaced by Fredonia. Moore prefers a rich, loose, well-drained soil. The berries sometimes crack and shell badly and bunches may be loose. Vines of medium vigour, hardy and moderately productive. Dessert quality fair to good.

Niagara. The most popular green grape. Vines are vigorous, only moderately hardy; when well grown more productive than Concord but more susceptible to diseases. Bunches are larger than Concord; very well filled. Quality good when properly mature, foxy. On suitable, warm, dry soils Niagara acquires a rich golden finish to the berries where otherwise they are inclined to be quite green even when fully mature.

Ontario. Vines vigorous, productive, moderately hardy, prefers the heavier grape soils. Bunches are a little loose and the fruit, which is green, does not keep or ship too well. Good for dessert and also used for wine. First class for home use. Ontario ripens three to four days before Moore.

Patricia. Ripens with or just after Moore. Vines vigorous, productive, healthy. Quality only fair, flesh somewhat pulpy. Its chief value lies in its earliness combined with vigour and productiveness as compared with Moore. Fredonia is a better-all-round blue variety than either Patricia or Moore.

Portland. An amber coloured variety ripening about with Ontario or a few days earlier than Moore. The vines are moderately vigorous, hardy, moderately productive. The quality of the fruit is not as good as Ontario, being somewhat foxy. It is better suited to sandy soils than Ontario, and like Ontario the bunches are somewhat loose. The fruit does not keep or ship too well.

President. A black fruited variety with medium-sized bunches, medium to large berries. Vines moderately vigorous and hardy, difficult to propagate. Used for producing high quality wine.

Ruby. A new red variety not generally known or planted in Ontario. Vines are vigorous, hardy, productive. Ruby follows Concord in season and shows promise as an attractive red grape for market and roadside sale.

Salem (Rogers' 22). A *self-unfruitful*, red Rogers. Often not productive and susceptible to mildew. Bunches are medium to large, compact; berries large, quality excellent.

Seneca. A very early white or yellow grape having fruit qualities of the European type. Bunches are medium sized; flesh firm, tender, excellent quality. Attractive to birds and therefore must be watched closely as it approaches maturity. Vines vigorous, hardy, productive.

Sheridan. A black grape which ripens too late for most locations in the Niagara district, otherwise it would be useful to extend the Concord season. The vines are vigorous, hardy and very productive. Where it ripens the quality is better than Concord.

Van Buren. Promising as a very early black variety for roadside markets. Clusters medium sized, berries smaller than Concord; quality good. Vines vigorous, hardy, moderately productive.

Vergennes. A late red variety which benefits from being interplanted with other varieties. The vines have a straggling habit of growth which is objectionable, and are variable in vigour and hardiness with a tendency to overbear. In warm seasons and when the crop is moderate it ripens well, is attractive in appearance, and stores well. In cool seasons, or where the crop is excessive it ripens unevenly and colours poorly.

Worden. An old blue variety. Compared with Concord, bunches and berries are larger; it is seven to ten days earlier, not as heavy a bearer, quality better, not as adaptable to varying soils. Crop is improved when it is pollinated by another variety. Berries are apt to split in wet weather. Does not hang on the vines or ship well.

PLANTING

PREPARATION OF THE SOIL. Thorough preparation is necessary. If sod land is to be planted summer fallow it for a season. Land already in cultivation is best prepared and cleaned by growing a hoe crop the year previous. In either case, just before planting the vines work the land well with a disk and spring-tooth cultivator.

DISTANCE OF PLANTING. Planting distances vary a great deal throughout the grape district, from 9′ x 12′ to as close as 7′ x 9′. Vines planted on the lighter, sandy soils require more feeding space than the same varieties planted on clay. Varieties such as Niagara and Concord are far more vigorous than Delaware, for example, and must be farther apart in the row since they require longer pruning. For varieties such as Concord and Niagara a distance of nine feet between the vines in the row is recommended.

The minimum distance between the rows has been practically fixed at ten feet, the smallest space in which a wagon can pass conveniently down the rows to gather fruit, or in which a tractor can operate to advantage. Up to twelve feet may be needed for large tractor implements, manure spreaders, etc.

When the vineyard is to cover a considerable area it is best to provide alleys crosswise and parallel to the rows. These will facilitate such operations as spraying, and gathering the boxes of fruit, by allowing shorter hauls. Alleys should be wide enough to permit easy turning with tractor implements.

NURSERY STOCK. If one-year-old vines are to be planted, they must be well grown, otherwise two-year vines are to be preferred as they have a larger root system and will produce more vigorous growth in the first season.

Frequently not enough importance is attached to obtaining first-class stock as the lower price of the poorer grades appeals to many. However, the eventual success of the vineyard will depend in considerable measure on the excellence of the planting stock.

As soon as the nursery stock arrives, the bundles should be opened, the vines spread out, heeled-in in some sheltered spot, and earth mounded well up about them. Care must be taken not to mix the varieties. Notify the nursery immediately of any errors in the order so that replacements may be made without delay.

PLANTING THE VINE. Vines may be planted in late fall or early spring with equally good results. If planted in the spring, the earlier the better, as this enables them to become well established before the heat of summer.

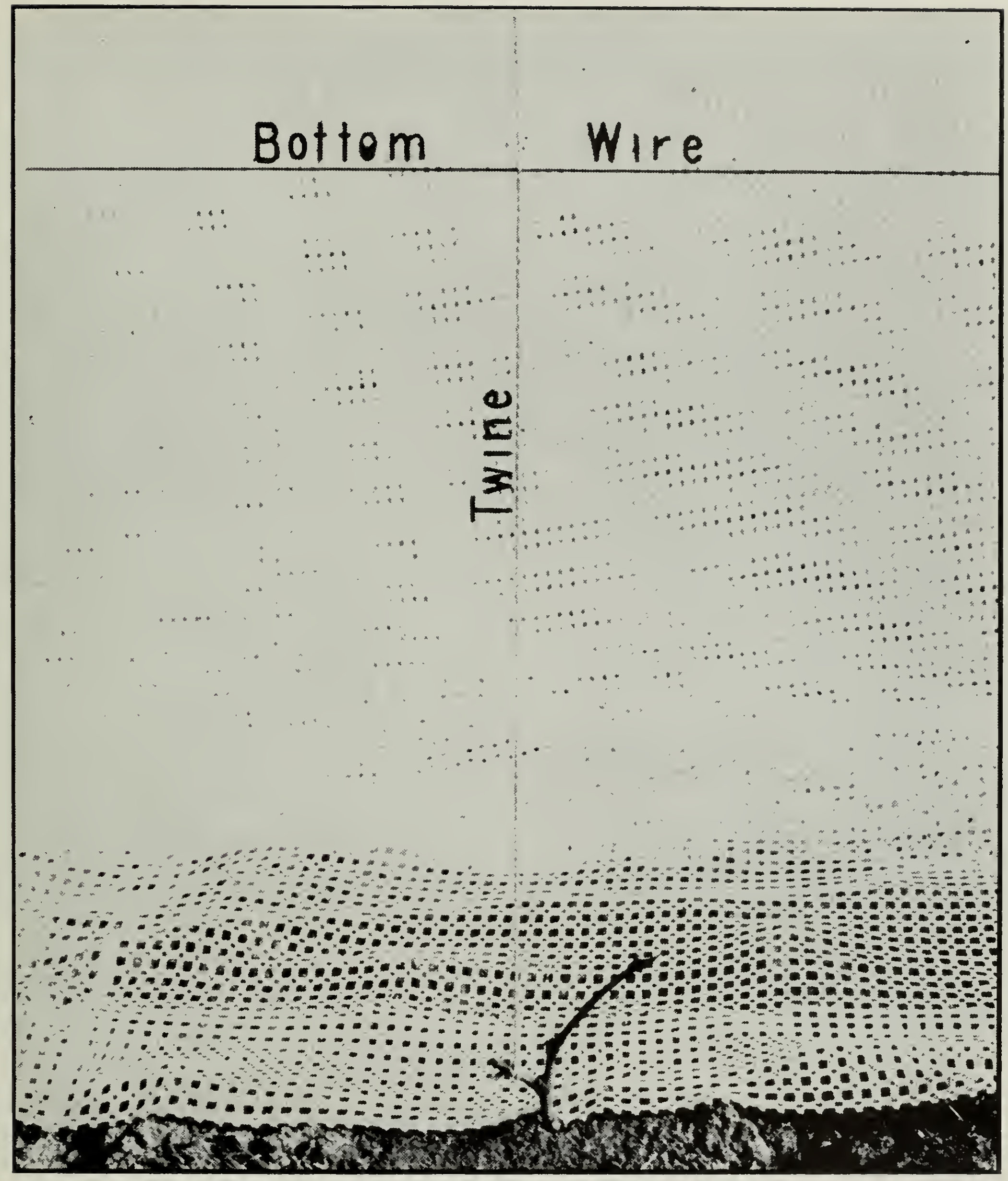
The young vines must be pruned before planting. The roots should be cut back to about nine inches, and may occasionally need some thinning out. If the vine has several canes, all but one should be removed, and this one should be shortened to two buds, although for convenience in planting this cane may be left full length until the vine is set. This pruning makes the vine less liable to dry out before rooting, and forces the growth from the few remaining buds thus producing more vigorous shoots.

In addition to the single two-bud cane a one-bud stub may be left as a convenient place to tie the grape twine when the vines are to be trained to the trellis in the year of planting. Tying the twine to the stub rather than the cane will avoid girdling as the cane increases in size.

Previous to planting, the vineyard must be staked to show the location of the rows. Care must be taken to make these straight as on this depends the ease of all subsequent vineyard operations. Stakes may be set at frequent intervals along the rows to facilitate striking a straight furrow in which to set the vine. As deep a furrow as possible is made the first time, and then by returning in the same furrow it can be made about ten to twelve inches deep, or sufficient for the vines. Where the soil is shallow, it may be necessary to dig all holes, using the plow for marking only. Some growers prefer this method as it provides more room for spreading the roots when planting.

As soon as the furrow is made to mark the row, planting may be begun, keeping pace with the plow. A rod cut to a length equal to the distance between the vines is convenient for marking but must be used carefully so that the vines line up crossways. In large plantings a better system is to place stakes where the end vines of the outside rows are to be located and to sight in intermediate stakes. With these stakes as a guide a heavy chain is drawn across the furrows to mark the location of the vines. For the next mark, the end stakes are moved the proper distance down the row and the intermediate stakes sighted in as before. This method of course necessitates that the striking out of furrows be completed before planting is started.

One man usually does the planting, but in the case of large plantings two men are often used and a boy supplies them with vines already pruned. In planting, the roots should be spread out carefully and the earth firmly tramped over them. The vines may be set a little deeper than in the nursery row. If they are set deep enough, the roots spread out, and the soil well firmed over them, the grower can count on very few failures.



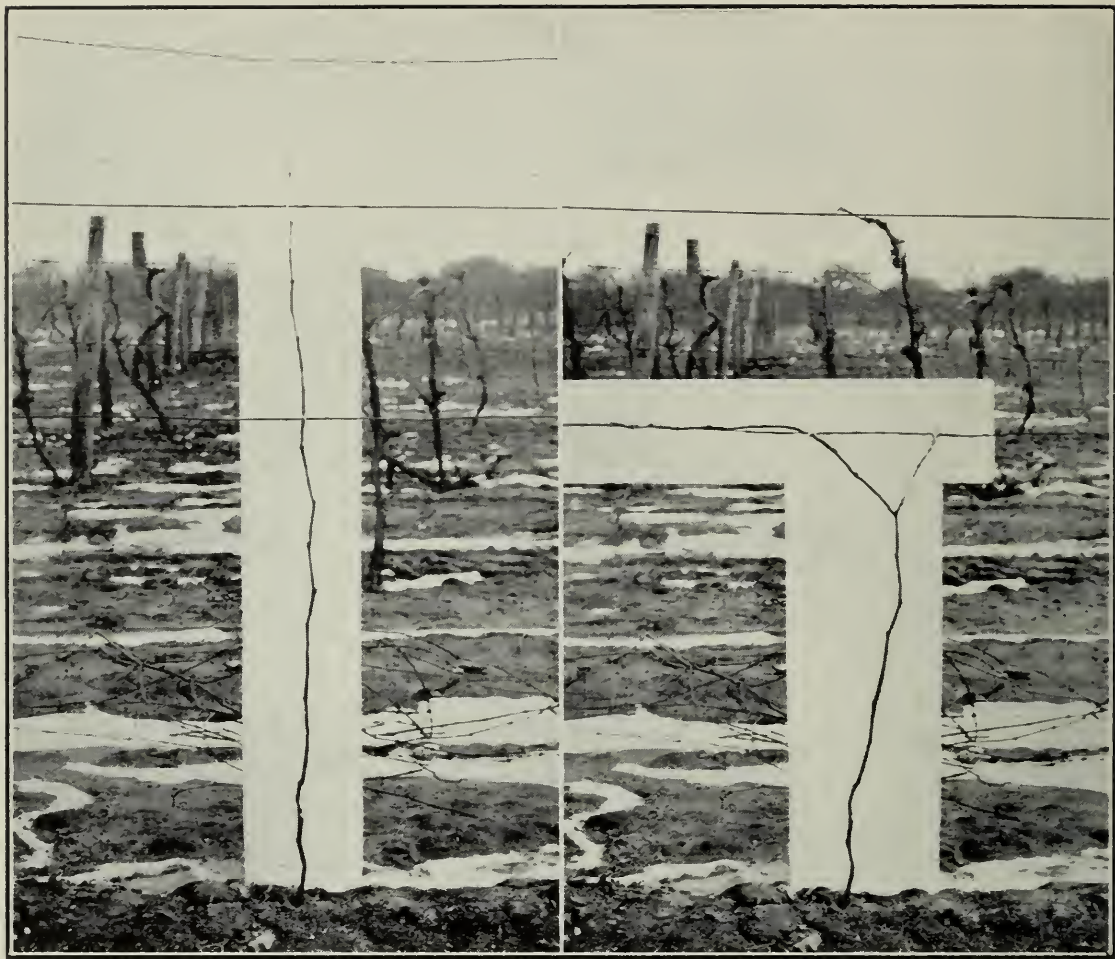
(Fig. 3) Newly planted grape vine showing method of tying twine to a stub.

CARE OF THE YOUNG VINEYARD

If posts are set and wired soon after planting, the training of the vines can be started immediately. The young vines will be out of the way of implements and the vineyard is easily kept free of weeds, advantages which may outweigh spreading the expense of planting and posting over two years.

The newly set vineyard requires thorough cultivation during the first season. This may be given economically in conjunction with a companion or intercrop requiring clean cultivation, such as sweet corn or tomatoes.

In training the vine, a grape twine is tied tightly to the one-bud stub mentioned previously or to the two-bud cane and to the wires above the vine as shown in Fig. 3. Tying to the two-bud cane which is to produce the trunk



(Fig. 4) Correct (left), and incorrect (right) method of tying the young plant after the first season's growth. In order to obtain a straight trunk, tie the selected cane full length to the highest wire it will reach. Heavy heading back at this time delays fruiting and accomplishes no useful purpose.

may result in girdling when the trunk grows larger. Usually both buds on the two-bud cane start growth. The weaker of the two should be removed when one to two inches long together with any other surplus shoots that may come up. As the vine grows in length it is twisted loosely about the twine, this operation being necessary two or three times during the season. When the cane reaches the top wire, which may take two years, it should be cut off immediately above the wire and should be tied tightly to it. If the cane is too short to reach the top wire the first spring after planting, cut it off above the last good bud. Tie below this bud, draw the cane up tight and straight and tie to the top wire.

If the posts are not set the first spring they should be set in the fall so that the vines may be tied up the following spring before new growth starts. If the first season's growth has been very weak the vines may again be cut back to one two-bud cane and a one-bud stub. Many growers make a practice of cutting back to two or three buds at the end of the first season's growth, regardless of the amount of growth the vines have made. However experimental work has shown that where good growth has been made there is nothing to

(Fig. 5) Four methods of bracing the end-posts. (1) Guy wire on straight end-post. (2) Guy wire on slanting end-post. (3) Short scantling brace. (4) Long scantling brace between end-post and special second post. Notice the guy wire in each case. Method No. 3 is to be preferred, but is the most expensive.

be gained by this delay in training. In fact, fruiting is delayed without any compensating benefit to the young vine. Train those vines which have made sufficient growth to the top wire, tying the plant as high as it will go and as straight as possible. With those of lesser vigour, some may be trained to the lower wire, while others will need to be cut back to two buds as already indicated.

During the second season's growth it is advisable to remove all suckers and secondary shoots not needed to form arms. If the trunk below the lower arms is kept free of shoots for the first four or five years very few will have to be removed later. In the above discussion it has been assumed that the Kniffen system of training is to be followed.

The mulching of young vines in the late fall with straw or strawy manure is recommended. The mulch not only serves as a protection but, when worked under in the spring, improves the physical condition of the soil.

(Fig. 6) Four methods of wire tightening. (1) ½-inch bent iron bar. (2) Large iron hook. (3) Square wooden block. (4) Iron reel. All four methods are good but No. 3 is the cheapest.

TRELLISING

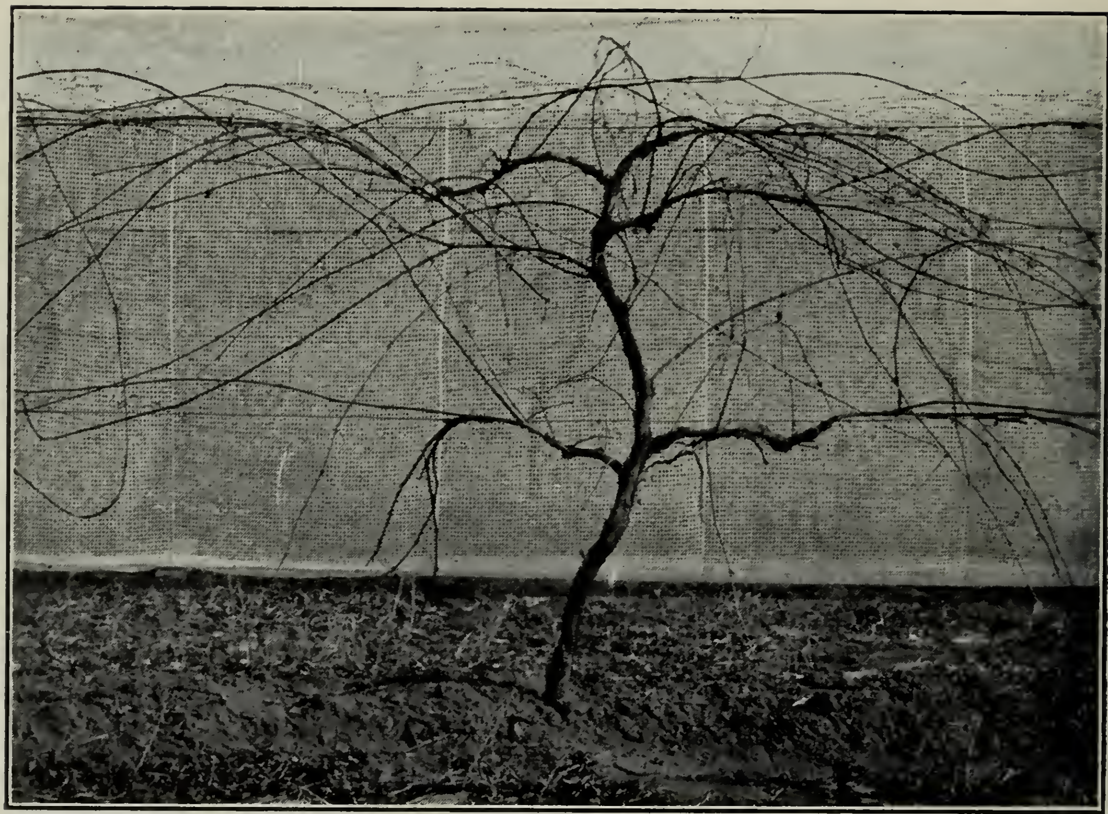
POSTS AND BRACING. Well-cured cedar posts are preferred by most growers. The end posts should be at least five inches in diameter and eight feet long, the intermediate posts three inches in diameter and eight feet long. The posts should be set approximately thirty feet apart in the row, depending on the planting distance of the vines and, in the case of the intermediate posts, should extend into the ground two and one-half to three feet.

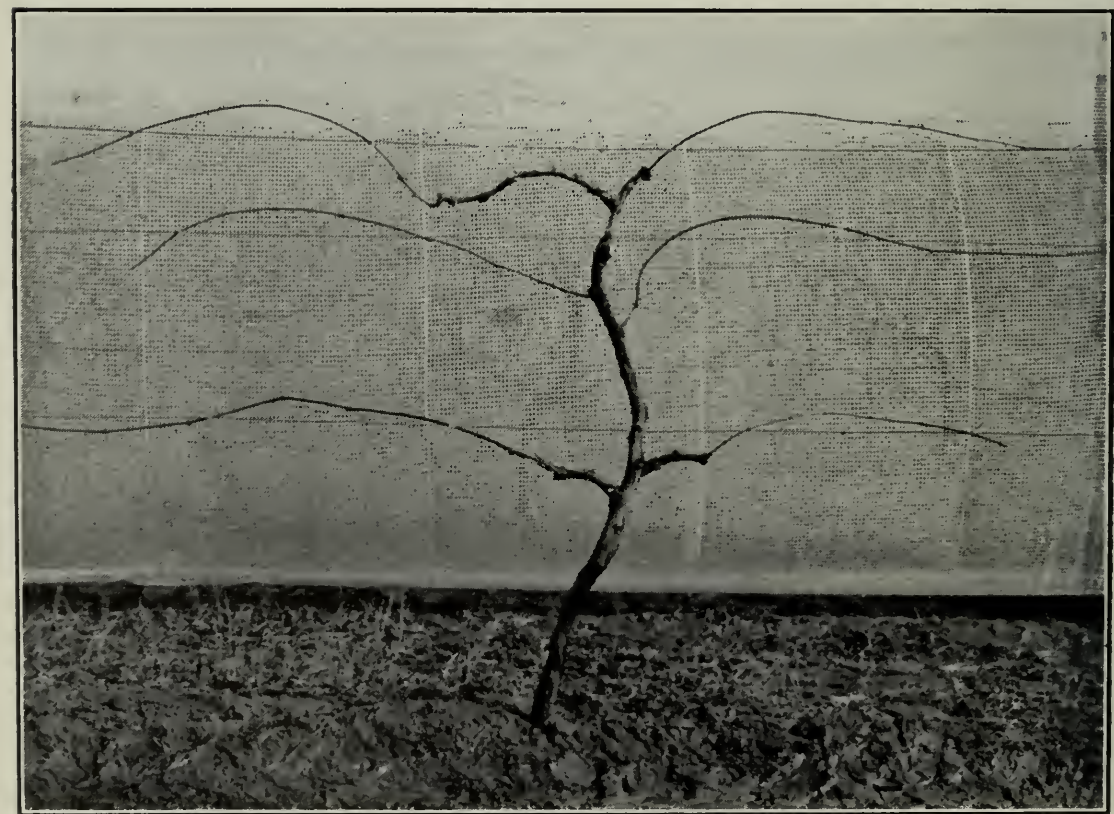
There are many methods of setting and supporting the end posts. In any case the end post must be set at least three feet deep to enable it to withstand heaving, and to support the weight of the vines and fruit. Perhaps the oldest method is that of bracing the end post with a rail or scantling from another post set about eight feet away in the row. The brace should reach from a point about a foot above the ground on the second post to within eighteen inches of the top of the end post. To complete the bracing a guy wire must be passed from about six inches below the top of the second post to a short distance from the ground on the end post. This method is one of the strongest and most satisfactory, though requiring considerable material.

Another method which is being much used because of its low cost is that of guying the end post. The post is set at a slight angle. Some large, heavy stones may be placed in the bottom of the hole and the rest filled and packed with soil. The post is then guyed with a strong galvanized wire, one end of which is fastened to the post one foot from the top and the other end to a stone, or short post, buried three and one-half to four feet in the soil and from four to five feet from the post, this being as near to the post as it is possible to get without decreasing its purchase. Besides the small original cost of setting these guys they furnish strong support to the posts while they last. The wires, however, are a nuisance in cultivating. The implements will not only often hitch into them, sometimes breaking them off, but the wires are bound to rust and break, and it is hard and expensive to replace them. Another point is that the headlands of the vineyard are much more difficult to keep clean when this method of supporting the end posts is used, than when they are braced or set in cement.

WIRING. The majority of the older vineyards have two wires, the plants being trained to the four-cane Kniffen system. Some growers prefer the six-cane system (requiring three wires) in that it spreads the growth over a larger area, thus making most cultural practices such as pruning, spraying, and harvesting somewhat easier. Then there is also the advantage that in unfavourable seasons more of the vine is spread out to the wind and sunshine, lessening disease and hastening ripening. In yield there is a slight difference in favour of three wires, but not enough to condemn the two-wire system on this account.

Use No. 9 galvanized for the top wire. A lighter wire gives way too soon. For the lower wires, especially on short runs, a lighter weight may be used. In a two-wire system the first wire is placed at thirty inches above the ground, and the second twenty-four to thirty inches above the first. If three wires are used, the first wire should be at least twenty-four inches above the ground and the other two at eighteen-inch intervals above the first wire.





(Fig. 7) *Very vigorous Concord vine before and after pruning. Weight of wood removed was 4½ lbs. Vine was pruned to 60 buds. Note that in Figs. 7, 8 and 9 the weaker the vine, the fewer buds are left.*

Wiring a vineyard may be done very quickly. Quarter-inch holes are bored in the end posts, the same direction as the wire is to be strung, and at the distances the wires are to be above ground. When the wire is stretched along the row, the ends are passed through the holes in each end post and made fast to the wire tightener. While a proper wire tightener with block and pulley is the most satisfactory, many simple devices may be used.

One of the most common is a block of hardwood, one and one-half inches square and eight or nine inches long, with a quarter-inch hole bored through the middle of it. The wire is passed through the hole and made fast; then the wire is tightened by turning the block with a monkey wrench. The block is kept in place by its shape, together with the tautness of the wire.

Another method is to use a small iron reel on which to wind the wire after it passes through the hole in the end post. Probably the commonest of all iron tighteners is the small, slightly curved iron bar about one-half inch in diameter. This can be wound up tight similar to the wood block.

When stapling the wires to the intermediate posts, space should be left to allow the free passage of the wire when it is slackened in the fall and tightened in the spring. Unless the wire is regularly slackened in the fall, it and the posts will be subjected to an undue strain when the already taut wire contracts with the cold weather. This strain will in time either loosen the posts or break the wire.

Number of Feet to the Pound of Different Sized Wire:

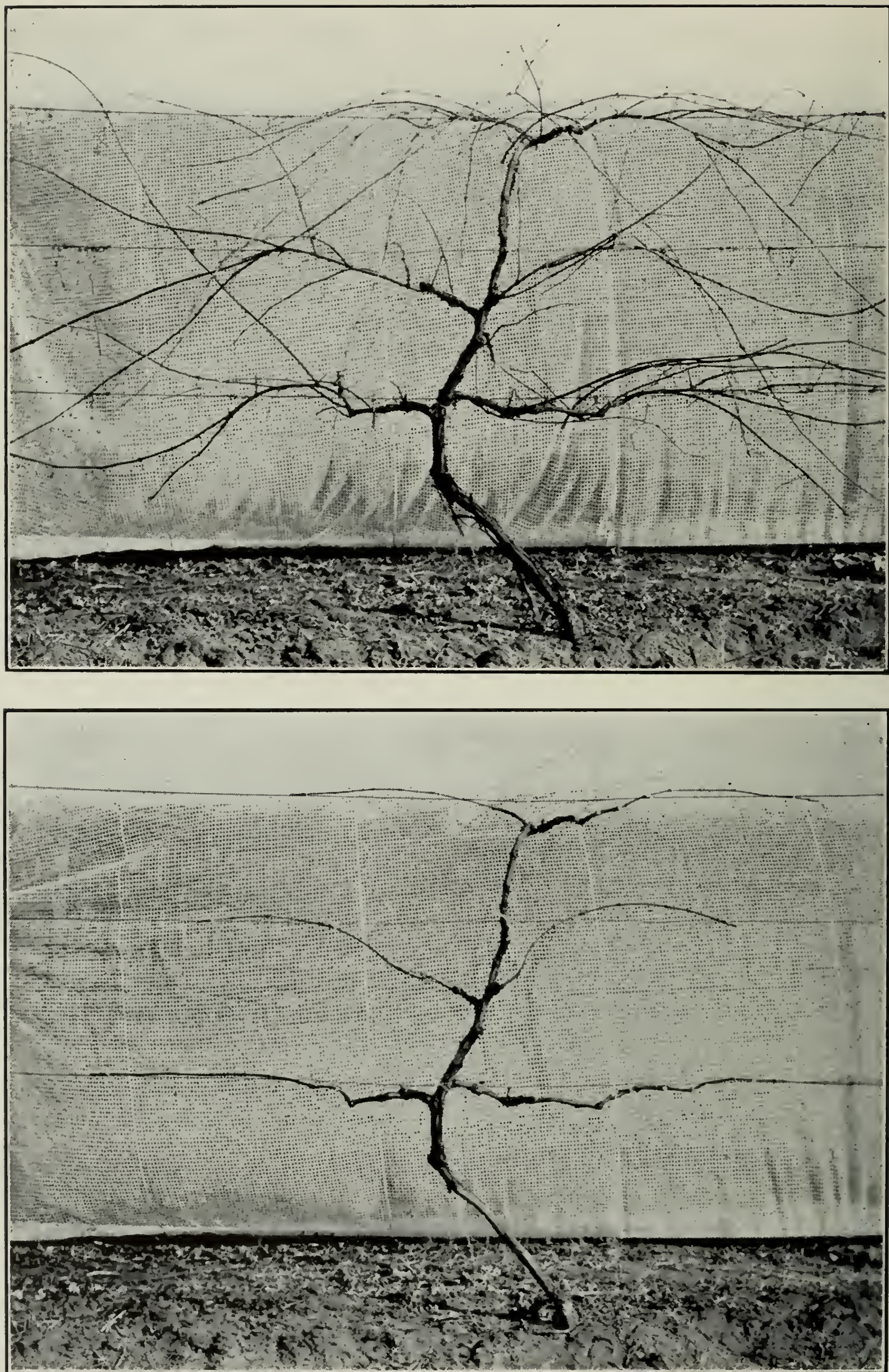
No. 9—Feet to the pound	17.95
10— " " " "	22.33
11— " " " "	27.34
12— " " " "	34.29

PRUNING, TRAINING, TYING

PRUNING. To the uninformed, grape pruning seems drastic. The bulk of the growth of the previous season is cut away, leaving only four to six new canes and these are reduced in length to six to twelve buds each. (See Fig. 7.) Fundamentally therefore, pruning is a simple operation but requires judgment in the selection of the few canes which are to remain. These should originate as close as possible to the trunk, or from it, and should be of normal vigour, about pencil size, avoiding weak growths and "bull" canes.

The pruning and training of young vines has been described in the section, "Care of the Young Vineyard." The present discussion concerns mature bearing vines.

SYSTEMS OF TRAINING. In the Niagara district several systems of training are followed, such as the Fan, Horizontal Arm, four and six-cane Kniffen, and "go as you please." The Kniffen and the Fan are most popular. In practice the Fan system often becomes a Horizontal Arm. Many of the younger vineyards are trained according to the six-cane Kniffen system, while



(*Fig. 8*) *Moderately vigorous Concord vine before and after pruning. Weight of wood removed was 2½ lbs. Vine was pruned to 42 buds.*

the four-cane Kniffen is commoner in older plantings. The main advantage of following any particular system is that the work is simplified and standardized, particularly pruning and tying.

The Kniffen system is shown in the accompanying illustrations (Figs. 7, 8 and 9) and needs no further description. The relative merits of the four and six-cane Kniffen systems are discussed under "Wiring."

TIME OF PRUNING. The usual practice is to do most of the pruning during January, February and March. However it may be done any time after the leaves have fallen, up until the vines start to bleed in the spring. The important point is that the vines be thoroughly dormant. Pruning should not be done on very cold days as the canes are then very brittle and those left may be injured in pulling out the brush.

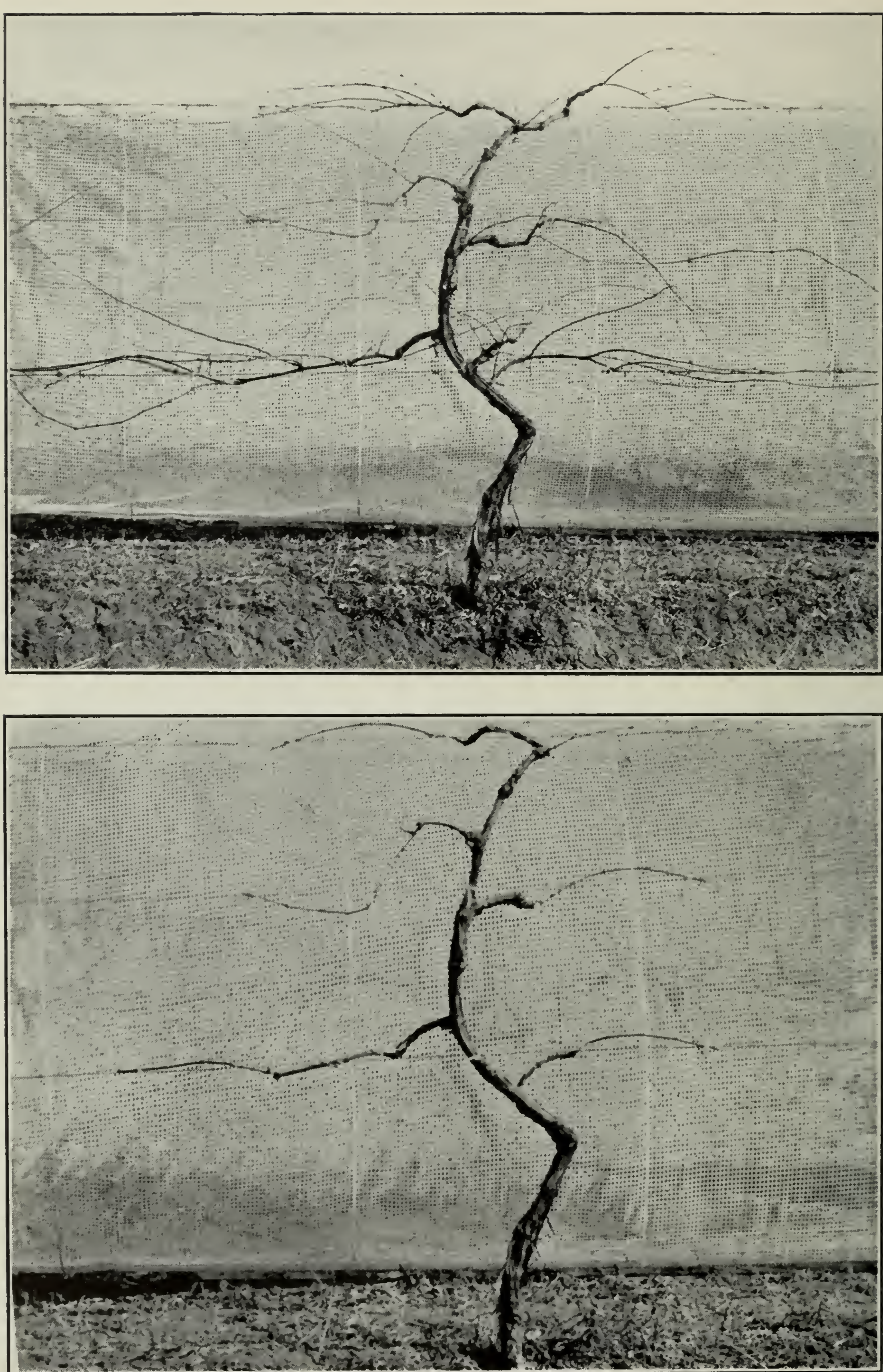
RELATION OF CANE DIAMETER TO FRUITFULNESS. That the bull canes are unproductive and undesirable is indicated in experimental data obtained by N. L. Partridge of Michigan. These data show that the medium or pencil-size canes of approximately one-quarter inch diameter are the most fruitful. An increase or decrease from this size is accompanied by decreased fruitfulness in both cases, the amount of the decrease being roughly proportional to the deviation from the optimum size—one-quarter inch. Where canes of the right diameter are unobtainable, those slightly above the quarter-inch are to be preferred to those falling below this diameter. In addition, canes of moderate length between the joints are to be preferred to short-jointed canes.

NUMBER OF BUDS PER VINE. The amount of wood or the number of buds to be left on the vine will vary with the variety and the vigour of the vine. Individual vines should be pruned according to their capacity to produce and ripen a crop, and this may vary from season to season depending on seasonal conditions, varying soil fertility, and amount of previous crop Generally speaking, the greater the vigour, the more buds may safely be left.

The date of maturity of the fruit is influenced by the size of the crop. This is an important point in the Niagara district, especially for those vineyards which are naturally inclined to be late in ripening. Vineyards close to the lake would fall in this class. In a general way, it may be stated that the greater the crop the later the maturity. It is obvious, therefore, that the grower who habitually suffers from too late maturity should practise more severe pruning. In his case the optimum number of buds is determined by the date of maturity rather than the quantity of fruit that the vine can support year after year without noticeable impairment of vigour.

Delaware canes are short-jointed. With this variety, number of buds should not be estimated by length of cane alone but by frequent count; otherwise far too many buds will be left by the average pruner.

The Rogers' hybrids, such as Agawam, are very vigorous growers and, apart from other considerations, a relatively large number of buds must be



(Fig. 9) Weak Concord vine before and after pruning. Weight of wood removed was 1 lb. Vine was pruned to 30 buds.

left or growth will be too rampant and of the bull cane type. Also Lindley and Agawam normally mature early so that this factor does not need the same consideration. Herbert is later in season and does require consideration.

It is evident then that no hard and fast rule can be laid down stating that so many buds, say forty, should be left for all varieties under all conditions. Rather, individual growers will have to determine the optimum number for their particular conditions, varying this number with the variety and to some extent with occasional vines which are above or below normal in vigour.

N. L. Partridge of Michigan has suggested that the weight of prunings should be used as a guide to the number of buds to be left per vine with the variety Concord (see Table II). It may be useful for other varieties also as an indication of vigour, but specific data are lacking on the number of buds to leave with varieties other than Concord. This system has been used successfully in experimental work carried on in a vineyard near Jordan.

TABLE II. WEIGHT OF PRUNINGS AS A GUIDE TO THE NUMBER OF BUDS TO BE LEFT

Pounds of Prunings	No. of Buds Left per Vine	Pounds of Prunings	No. of Buds Left per Vine
Less than 1/4 lb.	16	2 1/2	42
1/4	20	2 3/4	44
1/2	24	3	48
3/4	28	3 1/4	50
1	30	3 1/2	52
1 1/4	32	3 3/4	54
1 1/2	34	4	56
1 3/4	36	4 1/4	58
2	38	4 1/2	60
2 1/4	40	For each additional 1/4 lb. of prunings leave two more buds.	

Only the one and two-year-old wood removed from the vine at pruning time is weighed. If older wood is removed it should not be weighed. It would be impractical to weigh all the prunings in a large vineyard; however a pruner will soon learn to estimate the weight of prunings and to vary the number of buds accordingly. Prunings may be weighed occasionally to check on the work being done.

SPURS. In addition to the four to six regular fruiting canes, it is often advisable to leave additional short two-bud spurs from which new vigorous canes close to the trunk may be secured the following season. The function of such spurs is of course to provide a renewal of fruiting wood close to the trunk, and it is therefore unnecessary to leave such spurs where the arms are already short.

RENEWING OLD VINES. It is sometimes necessary to renew old vines where the trunk has become crooked and bent and has perhaps deteriorated from disease. If the root is healthy, such renewal can usually be effected by

(Fig. 10) Renewing a crooked old vine. The new cane is two years old. The old one will be cut away completely.

bringing a new shoot from near the ground. The old trunk may be removed at once, or may be left to fruit for one or two seasons until the new cane is ready to take its place.

The new shoot should be trained up to the top wire as rapidly as possible in the same manner as a newly planted vine. Any side shoots, except those needed for new arms, should be removed when not more than a few inches long.

TYING THE VINE. Following the dormant pruning and the tightening of the trellis wires in the spring, tying is the next vineyard operation. Tying should not be done when the canes are frozen as they are then quite brittle and easily broken. Nor can tying be delayed until after growth starts because of the danger of rubbing off the new growth.

Both grape twine and fine wire are used for tying, though most growers prefer the twine, considering it to be the better material. Wire cannot be used to secure the trunk and main arms of the vine to the trellis because of the danger of girdling the vines.

The trunk should be tied tightly to the wires in an upright, straight manner. Sagging, crooked trunks interfere with many vineyard operations. Before tying the canes (Kniffen system) it is a common practice to give the cane one or two twists around the wire. This secures the vine more firmly to the trellis than merely stretching the cane along the wire. However, such wrapped canes materially increase the difficulty of pruning the following season. In either case each cane should be tied twice, once at the tip, where a tight knot should be made, and once near the base; in this case a loose knot so that normal cane growth, without binding or girdling, may be made.

When tying with grape twine it is advisable to give the cord a couple of turns around the wire, knot it, and then tie the cane securely to the wire. This method prevents any slipping of the cord along the wire and, at the base of the cane, permits of a secure though loose tie, thus allowing for cane expansion.

It is false economy to hurry over the tying of the vines or to use material for tying which is not sufficiently strong or durable. This always results in much troublesome retying and often in injured arms.

SUCKERING. Suckering is the removal of all the shoots which appear on the trunk of the vine at or below the surface of the soil. These suckers bear little or no fruit, and hence grow vigorously, appropriating food materials which should go to the vine. A great deal of time and expense will be saved if suckering is done carefully during the first four or five years of the vine's growth. After the fifth year very few suckers will be produced from vines which have been carefully suckered when young. Vines on which the work has been carelessly done will always produce an abundant growth of these underground shoots every year. Suckering should be done early in the summer before the shoots have become hard and woody, not only because of the fact that they diminish the vigour of the vine, but also because, if the shoots are left for the whole season, or for any length of time, they promote the production of dormant buds below the surface of the ground. These old suckers are more difficult to remove than are the young shoots, and if imperfectly removed, the remaining part becomes an underground spur which will be a perennial source of trouble.

SUMMER PRUNING. The removal of two or more feet from the end of growing shoots during the month of August is sometimes practised in the Niagara district. This is done to admit light to the fruit and so control mildew by permitting a better circulation of air through the vine. Topping has little or no influence on colouring of the fruit, contrary to general belief. Since this topping is done toward the latter part of the summer, a great number of leaves are removed, which is weakening to the vine. In the case of very vigorous vines this may not be serious, but if severe topping is practised annually it is bound to eventually weaken even the strongest vines and so reduce fruit quality. In the most severe topping, not less than seven to eight leaves should be left beyond the outermost bunch of grapes.

Topping is justified, if at all, only in seasons of excessive growth, and after mildew is seen to be developing. The grower might better avoid excessive growth and maintain reasonable vigour by varying the number of buds left at the regular dormant pruning, as outlined under "Number of Buds Per Vine."

Also, it should be remembered that reduction of leaf surface by summer pruning reduces the ability of the vine to manufacture food and therefore reduces the sugar content—and quality—of the fruit.

VINEYARD SOIL MANAGEMENT

The general subject of soil management is discussed in some detail in Ontario Department of Agriculture Bulletin No. 437, to which the reader is referred. The following paragraphs deal briefly with soil management as it applies to vineyards.

CULTIVATION. The first operation in the spring, as soon as the soil is dry enough, is to work the soil away from the vines. This may be done either by shallow plowing or preferably by disking, as in friable soils, and where there is no cover crop, particularly rye, to plow under. Many growers prefer this method and, where soil and other conditions permit, it is to be commended as it is less disturbing to the root system than plowing.

If plowed, a gang plow is better than a single plow, as it does the work more quickly and evenly. A furrow three inches deep is sufficient to turn over the surface soil and still not deep enough to disturb the surface roots of the vine. It is very important that roots of well-established vines should not be torn up or exposed by deep plowing.

The grape hoe and hand hoe should now be used to work the soil away from the vines. Subsequent cultivation, at least every two weeks, should be shallow and given with the disk or spring-tooth harrow. Special care should be taken to cultivate before the soil has become caked and crusted after heavy rains.

All cultivation should be stopped by the 15th of July at the very latest, to give the vines a chance to ripen their fruit and wood before freezing. In backward seasons it is advisable to discontinue cultivation at least two weeks earlier. It is not advisable to plow up to the vines at this time as is frequently done since it destroys many feeding roots at a critical growth period.

Where the land is very flat and the rows are not ridged up a little to facilitate drainage it may be well to plow in the fall; also where the land is heavy and works better in the spring following fall plowing. However fall plowing should be delayed until normal leaf fall when the vines will no longer be stimulated into further growth. Where the soil tends to wash badly, plowing should be left until spring.

GREEN-MANURE CROPS. Green-manure crops should be used in the vineyard wherever possible. Their functions are: To check growth in the fall, thus giving the vine time to mature its wood properly; to utilize nitrogen available in the soil after the vine has ceased growth, and prevent its loss by leaching; to hold snow and thus prevent deep freezing; and, of great importance, to maintain or improve the organic matter content of the soil. A green-manure crop will help to prevent the topsoil washing away during heavy rains. If it is left standing over winter it will help prevent erosion, and will catch many of the grape leaves which add organic matter to the soil.

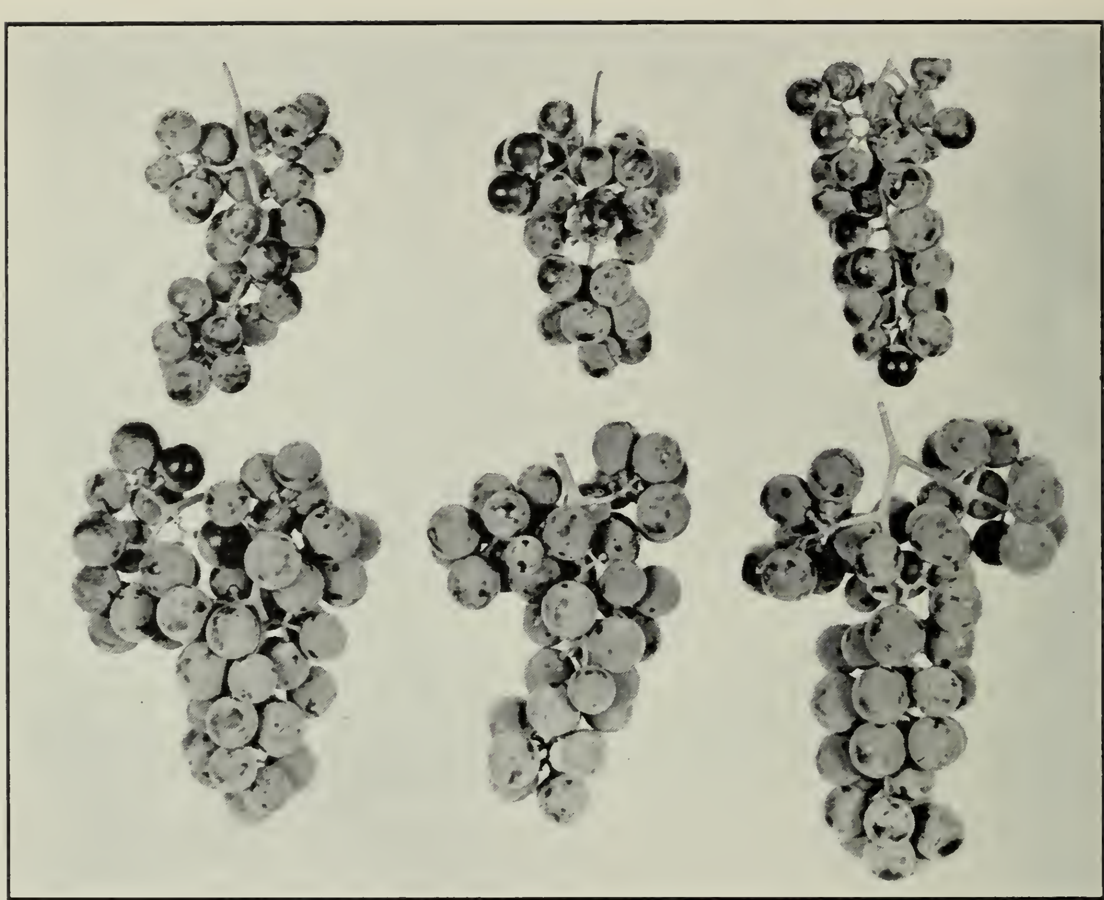
Organic matter, because of its moisture-holding capacity, may be said to form the basis of soil fertility. The grape is a long-lived plant, and unless

(Fig. 11) Japanese Millet used as a green-manure crop. Planted July 1st.

organic matter is maintained the soil will eventually decline in fertility. Farm manure, of course, is one of the best sources of organic matter and should be used whenever it can be secured economically, as a supplement to green-manure crops.

Some of the best green-manure crops are: oats (1½ to 2 bu. per acre), rye (1 to 2 bu.), millet (20 to 30 lb.). Oats and some millets (see Bulletin 437, Orchard Soil Management) make strong growth in the fall and may therefore be objectionable at harvest time. However, they may be knocked down with a stone boat or by running over them once or twice with a disk. On the other hand oats and millets are killed by frost, and there is no temptation to delay spring cultivation as in the case of rye which makes its heavy growth in the spring. It is essential that spring cultivation be done early. A delay gives a greater quantity of material to work under, but owing to its more mature condition it will break down too slowly, causing drying of the soil and reducing the soil's nitrate content, thus adversely affecting cane growth.

The green-manure or cover crop should be sown as soon as cultivation ceases in mid-July or a crop of weeds may be allowed to grow. If the distance between the rows allows it, it is convenient to use a grain drill to sow the cover crop, rather than a Cyclone seeder as no seed will be sown under the vines. A cover crop there might interfere with good air circulation, and in the case of rye it is difficult to turn it under properly when sown close to the wires.



(Fig. 12) Size of bunch is largely dependent upon the vigour of the vine. (Top row) Bunches of grapes from vines possessing poor vigour. (Bottom row)—from vines possessing good vigour. Both taken from the same vineyard.

FERTILIZERS. In common with other fruits, grapes require a soil adequately supplied with organic matter. Farm manure and green-manure crops, as already indicated, form the basis of the soil fertility program. These, with proper soil drainage and adequate cultivation during the first part of the season, will probably furnish all the plant food necessary in most Niagara district vineyards.

In one of the Station fertilizer experiments the organic matter and green-manure plots were the only ones returning an increase in crop yield sufficient to pay for the materials applied. This indicates the importance, especially where manure is not readily obtainable, of encouraging the growth of green-manure crops by proper fertilization. The mineral fertilizers used to promote the growth of green-manure crops will eventually be returned to the soil in a highly desirable organic form which is believed to be more suited to horticultural crops than the inorganic form.

Results from a carefully planned fertilizer experiment in a Jordan vineyard have shown very little benefit from surface applications of superphosphate and potash, the probable explanation being that the plant roots did not have access to the minerals applied in this way. Further experiments with deep placement of the fertilizers are under way. From our results it would seem advisable that minerals be applied deeply, and of necessity this should be done in the fall so that the plant will have time to overcome the shock of root cutting before the start of the next season's growth.

Taking a long view of the whole fertility problem, fertilizing the green-manure crop appears to be the best method of fertilizing grapes as, in the increased crop residue incorporated in the soil, the plant will have increased nutrients to feed on. Also, applying manure, straw, hay or other crop residue to the vineyard will give the plant an increased food reserve for future growth and fruitfulness. The following definite recommendations are based on the various considerations noted above.

1. Farm manure at the rate of ten tons per acre, applied at least every other year in order to promote growth of green-manure crops. A supplemental application of 400 lb. 0–12–15 per acre (or its equivalent) to balance the mineral requirements is suggested. The 0–12–15 mixture is not now obtainable (1944) due to war restrictions.

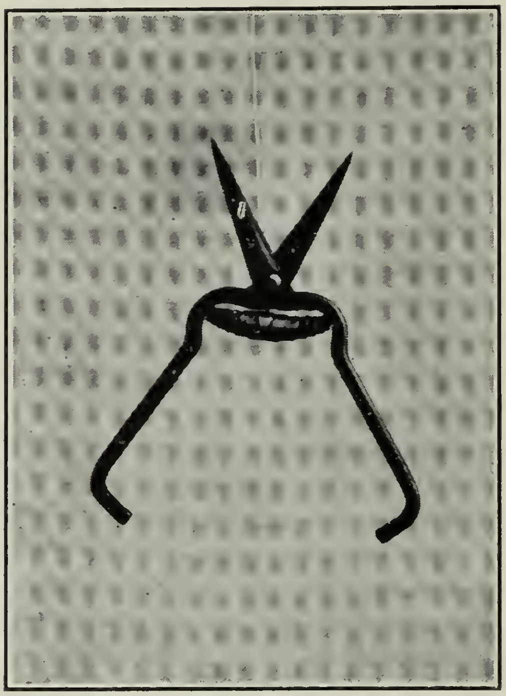
2. Where farm manure is not available and straw or hay are obtainable, use as follows:

(a) When using straw or non-legume hay, apply in the fall at the rate of two tons per acre, with 150 lb. of nitrate of soda (or equivalent) per ton of material. This nitrogen application should be divided in fall and spring applications, unless cyanamid is used, when the whole application may be made in the fall. The nitrogen is used up entirely by bacterial action in rotting of the straw or hay. Supplement with 0–12–15 as in (1).

(b) Where legume hay is used, apply two tons per acre in the fall, without nitrogen application. In this case there is enough nitrogen in the legume hay to satisfy bacterial decomposition. Supplement with 0–12–15 as in (1).

3. Where a complete fertilizer is desired, an application of 600–800 lb. of 4–8–10 per acre may be made every other year. This application will give some increase in vine growth and fruitfulness, more especially on light soils; but its main value on normal grape soils is likely to be in promoting the growth of green-manure crops. For this latter purpose it is hardly necessary to use such a high grade fertilizer or in such heavy amounts. Use rather a 2–12–6 at 250 lb. per acre.

4. Cease cultivation not later than the 15th of July and plant some suitable green-manure crop such as millet, oats, buckwheat, or rye.



(*Fig. 13*) *The best type of clipper to use in cutting the crop.*

HARVESTING

The one point in connection with harvesting which really needs stressing is that of proper maturity. Practically all varieties of grapes reach full size and have good colour several days before they are satisfactorily edible. They are not mature in the sense of full development of sugar content, which determines quality. The result is that many varieties are harvested before they should be. This is true of the green varieties such as Niagara, as well as red and blue varieties. It is believed, and no doubt with cause, that the placing of immature, low quality grapes on the early market seriously interferes with the later marketing of better quality fruit.

It should also be noted and emphasized that *there is no appreciable increase in sugar content once the fruit has been cut.* Most kinds of fruits continue to "ripen" after picking, but not the grape. Ripening processes cease immediately the grape is cut. It is obvious, therefore, that grapes should not be cut, even if well coloured, until sugar development is sufficient to ensure good quality. Taste is an easily made and sufficient test for all practical purposes.

A four-year experiment, carried out at Vineland from 1931–34 with the varieties Niagara and Concord, showed the following losses in fruit weight caused by cutting before the crop was mature. By cutting two weeks ahead of proper maturity 11.4 per cent less crop was harvested of Niagara and 9.6 per cent less crop for Concord. In other words, had the grower waited until the fruit was mature, for every ton of grapes he cut two weeks early he might have cut 2,228 lb. of Niagara and 2,192 lb. of Concord. Translated into six-quart baskets, this increase would amount to twenty-five baskets of Niagara and twenty-one baskets of Concord per acre.

(Fig. 14) Grape leaf hoppers on underside of grape leaf. (Courtesy Dominion Entomological Laboratory, Vineland Station)

GRAPE INSECTS AND DISEASES

The following very brief discussion is intended merely to assist the grower in recognizing the various symptoms and injuries caused by the common diseases and insects attacking grapes. Mention is made of cultural practices that assist in controlling the diseases and insects, but since spray recommendations are frequently modified, no directions for spraying are given and the grower is referred to the Ontario Spray Calendar for Pears, Stone Fruits, Grapes and Bush Fruits.

Where the spray schedule does not provide for the insect or disease, the grower is requested to write to the Horticultural Experiment Station for the latest control measures.

Grape Leaf Hoppers. Leaf hoppers are the most important insects affecting the grape. There are several species differing in appearance, but the colour is usually yellowish with brown, red and black markings; the body is about one-eighth inch long, and slender. The adults pass the winter in long grass and weeds or under brush and leaves along headlands, roadsides and waste land, and make their appearance in the spring. When the grape leaves appear they migrate to them in large numbers and soon commence laying eggs.

(Fig. 15) Grape leaf hopper adults—greatly enlarged. (Courtesy Dominion Entomological Laboratory, Vineland Station)

(Fig. 16) (Left) Newly set cluster of grapes webbed together by grape berry moth. (Right) Bunch of grapes infested by grape berry moth. (Courtesy Dominion Entomological Laboratory, Vineland Station)

The nymphs, or young, appear about mid-June to mid-July and are paler than the adults, usually cream colour. Both nymphs and adults live and feed on the underside of the grape leaves.

In some vineyards and in some seasons hoppers are relatively scarce, but in others they are innumerable and can injure the crop and vines severely. Small whitish spots appear on the upper surface of the leaves wherever they feed and when these are numerous the whole upper surface of the leaf becomes mottled, later turns brown and may die. If there is considerable injury the quality and maturity of the fruit is affected, and the vines will be weakened, thereby reducing the crop of the following season and making the vines liable to winter injury.

To control the insect, spray as directed in the Spray Calendar. In addition, grassy and weedy places in the vicinity of the vineyard where the adults over-winter should be burned over early in the spring.

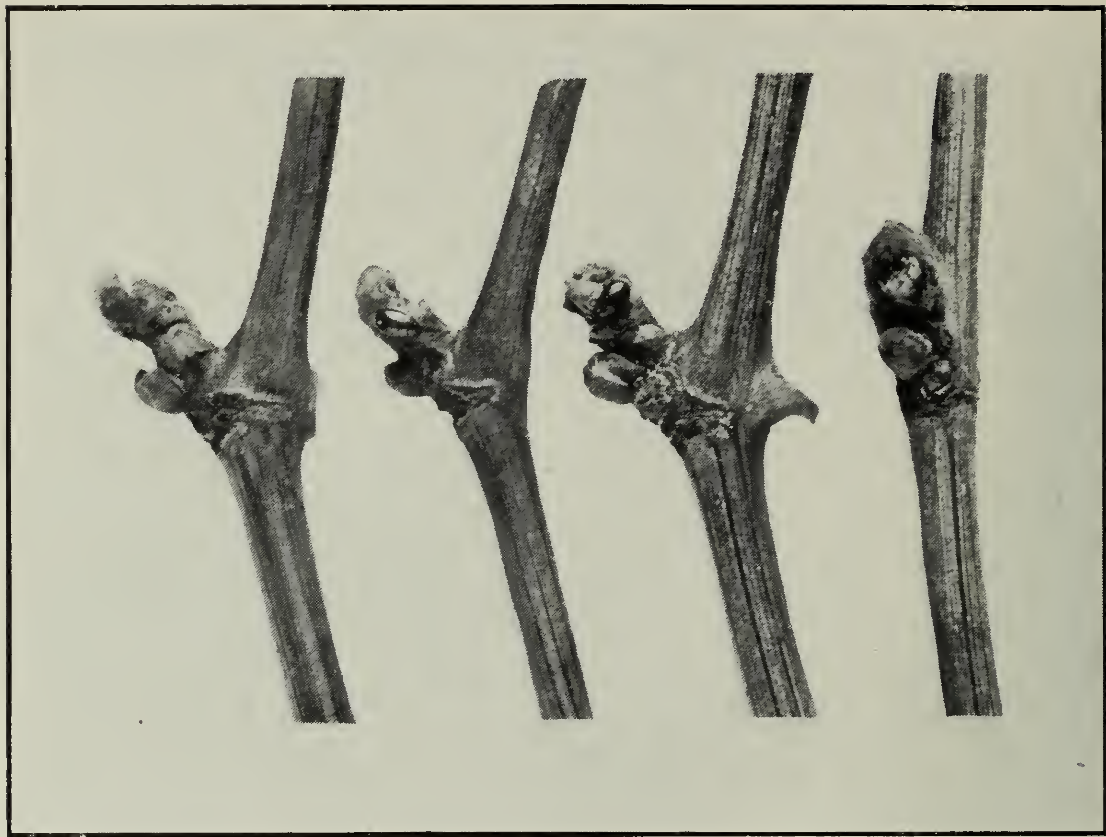
Grape Berry Moth. The berry moth occurs in all parts of the Niagara fruit belt but is destructive only in a few vineyards, particularly in Niagara, Grantham and Clinton townships. The berry-moth caterpillars are dark greenish or purplish and about three-eighths inch long when full grown. They web together and feed on the blossoms and newly set fruit, and a second brood attacks green and ripening fruit, tying the berries together with silken threads, boring through one berry to another and feeding on the pulp. Infested bunches show discoloured and shrivelled berries and are worthless.

This insect requires special control measures. Write to the Horticultural Experiment Station, Vineland Station, for detailed instructions.

Grapevine Flea Beetle. This insect is not common and usually occurs in destructive numbers only in vineyards close to woods and waste land. The adults are steel-blue beetles about one-fifth inch long and spend the winter under the shelter of rubbish near the vineyard, wild grapes, or Virginia creeper. They make their appearance in the spring when the buds are swelling, eat into the grape buds and completely destroy them. The larvae or young worms are brown with black heads and many black spots on the back and are about one-third inch long when full grown. They eat chainlike holes in the leaves. The adults also feed on leaves, but in most cases neither larvae nor adults do much injury to the foliage.

Waste land and headlands where the adults winter should be cleaned up. For spray directions write to the Horticultural Experiment Station, Vineland Station.

Rose Chafer. This insect can breed only in light sandy soils and so is troublesome only in such areas. The adults are yellowish brown or fawn coloured, long-legged, awkward appearing, somewhat slender beetles about three-eighths inch long. The winter is spent as a grub in the soil; it changes to a pupa during the latter part of May, and the beetle emerges early in June a few days before Concord grapes bloom. The beetles soon fly to host plants, including grapes where they feed on the leaves, blossoms and newly set fruit. When abundant they can easily destroy the whole crop.



(*Fig. 17*) *Grapevine flea beetle attacking grape buds.* (*Courtesy Dominion Entomological Laboratory, Vineland Station*)

The rose chafer can be controlled. However it must be done on a community-wide basis if it is to be effective. The important breeding places, waste sandy land, grass land and neglected fields are first brought under cultivation and then seeded to clover or reforested. Fruit plantings must be cultivated thoroughly when infested.

In the vineyard itself, special sprays are effective in protecting the fruit against rose chafers coming from nearby breeding places. Write to the Horticultural Experiment Station for detailed instructions.

Downy Mildew. This fungus disease is serious only in vineyards here and there and in wet seasons. Downy mildew attacks the young shoots, tendrils, leaves, blossoms and fruits. It is first seen on the leaves as irregular, pale yellowish blotches on the upper surface. These spots may increase in size or be so numerous that they run together and affect the whole leaf. The blotches later turn brown. A white, downy fungus growth develops on the undersurface of these spots if the weather has been damp. Whitish spots appear on the affected shoots which turn brown and wither if the disease is severe. If the berries are attacked when quite small, growth is stopped, the berry is covered with the white mildew and finally darkens and dries up. On larger berries, brown spots appear and increase in size, finally involving the whole berry which becomes shrunken and dark brown.

(*Fig. 18*) (*Left*) *Normal grape blossom cluster.* (*Centre*) *Blossom cluster destroyed by rose chafers.* (*Right*) *Rose chafers feeding on apple.* (*Courtesy Dominion Entomological Laboratory, Vineland Station*)

To prevent the disease spray thoroughly with the materials recommended in the Spray Calendar.

Powdery Mildew. Powdery mildew affects young shoots, leaves, blossoms and fruits. It is first seen as a circular whitish spot on both sides of the leaf. The spots may enlarge and run together until the whole leaf is affected. Badly mildewed leaves may be stunted and distorted. Mildewed blooms do not set fruit. Affected berries may cease to grow and drop, or develop irregularly and not ripen.

To prevent this disease spray as directed in the Spray Calendar.

Dead Arm. Dead arm is primarily a disease of the trunk and arms of the vine. It can be identified by the appearance of a dead arm or arms on the diseased vine; and on arms not already killed, the leaves are small, yellowish, and curled and crinkled on the margins. The leaf symptoms are most noticeable during June and early July. Later the yellowing disappears but the dwarfing, curling and crinkling remain. The disease is rarely found in young vines and may be present for several years in old vines before the symptoms appear in the arms.

Affected vines or arms should be tagged during June and early July so that they may be recognized and removed at the regular pruning time. Cut well below the diseased wood. Where the trunk is not diseased at ground

(Fig. 19) Grapevine showing upper arm to the right with dwarfed, curled and crinkled leaves—typical symptoms of Dead Arm.

level a new trunk may be trained up as discussed under "Renewing Old Vines." Periodic renewal of vines more than ten years old will help to keep the disease in check.

Black Rot. The fungus causing black rot of grapes may attack the leaves' tendrils, shoots, blossoms and fruits. Usually the disease does not attract attention until the half-grown berries start to rot. Light spots first appear on the berries; these enlarge quickly until the whole berry is affected and becomes a shrunken, black, hard mummy. The surface is covered with minute, black, pimple-like structures which contain the spores. The whole bunch or only a few berries may be affected.

On the leaves small, circular, brown spots with dark borders appear. Minute black specks may be seen on these spots.

To prevent this disease spray as directed in the Spray Calendar. At pruning time, no mummified fruits should be left hanging on the vines or wires. Burn the prunings early. Plowing in the spring to cover the diseased leaves and dropped fruits will help in controlling the disease. This should be done as early as possible.

ORCHARD GRAFTING

By W. H. UPSHALL

HORTICULTURAL EXPERIMENT STATION

VINELAND STATION, ONTARIO

BRIDGING, ONE FORM OF ORCHARD GRAFTING-- BRIDGE TRUNK INJURIES AND SAVE TREES.

ONTARIO DEPARTMENT of AGRICULTURE

STATISTICS AND PUBLICATIONS BRANCH, TORONTO, ONTARIO

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An understanding of the procedure in orchard grafting is often very useful knowledge to a fruit grower. It may be applied in changing the top of a tree, or part of it, from one variety to another, or in repairing damage to trunk or main branches. The former is commonly called topworking and the latter, repair grafting.

Topworking methods are used for the following purposes:

(1) To change the fruit-bearing area to a variety giving greater financial returns.

(2) To correct pollination troubles, i.e., the changing of the tops of a few of the trees to a variety which will be an effective pollinator for the main variety.

(3) To topwork desirable commercial varieties which, however, are subject to trunk and crotch injury, on to other varieties of proven hardiness in these respects.

Repair grafting is done to save trees or to improve their growth following injury to trunk or main branches by mice, rabbits, fire blight, freezing, or implements.

There are already innumerable methods of grafting and new ones are constantly being described. In this publication however, only a few of the more desirable methods will be considered, selection being made on the basis of labour availability at the required time, ease of execution, and permanence of union. The orchardist who is interested in methods as such is referred to standard text books on propagation and fruit growing.

ESSENTIALS OF SUCCESS

There are four main essentials of success in the grafting operation:

(1) The scion and stock must be of the same plant species or of nearly related species. Pear grafted on apple for instance, may result in a union of a sort but there is likely to be sufficient disagreement between the two that there is interference with the flow of water and food materials past the union, or that breakage occurs at that point.

(2) The cambium layers of both scion and stock must be placed and held in close contact so that the two unite as the cells of each divide and re-divide in their growth processes.

(3) Scions must be in a dormant state, or very nearly so.

(4) All of the tissues wounded in the grafting operation must be protected from drying out by covering them with some tying material, or grafting compound, or both.

In the orchard, grafting is usually done in spring or early summer. However, a form of grafting called budding is done in the latter part of the summer, using buds from the current season's growth. Here the scion is very small, consisting usually of one bud only, adjacent bark, and a very thin strip of wood under it, or perhaps none at all.

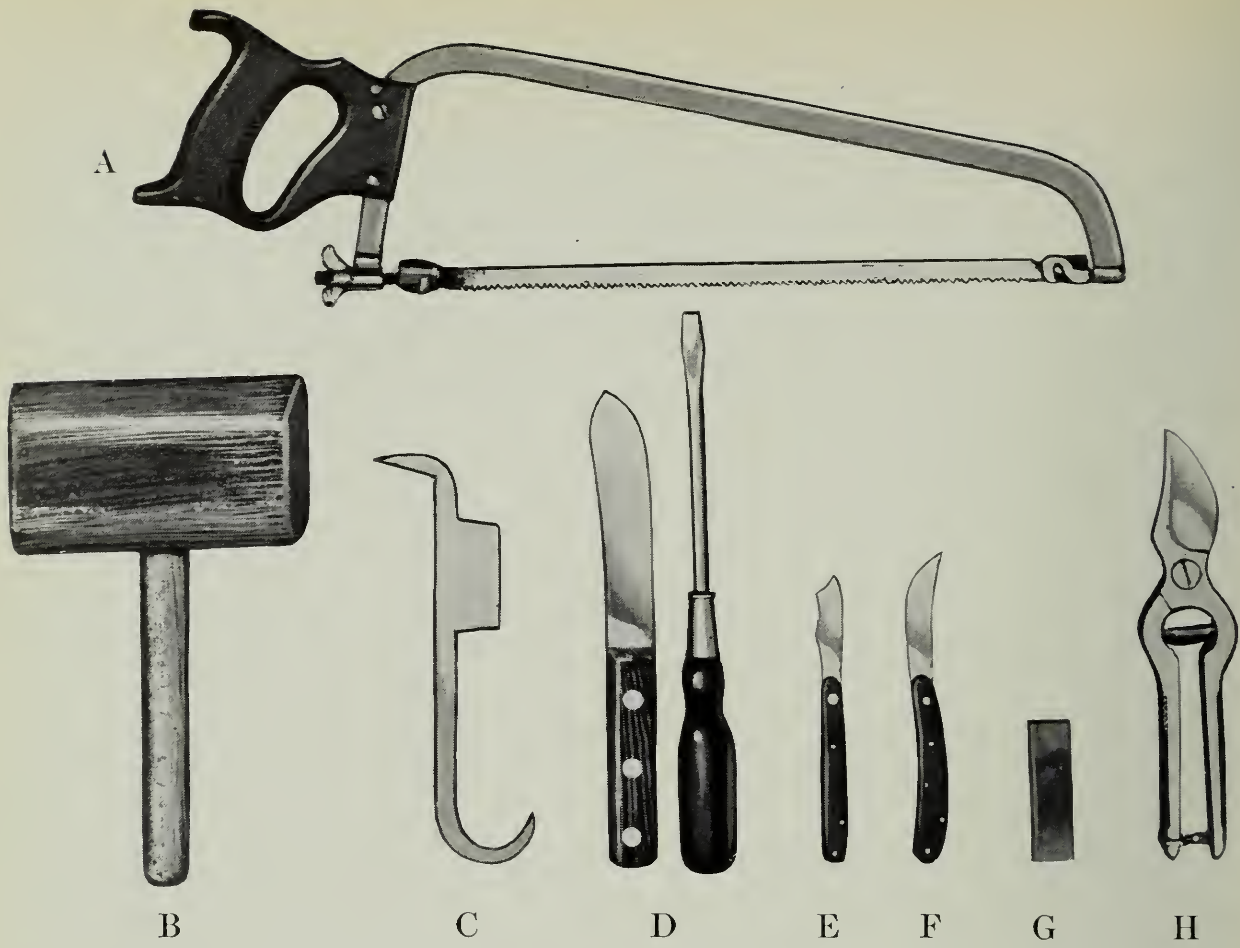

FIG. 1. Tools used in topworking and repair grafting.

A—Saw; B—Wooden mallet; C—Grafting tool;
D—Butcher knife and screw driver, satisfactory substitutes for grafting tool C;
E—Budding knife; F—Knife for stub and oblique side grafting;
G—Pocket hone; H—Pruning shears.

TOOLS

By far the most important grafting tool is a sharp knife. In addition to a sharp edge it should have a thin blade. If it fulfills these specifications it can be an ordinary pocket knife or the specialized budding knife (Fig. 1 E). A small fine-grained pocket hone (Fig. 1 G) should always be available so there may be no excuse for using a dull knife. A good saw, kept sharp and with proper amount of set, is an important asset. An adjustable blade type as shown in Figure 1 A is very satisfactory. A grafting tool (Fig. 1 C) is useful but not absolutely necessary since a heavy butcher knife and a steel-shafted screwdriver (Fig. 1 D) are suitable substitutes. A wooden mallet (Fig. 1 B) or piece of wood is needed to pound the grafting tool or knife into the stock in making the cleft.

GRAFTING COMPOUNDS

Up to a few years ago grafting waxes, made from various recipes, were used almost exclusively for covering the wounded surfaces at the point of grafting. Most of them were heated and applied with a brush. Recently water emulsions of asphalt are coming into favour for this purpose. They give equally as good results as the grafting waxes, have better tenacity, are no more costly and, best of all, do not require heating at time of application. This latter quality has special appeal to those artisans who have had difficulty in keeping the waxes constantly at proper temperatures and in sufficient supply.

The asphalt emulsion grafting compounds are available at hardware and other stores under various trade names. Precaution must be taken to get only the asphalt emulsions recommended for wound dressings on trees, not those used for roofing purposes which may contain additional materials injurious to fruit trees. The asphalt emulsion should be kept from freezing as otherwise the emulsion will be broken down and become useless as a wound dressing. Also, to prevent drying out after the container is opened, the unused emulsion in the pail should be kept covered with water which may be poured off before the next time of usage, if necessary. In the form in which the emulsion is sold it is best applied with a thin narrow wooden paddle but, by addition of some water, it may be applied with a brush.

If asphalt emulsion is not desired or is not available a good brush wax may be made from 5 lbs. resin, 1 lb. beeswax, ½ lb. lampblack or powdered charcoal, and ¼ pint of raw linseed oil. Melt the resin, add beeswax and melt, add linseed oil, remove from fire, add the lampblack a little at a time, stirring constantly. For immediate use cool to a safe temperature; if for later use, pour to one inch depth in shallow pans. After thorough cooling, knock out of the pans by a sharp blow and, for later convenience, break into small pieces.

At the time of grafting, this wax may be heated in a small pail with a one-burner coal-oil heater which is set in a box or short barrel in which there is an opening near the base for air intake. To ensure no interruption in the work there should be two pails of wax, one in use and one being heated. A one-inch brush is the right size to use in applying the wax.

COLLECTION AND CARE OF SCION WOOD

The best scion wood for topworking is of about lead pencil thickness. For repair grafting somewhat heavier wood is desirable. For both purposes terminal growths or suckers are used but in either case it should be wood of the previous season's growth only. The use of older wood would be justified only in case of extreme scarcity and then a reduced take of scions must be expected. For topworking, the best scions are obtainable in the central portions of these shoots, the buds in the basal portion being weak, and in the terminal portion either immature or having a proportion of undesirable blossom buds. For bridge grafting, the terminal portions are undesirable but the basal portions may be used with success.

FIG. 2. Topworking by cleft grafting. Four limbs of good distribution around the tree have been sawn off and two scions placed in each one. The leader has been treated similarly but the scions in it cannot be seen readily. The balance of the top is being left for one season to furnish partial shade for the grafted branches and to keep the scions from growing too vigorously and too late in the fall.

For grafting in early spring, ordinarily nothing is gained by cutting the scions far in advance of the grafting operations. The scions may actually be injured in storage through keeping them in a medium either too wet or too dry. However, where scion wood of a given variety is scarce it will be desirable to obtain it before that variety is pruned as otherwise suitable scion material would be lost. Stored scions should be kept moist and cool. Sawdust and peat moss make good storage media. Both should be thoroughly moistened and then all excess water wrung out by hand squeezing. Tied in small bundles and labelled correctly the scions should be covered with the moist medium and kept below 40°F. in ice house, cold storage, refrigerator or cellar. It is of the utmost importance that scions be in a dormant state when they are used in the grafting operation. With buds only slightly swollen some of the scions may be expected to make unions but the stand will be less than from completely dormant scions. Scion wood should not be allowed to dry out while the grafting is being done.

The collection, preparation and care of budsticks is discussed under **Budding**, (Page 16).

TOPWORKING

TOPWORK OR REPLANT?

Stone Fruits. It is generally considered inadvisable to try to topwork stone-fruit trees. If the trees of the unwanted varieties are four years or under they may be budded with fair success even in two- and three-year-old wood **provided the operation is properly timed,** this probably being where most operators fail. So far, no one has set any optimum time for budding orchard trees of the stone fruits, either by calendar date or growth stage of scion or stock. In any event newly planted trees of the stone fruits grow rapidly and bear early, so that little or nothing is gained by topworking. Grafting on trees older than four years is even more uncertain in its results than the topworking of younger trees. In the peach there is also the danger of canker infection at the grafting wounds followed later by breakage at this point. In the plum there is the danger of transmission of a virus disease from a variety which does not show its effects to one which is adversely affected by it; for example, Italian Prune grafted on Damson often becomes infected with Prune Dwarf.

Apple and Pear. Topworking of apple and pear is usually much more successful than it is with the stone fruits and is justified under the following conditions:

(1) The stock tree must have a good framework, uninjured, and with strong crotches.

(2) It must be in a good growing condition. A poor state of growth may be an indication of some poor physical condition of the soil incapable of correction and which would therefore make the tree, regardless of variety, continuously unprofitable.

(3) There must be suitable places for inserting grafts so the new bearing area is not too far from the ground for profitable management. In ordinary cleft grafting for instance, it is usually unwise to place scions more than seven feet from the ground. In topworking a tender variety on a hardy framework the bud or scions should be placed at least 18 inches from the trunk.

(4) There must be prospects of sufficiently increased profits from the new variety or strain to more than compensate for the loss of yield through the heavy pruning incident to the grafting operation. As an example, the topworking by cleft grafting of an eight-year-old McIntosh apple tree (Fig. 2) to a superior colour strain reduced

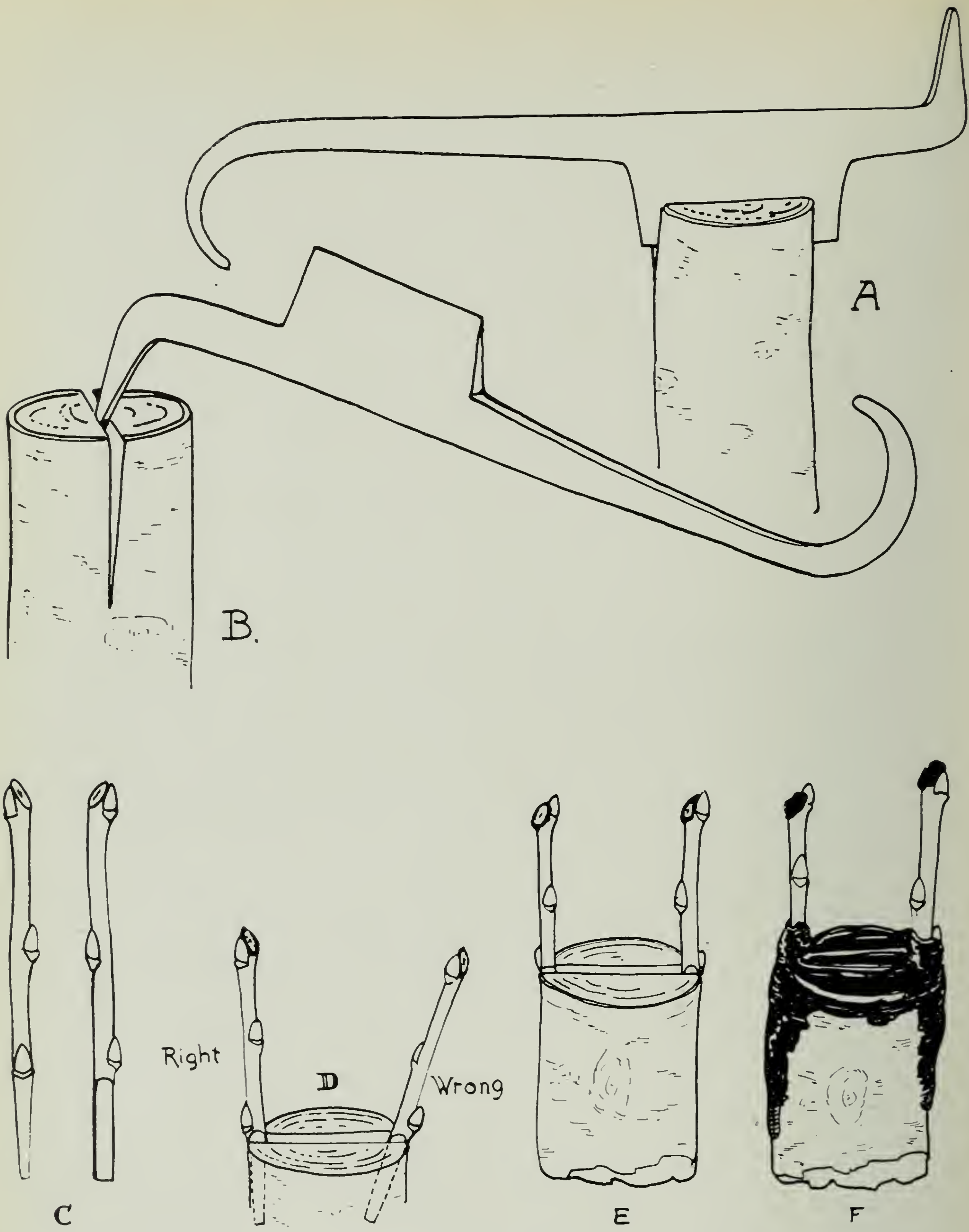

FIG. 3. The steps in cleft grafting. A—Making the cleft. The limb is split by pounding grafting tool or knife with a wooden mallet or piece of wood;

B—Opening the cleft to insert the scions; C—Two views of the scions;

D—Right (on left) and wrong (on right) placement of scions; E—Scions in place;

F—After covering the wounds with grafting compound.

the crop from this tree over 1400 lbs. in the succeeding six years when compared to an adjacent ungrafted tree. However, when the original variety is worthless or of much less value than the new scion variety, the costs of grafting and crop loss would eventually be returned to the grower through increased returns from the new top.

(5) Stock and scion must be congenial. As far as is known no uncongeniality exists between apple varieties commonly grown in Ontario though it is generally considered unwise to topwork a strong-growing variety on a weak one. Kieffer pear stock has not been satisfactory for Bartlett.

THE CLEFT-GRAFTING METHOD

On the tree to be cleft-grafted, some time should be spent in selecting the branches on which grafting is to be done. The grafting of four or five well-spaced branches, two scions in each, should be sufficient to produce a satisfactory new top on the tree (Fig. 2). Usually there are more than four or five primary and secondary branches on a tree. These extra branches should be left intact and unpruned for one year during which time they furnish partial shade to the grafted branches, a protection against sunscald; also, by their competition for nutrients, they keep the scions from making excessive and late growth. Trees have been killed outright in a severe winter following grafting when all, or a large percentage of the top, was removed at the time of grafting.

Some authorities recommend a two-year job in topworking large trees but, with apples, where it is possible to leave a third or more of the top intact for a year and still find places for eight or ten scions in four to five limbs, it seems unnecessary to prolong the operation to a second spring. The balance of the original top should be removed a year after the grafting operation. With pears, because of the greater danger of infection with fire blight on trees forced into strong growth by heavy pruning, there is good argument for extending the topworking over two seasons.

The best take of scions will be obtained on branches 1 to 2½ inches in diameter at the point of grafting. Smaller branches may not furnish enough tension to hold the scions tightly in place and on larger ones the tension may be so great as to crush the scions. At the chosen point the limb is cut off, the cut being made as nearly as possible at right angles to the direction of the branch.

Make a cleft in the stub (Fig. 3 A) by placing the grafting tool or knife directly over the centre of the cut and pounding gently with a mallet or piece of wood. The cleft should be made more or less across the stub rather than in a vertical direction.

With a quick drawing cut towards the base of the scion-stick the scions are cut to a blunt wedge-shape (Fig. 3 C) with one edge of the wedge slightly thicker than the other (Fig. 5 A). The wedge should be cut in such a way that the lowest bud of the scion will be immediately above the wedge on the thick side (Fig. 3 E). The leaf growth from this bud will speed callus formation at the upper area of contact and result in the rapid healing of the wound which is so desirable. Three-bud scions, with the top cut made close to the upper bud, are commonly used.

FIG. 4. Preparation of scions. A scion prepared with a blunt end (left) gives more complete cambium contact and more stability than a scion bevelled to a point (right). (*Photo courtesy Michigan State College*).

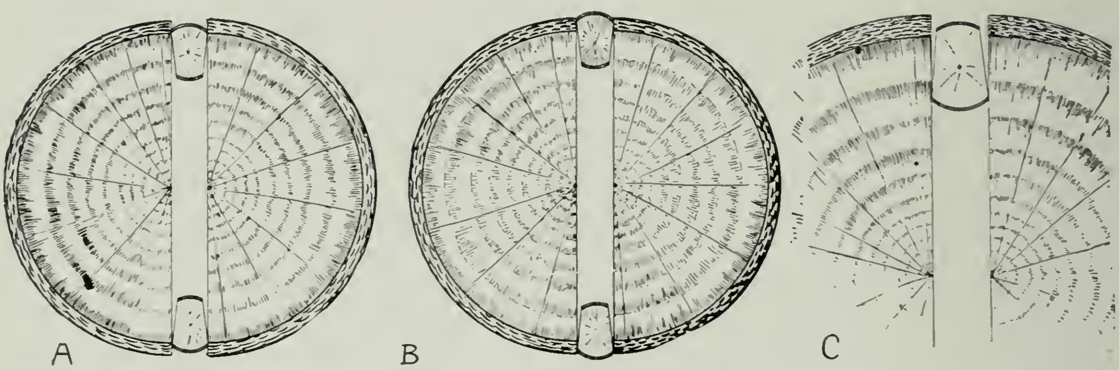

FIG. 5. Placement of scions, cross-section view. (*Michigan State College*).

A—Correct. Scions set slightly inside the outer perimeter of the stock to allow for differences in thickness of bark;

B—Incorrect. No allowance for these differences and therefore no cambial contact, result failure;

C—No cambial contact owing to undue thickness of inner side of scion.

The cleft is opened with grafting tool or screw driver (Fig. 3 B) and the two scions are placed so that the cambium layers of scion and stock are in contact or very close proximity **throughout the whole length of the scion wedge** (Fig. 4, left and Fig. 5 A). This means very careful cutting and placement of scions with due allowance for the differences in bark thickness between scion and stock (Fig. 5). Of importance too is a uniform thickness of wedge for the two scions in any given stub. If one is thicker than the other the former may reduce the pressure by which the latter is held, thereby preventing good contact. When the operator is satisfied with the contacts of both scions, the grafting tool (or screw driver) is removed and all wound surfaces are thoroughly covered with a grafting compound (Fig. 3 F).

FIG. 6. In cleft grafting, wound healing is hastened by retention of both scions for a few years. The less desirable one (arrow) is dwarfed by light annual pruning, and is finally removed by means of a diagonal saw-cut at its base (white line).

Up to a few years ago it was considered good practice to tilt the scions outward (Fig. 3 D, wrong) so there would be absolute assurance of cambial contact at one point at least,—where the two cambium layers crossed one another. Investigations in Michigan have shown that this practice often led to poor growth and faulty unions. Based on this work the commonly recognized objective is cambial contact for the **full length** of the wedge of the scion.

If both scions on a stub grow successfully they are left intact and unpruned during the first summer. At pruning time each succeeding year the less desirable of each pair is pruned lightly to dwarf it (Fig. 6), and when the wound is nearly healed over, the dwarfed scion is cut away entirely. Until fruit bearing commences the only pruning recommended for the permanent scion is the elimination of crotches sharper than 35°, which are inherently weak and subject to later breakage.

Where one of the pair of scions has failed but a sucker has arisen from this side of the stock and close to the cut, it is treated as described above for the less desirable scion. If a suitable sucker does not arise at this point, this side of the stub is sawn off at a sharp angle during the first summer (Fig. 7). This procedure permits the healing of the new wound around its whole perimeter. Without this oblique cut an area of dead wood opposite the growing scion is inevitable and offers a place of entrance for wood-rotting organisms.

FIG. 7. Treatment of a case where one scion died. A diagonal saw-cut, as shown, allows for callus formation all around the margin of the cut.

THE FRAMEWORKING METHOD

Frameworking may be a new term to many Ontario fruit growers. It refers to the grafting of many small branches, making it possible to leave the skeleton of the tree intact (See Fig. 8 and compare with Fig. 2). The use of 50 to 250 scions per tree, depending on its size, is required by this method. Two kinds of grafts can be recommended, **stub**, and **oblique side** grafting, neither of which requires tying and both of which are therefore done relatively quickly. Provided dormant scions are available, frameworking may be done any time during the spring but late March or early April gives best results.

Frameworking takes much more time per tree than the ordinary cleft grafting so commonly used, but the owner is well repaid for the extra time required, for frameworked trees come into bearing at an earlier date and the first fruits are of better quality. This result is to be expected from the known effects of pruning on fruit bearing, fruiting being disturbed in direct relation to the amount of pruning done.

Occasionally some fruit may be produced from frameworked trees in the year after grafting but there will be no appreciable crop until the scions are in their third year. However, this time will be about two years in advance of trees topworked by orthodox cleft-grafting methods.

FIG. 8. Apple tree before (above) and after frameworking. Stub grafts and oblique side grafts, 145 in all, were used. Scions are 5 to 7 buds in length.

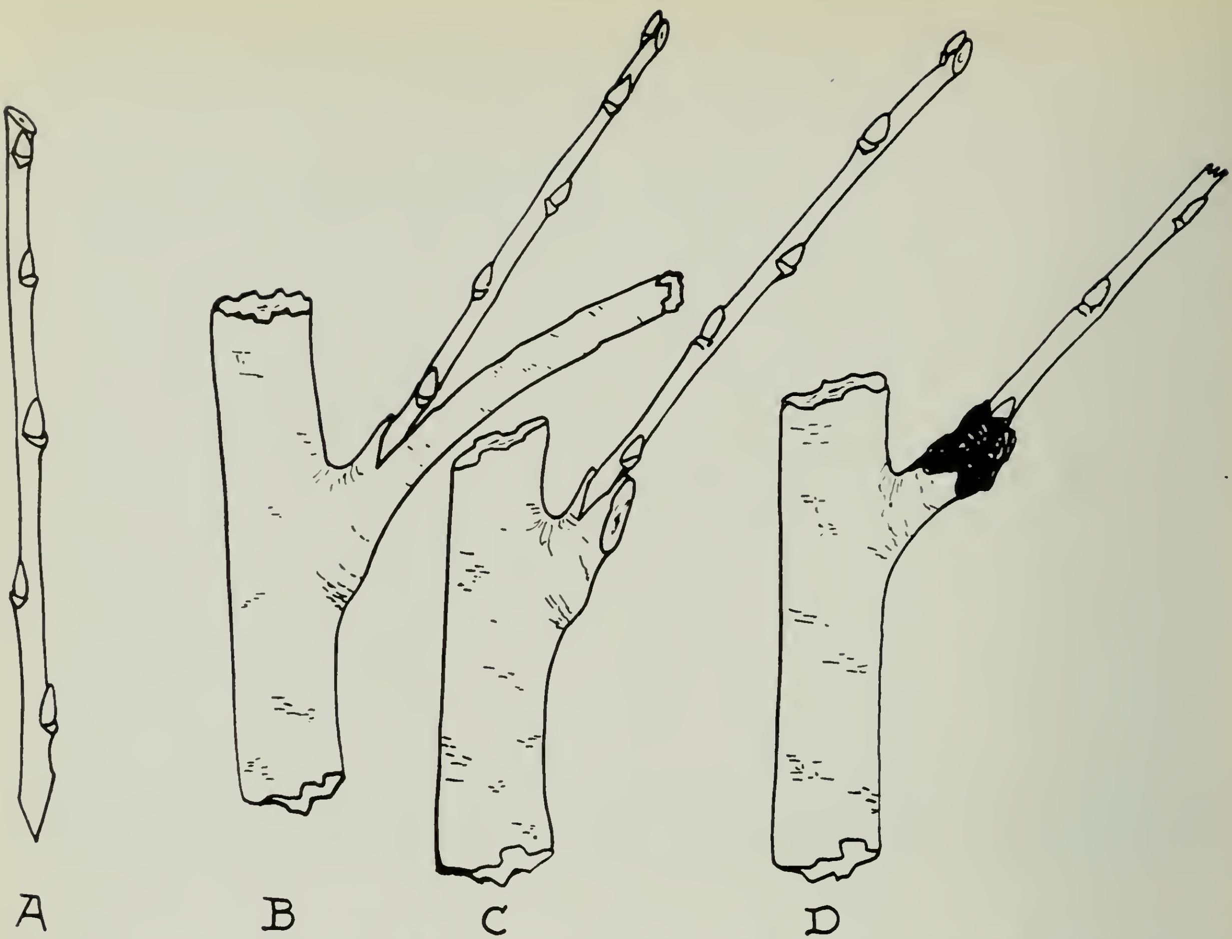

FIG. 9. Stub grafting. A—Prepared scion; B—Scion placed in diagonal cut; C—Branch cut off close to the base of the scion; D—The wound covered.

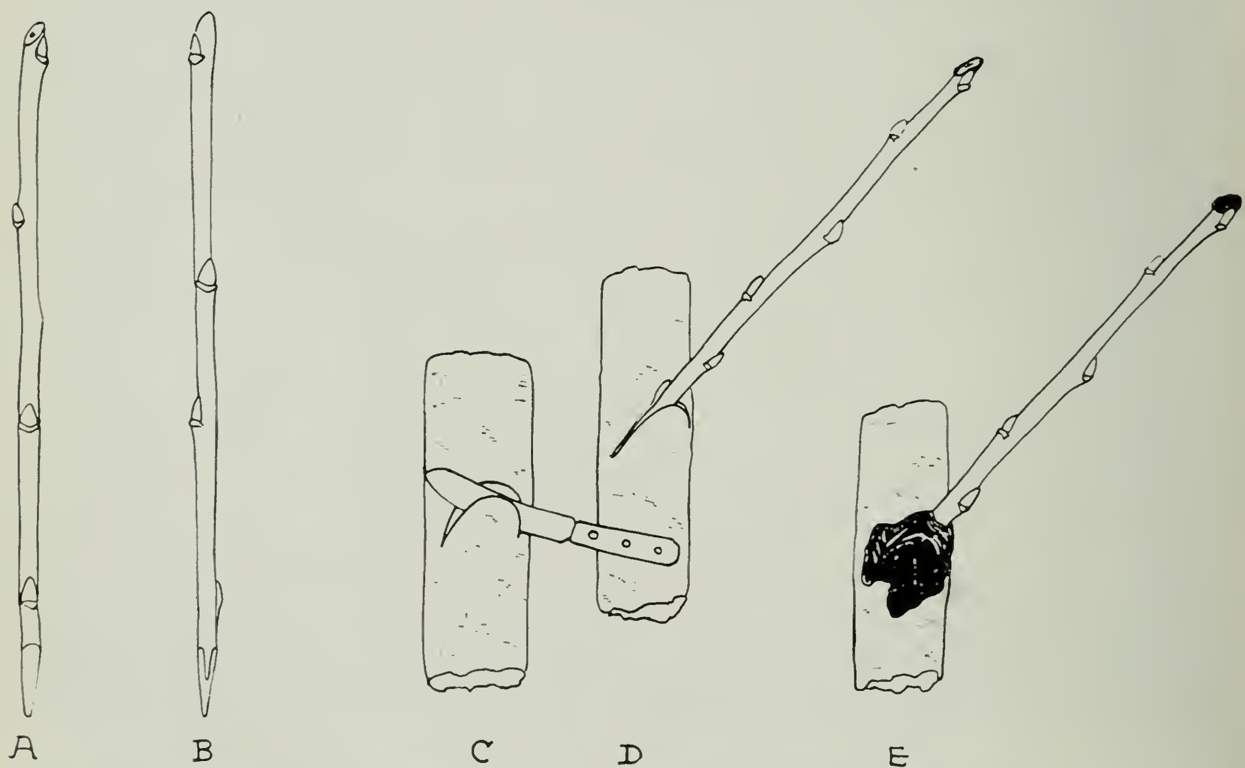

FIG. 10. Oblique side grafting. A, B—Prepared scion two views; C—Making the cut in the stock; D—The scion in place; E—The wound covered.

Stub Grafting. All suitably placed branches of ¼ to ¾ inch diameter at the base, and having wide-angled crotches, are used for grafting. Other branches are removed completely before grafting or during the grafting operations. The terminals of all branches are cut off at a point immediately above the uppermost stub graft. The greater the number of scions used the less will be the interruption of fruiting. In each sector of the tree, scions should be placed and wounds covered, working from the top of the tree towards the base. This order eliminates the danger of accidental displacement of scions during the operations.

Scions bearing 5 to 7 buds are used in preference to the orthodox three-bud scions used in cleft grafting, the claim for them being the encouragement of earlier fruiting. This is a reasonable expectation in that longer scions allow for a greater leaf area per scion. There is also some tendency towards better crotch angles between the scion and laterals arising from it.

Scions are cut with a short wedge at the lower end, one side slightly longer than the other (Fig. 9A).

Beginning about one-half inch from the base of the lateral to be grafted, a diagonal cut is made to the base and **not more than one-half way** through the lateral. A relatively heavy knife with straight or slightly concave blade (Fig. 1 F) is required for making this cut. The lateral is pulled downwards to open the cut for convenience in placing the scion, which is inserted with the longer side of the wedge underneath and with the cambium layers in line along one side. The lateral is allowed to go back into position and as a result the scion is held in place by tension so that no tying is required (Fig. 9 B). The lateral is then cut off with a knife or sharp pruning shears as close as possible to the scion (Fig. 9 C) and all cut surfaces are covered with a grafting compound (Fig. 9 D). To ensure strong crotches care must be taken against creating branch angles less than 35° between the parent limb and the scion.

Oblique Side Grafting. Oblique side grafting is more difficult to execute properly than stub grafting but may be very useful to fill in gaps on a branch where suitable laterals for stub grafting are absent. In other words, the best job of frameworking may often be done by a combination of stub and oblique side grafting. For this latter method the 5 to 7 bud scions are cut to a one-inch sharp wedge, one side of which is thicker and longer than the other (Fig. 10, A, B). An oblique cut is made in the limb of the stock, and not more than one-quarter way through it (Fig. 10 C). By bending the branch slightly or opening with the knife the scion is inserted, thick side of the wedge uppermost, and pushed into the proper position for cambial contact with the stock (Fig. 10 D). As in stub grafting, a heavy knife is required in making the cleft and care must be taken to have the scion so placed that narrow crotch angles do not develop between scion and stock. No nailing or tying is required, only a coating of a suitable grafting compound (Fig. 10 E).

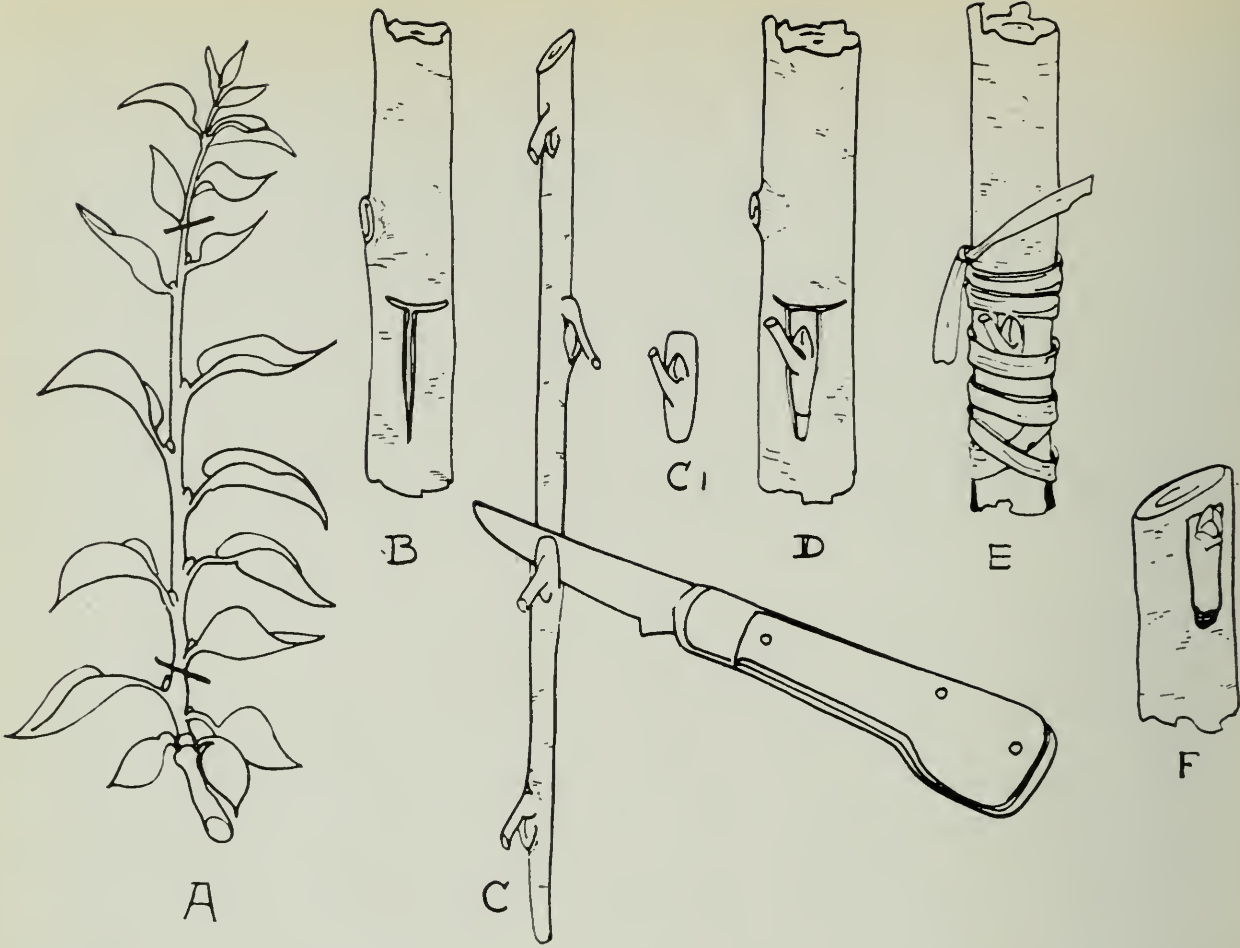

FIG. 11. Shield budding. A—Terminal growth of current season, the source of buds;

B —The T-cut in the stock; C—The prepared budstick showing the cutting of the bud;

C1—The shield bud; D, E—The bud in place and tied tightly against the stock with raffia;

F —The branch of the stock cut off close to the bud in the following spring.

BUDDING

Budding is a form of grafting easily learned by the inexperienced person. The main disadvantage is that normally it must be done in the summer time when there is so much other work to be done.

For success in budding, the cambium layer of both scion and stock must be in an active growing condition. If the bark lifts freely from the wood there is then no doubt that this condition holds. Only by actual testing with a knife can the state of the cambium be determined. If the bark does not lift freely and clean from the wood, budding will be largely unsuccessful. There are numerous forms of budding which involve slight modifications in the technique of cutting the bud or making the opening in the stock, but for most purposes the common shield bud is quite satisfactory. Therefore only this method is described.

In shield budding the scions are usually single buds attached to a shield-shaped piece of bark and with or without a thin strip of wood on the under side. The shield buds are obtained from terminal growths of the current season (Fig. 11 A). Buds from the upper and lower portions of these terminals are not used, the former being too immature and the latter small and weak. Discard them. From the remainder of the shoot remove the leaves **before any wilting occurs,** leaving only a small piece of the base of the leaf stem (handle) for convenience in placing the bud into the stock (Fig. 11 C). Shoots thus prepared are known as budsticks. Keep them in moist burlap or newspaper from the time they are taken from the tree until the budding operations are completed. Not more than two or three days' supply should be prepared at a time.

The best results in budding are usually attained on stock wood of the current season's growth. However, under orchard conditions, this wood seldom gets large enough to hold a bud properly and it is therefore necessary to use two-, three- and even four-year-old wood. The older the wood the thicker the bark, and consequently the greater are the physical difficulties in placing the bud. However, with proper timing of the operation, the take of buds even in three- and four-year-old wood can be reasonably good. If suitable wood of these ages cannot be reached from the ground it is advisable to top the tree severely in order to encourage a growth of suckers from the lower part of the framework, buds being placed in these suckers. This procedure is justified only when the trunk and main branches are in a healthy condition, and when spring grafting cannot be done in suitable wood below the seven-foot level.

In the orchard, budding should be done in late July or early August as after this time the bark of the stock may not lift readily. With a special budding knife (Fig. 1 E), or a good pocket knife with rounded blade, a **T**-shaped cut is made in the bark on the upper side of the limb and at least 18 inches from the main trunk. The top of the **T** is made first and then the stem is made beginning about 1¼ inches below and ending at the horizontal cut. Before removing the knife, the flaps of bark are opened by means of a twisting motion with the knife (Fig. 11 B).

In cutting a bud from the budstick the usual procedure is to hold the small end of the stick toward the body and cut from below, ¼ to ½ inch, to about the same distance above the bud. The shield is then released by a horizontal cut (Fig. 11 C and C 1). Some budders cut a thin strip of wood tissue with the shield and then remove it before inserting the bud. For fruit trees however, there appears to be no evidence in favour of this method over the less difficult technique of cutting the shield so shallow that the only wood tissue is that immediately under the bud.

Holding the shield by the handle it is entered under the flaps of bark and pushed down into the incision until its upper end is flush with or slightly below, the top of the **T** (Fig. 11 D). To double the chances of getting a tree completely budded over to another variety in one year it is a common practice to place two buds in each limb where a new branch is desired.

In topworking, the common tying material is dry raffia which may be obtained from firms handling nursery and florists' supplies. Beginning at the lower end of the incision the raffia is wound tightly around the wound and as closely as possible to the bud both below and above it. The lower end of the raffia is carried **underneath** the turns of raffia in sufficient length to allow for tying with the other end at the top of the **T** (Fig. 11 E).

Where the stock is growing rapidly the raffia may have to be cut about three weeks after budding, otherwise there will be partial girdling of the branch at this point. If the constriction is not appreciable the tie may be left intact until spring by which time it may have been naturally loosened by partial disintegration.

In nursery budding operations ready-cut rubber strips are tending to displace raffia as bud ties. However, in orchard work, the range in size of stock branches might make the use of any one length of strip unworkable though the operator can use two rubber strips per bud on the larger branches where one strip gives insufficient tension. One definite advantage of rubber strips over raffia is the elimination of the need for cutting as a precaution against girdling of the limb. As the limb increases in size the rubber stretches and finally breaks away as it disintegrates from weathering processes. An air-tight tie, or complete coverage of the wound through overlapping of the turns of the tying material, is not required, but the shield must be held firmly in place particularly immediately below and above the bud.

Normally the bud does not start into growth until the following spring. Just as it begins to swell, or very soon thereafter, cut the branch off as close as possible to the outermost bud but without injuring it. The longer the stub left beyond the bud the slower will be the healing of the wound. To further facilitate healing, this cut should slant away from the bud (Fig. 11 F). If the outermost bud fails to grow, cut the branch to the inner bud. If both buds are growing, eliminate the less desirable one.

The degree of success of the budding operations will be evident in 10 to 14 days. If the handle has dropped off the bud shield, and if the bark around the bud looks fresh, it is almost certain that a union has been made. If, on the other hand, the handle has dried up and still adheres tightly, and if the bark looks brown or shrivelled, the operation has been a failure. If necessary more buds may be put in at this time provided the bark still lifts freely.

SUBSEQUENT CARE OF TOPWORKED TREES

Regardless of the method of topworking, these trees require constant care if full returns on the investment are to be realized. Unless there is special reason for leaving them, suckers arising from the stock should be rubbed off as they develop or should be cut off not later than the following spring. Up to time of fruit bearing, pruning should be confined to the elimination of weak crotches and, in cleft grafting, the dwarfing of one of the pair of scions. Normally, strong growth arises from scions and buds placed in established trees and soon the new tops become very dense, actually unsightly. Nevertheless, pruning is undesirable, except for the purposes just mentioned. It delays fruit bearing, and this in turn delays the opening up of the tree brought about by the crop's downward pull on the branches.

Ordinarily it is unwise to apply nitrogen fertilizers to recently topworked trees as, even without them, growth may be excessive, subject to fire blight and aphid injury. As a minimum requirement, these trees should be sprayed as recommended in the Spray Calendar for Young Nonbearing Orchards, (obtainable from the Dominion Entomological Laboratory, Vineland Station, Ontario).

REPAIR GRAFTING

GENERAL CONSIDERATIONS

The purpose of this form of grafting is to repair injuries caused by mice, rabbits, winter cold, fire blight, and implements. At its best repair grafting is a tedious time-consuming job, another instance of prevention being better than cure.

Mouse and rabbit injury can be reduced to negligible proportions by the use of poison baits and by protective measures such as tree guards and repellents. For details of procedure the reader is referred to Ontario Department of Agriculture Bulletins 435 and 436.

Injury from winter cold and fire blight may be reduced by avoiding over-stimulation with nitrogen fertilizers, excessive use of farm manure, too heavy mulches of legume crops, heavy pruning, and cultivation continued too late in the season.

Mechanical injuries can be reduced only with care in working with tools and implements. When mechanical injury occurs in late spring or summer the loose bark should be tacked down at once but no protective covering should be applied to the exposed part of the wound, the tree being able at that time of the year to supply its own wound dressing.

During the dormant season, regardless of the type of injury, the chances of a satisfactory recovery are proportionately greater as the time interval between injury and treatment is reduced. This suggests frequent inspection of the orchard during winter and early spring. If the injury is discovered soon it may be possible to save some of the cambium layer cells by promptly applying asphalt emulsion paste or a liquid grafting wax. In this case new wood and bark cells will be regenerated from the cambium cells and the wound will be healed over much more quickly than when dependent on healing from the edges only. Before applying the protective coating all injured bark should be removed and the rough edges of the wound smoothed off, but by no means should the grower remove any intact inner bark from the area of the wound, or scrape the surface, for fear of removing some of the all-important cambium cells. In fact patches of live cambium cells over the surface of the wound may make it unnecessary to use the bridge grafts described below.

Trees which have been in the orchard less than four years are usually too small for successful bridge grafting. If they are completely girdled, or nearly so, and there is still a collar of live bark above the ground, saw the top off at a point immediately below the injury and place cleft grafts in the remaining trunk as shown in Figure 3.

If the girdled trees have been only one year in the orchard the grower can count on a high proportion of them developing one or more new shoots from above the nursery graft union without the necessity of cleft grafting. The strongest shoot, if reasonably straight, should be saved for a new trunk, and the others rubbed off while still in a succulent state.

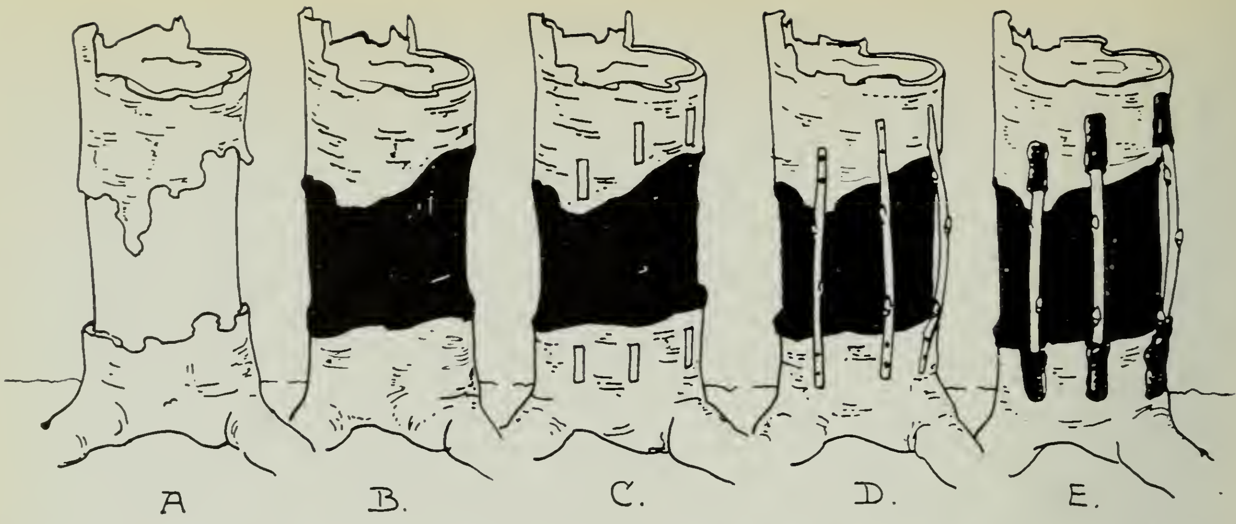

FIG. 12. Bridge grafting under conditions where the wound was treated with a protective covering previous to the grafting operation.

A—The wound showing ragged edges; B—Edges trimmed, grafting compound applied;

C—The channels, about two inches apart, prepared for application of the scions;

D—Scions in place and fastened with one-inch box or basket nails; E—Wounds covered.

BRIDGE GRAFTING

Bridge grafting is the bridging of a tree wound, usually on the trunk, by grafting scions into the uninjured bark above and below the injury in order to re-establish sap flow. Scions are placed by bark-grafting methods and it is therefore necessary that the bark lift freely from the wood. Usually this does not take place until early May. By this time dormant scions may not be available in the orchard and fortunate is the grower who has arranged beforehand for a supply. Some growers and co-operatives anticipate a possible need and make a practice of saving and storing suitable material at pruning time. Lacking dormant scions, the grower who is not aware of the injury until after the trees start into growth is "out of luck". For apples, well-matured sucker growths of hardy and disease-resistant varieties such as Duchess, Fameuse, McIntosh and N.W. Greening are approved material. Details of the handling of scion wood may be found under **Collection and Care of Scion Wood** (Page 5).

Where one-quarter or less of the trunk circumference has been girdled there is some doubt concerning the necessity of bridge grafting, but a wound dressing applied in early spring is always helpful, even to these less extensive injuries.

There are numerous methods of bridge grafting but generally the channel or inlay method is preferred. Two variations with respect to location of the channel are required, depending on whether or not the wound has been treated previously with a protective covering. Where the wound has been covered some time before the grafting operations the method shown in Figure 12 will apply; otherwise the method shown in Figure 13 is more desirable particularly with regard to speed of operation.

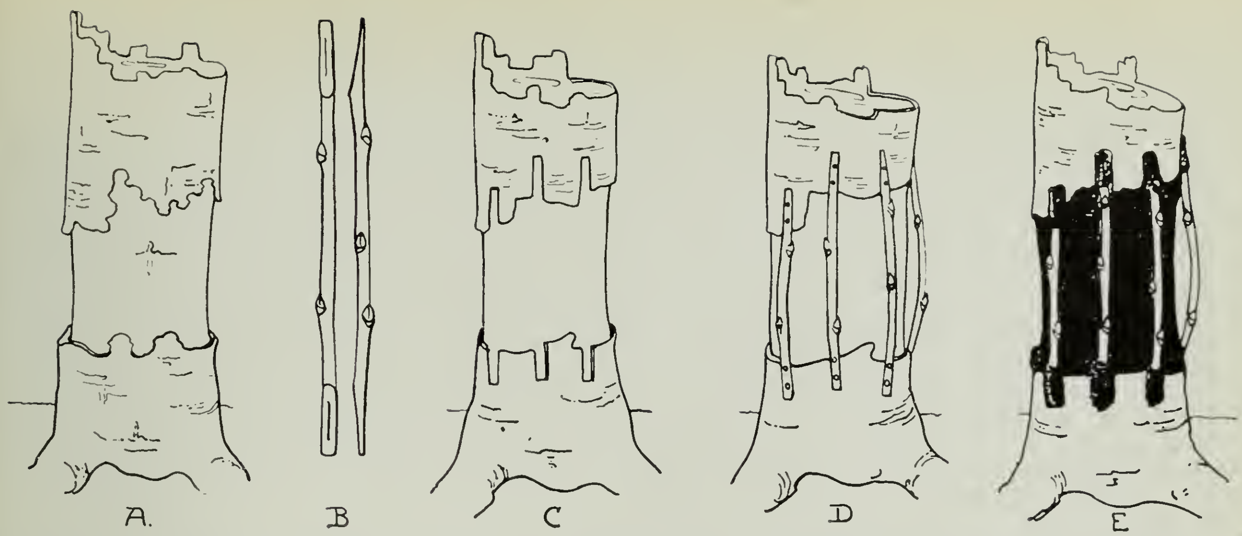

FIG. 13. Bridge grafting where the wound was not treated previous to grafting:

A—The wound showing ragged edges of loose bark; B—Prepared scions, two views;

C—Loose and dead bark removed and channels made;

D—Scions in place and fastened with one-inch box or basket nails; E—Wounds covered.

The reason the latter variation is not applicable to the case shown in Figure 12 is that the knife will get gummed up with the grafting compound as channels are prolonged into this material.

In both instances prepare the scions as shown (Fig. 13 B) with the bevel on the side opposite the natural bow of the wood. When a scion has been cut to the proper length and bevelled for two to three inches at each end it is laid over the wound in the position it is to occupy. By marking around the ends with the knife point for the channels, an almost perfect fit of the scions in the channels is possible (Figs. 12 C, D and 13 C, D). The distance between the extremities of the channels should be slightly less than the length of the scion which will allow for a slight bow of the scion when the job is completed. This slight bend allows better contact of scion and stock and also reduces the danger of breaking connections when the tree sways with the wind.

With the aid of a screw driver lift and remove the strips of bark from the channels. If these strips do not come away readily from the wood it means that the sap is not flowing freely and the work should be postponed until it does. Place the lower (thicker) end of the scion in position and nail it there with two one-inch box or basket nails. Then spring the upper end into position and nail it similarly. Place scions about two inches apart over the injured area and then cover all wounded surfaces thoroughly with asphalt emulsion or grafting wax (Figs. 12 E and 13 E).

Occasionally suckers are present or arise later from the area below wounds. If these suckers extend above the wounded surface they may be used as inlay "scions" at the top end as already described.

Where girdling extends to, or even into, the roots, preventing proper contact of scions below the wounded area, one or more nursery trees may be planted around and as close as possible to the orchard tree, to be used for grafting into the trunk or main limbs above the injury.

Needless to say, adequate precautions should be taken against injury of the bridge grafts by mice or rabbits. This tender tissue is particularly attractive to them.

All shoots arising from the scions should be left during the first year as an aid in healing and to speed up the growth and thickening of the scions. Whether or not they should also be left for a second year is a debatable point but if the growth of scions has been poor in the first season it would probably pay to leave these side growths for another season. When these growths are removed they should be cut flush with the scions, preferably with a saw. This removes latent buds which might otherwise grow into "nuisance" shoots in succeeding years. During the first year or two, when there are side growths and therefore leaves on these bridge graft scions, they should receive the regular tree sprays to control insects and diseases.

ACKNOWLEDGMENTS

The writer is indebted to Miss L. Heringa of the Department of Horticulture, O. A. College, Guelph, for the drawings shown in Figures 3, 9, 10, 11, 12 and 13 and to Michigan State College for use of the illustrations shown in Figures 4 and 5. In preparing this bulletin, use was made of the following publications:

TOPWORKING AND REPAIR GRAFTING. *Ont. Dept. of Agric. Bull. 357 (1934).* (Out of print).

PROPAGATION OF FRUIT TREES. *Mich. Spec. Bull. 142 (1943).*

GRAFTING ESTABLISHED FRUIT TREES. *Ann. Rpt. East Malling Research Station 29, 60-68 (1942).*

C O N T E N T S

CURRANTS AND GOOSEBERRIES

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CURRANTS AND GOOSEBERRIES

W. J. STRONG

INDEX

CURRANTS AND GOOSEBERRIES

W. J. Strong

Currants and gooseberries are native to the more northern, cooler parts of America, Europe and Asia. The cultivated varieties of red and white currants are derived from several *Ribes* species, and most varieties of black currants from *Ribes nigrum* of northern Europe and Asia. One variety of black currant, the Crandall, comes from an American species, *Ribes aureum*, commonly known as the flowering currant. The English or European gooseberries are derived from *Ribes grossularia* while the American gooseberries are chiefly from *Ribes hirtellum;* some varieties are hybrids between the two species.

Currants and goosberries have been considered of minor importance in Ontario and for a long time they were somewhat neglected. In recent years, however, the interest has greatly increased, particularly in the black currant. This new interest is due no doubt to better fruit prices owing to the increased demand for processing in home and factory, this in turn being largely due to the very high vitamin C content of the fruit.

In Ontario the chief producing area of currants and gooseberries borders on the western end of Lake Ontario and includes the counties of York, Peel, Halton, Wentworth, and Lincoln but particularly the last two. Other smaller producing areas are to be found in the counties of Brant, Elgin, Kent, Lambton, Middlesex, Oxford, and Welland.

Currants and gooseberries vary considerably in yield, depending on location, soil, variety, planting distance, season, and care. Generally speaking, however, a good yield for currants is 150 to 200 bushels per acre; for gooseberries from about 200 to 400 bushels, the lower yield being for the European varieties and the higher for the American. On a per plant basis, 6 quarts is a very good yield for any of these fruits, while 3 or 4 quarts is probably nearer the average.

Actual tonnage figures are of interest. At the Central Experimental Farm at Ottawa the following rates per acre for black currants were obtained in 1941; Saunders and Kerry over 4 tons, Magnus 3¾ tons, Climax about 4½ tons, and Boskoop Giant 2¾ tons. One ton equals approximately fifty bushels.

POLLINATION

In general, currants and gooseberries are self-fruitful hence there is no necessity for interplanting varieties for cross-pollination. However, several groups of black currant varieties and particularly that group represented by Boskoop Giant, have a peculiar flower structure which prevents many of the flowers from being self-pollinated.

By careful examination of many flowers of Boskoop Giant and other varieties, experiment station workers in England, (Long Ashton and East Malling) found that there were notable differences in the length of

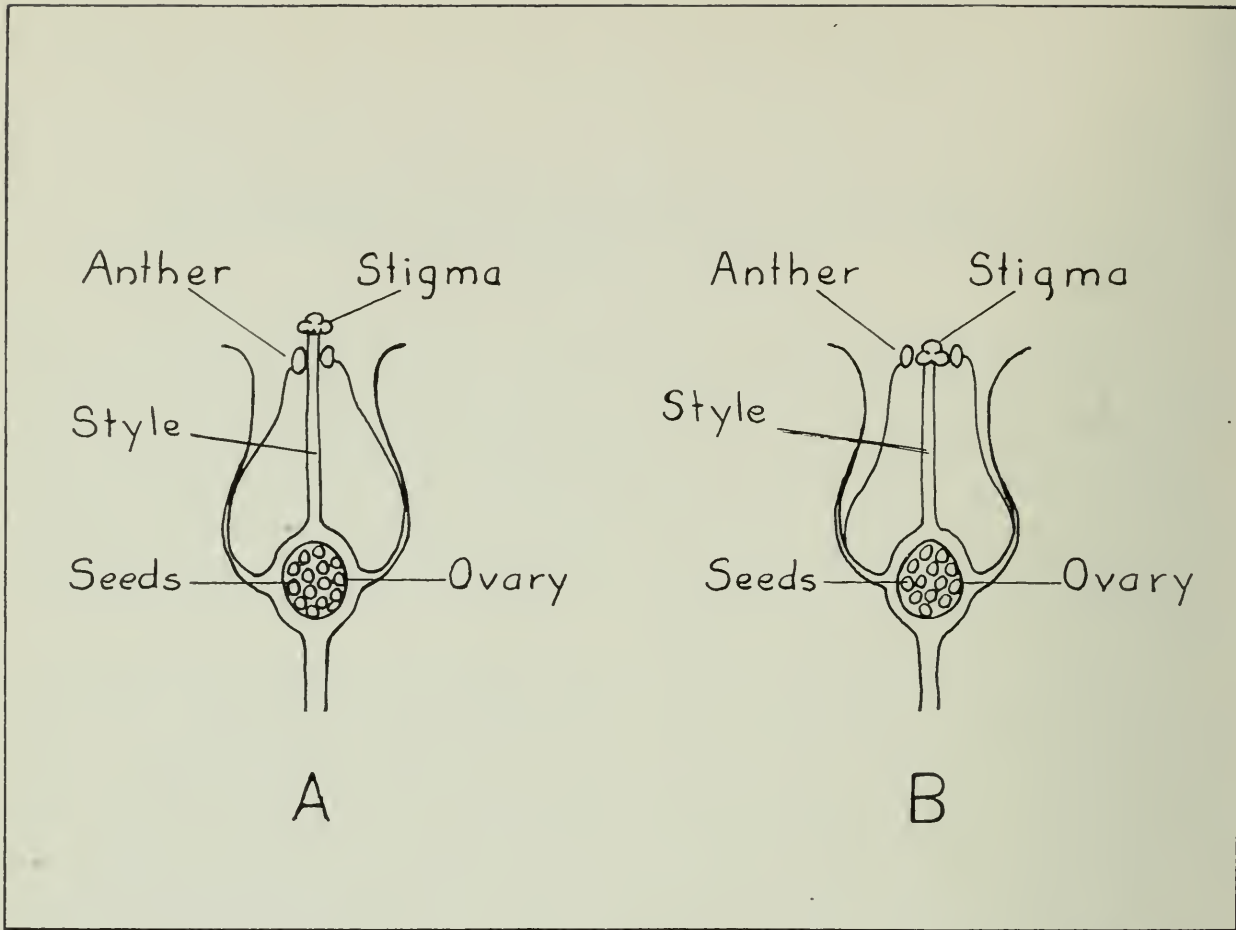

FIG. 1. In the black currant there are differences in flower structure which affect pollination and therefore fruitfulness. In A, since the stigma protrudes beyond the pollen-bearing anthers it is not easily self-pollinated and yield is adversely affected. In B, the stigma and the anthers are on the same level, facilitating pollination and therefore fruit-setting.

the styles (see Fig. 1) in individual flowers. Some were of such a length that the stigmas protruded beyond the anthers (Fig. 1. A) in varying degree, while in others the stigmas were held just even with or slightly above or below the anthers (Fig. 1. B).

In all varieties examined it was also found that the first one or two flowers at the base of a cluster, held their stigmas level with the anthers, or slightly above or below, but that as the flowers progressed towards the tip of the cluster there was a general tendency for the stigmas to be held out beyond the anthers.

The placing of stigmas in relation to the anthers also varied considerably with variety. Some varieties examined had flowers in which the great majority of the stigmas were held level with the anthers or very slightly above or below them (Fig. 1. B), while in others, including Boskoop Giant, many of the flowers especially those toward the tip end of the cluster, held their stigmas out beyond the anthers in varying degree, (Fig. 1. A).

This difference in stigma position in relation to the anthers has a direct relationship to the amount of fruit set. This was rather definitely shown by a series of experiments on artificial self-pollination conducted by the Experiment Station at East Malling, England.

It has been generally observed that Boskoop Giant is an uncertain cropper in Ontario and this work at East Malling indicates the reason. If the weather at the time of blossoming is favourable to insect activity so that pollination is effectively achieved, then a good set of fruit on Boskoop Giant and similar varieties, may be expected; but if the weather and therefore conditions for pollination, are not favourable then only a few easily self-pollinated flowers at the base of the clusters will set fruit. As indicated, varieties other than Boskoop Giant, may have this same fault although it is probably the only one of those commonly grown in Ontario which is likely to be seriously affected.

RECOMMENDED VARIETIES

The accompanying recommendations are from Ontario Bulletin 430 "Fruit Varieties".

In evaluating these recommendations and determining the value of any variety for his particular conditions, the grower should freely consult the Variety Descriptive Notes, which follow the recommendations.

RED CURRANTS

List No. 1 COMMERCIAL PLANTING	List No. 2 TRIAL (Limited) PLANTING
Cherry	Stephens No. 9
Fay	Red Lake
Perfection	
Wilder	
Victoria	
Prince Albert	

While comparatively new and therefore not fully tested, Stephens No. 9 and Red Lake are probably superior to the older varieties in List No. 1. Growers are therefore encouraged to give them extended trial in the expectation that they will eventually replace, to some extent at least, present commercial varieties.

BLACK CURRANTS

List No. 1 COMMERCIAL PLANTING	List No. 2 TRIAL (Limited) PLANTING
Climax	No
Kerry	Recommendations
Magnus	
Saunders	
Naples	

GOOSEBERRIES

List No. 1 COMMERCIAL PLANTING	List No. 2 TRIAL (Limited) PLANTING
Clark	Fredonia
Poorman	Silvia

VARIETY DESCRIPTIVE NOTES

These brief notes on some of the newer or otherwise noteworthy varieties of currants and gooseberries are not intended to be completely descriptive. The purpose is rather to indicate the value of each variety based on its performance at Vineland or elsewhere in Ontario. Generally therefore, it may be assumed that, unless otherwise indicated, a given variety is commercially satisfactory in such characters as vigour, hardiness, cropping ability, fruit size, appearance, and quality. It has seemed of more importance to indicate special qualities or limitations, or some particular distinction of value to the grower in determining whether or not to plant.

Also, it should be recognized that the variety comment or appraisal applies to Ontario conditions. Performance elsewhere may well be substantially different.

RED CURRANTS—The varieties most commonly planted in the past, in order of importance, have been Fay (Fay's Prolific) and Cherry, with considerably less acreage of Wilder, Perfection, Victoria and Prince Albert. Two new varieties that show considerable promise are Red Lake and Stephens No. 9. Following are brief descriptive notes.

Cherry—Many bushes thought to be Cherry are not true to name. The true Cherry is unproductive. The bushes are spreading, quite large and vigorous but with fewer canes than some other varieties. Fruit quite large and of good quality. Clusters small to medium size, with short stems.

Fay—Resembles its Cherry parent. Plants of moderate vigour and rather sprawly habit and canes which break easily. Only moderately productive. Fay flowers early and so is apt to be caught by frost. Clusters and fruit large, stems fairly long, hence easy to pick. Fruit of good quality, moderately acid, hangs well on the plant, ripens in mid-season.

Perfection—Plant of medium vigour and hardiness and seems to thrive best on a clay loam soil. Only a few canes are sent up from below the surface of the soil hence the plant is not renewed as readily as in some other varieties. The fruit is borne on older wood than usual for red currants. Perfection blossoms somewhat later than Fay and is therefore less subject to frost injury. Clusters are large with long stems. Fruit quite large, of good quality, but is inclined to scald on the bushes and so must be picked promptly when mature.

Prince Albert—Vigorous, moderately productive. Plants stiff and erect. Foliage and bloom are late in appearing. Clusters are of medium length, berries large but rather sour and seedy. Fruit ripens very late and hangs on well, this being its chief value.

Red Lake—A new variety from the Fruit Breeding Station, Minnesota. Vigorous, hardy and productive. Fruits large, in fairly large clusters with long stems, good quality. Rather lighter in colour than some of the older varieties such as Cherry and Fay. Ripens mid-season to late. Well worthy of an extensive trial.

Stephens No. 9—A new variety being distributed by the Central Experimental Farm, Ottawa. Moderate vigour, inclined to be sprawly in habit, hardy and productive. Clusters medium to large with fairly long stems. Fruit large and of good quality, less acid than some. Ripens in mid-season. Worthy of extensive trial.

Victoria—Very vigorous and quite hardy. Clusters medium size. Fruit small to medium, rather acid. Ripens in mid to late season, hangs on a long time. Useful in colder parts of Ontario, where hardiness is a vital consideration.

Wilder—Vigorous, moderately hardy and very productive. Clusters large, fruit large and borne on long stems, quality good, mild. Ripens late mid-season, fruit clings well. Recommended for the milder parts of Ontario.

BLACK CURRANTS—The varieties now commonly grown in Ontario, in order of importance are Champion, Black Victoria, Naples and Boskoop Giant. Others planted to a lesser extent are Kerry, Magnus, Saunders, and Climax.

It will be noted that the recommended list differs considerably from the list of those varieties, which now constitute the bulk of commercial planting. Most of the varieties in the recommended list are comparatively new and while believed to be superior to the old varieties, they are not yet extensively planted.

Black Victoria—Vigorous and hardy. Clusters short, berries variable in size and ripen unevenly. Late season.

Boskoop Giant—Moderately vigorous. Fruit large and of good quality, ripens early. Production variable and uncertain on account of poor self-pollination due to peculiar flower structure (see paragraphs on pollination, pages 5-7).

Champion—Vigorous and productive. Clusters short, fruit ripens unevenly, later than Black Victoria.

Climax—Vigorous and productive. Clusters large, fruit large, ripens evenly. Mid-season.

Kerry—Vigorous and productive. Clusters large, fruit large, ripens evenly. Mid-season to late.

Magnus—Moderately vigorous, productive. Clusters medium size, fruit large, ripens evenly. Mid-season.

Naples—An old standard variety, very much planted in some parts of Ontario. A good grower and productive. Fruits vary considerably in size. Ripens late.

Saunders—Vigorous and productive. Clusters medium size. Berries rather variable in size from small to medium. Ripens in mid-season.

Climax, Kerry, Magnus and Saunders were all originated by Wm. Saunders of London, Ontario, and distributed by the Central Experimental Farm, Ottawa.

GOOSEBERRIES—Varieties of the European (English) type are preferred by some growers on account of their large fruits and fine appearance but they are quite susceptible to mildew necessitating careful spraying. Also they lack the hardiness of American varieties. On the other hand varieties of the American type are more generally grown as compared with the European varieties; in addition to being hardier they are more vigorous, less susceptible to mildew and easier to propagate. Their fruits, however, are generally smaller.

The most commonly planted gooseberries in Ontario have been the Downing, Josselyn (Red Jacket), Houghton, Clark and Pearl. Others planted to a lesser extent are Charles, Fredonia, Poorman and Silvia.

Here again, as with black currants, the list of varieties recommended for planting, differs considerably from the list of those most commonly grown. The varieties in the recommended list are comparatively new. It is believed, however, that they are superior in one way or another to the varieties usually planted. Following are brief descriptive notes.

Charles—American. Similar to Pearl but rated better than that variety by the C. E. F. Ottawa. Vigorous, healthy, hardy and productive. Red when fully ripe.

Clark—A large-fruited European type, thought to be a natural hybrid between European and American varieties. Moderately vigorous, productive, fruit easy to pick. Generally free from mildew. Hardy, except in the colder parts of Ontario. Propagated by layering. Ripens late mid-season.

Downing—An old standard variety of American origin and planted more than any other variety in Ontario. Vigorous, hardy and healthy. Very productive but fruit small. Moderately easy to propagate by cuttings. Should probably give way to such varieties as Charles and Silvia or to the large fruited kinds like Clark, Poorman, and Fredonia.

Fredonia—This is a new, large fruited European type from New York State. Plants vigorous and of open habit, which makes for easy picking. Fruit large, attractive and of good quality. Matures late, and is dark red when fully ripe. Well worthy of a trial.

Josselyn—(Red Jacket)—American. Thought to be from a cross between Houghton and Red Warrington. Plants vigorous and productive. Fruits of medium size, somewhat larger than Pearl or Downing and of good quality. Ripens early.

Pearl—American type, vigorous and productive. Fruit a trifle larger than Downing.

Poorman—Of American origin. Plants very vigorous, upright and spreading, productive. Has a preference for the heavier soil types. Fruit above medium in size but not so large as Clark and Fredonia. Early mid-season, red when ripe, good quality. Easily propagated by cuttings.

Silvia—American type. Vigorous and hardy, somewhat variable in yield. Red when ripe. Considered by the C. E. F. at Ottawa to be rather better than Charles.

Whitesmith—Of English origin. Plants large and vigorous, usually productive. Fruit medium to large, good quality, ripens early. Subject to mildew. Propagation by layering. Probably grown more than any other English sort in North America.

PROPAGATION

CURRANTS—Currants are propagated by hardwood cuttings from the new wood, which may be taken any time after the plants become dormant and the wood is fully ripened. They are often taken at the time of pruning.

Cuttings should be made six to eight inches long with the lower cut just below a bud to facilitate callousing. The top cut is usually made at least half an inch above a bud to prevent drying out around the top bud.

If the cuttings are made before the ground freezes they can be immediately planted in a nursery row, if desired. Select a well-drained location where there is no danger of water standing at any time. Place the cuttings about six inches apart in furrows about three feet apart. The furrow should be deep enough so that only one or two buds are above ground. This deep planting prevents drying out and encourages root formation. Plant the cuttings in a slanting position and firm the earth well about them. During the winter it is advisable to cover them with a straw mulch to prevent heaving caused by intermittent freezing and thawing of the ground. Cultivation should be started in early spring and continued throughout the season. By fall the cuttings should have made good growth and be ready to set out permanently.

When cuttings are to be held over winter, tie them in bundles and store, either in a cool cellar or in a cold-frame covered with sash. In either case place them butt end up and cover with two or three inches of sawdust, peat, sandy soil, or sand. Sprinkle occasionally to keep them from drying out. This "down-side-up" position encourages callousing and rooting as the base of the cutting gets more air and warmth than if right end up, also the tops are kept cooler and the buds retarded somewhat from starting into growth. If the cuttings are placed right end up, the upper buds are apt to start into activity before proper callousing has taken place. This is most likely to happen if cuttings are taken late.

In the spring after the soil has warmed up a bit the cuttings are set out in nursery rows as previously described.

GOOSEBERRIES—This fruit is propagated both by cuttings and by layering. There is considerable variation in the ability of varieties to root from cuttings. Thus varieties of the American type in general root much more readily than those of the European type. In fact the latter root with difficulty or not at all from cuttings hence have to be propagated by layering.

Gooseberry cuttings are treated in the same way as currant cuttings, as described for that fruit.

Layering may be done in two ways. If only a few plants are needed, several branches, while still attached to the plant, are bent down and partly covered with earth. They are held securely in place by the weight of the earth or by hooked pegs forced into the ground. This layering may be done in the fall or spring and by the following fall the layers should be rooted sufficiently to be set out in a nursery row. Slow rooting varieties will need another year before they are rooted well enough to be moved.

Mound layering is used for quantity production of plants. The first step is to cut back severely, in the dormant season, the main branches of established bushes. This will induce the formation of many vigorous shoots the following year. Early in July, when these young shoots have about completed their growth, heap earth up and amongst them until about half the length of the shoots is covered. In extensive operations this mounding up may be done with a plow, otherwise a spade or shovel will serve. Pack the earth well around the plants and leave a mulch of loose earth, peat, or sawdust to keep the soil cool and moist.

SOIL AND LOCATION

Currants 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 to scalding 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. Some reduction in the intensity of the sun's rays, as from shade of fruit trees, will be found advantageous, especially with gooseberries, shading and the cooler atmosphere helping to control mildew. A shade which is low and very dense, preventing good air circulation, is undesirable, because this condition also induces mildew, but shade with good air drainage makes an ideal location for currants and gooseberries, hence these two fruits often thrive well in the orchard. This shading is, of course, most advantageous in those districts, such as the Niagara, which have a much warmer climate than that naturally favoured by the currant and gooseberry.

Also, 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 unfavourable soil.

ESTABLISHING THE PLANTATION

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 than two-year plants, and make a better growth than they would during the same time in the nursery. There is also the danger that two-year plants may be the cull one-year stock, left over and grown a second year.

PREPARATION OF 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 farm manure, be plowed deeply 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 gooseberries start growth very early in the spring. Fall planting can be done as soon as the leaves are off and any time up to freeze-up. If, however, the ground is very dry it may be better to delay planting until spring.

On account of the early start into growth, spring planting should be done quite early, just as soon as the ground is thawed out and dry enough to permit of the work being done. If delayed until the buds are beginning to burst the plants are apt to receive a check which will affect them throughout the first growing season.

DISTANCE OF PLANTING—Generally speaking, black currants are stronger growers than red currants and gooseberries, hence the old recommendation of 4′ x 4′ for red currants and gooseberries and 5′ x 5′ for black currants. However, other factors in addition to size of plant must be considered. In dry seasons especially, the closely planted plantation will suffer more than where the rows are farther apart. Consideration must also be given to spraying and the use of cultural implements.

Spraying is a necessity with these fruits just as with orchard fruits and most growers now use large spray outfits requiring a considerable distance between rows or groups of rows. The bushes may be set out in a long but narrow plantation so that all rows can be reached from the outside. A modification of this plan, suitable for a large plantation, is to leave an occasional wide space, perhaps every five or six rows.

If larger implements than the single horse cultivator are to be used for cultivation then the wider spacing will be needed between every row. Not only team cultivators and disks are being used, but also the tractor disk. This of course, makes for much greater speed in cultivation but it is doubtful if such a heavy deep-cutting implement as a tractor disk should be used with shallow-rooted plants like currants and gooseberries.

Just how far to space the rows must be decided by the individual grower, but 8 to 10 ft. is suggested. In the rows, plant red currants 5′, gooseberries 5′ and black currants 6′-7′ apart. This spacing, which is greater than recommended in the past, results in greater feeding area and greater water supply per bush and will be reflected in more vigorous growth and greater yield **per bush.** However, to obtain the greatest yield **per acre,** it will be necessary to arrive at a reasonable balance between the number of bushes or spacing and yield per bush. The spacing can be overdone, with reduced per acre yield.

Planting currants and gooseberries between orchard trees is a fairly common practice and here considerable thought should be given to proper spacing. One of the main faults with this interplanting has been the crowding of too many bushes between the orchard trees. This has resulted in a deficiency of moisture and fertility for both trees and bushes and also has caused considerable inconvenience in orchard operations. Where trees are set only 20 ft. apart there is room for only one black currant bush between each pair of trees and it is questionable whether there is enough space between tree rows for a row of currants. At greater distances, say 24 ft., there would be sufficient room for two black currant bushes between each pair of trees and also for a full row of currants or gooseberries between rows of trees.

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. Also cut back the branches somewhat to balance the reduction of roots.

CARE OF THE PLANTATION

CULTIVATION—The general subject of soil management in horticultural practice is discussed in Ontario Bulletin 437 "Orchard Soil Management" to which the reader is referred for detailed information.

Cultivation controls weeds and thus conserves soil moisture. Also, since it speeds up the decomposition of organic matter, it helps in releasing plant foods. However, as currants and gooseberries are shallow rooted, all cultivation, especially near the plants, should be shallow to avoid destruction of feeding roots.

In a newly set plantation it is customary to plow towards the plants as soon as planted in the fall. This provides extra cover of soil immediately around the young plants and does much to prevent heaving due to thawing and freezing in the spring.

In older plantations plowing may be done in fall or spring, preference usually being given to the former. In fall plowing, plow up to the plants and this will leave a furrow between rows to drain off surface water. If plowing is left until the spring it is usual to plow away from the plants. In either case be sure that the furrow immediately alongside the plants is quite shallow. Also, when soil is taken away from the rows by plowing, an out-throw disk should be used as soon as possible to turn some of the soil back again towards the plant rows.

Start spring cultivation as soon as the ground is dry enough to work nicely and continue throughout the season until the fruit is picked in midsummer. After the fruit is harvested a cover crop may be sown or the ground may be left to grow a crop of weeds. The purpose of this is to gradually reduce the supply of moisture and nutrients to the bushes so that growth will be slowed up and maturity of the new wood induced in preparation for winter.

The type of implement to use in cultivation will depend very much on the grower's particular circumstances. If these fruits are being grown on a fairly large scale and the distance between rows permits (see paragraph on distance of planting, page 13) then the large implements will be used but if on a relatively small scale the work will most likely be done by single horse cultivator. In any case a considerable amount of hand hoeing will be necessary to level the soil and destroy weeds immediately around the plants.

MULCHING—Mulching of fruit trees with various materials such as manure, straw, and old hay, has been used to advantage in conserving soil moisture and in reducing or eliminating cultivation. Mulching may be just as beneficial a practice with gooseberries, at least according to the experience of one grower who reports excellent results with that fruit. He used quite heavy and frequent applications of alfalfa screenings and covered all the ground around the bushes to a depth of five or six inches. The increase in size of bush, size of fruit and total crop was very marked and he considered it very much worth while in spite of the heavy cost of material.

Mulching, to be of any real advantage, must be well done, and to be continuously effective it must be well maintained. Additions of material will be necessary from year to year to replace that which decays and becomes incorporated in the soil.

A good mulch will smother weeds, conserve moisture, and keep the soil cool. These are soil conditions most congenial to the currant and gooseberry and especially important in southern Ontario's normally hot dry summer conditions. Disadvantages are that the mulch harbours mice and is a fire hazard.

While the heavy mulching practised by this one grower may be out of the question on a large scale, due to the cost and the difficulty in obtaining enough material, yet it has much to commend it, and in smaller plantations at least, could be used to advantage.

If a non-legume straw or hay is used as mulching material some nitrogen fertilizer, such as nitrate of soda, will be needed to provide the bacteria, active in the rotting process, with enough nitrogen for their needs; otherwise they will use the nitrogen in the top soil and rob the gooseberry plants. If, however, a legume hay such as clover and alfalfa is used the extra nitrogen will not be needed.

FERTILIZERS—Currants and gooseberries are heavy feeders and must have their food readily available and close at hand, as the roots do not spread far or deeply. Farm manure is undoubtedly the best fertilizer for these fruits, with perhaps potash and phosphoric acid applied extra in some form. Soil fertilization need not be heavy until the plantation has come well into bearing, when annual applications of manure and fertilizers should be made.

There is little danger of overfertilizing the currant and gooseberry plantation. It is particularly important to keep up the organic matter content of the soil. This may be done by the use of farm manure, green-manure crops, also by the application of straw or old hay, plus some nitrogen fertilizer to help the process of decay. (For detail consult Ontario Bulletin 437, "Orchard Soil Management").

Increased yields of the Wilder red currant are reported from Ohio by the use of nitrogen (sulphate of ammonia). Both in Massachusetts and in England, currants have benefited from potash applications. Also, in England, potash was of value on gooseberries. Experiments in Ohio with the Wilder red currant also showed increased yields from farm manure alone, from manure plus super-phosphate, and from straw plus nitrogen.

FIG. 2. Unpruned red currant. In pruning red currants remove wood that is becoming unfruitful—generally, that which is over 3 years of age. Also, thin out the new shoots so that 6-8 are left to develop into fruiting wood.

FIG. 3.—The same bush, as in Fig 2, after pruning. Five main fruiting branches are left, also eight new shoots. Care should be taken to leave these new shoots evenly distributed.

PRUNING CURRANTS—Proper pruning is essential to the production of good crops of fruit. The fruiting habits of red currants and black currants differ 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 red currants it is necessary to maintain a good supply of vigorous wood two years or more in age, while in pruning black currants we must look to the production of a plentiful supply of young wood.

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. About six or eight main fruiting stems, properly distributed, will bear a good crop of fruit and future pruning should aim at maintaining this number with younger ones coming on to take their places as they become unproductive and are removed.

In red currants the young vigorous shoots that are to take the place of the older canes may be shortened to prevent the bush from becoming straggly and to force the development of fruit spurs evenly along their whole length, instead of mostly at the ends. In black currants this shortening of the branches is not advisable.

In pruning both red and black currants, therefore, the objective is to have vigorous young growth always coming on to take the place of the older branches as they become unproductive. As already indicated, wood older than three years in red, and two years in black currants should be removed. Where borers are troublesome in black currants it is particularly important that all wood older than two years be removed; also any canes that do not appear to be thrifty should be cut out.

PRUNING GOOSEBERRIES—The fruiting habit of the gooseberry is similar to that of the red currant, hence the method of pruning is practically the same. After two or three years of bearing, the wood begins to fail and produces inferior fruit in smaller quantities, and so there should always be vigorous growth coming on to take the place of older wood as it is removed.

As previously noted, (See paragraphs on Soil and Location) excessive sunlight may cause scalding of the fruit and may favour the development of mildew, especially in the European varieties, hence pruning in the gooseberry should not be overdone. However, the bush must be kept reasonably open to facilitate picking and spraying.

RENEWAL OF PLANTATION—Currant and gooseberry bushes, with good care, liberal fertilizing, and proper pruning, may be kept in profitable production for many years. After eight or ten crop years, however, the plantation usually begins to fall off in vigour and productiveness. Hence it is advisable to set out a new plantation about every ten years, or as soon as any notable decline is apparent in vigour and fruitfulness.

FIG. 4. This black currant bush has been allowed to get too thick. Pruning should have been done annually, removing all fruiting wood over two years old and thinning out surplus new shoots.

FIG. 5. The same bush as in Fig. 4, after a rather severe pruning. All old wood has been cut out, leaving only the youngest and best fruiting branches, with enough young wood to come into bearing next year. This heavy pruning may cause an excess of young shoots to come up in the next growing season. Moderate annual pruning would avoid this.

INSECTS AND DISEASES

Insect pests and fungus diseases must be controlled if currants and gooseberries are to yield their maximum annual crops and high quality fruit. Neglected currant and gooseberry bushes become a prey to aphids which cause the leaves to curl and blister, and the foliage of red and white currants is devoured by green worms. All varieties of currants are attacked by such fungus diseases as Leaf Spot, Anthracnose, and Currant Rust, which cause the leaves to fall early in the season. Powdery Mildew often disfigures the foliage and ruins the fruit of English gooseberries. If these pests are not controlled, the vitality of the bushes is soon lowered and they cannot possibly produce profitable crops. Growers therefore, should make themselves acquainted with the insect pests and fungus diseases described on the following pages of this bulletin.

Most of these troubles can to a large extent be controlled by spraying. The latest directions for spraying currants and gooseberries will be found in the **Ontario Spray Calendar for Pears, Stone Fruits, Grapes and Bush Fruits,** which is revised yearly. The latest calendar may be obtained by writing to the Fruit Branch, Dept. of Agriculture, Toronto.

THE MORE IMPORTANT DISEASES

J. E. Howitt, Department of Botany, Ontario Agricultural College

POWDERY MILDEW OF THE GOOSEBERRY, (*Sphaerotheca mors-uvae*). This is particularly a disease of the English varieties of the gooseberry and is one of the greatest obstacles to the growing of these varieties in Ontario. It seldom does much damage to American varieties, or currants.

This disease first appears on the young leaves and tender tips of gooseberry bushes as a white powdery mildew. This may spread over a considerable portion of the bush and cover the young fruits soon after they are formed. Later, this white powdery mildew becomes dark brown, forming a thick felty coating over the affected parts. As a result of the mildew the twigs are stunted and fruits dwarfed and rendered useless. Sometimes nearly the whole crop is ruined.

The mildew is spread during the summer months by means of numerous spores produced upon the surface of the affected parts. Later in the season another form of spores is produced on the affected leaves. These serve to carry fungus over the winter. Warm weather accompanied by frequent showers appears to favour the development of this trouble.

ANTHRACNOSE OF CURRANTS, (*Pseudopeziza ribis*).—This is a troublesome disease of red and black currants. It is also sometimes seen, to a slight extent, on gooseberries. It is usually recorded as being worse on red currants but, here in Ontario, however, in some seasons it is just as bad on black currants. It causes spots on the leaves, young canes, fruit stems and fruits. The spots on the leaves are the most conspicuous symptom of the disease. These are small brown spots which are often very numerous. If these spots are examined carefully little cracks or fissures will be seen in them. Badly infected leaves turn yellow and drop. The chief damage is the early defoliation of affected bushes, which may take place as early as the end of July.

The disease is spread during the summer by means of spores produced in the little cracks or fissures in the spots on the leaves. It is carried over the winter in the fallen leaves and probably on the canes.

LEAF SPOT OF CURRANTS AND GOOSEBERRIES, (*Mycosphaerella grossulariae*).—This disease attacks currants and gooseberries. It is usually most troublesome on black currants. The chief symptom is a spotting of the leaves. The spots are at first brown, but later become pale or gray and, if examined with a hand lens, little black specks (the fruiting bodies of the fungus) may be seen in them. Badly affected leaves turn yellow and drop. In severe attacks the bushes may be completely defoliated early in the season.

EUROPEAN CURRANT RUST, (*Cronartium ribicola*).—This disease affects gooseberries and currants, but appears to injure black currants only. In Ontario in wet seasons, many black currant plantations have been almost completely defoliated by this disease. Such defoliation, occurring as it does several weeks before the normal time, must of necessity lower the vitality of the bushes. The disease is seen on the lower surface of currant leaves as little clusters of yellowish-red or orange-coloured spots. These may be few and scattered, or numerous and close together, depending upon the severity of infection. Later they are replaced by elongated, thread-like or horn-like, dark, reddish-brown structures. If these are numerous they give the under surface of the leaves a felt-like appearance, and hence the name "Felt Rust of Currants" has been suggested for this disease.

Little can be done in the control of this disease except planting black currants as far away from white pine trees as possible and spraying them as directed in the Ontario Spray Calendar.

REVERSION DISEASE OF BLACK CURRANTS—This is a serious disease which is widespread in the British Isles and probably in Europe. It has recently been reported as occurring in Ontario. Growers should be on the lookout for it as once a bush is infected, there is no cure. It is spread by mites and probably by aphids.

* There are two chief ways of detecting Reversion Disease of Black Currants, namely, by the colour and the shape of the blossom buds and open flowers, and by the abnormal leaves that develop in June. Infected blossoms are smaller, saucer-shaped and more yellow in colour than normal ones. Unopened blossom buds are dark in colour and free from the down, which is characteristic of healthy buds. The abnormal leaves which develop in June are elongated, with fewer and more rounded teeth. Another symptom of Reversion disease is the production of many lateral branches on the current season's shoots.

Growers should examine their black currant bushes in June and July for leaf symptoms and destroy any infected bushes. Spraying as directed in the Ontario Spray Calendar will do much to control the insect pests that spread the virus causing this disease.

The latest control measures for the above described diseases of currants and gooseberries are given in the Ontario Spray Calendar, which the grower should consult.

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* Information concerning this disease secured from article by H. H. Cook, in Gardeners' Chronicle, March 14, 1942.

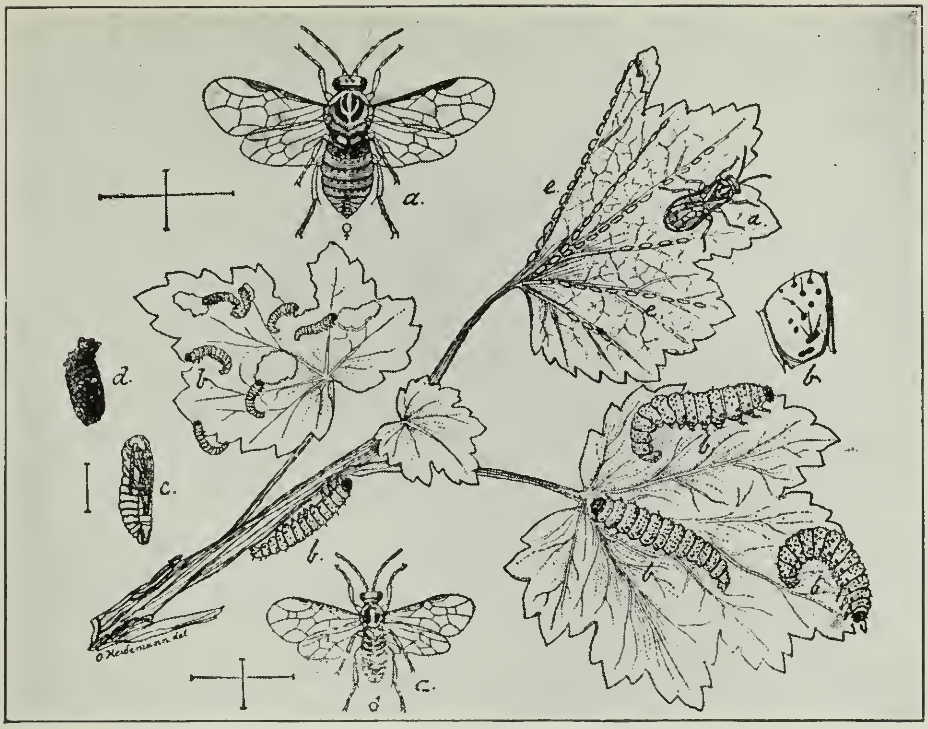

FIG. 6. Imported Currant Worm: (a) Female and male adults enlarged (the lines to the left show the natural size); (b) larvae, those to the left immature, the others about mature; (c) pupa enlarged; (d) cocoon formed in the soil; (e) eggs laid on under surface of leaf. (After Lugger).

THE CHIEF INSECT PESTS

R. W. Thompson, Provincial Entomologist

IMPORTED CURRANT WORM (*Pteronidea ribesii*).—This insect is very common and in most years would, if not controlled, strip gooseberries and red currants and white currants of almost all their foliage. It does not, however, attack black currants. The worm is, when full grown, about ¾ inch long. It is bluish-green in colour but with the head black and with many black spots over the body. There are two full broods each season and sometimes a partial third.

CURRANT BORER, (*Conopia tipuliformis*).—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 some may even die. The borer is white and is the larva of a clear-winged moth. The moth is about ½ inch in length, blackish in colour with several narrow yellow bands around the body. This gives it somewhat a wasp-like appearance. In Ontario these 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 in any little openings on the canes. The young larvae on hatching bore into the pith where they feed until full grown. Here they winter. If an infected cane is cut through, the darkened pith shows clearly the work of the borers. There is only one brood each year.

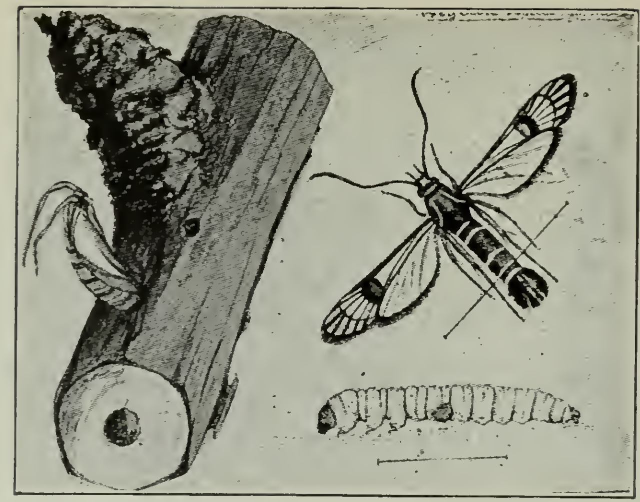

FIG. 7. Currant Borer: moth, larva and empty pupae case still attached to exit hole. The dark hole in the end of the cane shows where the larva has tunnelled in the pith. (After Lugger).

Control Measures—So far as known, spraying will not control this pest and the only practicable means of control seems to be to practise a system of pruning by which the wood is removed after bearing one or at the most two crops and new shoots allowed to grow up to take the place of those cut out. 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.

AGRILUS COMMUNIS RUBICOLA—Canes of black currant and gooseberry, and to a much lesser extent red currants, are at times killed by the larvae of a beetle sometimes called the rose stem girdler and which is closely related to the red-necked cane borer. The injury is almost entirely due to the larvae tunnelling in the canes, frequently girdling them and killing the shoot above the point of attack. In addition to the bush fruits mentioned above, this insect attacks also cultivated and wild roses as well as raspberries. The girdling can be seen on both roses and raspberries, but on gooseberries such external signs are not readily seen owing to the rough character of the gooseberry stem. On currants there is commonly no external indication of injury other than the wilting and dying of the canes. Consequently in currants the injury has frequently been ascribed to the currant borer. The internal injury to the currant canes resembles somewhat the injury caused by the larvae of that insect.

The Bordeaux-arsenical sprays mentioned in the Ontario Spray Calendar will be found to give reasonably good control of the adult beetles which feed to some extent on currant foliage during June and sometimes early July. Some benefit should also be found from the removal of wild raspberry canes and rose bushes in the neighbourhood of currant and gooseberry patches.

FIG. 8. Currant leaves curled by aphids. (After Close).

CURRANT APHID, (*Capitophorus 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 of the upper surface between the veins are usually elevated in large, irregular blisters which are often reddish in colour. Affected leaves in many cases are so much weakened that they die.

RED SPIDERS, (*Tetranychus telarius*).—Red spiders are mites that feed on the under surface of the leaves of numerous plants. They have sucking mouthparts and cause currant leaves to become brownish or yellow in colour 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 under surface 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 whitish or pale yellowish colour. They can just be seen with the naked eye. The eggs are like very tiny pearls. The mites winter in the soil around the base of the plants and attack the plants in spring soon after the buds burst.

SAN JOSE' AND OYSTER SHELL SCALES, (*Aspidiotus perniciosus* and *Lepidosaphes ulmi*).—Currant bushes frequently, and gooseberry bushes sometimes, are severely attacked by either the San José or the 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. Both of these insects suck juices from the tender wood of currant and gooseberry bushes and occasionally are seen on the fruit. The scale covering of the San José is circular and of an ashy-brown colour while that of the Oyster Shell is brownish and looks very much like a tiny oyster shell. Frequently either may become thick enough to completely cover the surface of the wood.

The latest control measures of the above described insects attacking currants and gooseberries are given in the Ontario Spray Calendar, which the grower should consult.

MASTITIS OR GARGET IN COWS

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FOREWORD

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This bulletin has been prepared to meet a popular demand and to furnish such information regarding "Mastitis or Garget in Cows" as may seem justified at the present time. In the hope that it may serve a useful purpose it has been deemed desirable in its preparation to avoid the use of technical terms as far as possible. It should be kept in mind that mastitis is essentially a serious infectious udder disease of cows requiring technical skill for its prevention and treatment. As a rule owners will find it both prudent and timely to consult their veterinary surgeon as to the handling of this disease as soon as it appears in their herd. By so doing those concerned will be serving their own interests rather than to attempt temporizing treatment of individual cases which may result in the further spread of the disease in their herd.

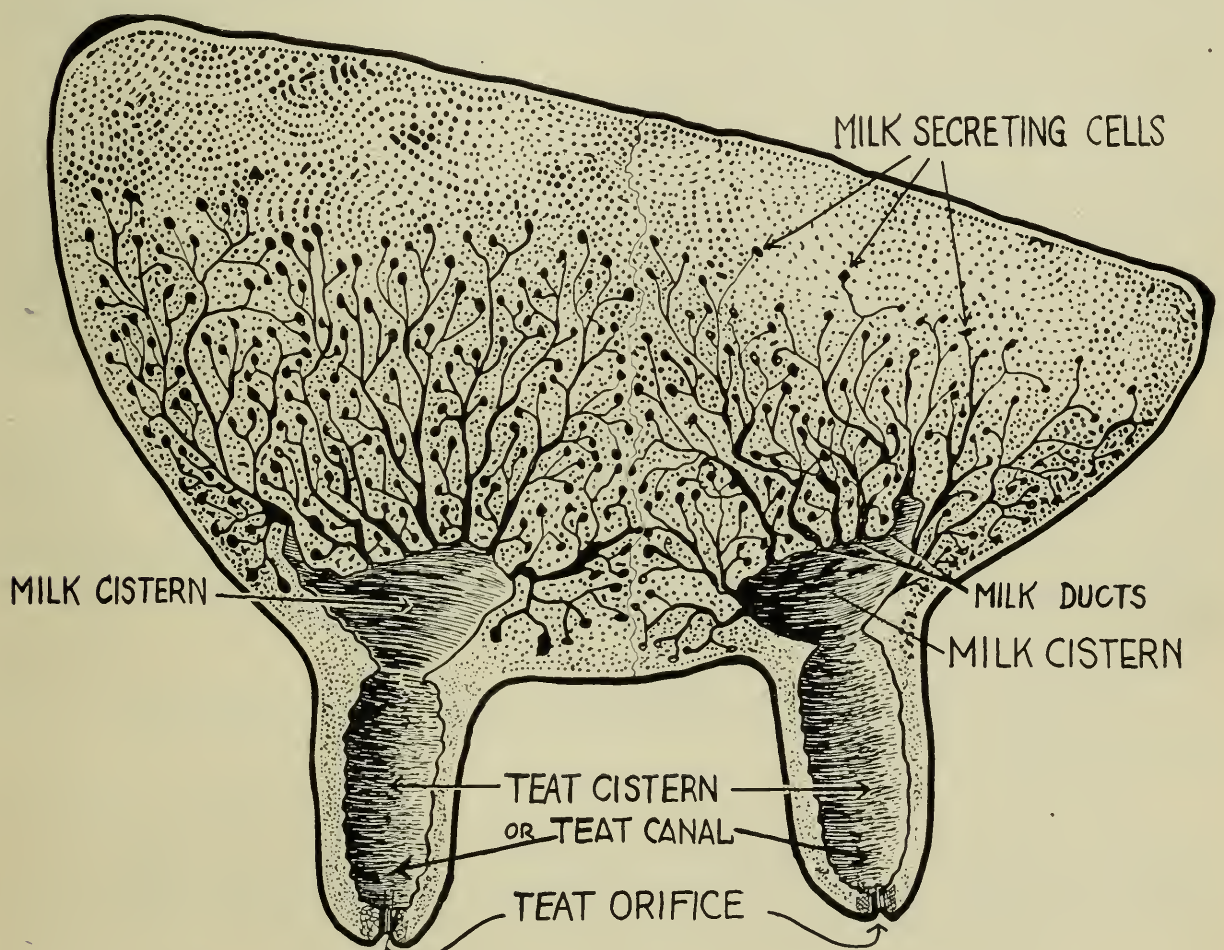
The disease is not one which usually responds to ordinary palliative treatment but is one which requires skillful help and guidance for its control in most cases.

MASTITIS OR GARGET IN COWS

STRUCTURE OF THE UDDER

The udder of the cow is a milk-secreting structure consisting of four functional quarters. The right and left halves of the udder are separated by a middle partition (septum). Each half consists of a front and hind quarter closely joined. Each quarter has a teat at its lowest part. At the end of each teat is a small opening (the teat orifice) which is kept closed by a small circular muscle (sphincter) preventing the escape of milk between milkings. Above the opening in the teat is a channel (teat canal) which communicates above with a larger cavity in each quarter of the udder known as the milk cistern, which is divided into various sized pockets. Opening into the milk cistern are from eight to twelve large tubes (milk ducts) which have numerous branches forming a complete drainage system for each quarter of the udder. The terminal ends of these milk ducts are slightly expanded and lined with highly specialized milk-secreting cells.

DIAGRAM ILLUSTRATING THE STRUCTURE OF THE UDDER



The Physiology of Milk Secretion:

Milk is made in the cow's udder by the special cells which line its ducts and cavities. Changes in the number and working capacity of these cells accompany changes in the genital tract of the animal. The working of these cells may also be affected by the general health or nutrition of the cow—

because these cells in the udder make the milk from materials carried to them by the blood. If the blood does not circulate properly—or if it lacks the necessary materials—or if the cells become diseased, as is the case in mastitis —then they will not produce normal milk in the proper quantities.

NATURE OF THE DISEASE

Mastitis, which is commonly known as "garget," is essentially a progressive inflammation of the milk-secreting tissues of the mammary gland or udder.

Usually the disease is first introduced by obtaining a cow with an infected udder, and the prevalence of the disease in some herds is continued by the purchase of new additions to maintain the milking capacity of the herd. The spread of the disease is also favoured by unsanitary stable conditions and insufficient bedding in the stalls.

High producing cows are most susceptible; hence the disease is more prevalent and detrimental in good dairy herds. It may occur in various forms, influenced to some extent by—the age and condition of the cow—high protein feeding—the degree and stage of lactation—the physical condition of the udder—and the exact nature of the agent or cause responsible for the attack. For convenience of general description the various forms of mastitis may be divided into acute and chronic cases.

The initial attack may be acute and develop suddenly—but generally speaking the majority of cases incline to the chronic form, consisting of a progressive inflammation with occasional acute attacks.

The persistence of the inflammation damages and destroys the milk-secreting tissues of the udder—and results sooner or later in fibrous induration (caking or hardening of the udder) with altered and diminished milk secretion.

As a rule the disease is of infectious origin and is therefore frequently spoken of as "*Infectious Mastitis*" or "*Streptococcic Mastitis.*" This is owing to the fact that the germs causing the disease usually belong to the *Streptococci* group of bacteria. Mastitis has also a special significance in relation to public health—as human beings may sometimes contract "septic sore throat" through the use of unpasteurized milk from affected cows.

CAUSE AND TRANSMISSION OF THE DISEASE

Acute Mastitis:

Acute cases of mastitis or garget may sometimes result from a variety of incidental causes such as—bruises and injuries to the udder and teats—over-feeding and over-stocking of the udder at calving time—allowing freshly calved cows with distended and congested udders to lie on damp, cold cement stable floors—or to lie outdoors on cold, wet ground—chilling of the udder through exposure—irregular or incomplete milking. While these different causes may produce attacks of acute garget they are, after all, incidental, and it should always be definitely understood that the majority of cases are caused by bacterial invasion or germ infection of the udder, resulting in cases of infectious mastitis—which sooner or later incline to become chronic and persistent cases.

Chronic Infectious Mastitis:

Chronic cases of mastitis are the most common and are invariably caused by bacterial invasion or germ infection of the udder. The disease germs belong usually to the *Streptococci* group of bacteria, of which the organism known as the "*Streptococcus mastitidis* (*agalactiæ*)" is the most frequent cause. Other bacteria, including "*Staphylococci*," also occasionally cause mastitis. Irrespective of the exact type of bacterial infection present, the disease is always of the same nature and readily conveyed from cow to cow in the herd, chiefly by the hands of the milker.

Affected cows always harbour the disease germs in their udders, and the hands of the milker serve as the medium to carry and transmit the infection to the other cows during the ordinary process of milking. The disease germs gain entrance to the udder by passing up the teat canal. The milking of cows with soiled hands favours the spread of the disease from one cow to another.

What is known as "*wet milking*" (milking with wet hands) always aids in spreading the infection from one cow to another.

Milking by the use of a milking machine will also spread the infection unless the teat cups and other parts of the machine are kept absolutely clean.

The improper use of milking tubes and teat dilators may also be harmful.

The view is also expressed by some that young heifers may become directly infected during calfhood—through the common habit of calves sucking each other following drinking mastitis-infected milk. The infection may then directly enter the teat canal—and is presumed to remain latent or concealed in the udder of the young heifer until the time of freshening—and then produces an attack of mastitis.

While this type of early infection and origin of the disease is difficult to definitely establish—there is nevertheless a great deal of circumstantial evidence in support of calfhood udder infection in some cases. This possibility may to some extent account for the development and appearance of infectious mastitis in young heifers at their first period of freshening. Some writers on the subject of mastitis have also asserted that the disease takes place to some extent in the adult cow by mouth infection as well as by teat infection. As yet, natural infection by the mouth in the adult cow has not been experimentally established—and the majority of investigators incline to the view that teat infection is the more common and prevailing avenue of bacterial invasion so far definitely established.

In any event the presence of a cow with infectious mastitis always results sooner or later in the widespread dissemination of udder trouble in a dairy herd.

SYMPTOMS AND COURSE OF THE DISEASE

The symptoms and course of mastitis vary according to the cause as well as the nature and extent of the inflammatory process in the udder.

Acute Mastitis:

Acute attacks of garget are usually manifested by the sudden development of udder trouble and systemic disturbance. When acutely inflamed the udder and teats become hot and tender, highly reddened and tensely swollen. In severe cases the cow is feverish and the temperature rises—the appetite is lessened and rumination or "chewing the cud" ceases for a time.

The milk flow is immediately lessened and changed in appearance, containing flakes and clots—or it may be mixed with the inflammatory exudate consisting of a yellowish serous fluid or have a reddish, bloody appearance.

Milking in these cases is difficult to perform, as pressure on the teats increases the pain.

Where acute cases develop from incidental causes, the course of the disease may be favourable, and recovery may take place with proper treatment.

On the other hand, if septic infection is present pus may form—resulting in abscesses developing in the udder—or the udder may become gangrenous (putrefactive), which is evidenced by the skin covering the udder and teats becoming a purplish or greenish-black colour—and the skin may slough or peel off in places. In such cases the udder may be permanently damaged—resulting in the destruction of one or more quarters of the udder—with "blindness" of one or more of the teats—causing what are commonly known as "three-teated cows." While acute attacks of garget are liable to occur occasionally in high producing cows during the first month after calving—nevertheless they may occur at other times during the course of infectious chronic mastitis.

Chronic Infectious Mastitis:

The chronic form of mastitis, with or without acute attacks, is the type of the disease which is most common.

Whenever udder trouble develops in a herd it should be suspected as infectious mastitis. The symptoms are not always definite at the beginning, as little or no constitutional disturbance is present except when acute attacks occur.

In chronic infectious mastitis the inflammation is persistent and gradually progresses—resulting sooner or later in diminished milk secretion. The milk is also altered in appearance—becoming thinner and changed in colour. It does not keep well and frequently contains flakes and clots which are characteristic.

For a time only one of the quarters may be affected—but sooner or later the other quarters of the udder may also become involved. The inflammatory process tends to damage and destroy the milk-secreting cells and tissues of the udder—resulting in the formation of fibrous connective tissues (fibrosis), causing the affected parts to become firm and hardened (induration)—and in some cases results in altering the general shape and appearance of the udder. Sometimes one of the first things to attract notice is the development of small, firm lumps (nodules) in the udder near the base of the teats. The nodules or lumps gradually increase in size and numbers until they can be easily felt as distinct indurations or hardened masses. The normal healthy udder is always pliable and elastic to the touch after milking is completed, and induration or hardening (fibrosis) of one or more quarters is indicative of mastitis.

In some cases abscesses develop in the udder, and pus can be squeezed out of one or other of the teats. The ultimate effect of chronic mastitis is to damage the udder—and where the damage is extensive one or more of the quarters may be permanently destroyed as far as milk secretion is concerned. The presence of infectious mastitis in a herd tends to spread from cow to cow, chiefly by the hands of the milker—resulting in a marked and serious loss in milk production.

THE DETECTION AND CONTROL OF MASTITIS

Every case of mastitis should be considered as an infectious udder disease which is liable to spread in a herd unless controlled.

The early detection and separation of affected cows forms the basis for controlling the disease. For detecting cases of chronic infectious mastitis the following diagnostic methods and tests are employed:

"*Physical or Clinical Examination of the Udder*": The attending veterinarian should make a careful clinical examination (palpation) of the udder of every cow on the premises.

The examination should be made immediately after the udder is milked empty, and any cow showing signs of udder trouble (induration) should be removed from the regular milking line.

The affected cows should then be grouped together according to the stage and extent of the disease in their udders so that the slightly affected cows will be milked first and the worst cases last. The sound cows must always be milked first before commencing to milk the affected ones—and the hands of the milker should be washed before milking each cow. This is important, to prevent the further spread of infection from cow to cow by the hands of the milker. The clinical examination of the herd can be supplemented by the use of any of the other following methods of test or diagnostic aids:

"*The Strip-Cup Test*": The strip-cup test consists essentially in the use of a porcelain or tin cup, over the top of which is fitted a fine mesh screen or piece of black muslin cloth which serves as a sieve—through which a little of the milk from each teat is squirted. Any clots or flakes present in the milk are caught in the meshes of the screen and can be readily observed. The presence of clots or flakes in freshly drawn milk is always an indication of garget and serves as a guide in detecting new cases.

"*The Bromthymol Blue Test*": This is known also as the thybromal test and is used to determine the alkalinity of the milk. The milk from mastitis cases is usually alkaline in reaction, which this test will reveal. The test is of definite value when used by a skilled person together with a clinical examination of the udder of each cow and the use of the strip cup.

"Other Diagnostic Methods": There are a number of other reliable diagnostic methods used, but they are of a technical nature requiring a knowledge of laboratory procedure and for that reason are not described in detail. They may be used when desired to make a more exacting examination of the milk, and are termed respectively—the Chloride Test, the Rennet Test, the Catalase test, the Hotis, and other Bacteriological Tests.

PREVENTION AND TREATMENT OF MASTITIS OR GARGET

The general treatment of mastitis or garget in any form is always troublesome. Acute and chronic cases should be regarded as being essentially stages or forms of the same disease.

General Treatment of Acute Mastitis Cases:

In the prevention of acute mastitis incidental causes should be avoided or corrected in the general management of the herd. Towards this end cows at the time of calving should be kept in clean, comfortable, well-bedded stalls —and protected against bruising of the udder—exposure and sudden chilling of the udder—over-feeding and over-stocking of the udder—incomplete and irregular milking. During acute attacks of garget the heat, pain and swelling (congestion) may be reduced first by the use of cold applications to relieve the congestion—followed by repeatedly bathing or fomenting the udder with hot water. This is best done following each milking, and the milking should be done at frequent intervals—preferably every two hours so as to keep the udder in a relaxed condition. This is essential in the treatment of all cases to relieve the tension on the inflamed glandular tissues. Bathing of the udder can be done to better advantage by means of canvas soaking bags or suspensory bandages, applied by using pieces of felt or woollen blankets cut to fit the udder with holes for the teats—and kept in place by fastening up over the back. Another means of applying heat is to coat the surface of the udder over thickly with hot antiphlogistine paste.

Other popular applications are warm poultices and liniments. As a rule poultices are hard to keep in place and may fail in that respect to accomplish their purpose. Strong irritating liniments should be avoided, but after the acute pain and heat is relieved the udder can be rubbed or massaged with a bland stimulating liniment or ointment such as iodine liniment or ointment. Generally speaking, acute attacks of mastitis are benefited by the foregoing line of treatment if intelligently carried out.

At the beginning of an acute attack a dose of physic can be given, consisting of a pound of Epsom salts dissolved in two quarts of water and given carefully as a drench. The diet of the cow must be regulated for a time, and should consist chiefly of bran mash three times a day, to which may be added a tablespoonful of hyposulphate of soda.

In the medicinal treatment of individual cases the following drugs have been used quite extensively: Half an ounce of potassium nitrate (saltpetre) added to the drinking water once or twice a day as may be desired. Formalin and spirits of turpentine given in half-ounce doses as a drench in a quart of milk two or three times a day. Recently the administration of Sulphanilamide is being advocated in doses of thirty grams dissolved in a little water and given as a drench two or three times a day for a period of from one to two weeks' time. However, the therapeutic value of this drug has not as yet been established to definitely recommend it as a cure for mastitis.

Direct udder infusion with different drugs, including Sulphanilamide, suspended in mineral oil is now being recommended as of some value in the treatment of selected cases. The attending veterinarian is the best person to select the cases for this method of treatment and to apply same intelligently.

Vaccination has also been practiced, but with doubtful results. Some also favour the drenching of the cow with a pint or two of its own milk from the affected quarters of the udder. Where abscess formation or gangrene of the udder develops, special antiseptic and surgical treatment is necessary, which should be done by the veterinarian in attendance.

Chronic Infectious Mastitis—Herd Management:

This form of mastitis or garget should always be regarded as a serious, infectious udder disease—which is liable to spread in a herd unless controlled. Unfortunately there is no specific vaccine or medicinal remedy available at the present time for the satisfactory prevention and cure of the disease. The control of infectious mastitis is based on the detection and separation of affected cows—and the building up of a sound herd as conditions permit. Whenever this udder disease appears in a herd the owner will be serving his own best interests by securing the services of a veterinarian for the purpose of detecting all of the affected cows and applying control measures and individual treatment as may be indicated. The first and essential thing to do is to have a careful clinical examination made by the attending veterinarian of the udder of every cow in the herd—supplemented by the use of the strip-cup test—and the bromthymol blue test or any other of the recognized methods of test. Following this every cow showing signs of udder trouble should be removed from the regular milking line. The cows should then be arranged in two groups—comprising the group with sound udders and the group with affected udders. The group with sound udders must always be milked first, and the milker's hands should be washed clean before milking each cow.

This is important in order to prevent or limit the further spread of infection. The cows with affected udders should then be grouped separately according to the stage and extent of the disease in their udders. The milking of this group should be arranged so that the slightly affected cases will be milked first and the worst cases last. The affected cows should then be kept under observation, and when considered desirable can be treated individually as already described, namely—by frequent milking to keep the udder relaxed—by hot fomentations or bathing the udder—by massaging or hand rubbing the udder with iodine liniment or ointment—by regulating the diet to lessen milk secretion, and by medicinal treatment. Cows with badly damaged udders should be removed from the herd—together with those which do not respond to treatment within a reasonable time.

As in all other infectious diseases the aim should be to eliminate all of the affected cows that may act as carriers and spreaders of infection—and to ultimately build up and develop a sound herd from the healthy cows and their offspring. While this naturally will take time it should, however, be clearly understood that as yet no other satisfactory plan is available for controlling chronic mastitis in affected herds. The udders and flanks of all milking cows must be kept clean, which can be done by regular brushing and washing from time to time. In milking affected cows care should be taken that none of the milk is spilled on the bedding. The stalls occupied by milking cows should be periodically disinfected, and must be kept clean and well bedded.

In the event of any new cows being purchased, they should not be admitted to a clean herd until they have been clinically examined and tested and found to be free from mastitis. In order to protect public health the milk from mastitis-affected herds should not be used for human consumption unless it is properly pasteurized.

Treatment of Chronic Infectious Mastitis Cases:

During the last few years so many different remedies have been advocated as cures for mastitis that it has become increasingly difficult to exactly determine their relative therapeutic value—or to pass final judgment on their merits. Recently some progress has been made in the treatment of infectious (*Streptococci*) mastitis by the use of drugs used in the form of udder infusions. Among the drugs being used at the present time for this method of mastitis treatment, the most favourably regarded appear to include the following—Sulphanilamide—Novoxil—Acriflavine—Tyrothricin and Gramacidin. The choice of these udder infusion drugs must be left to the discretion of the attending veterinarian, based on his experience as to their efficacy in different stages or types of mastitis cases, as some seem to be better adapted for certain cases than for others.

Generally speaking, their method of use and application are along the same general lines in that each particular drug is recommended to be used suspended in a 35 to 50 per cent mineral oil emulsion and injected with a suitable hypodermic syringe and teat tube up the teat canal into the milk cistern of the udder.

Before making the injection the affected quarters of the udder should be emptied. The treatment should be repeated daily for three or four days, and if no improvement is noticed in ten or twelve days' time the treatment should be repeated. As a rule the manufacturers and distributors of these different agents, recommended as udder infusions, furnish directions as to their use, and the one administering the treatment should be guided thereby. While the different udder infusion treatments should not be regarded as specific cures for all cases of mastitis, nevertheless they are worthy of a trial, and in selected cases have been successful in overcoming udder infection and restoring many affected cows to milking usefulness.

SUMMARY

The Systematic Control of Mastitis:

(a) By arranging the cows in the milking line so that the affected and non-affected animals are milked separately.

(b) By the adoption of precautionary measures to limit the further spread of the disease, including sanitation and hygiene.

(c) By elimination of the affected animals from the herd as conditions permit.

(d) By developing a mastitis-free herd from the offspring, and by replacement or addition of non-affected cows.

BARLEY IN ONTARIO

By R. KEEGAN

DEPARTMENT OF FIELD HUSBANDRY

ONTARIO AGRICULTURAL COLLEGE

GUELPH, ONTARIO

AN INCREASE BLOCK OF A PURE VARIETY AT O.A.C.

ONTARIO DEPARTMENT of AGRICULTURE

STATISTICS AND PUBLICATIONS BRANCH, TORONTO, ONTARIO

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BARLEY IN ONTARIO

by

R. Keegan

THE IMPORTANCE OF BARLEY IN ONTARIO

Barley is one of the most important grain crops grown in Ontario. The following table shows the relative importance of barley, oats, and mixed grains which consist largely of barley and oats sown together.

ONTARIO—ANNUAL AVERAGES FOR THE PERIOD 1932 TO 1941*

Crop	Acreage	Bushels
Barley	492,929	14,664,449
Oats	2,278,772	76,995,402
Mixed Grain	953,834	32,737,264

Barley usually outyields oats in a mixture. Therefore the bushels of mixed grain shown in the table probably consist of more than half barley. This indicates that the production of barley in this Province is more than double the amount shown by the figures for barley as a pure crop.

During the last ten years in Ontario barley has produced over 300 pounds more digestible nutrients per acre than oats. Barley produced an average yield of 1,426 pounds of grain per acre, compared with 1,149 pounds of oats. The percentage of digestible material in the grain is 7 to 8 pounds per hundred more in barley than in oats.

While barley is a more efficient producer of feed grain than oats there are several reasons why it is less popular as a farm crop.

1. The rough awns on some varieties cause discomfort to workers who handle the crop, and are objectionable when the straw is fed to livestock. This difficulty has been overcome by the development of varieties with smooth awns.

2. Barley does not yield as well as oats on soils of less than average fertility.

3. The oat crop is preferred when straw is used as a roughage for livestock.

BARLEY FOR LIVESTOCK FEED

BARLEY GRAIN

In Ontario barley occupies the same place in grain rations that is taken to a great extent by corn in many areas of the United States. It may be fed to all kinds of farm animals as part of the concentrate ration, and usually gives best results when combined with lighter feeds such as ground oats or bran, especially when animals are being fed heavily on grain. The proportion of barley may be increased in a mixed grain ration for fattening animals, as it contains a higher percentage of carbohydrates than oats, with which it is usually fed.

*From the Annual Report of the Statistics Branch, 1942.

Barley fed to growing and to fattening hogs produces an excellent quality of ham and bacon. It is especially important at the present time that the use of this feed be maintained or, when possible, increased in our hog feeding program, as there is a ready market for Canadian bacon and pork products in Britain. Feeding for quality will be the best method of retaining our share of this market at the conclusion of the present war, when we shall find ourselves again in competition with other bacon-producing countries in the export trade.

BARLEY STRAW

Barley straw is not as popular a roughage for livestock as oat straw. The use of smooth awned varieties will provide straw that is less irritating to the digestive tracts of farm animals than that of the rough awned varieties.

BARLEY FOR MALTING

Barley of the right type and quality finds a ready market for the manufacture of malt. O.A.C. No. 21 and Mensury are suitable varieties for malting, the former being the principal variety used in Canada for this purpose at the present time. Some malt is made in the prairie provinces from Hannchen. Montcalm appears to be the best of the smooth awned varieties tested for malting to date. O.A.C. No. 21 is in great demand by maltsters, as it sprouts quickly and uniformly, makes excellent malt, and is available in large quantities in Canada.

Good malt cannot be made from unsuitable varieties.

Grain for malting should have the same characteristics as high grade seed. It should be plump, well graded, well matured, and bright coloured, and should produce a high germination percentage of strong sprouts when tested.

Barley suitable for malting usually commands a premium in the cash grain market, and is a good cash grain crop where soil and climatic conditions are favourable for the development of the desired quality. The crop may be grown for this purpose in any part of Ontario that produces good grain crops.

VARIETIES OF BARLEY

ROUGH AWNED, SIX-ROWED, WHITE GRAINED VARIETIES

O.A.C. No. 21 is a medium early variety. The aleurone layer beneath the hull is a bluish gray unless discoloured by weathering. The straw is strong and the yield of grain is good. It should be harvested before it is dead ripe, as the heads tend to break over badly at maturity. This variety is well adapted to sowing in mixtures with early oats for livestock feed, as it matures at about the same time as Alaska and Cartier oats, which is usually about ninety days from seeding when the seed is sown early. O.A.C. No. 21 was developed at the Ontario Agricultural College by pure line selection from a barley of the Manchurian type imported from eastern Asia.

Mensury (Ottawa 60) is similar in appearance and performance to O.A.C. No. 21, except that the aleurone layer is frequently white or yellowish. This variety was developed at the Central Experimental Farm, Ottawa, from a barley of the Manchurian type.

BARLEY AWNS MAGNIFIED 12 TIMES

(Left) Rough awn showing barbs.

(Right) Smooth awn showing absence of barbs.

SMOOTH AWNED, SIX-ROWED, WHITE GRAINED VARIETIES

Nobarb 1 is a mid-season variety which matures in about ninety-five days from seeding at Guelph. The straw is fairly strong, and the grain is a little larger and plumper than that of O.A.C. No. 21. The yields of both grain and straw have been greater than those of O.A.C. No. 21 in most of the tests at the Ontario Agricultural College and throughout the Province. Nobarb 1 is a pure line selection from the progeny of a cross of O.A.C. No. 21 and Lion made in 1921 at the college.

Nobarb 2 is a more recent selection of the same breeding as Nobarb 1. It is somewhat similar in type to Nobarb 1, but has shorter, stronger straw; larger, plumper grain, and a little earlier maturity. It has the greatest bushel weight of any variety yet produced for distribution by the college, and is a good variety to grow for livestock feed.

Galore is a mid-season variety, maturing three or four days later than O.A.C. No. 21. The bushel weight of grain is similar to that of a good sample of the latter variety. Galore is one of the highest yielders of grain ever grown at the college. The length of straw is about the same as that of Nobarb 2, and is shorter than that of O.A.C. No. 21 or Nobarb 1. It has the strongest straw of any variety yet distributed by the college, and is one of the best varieties for combine harvesting. Galore was selected from the progeny of a cross of O.A.C. No. 21 and Lion which was crossed back to O.A.C. No. 21. It may be distinguished from the other O.A.C. varieties by the fact that it has long rachilla hairs, while those of the others are short.

Velvet is a high yielding variety introduced from Minnesota. It was one of the first smooth awned varieties grown in Ontario, but is now being replaced by newer varieties. It matures two or three days later than O.A.C. No. 21. It resembles Nobarb 1 to some extent, but is not as good a yielder.

Plush is a variety bred at the Dominion Experimental Station at Brandon, Manitoba. It is about one week later than O.A.C. No. 21. The straw is strong, and the grain is large and plump, but the yields of grain obtained in Ontario have not been as large as those of Galore and Nobarb 2.

Newal is a variety bred at the University of Alberta. Its maturity is about the same as that of O.A.C. No. 21. It yields fairly well in Ontario, but has not yielded as well in tests here as Galore, Nobarb 2, and Velvet.

Regal was bred in Minnesota, and introduced into Canada by the University of Saskatchewan. It has given a little better yield of grain at the college than Newal, but is probably better adapted to western Canada than to Ontario.

Montcalm is a variety recently introduced into Ontario from Macdonald College, Quebec. This variety appears promising, but has not yet been tested extensively enough to determine its value in western Ontario.

Byng is a semi-smooth awned variety bred at Macdonald College, Quebec. There are barbs from the tips of the awns about halfway to the kernels. This variety is one of the heaviest yielders of grain, but is weak strawed, and lodges badly on fertile soils. It matures two or three days later than O.A.C. No. 21.

ROUGH AWNED, TWO-ROWED, WHITE GRAINED VARIETIES

Hannchen is a nodding headed variety which was imported from Sweden. It is the best yielder of any of the two-rowed varieties under test at Guelph at present, but it often lodges badly, not having as strong straw as the best of the six-rowed varieties. It is about a week later than O.A.C. No. 21. The weight per bushel of grain is usually a little above the standard.

Stephan is a nodding headed variety recently imported from Europe. In tests at the college this variety has not produced as good yields of grain as Hannchen, and in regional tests throughout western Ontario it has been inferior to the best six-rowed varieties. It has about the same straw strength and weight per bushel as Hannchen. Stephan is very resistant to barley mildew, which is a common disease in this region, often causing a reduction in the weight per bushel of susceptible varieties.

HULLESS VARIETIES

In these varieties the parts which adhere to the kernel and form a hull in other varieties are attached loosely to the kernels so that they thresh off as chaff, leaving the naked kernels, as is the case with wheat and rye. The grain has similar feeding value to that of wheat.

Of all hulless varieties tested to date Guy Mayle has given the best yields of grain. Black Hulless and Winnipeg No. 2 have produced fairly good yields. No hulless variety has produced as high yields of grain as the best hulled varieties in tests conducted at the college.

WINTER BARLEY

Tennessee Winter is a variety which is sown at the same time as winter wheat. It is not as hardy as winter wheat, and for that reason cannot be depended upon by the livestock feeder to produce a supply of feed grain year after year in most of Ontario. Winter barley appears to be increasing in popularity in Kent and Essex where there is less winter killing than in most of the rest of the Province, because it will give heavy yields of grain where it survives the winter.

Some promising new mildew resistant, smooth awned types of barley being developed at the Ontario Agricultural College.

Tennessee Winter barley is six-rowed, white grained, and rough awned. Both the grain and the standing crop resemble O.A.C. No. 21 somewhat in appearance. This variety is the first grain to ripen at the college each year.

Other varieties of winter barley have been tested, but have not proven as hardy or as good yielders as Tennessee.

BREEDING NEW VARIETIES

A great deal of progress has been made in the last twenty years in the development of improved varieties of barley, but up to the present time no one variety has been bred which has a good combination of all the desirable characteristics. Such a combination may be a difficult or even an impossible achievement, but it is an objective which all barley breeders must keep in mind. The variety descriptions indicate that such characteristics as smoothness of awns, high yield, good weight per bushel, and straw strength have been combined with some degree of success. In these there can be further improvement, and with them may be combined resistance to barley diseases, better malting quality, and other desirable features.

In the cereal breeding plots at the college new strains are being bred and developed which have a high degree of resistance to barley mildew, which is one of the main causes of light weight kernels. Breeding for smut and stem rust resistance is being carried on. Testing for malting quality is now an important part of the work. Some progress has been made, but much work must still be done before these may be combined with the combinations already established.

THE PLACE OF BARLEY IN THE CROP ROTATION

Barley often follows a hoed or cultivated crop and precedes a hay crop. It is a good nurse crop with which to seed down to grasses and clovers, because it is harvested early and because the foliage is not dense. If it is grown as a second grain crop in the rotation special attention should be given to maintaining soil fertility, as barley is not a profitable crop on soils where plant food material is not readily available. It may also be sown after a hay crop or pasture.

SOILS FOR BARLEY

Barley may be grown on a fairly wide range of soil types, but it does not yield as well as oats on the poorer soils. It yields best on well drained, fertile, clay loam. Barley requires more lime than the other small cereals, and will not grow as well on acid soils.

Barley is likely to lodge badly on heavy soils if they are very fertile, or if there is an excess of nitrates.

On poor soils or sandy soils the grain is of poor quality, and the straw is short.

FERTILIZING THE SOIL FOR BARLEY

When barley follows a hoed crop there are usually unused plant food materials remaining from the barnyard manure applied to the previous crop. If it is grown as a second grain crop it will be benefited by a direct application of manure. When manure is the chief means of maintaining fertility, and when clover and alfalfa follow barley in the rotation, it generally pays the grower to use some commercial fertilizer containing a high percentage of phosphate and potash. The kind and amount to use may be determined by having the soil tested. Commercial fertilizer is of special value in correcting soil deficiencies which may be revealed by tests. On acid soils barley will benefit more than oats by the application of lime. Information about soil testing and fertilizer requirements may be obtained by writing to the Soils Division, Department of Chemistry, Ontario Agricultural College, Guelph; the Kemptville Agricultural School, Kemptville; the Western Ontario Experimental Farm, Ridgetown; or by consulting the Agricultural Representative for the county in which the farm is located.

CULTIVATION OF THE SOIL

Fall plowing usually gives better results than spring plowing on the heavier soils. When the soil is top worked after fall plowing to control weeds it may be ridged with a double mould board plow, if time and available labour permit. If the land is not level the ridges should cross the slopes, if possible. This helps control erosion by surface drainage. Ridged land may be worked sooner in the spring, as it dries more quickly than level land. It may be levelled down in the spring with a broad-tooth cultivator driven lengthwise of the ridges, and then harrowed until a fine seed bed is made. The fineness of the seed bed is particularly important when grass and clover seed is sown with the barley. After seeding the land can be rolled to compact the soil and break lumps, but when a roller is used it should be followed by a light drag harrow. The use of a cultipacker instead of the roller and harrow gives good results, especially when seeding down to grass and clover.

PLOWING VS. OTHER MEANS OF CULTIVATION

If the nature of the soil or the method of cultivating the previous crop make plowing unnecessary the land may be prepared for barley more cheaply and quickly by the use of the one-way disc, the disc harrow, or any implement which will work up a good seed bed. If the subsoil is open enough to permit good drainage and root growth all that is necessary is enough top working to kill weeds and provide a seed bed. Unnecessary working of the soil increases the cost of production and seldom increases the yield. It increases soil erosion on hilltops and hillsides, particularly in light soils.

Plowing will leave cleaner, more easily worked soil in sod, and where there is a large amount of refuse from the previous crop.

PREPARATION OF THE SEED

The treatment of barley seed with recommended dusts, or formalin, will control covered smut and some other diseases which are carried in the spore stage on the surface of the seed. Covered smut is not a serious disease of barley here, as it is seldom found in Ontario. Directions for seed treatment can be obtained by writing to the Department of Botany, Ontario Agricultural College, Guelph.

Loose smut of barley cannot be controlled by any chemical treatment. The hot water treatment is effective, but for this proper equipment is necessary, which is usually not available on the farm.

If the barley crop becomes badly affected by this disease it is best to get new seed from fields which were free of loose smut the previous year. Registered seed is recommended, as it is produced in fields which are inspected for diseases.

Tests of seed carried on for six years' crops at the college showed that a good grade of seed produced a 17 per cent larger yield of grain than that grown from a poor grade of barley seed.

Large plump seed may be obtained by the use of a fanning mill equipped with the proper screens for the crop, and run and fed at the right rate of speed. Such adjustments can be determined by observing the kind of grading for each lot of seed. Different adjustments are required for different varieties of barley as there is a difference in kernel size. Weed seeds are removed at the same time.

Commercial seed cleaning plants do good work in cleaning out weed seeds and grading seed.

Clean, well graded seed pays crop dividends.

TIME OF SEEDING

Experiments at Guelph have shown that the earliest possible seedings have usually given the best yields. Barley should be sown within a week of the time when it is possible to work the land properly, in an average season. Later seedings have nearly always given lower yields. Very early seedings sometimes result in frost damage to the young plants, but the possibility of loss is usually greater from late sowing than from frost damage.

RATES OF SEEDING

Varieties of the O.A.C. No. 21 type should be sown at the rate of at least 2 bushels per acre, or 1½ bushels per acre if grass and clover seeds are sown with the barley. Larger seeded varieties such as Nobarb require a rate of 1 or 2 pecks more seed per acre. Barley sown at the rate of 3 bushels per acre is an effective smother crop for many weeds commonly found in grain fields. The standard weight per bushel of barley is 48 pounds.

DEPTH OF SEEDING

Shallow sowing is best for barley. Sow just deeply enough to cover the seed. Deeper sowing is necessary in soils which dry out quickly near the surface.

HARVESTING

Cutting with the binder should be done when the grain is in the hard dough stage. If left until dead ripe the loss of grain through head shattering will be increased. Barley dries better in long stooks than in round or capped stooks. Leave the crop in the stooks until the grain hardens, and the straw is dry enough to thresh easily. Then it may be stook threshed, or stored in barns or stacks until a threshing machine is available.

If the crop is harvested with a combine it should be left until the grain is well ripened and dry.

THRESHING

Stook threshing should be done as soon as the grain is dry enough. The grain is ready for threshing as soon as the moisture content is reduced to not more than 14 per cent. The experienced grower knows by handling and seeing the grain when it is ready for threshing. If threshed when moist the awns are not removed closely, and the grain may heat in the bin. Barley that has been stored in stacks or barns often threshes better than when it is stook threshed.

The cylinder speed for small grains is usually 1,200 revolutions per minute. The speed of the cylinder and the adjustment of the concaves should be such that the awns are removed without shattering the kernels or splitting the hulls. Some varieties are more easily threshed than others and require different adjustments of the threshing machine.

STORING THE GRAIN

Barley having a moisture content of 14 per cent or less may be stored in bins or sacks without danger of spoiling.

If it is necessary to combine or stook thresh grain having a higher moisture content because the weather continues damp during the harvest the grain can be stored in shallow piles, and moved once or twice before it is put in deep bins.

Note.—Photographs by the Department of Extension.

SWINE DISEASES
AND
THEIR PREVENTION

By

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GUELPH, ONTARIO

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FOREWORD

Freedom from disease and continued thriftiness throughout the growing period of a pig's life are the most important factors in determining whether those engaged in the production end of this industry reap a profit or experience a loss. Choice blood lines, model breed characteristics and good conformation mean but little if a pig is not healthy and vigorous.

The disease problem in swine is a serious one, particularly in the colder seasons of the year. Many of the diseases encountered have their origin in mismanagement or error in the care, housing and feeding of swine. For these reasons, this bulletin, covering the more common ailments of swine and the manner in which they may be prevented, has been prepared. The publication of it has been done with the desire to assist those engaged in swine production and also with the hope that they will be guided by the suggestions contained therein.

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SWINE DISEASES AND THEIR PREVENTION

By

R. A. McIntosh, M.D.V., B.V.Sc

In the preparation of this bulletin it is felt that it would be advisable to reveal the various diseases of swine from the time of birth until they are of marketable age.

The purpose of arranging the bulletin in this form is to impress the swine raiser of the necessity for the continued application of preventive measures from the time the pigs are born until they are ready for market. Neglect of the sow during pregnancy will be reflected in the newborn. Lack of attention while in the suckling stage will lead to trouble at weaning time. Improper feeding during the weaning stage will be followed by poor growth and development in the feeding stage, which in turn leads to disappointment when finishing the pigs off for market. There is a relationship between the care that pigs receive during these several stages of their growth and the diseases which may occur. Some of these ailments come on gradually and insidiously and are not easily observed until the animals are obviously sick. The wise pigman anticipates this and does not wait until the pigs are sick. He avoids loss by the practice of prevention throughout his pig-raising programme.

STILLBORN, BLIND AND WEAK LITTERS

On occasions whole litters are born dead, in some instances blind and at other times weak and lacking in vitality. At the present time this is believed to be due to a lack of vitamin A in the diet of the sow during pregnancy. This vitamin is important because of its anti-infective properties, the normal development of the tissues and its health maintaining factors. The chief sources of it in swine feeds are the green coloring matter of plant life, wheat bran, yellow corn, and to some extent in the protein rich foods such as linseed and soya bean meal.

The occurrence of such losses is more frequently observed when sows farrow in the winter or are kept closely housed and not fed any green stuff in other seasons of the year. When such practices are followed, it is advisable to supplement the diet by the addition of a vitamin A potent feed oil. These so-called feed oils have been prepared as a substitute for the more expensive cod liver oil, and are made with a less expensive oil to which vitamins D and A are added in known quantities. There are four types made under government supervision:

Type	A	contains	200	units of	D	and	1000	units of	A	per gram
"	B	"	200	"	" D "		1500	"	" A "	"
"	C	"	400	"	" D "		1850	"	" A "	"
"	D	"	400	"	" D "		3000	"	" A "	"

When used as a supplement to the diet of a sow, two teaspoonfuls a day of Type A or B throughout the pregnancy period will suffice. If Type C or D are used, one teaspoonful is sufficient. Providing feed oil may not be necessary if the pregnant sows are fed fine leafy alfalfa or clover hay along with mixed grain and skim milk.

GOITRE OR HAIRLESSNESS OF THE NEW-BORN

The term goitre is applied to an enlargement of the thyroid gland. This gland regulates the utilization of food products as they are carried to the tissues of the body and also the elimination of waste products. The normal functioning of the gland is dependent upon a sufficient amount of iodine being present in the body. The gland commences to function before the little pigs are born, and if the pregnant mother should be lacking in iodine, the thyroid glands of the developing litter will also suffer. When this happens, the little pigs are born without hair, the skin is puffy, the neck thick, and they are often born dead. Those that are born alive usually die within a day or two after birth.

This condition occurs with relative frequency in certain parts of the country and more often in winter litters. It can be effectually prevented by dissolving seven ounces of potassium iodide in one gallon of water and giving each sow one tablespoonful of the solution once a week. The solution should be kept in a glass or enamel ware container.

ANEMIA OF SUCKLING PIGS

Anemia may be looked upon as an excessive watery condition of the blood. The blood is deficient in its solid constituents, its cellular content and its red colouring matter. To enable a realization of the importance of the blood an explanation of some of its functions in the body would be of value. First, it is the means by which nutrient substances are carried to the tissues. Second, it carries oxygen from the lungs to the tissues. Third, it removes waste products from the tissues and carries them to the organs of excretion. Fourth, it assists in maintaining the level of the body temperature. Fifth, it assists in the body defences against infection.

Anemia of suckling pigs occurs because of a deficiency in iron, one of the important elements found in the red colouring matter of blood. Ordinarily little pigs get their iron from the ground and other material they may eat. During the colder seasons of the year, however, they are generally kept penned in rather small quarters, often on cement floors, and they tend to remain hived in the bed. If there is no soil or other material in the pen for them to eat and root in they do not get any iron, neither is there a sufficient amount in their mother's milk to meet with their requirements. Strong young litters of pigs grow very rapidly and the need of iron (on those occasions when it is deficient) commences at about the end of their first week of age. If preventive measures are not taken, they will be badly affected by the time they are three or four weeks old. Normally, little pigs of the white breeds have a pink skin. Their bristles are bright, shiny, and smooth, and they are playful, but when they become anemic they do not thrive, their skin becomes a pasty white, the bristles lose their lustre and commence to curl. At this stage, because of an impoverished blood stream, they are much more susceptible to other diseases, and as a result scours often occur or lung trouble with coughing and pneumonia. The symptoms described apply to any breed of swine, but are more obvious in the white pig. Once the little pigs commence to eat there is no danger of a lack of iron. The dangerous and critical period is in the first four weeks of their lives.

Anemia can be prevented by dosing the little pigs with a suitable iron preparation. It is important to commence giving the iron within three or four days after they are born and to continue dosing them once a week until they are eating solid food freely. Four doses are usually sufficient. Reduced iron is the preparation most frequently used. The dose of it is three grains for each pig and care should be taken not to exceed that amount. A sample dose should be obtained from the druggist to serve as a guide when giving it to the pigs. It can be obtained in pill form combined with a very small amount of copper. Each pill contains the exact amount of iron required and if they are used dip the pill in a mineral oil so that it will slip down the throast eaily. Dosing them individually may be avoided if a few sods are put in the creep or pen and to insure the presence of iron in the sods they may be sprinkled with a solution of iron sulphate. The solution is made by dissolving an ounce of iron sulphate in a quart of water. If the pen is warm the little pigs will root and play in this dirt and apparently get enough iron to prevent anemia. The sods should be renewed twice a week.

SCOURING IN SUCKLING PIGS

When suckling pigs scour it is believed at the present time to be due (to some extent at least) to a lack of vitamin A and B in the milk of the mother. This has occurred because the sow has not been fed adequately during pregnancy and also while nursing her young. The part a lack of these vitamins play in the incidence of scours may not be completely understood but it is believed that the lining membranes of the stomach and intestines are easily invaded by disease-producing germs which set up an inflammation of the gut followed by scouring. Undoubtedly there are other causative factors but these are apparently most important.

Scouring in very young pigs very quickly seriously affects them and steps should be taken at once to correct it. It is advisable to keep them warm and comfortable and change the mother's diet at once by feeding her nothing but shorts or feed flour mixed with lime water and skim milk in equal parts. A tablespoonful of formalin and two cupfuls of linseed oil may be added. Continue with this diet until the little pigs have recovered after which she may be gradually brought back to her regular ration to which may be added a dessertspoonful of feed oil and three tablespoonfuls of dried brewers yeast once a day.

SHIVERING AND SHAKING IN NEWBORN PIGS

This condition is occasionally observed in litters of young pigs and may appear soon after birth. At the present time it is thought to be due to a lack of vitamin B and may be corrected by adding dried brewers yeast to the grain ration of the sow and also giving the little pigs teaspoonful doses of powdered yeast moistened with a little milk.

CONVULSIONS, STIFF SICKNESS AND CRIPPLING

One of the most critical times in the life of a young pig follows weaning. Until they are weaned their chief article of diet has been their mother's milk. This, of course, is the ideal food for them, providing the mother has been properly fed. As soon as they are weaned, however, they are often provided with a ration which is too coarse, rough and deficient in certain elements of food which they require at this period. There are two elements they need particularly at this time, that is, calcium and phosphorus. These have much to do with the normal growth and development of the bones and other tissues of the body. They are also essential for the normal functioning of the nerves, the blood stream, the muscles of the intestines, and the digestion and assimilation of food. In addition to it being necessary that the food provided for them contains these elements in adequate amounts, it is also essential that the rations contain other factors necessary for the utilization of these minerals. These factors are known as Vitamines A and D, and particularly the latter.

If the food provided for the pigs is lacking in calcium or the vitamin factor, certain symptoms are frequently observed. First, it may be noticed that the pigs tend to remain hived in the bed and when they are fed they may rush up to the trough, take a bite or two, and then go into a convulsion or fit. Sometimes they will die in the fit, but usually it passes off. Later on it may be noticed that some of the pigs are becoming stiff and are reluctant about coming to the trough to feed. They squeal with pain and in time they grow worse and finally become so crippled they will not move unless forced to do so. The joints may swell and in some instances the legs become crooked as in rickets. In reality it is a true rachitic disease. This condition usually comes on about four weeks after weaning and until they are four or five months old. In the majority of cases this is the reason for crippling although it may have other causes. It is purely a deficiency disease and like some of the other conditions mentioned, lowers the defensive powers of the body so that they become the prey of intestinal disorders and lung troubles.

PREVENTION OF CRIPPLING

The cost of feeding pigs just weaned is not great but it is very important that they are adequately and properly fed at this time. It is cheap insurance. Later on when they attain some size and age coarser and cheaper feeds may be fed more safely. The food provided for weanling pigs should be easily digestible and the following recommendations will serve as a guide in feeding and will prevent the occurrence of crippling.

The feed mixture should be low in hull or fibre. If common oats are used, they should be ground and sifted or put through a fanning mill to remove the hulls. If hull-less oats are available and ground they are most acceptable.

Newly weaned pigs should be fed three times a day but do not overfeed them and the amount they get should be gauged by their appetites. There should not be any feed left in the trough by the time of the next feeding. Wherever skim milk or buttermilk is available it should be given to them because they are particularly valuable for the young growing pig. Care should be taken not to make abrupt changes from skim milk to sour milk or vice versa. If no milk product is available a protein mineral supplement should be added to the grain mixture.

During winter, and even in other seasons, if the pigs are kept closely penned a standard feed oil of either type A or B containing 1,000 units of Vitamin A and 200 units of Vitamin D should be added to the feed once a day. This is to safeguard against crippling.

At any time when changes of feed mixtures are contemplated, it should be done gradually rather than abruptly. This should be done to avoid digestive disturbances which sometimes follow quick changes in the diet.

DIARRHEA AND INFECTIOUS ENTERITIS OF GROWING PIGS

Quite often after pigs have been weaned and on until they are four or five months of age, diarrhea due to intestinal inflammation and infection occurs. In some outbreaks the disease is quite severe and serious losses are experienced both from pigs which die and those which become chronically affected and remain stunted.

At the present time the cause of the disease is thought to be due to a deficient nutrition and germs which damage the lining membrane of the intestines. In the early and acute stages of the condition the affected animals may be quite sick, off feed and fevered. Some may die within a day or two after they are first noticed sick. Others become chronically affected and if the intestines are examined by post mortem it will be found that much of the lining membrane of the bowel has been destroyed.

In many instances outbreaks of this nature occur in pigs that are not being adequately fed and are being kept in dark, damp and filthy pens. Such circumstances favor the occurrence of the disease for if there are important elements of feed lacking the disease resisting powers of the pigs are lowered and the unsanitary pig pen usually provides the infection. Occasionally, however, an infectious enteritis appears in groups of young pigs that are apparently well fed and cared for. The first noticeable symptom is diarrhea although the affected pigs may not have been eating as well as usual and they are fevered. The diarrhoeic discharges are watery, sometimes blood tinged and the animal loses flesh rapidly. In very acute cases they may die in two or three days after the commencement of the disease, other cases linger on, become chronic and do not thrive.

When an outbreak of disease of this nature occurs no time should be lost in endeavoring to control it. It is advisable to separate the sick from the healthy pigs, putting both groups in a clean pen. Fast them overnight .Do not feed them an evening meal, and instead of breakfast give them raw linseed oil, as much as two cupfuls for each pig weighing a hundred pounds. Put the oil in the feed trough and because they are hungry they will drink it. Procure a quantity of dried brewers yeast, and feed oil type A or B, and mix two heaping tablespoonfuls of yeast for each pig in the feed twice a day. The feed oil should be given in two teaspoonful doses once a day. Equal parts of middlings and sifted oat chop in rather small amounts with buttermilk or sour milk should be fed for a few days until improvement is noticed, after which they may be gradually brought back to a suitable growing and fattening ration. The dried yeast may be discontinued after ten days or two weeks although a small amount continually fed may keep the pigs in better health.

The pen in which they developed the disease should be thoroughly cleaned out and disinfected before they are returned to it or other pigs are put in it. Diarrhoeic affections in pigs should never be regarded lightly for in some instances it is a symptom or a complication of the more serious infectious diseases such as swine erysipelas and hog cholera.

PNEUMONIA AND RESPIRATORY INFECTIONS

The nasal passages, larynx, bronchial tubes and lungs of young growing pigs are a common seat of disease. Such conditions commonly referred to as thumps, chronic bronchitis and coughing are all manifestations of respiratory disease, the cause of which is a germ of one kind or another. Too often diseases in which coughing and difficult breathing are observed are diagnosed as shipping fever. On some occasions the disease may be caused by the germ of shipping fever but on the other hand it may be caused just as often by some other disease-producing organism.

Respiratory diseases are always much more prevalent in the colder seasons of the year when the weather is changeable and the pigs are closely housed. Again as in the case of scouring, bronchitis and pneumonia more often occur in pigs that are inadequately fed and improperly housed and cared for. Quite often pneumonic affections follow scouring. The fact that respiratory disease frequently follows poor pig husbandry and diarrhea, indicates how important it is to be particularly careful regarding the character of the rations provided and the care and housing of the animals.

In some instances chronic coughing and pneumonia are caused by lung-worms. This is not apt to occur in young pigs but is observed in pigs four months of age and older.

The important features in the prevention of pneumonia and respiratory infections lies in maintaining the health of the pigs at the highest possible standard by correct and adequate feeding and seeing that the quarters are kept reasonably sanitary, protected from cold and properly ventilated without draughts. In the winter the provision of a Vitamin A potent feed oil along with their grain ration daily is a means of increasing the disease resisting powers of the pigs. When pneumonia is known to be present in a herd it is advisable to separate those that are sick putting them in clean, warm, dry quarters. An ample supply of clean drinking water should be provided and a purgative dose of epsom salts early in the disease sometimes reduces the severity of it. If they show an inclination to eat give bran mashes or other kinds of sloppy laxative feed.

Since pneumonia and other respiratory affections are frequently associated with certain acute infectious diseases of swine, owners should be on the alert for possible outbreaks of some of the more serious infectious diseases, particularly when a considerable number of the herd are observed to be sick. Under such circumstances a veterinarian should be consulted immediately with a view of obtaining a prompt and accurate diagnosis and his advice with regard to the proper procedure in controlling and preventing further spread of the disease should be strictly followed.

MANGE OF SWINE

Mange of swine is a contagious skin disease caused by a very small insect scarcely visible to the naked eye but can be seen under a hand lens or with a microscope. The disease is quite prevalent in swine and more particularly in the colder seasons of the year and also when the stabling quarters are allowed to become filthy and dirty. Once any of the swine in the herd are infected the disease spreads rapidly and it is only a short time until all of the hogs in the piggery are showing signs of the disease. Younger animals are most susceptible.

The first lesions caused by the mange mite usually appear around the nose, eyes and ears where the skin is tender and the hair is thin. From these parts the infection spreads over the neck, shoulders and back and along the sides and may finally involve the entire body. The mites burrow into the skin where they deposit their eggs, causing irritation, intense itching and inflammation in the skin. Following the inflammation exudation occurs and the skin becomes scabby, blackish and wrinkled in appearance. While a mange infestation does not very often cause the death of pigs, nevertheless in heavy infestations they become unthrifty and remain stunted until something is done to correct the condition.

The proper treatment of hogs infected with mange mites consists of killing the parasites by applying medicated liquids known as dips. There are several different kinds of effective dips available, oils and lime-sulphur being the ones most commonly used. Where large numbers of swine are raised and become infected it may be advantageous to construct a dipping vat into which the swine are driven and as they pass through they are immersed in the preparation used for the destruction of the parasite. In smaller lots the oil or dip may be applied with a paint brush, taking care to apply it liberally on those parts of the body the mites frequent. This should be done once a week for four weeks so as to destroy any young mites which may hatch after the first application. It also requires a thorough cleaning out of the pens and the destruction of mites which may be on the floor or in the cracks of the walls of the pen. This is most effectually accomplished by dissolving a pound of lye in thirty gallons of hot water and thoroughly washing the walls and floors of the pens with it. A 3 per cent of creolin solution is also effective. Afterwards when the pen is dry it may be whitewashed. Oils suitable for the destruction of the mite are used crankcase oil and there are also proprietary brands of oils available for this purpose.

HOG LICE

Swine are commonly infested with lice. These are blood-sucking parasites and while not as dangerous as mange mites nevertheless cause a great deal of discomfort and interfere with the well-being of the pigs. They are easily seen for they are the largest of all varieties of lice which are found on domestic animals. They are easily gotten rid of by the application of the oil recommended for the destruction of mange mites.

Periodical examinations of pigs for both mange and lice during the colder seasons of the year should be made for evidence of these parasites and if there is any indication of their presence an application of oil will at once prevent heavy and harmful infestations.

PARALYSIS OF THE HINDQUARTERS

Paralysis of the hindquarters occurs with relative frequency, particularly in brood sows. In the majority of cases it appears in advanced pregnancy or at the conclusion of the nursing period just after the litter has been weaned. Upon occasions, however, it appears at other times and in pigs that are not breeding.

In some instances the cause is obscure but because the condition is most frequently observed at farrowing and during lactation it is felt that it is probably due to the depletion of certain mineral elements and vitamins at the times when sows are developing their young within them or afterwards when they are secreting milk for the young. It is quite probable that such sows are not being adequately fed at such times for paralysis seldom occurs in sows that are properly fed and cared for. Too often when a sow becomes pregnant little thought is given to the character of her diet when in reality it is a time when much consideration should be given to her ration for she has placed upon her the burden of developing the litter and after its birth the secretion of milk to provide them nutrition. Other causes, such as injury to the spine, tumors, abscesses, and infection involving the spinal cord are known to produce the condition, but rather rarely.

As a rule, posterior paralysis develops gradually. The first indications are an unsteady gait and inability of the animal to control the hindquarters; as the condition progresses, walking becomes more difficult and weakness of the hindquarters more pronounced. Finally the animal is unable to stand on the hind feet and if forced to move will drag the hindquarters. Some may be so seriously affected as to be unable to move. They, as a rule, eat and drink fairly well but gradually lose flesh.

Treatment is not very satisfactory except in those cases where it is evident that the paralysis has occurred as the result of nutritional deficiencies and the lack of exercise. In these cases veterinarians can get some of them on their feet by the injection of calcium preparations and other stimulative medicine. In all instances the affected animal should be placed in clean comfortable quarters, fed carefully on a laxative well-balanced ration and not allowed to remain lying on one side or in the same position too long. It is also advisable to try and get her on her feet once or twice a day because the longer they remain unable to rise the more likely they are to become permanently affected.

Preventive measures consist of providing adequate rations while the sows are pregnant and also while suckling their young. If pasture or green feed is not available, vitamins and mineral supplements should be added to the feed. Plenty of exercise during pregnancy is also essential to the vigour and general health of the sow.

UDDER TROUBLES AND MASTITIS IN SOWS

In order to raise good litters of pigs it is essential that sows have good udders, free from disease. It is not uncommon to meet with cases in which the sow will fail to secrete milk or fail to let the milk down immediately after farrowing. When this occurs it is very often due to the fact that labour has been prolonged and the sow is sick and fevered. Such an occurrence is serious for unless the newborn pigs are able to get nourishment shortly after birth they soon commence to weaken and will perish. Cases of this kind require the immediate attention of a veterinarian for there are certain biological products available which can be injected into sows affected in this manner that stimulate them and also cause the milk to come down and be available for the young. Such sows very often need a dose of laxative and any feed that is given them should be of a sloppy laxative nature.

It is not very often that the whole udder becomes involved in a mastitis but quite frequently one, or two or more, of the glands are inflamed, enlarged and do not secrete very much milk. The rear glands of the udder are more often affected and this is partly because they are more subject to injury. As a rule these tumified glands are also infected with a disease-producing germ. In some instances it may be tubercular or actinomycotic, and in other cases some extraneous infection.

Most of these infections gain entrance to the tissues of the glands through an abrasion or injury. When some of the glands are infected in this manner they may be a source of danger for the young which suckle such teats and give rise to disease in the litter.

The prevention of chronic infections in the glands is largely a matter of cleanliness and sanitation in the pens and also constructing the pens so that possible injury to the udder is minimized. For instance, if the sow has to step over high door sills or other obstacles which might bruise or injure the udder. When any sores or abrasions are observed on the teats or glands, carbolized vaseline should be applied to hasten the healing of them and reduce the likelihood of infection. When a number of glands become affected it may not be wise to keep such a sow for breeding purposes.

INTERNAL PARASITES OF SWINE

There are a considerable number of parasites which infest swine, any of which may do a considerable amount of harm upon occasions. There are stomach worms, worms which infest the small intestines, others which live in the large bowels and others which develop in the lungs. Those which are most harmful in Ontario are the ascarids (the large round worm of the small intestines) and the lung worm.

It is rather remarkable, but nevertheless recently revealed to be true, that the pigs in which parasitic infestation proves to be most harmful are those which were not healthy or were not being properly fed before they became very wormy. In other words, healthy vigorous pigs that are being adequately fed do not suffer from parasitism. They are resistant to the infection. This feature again reveals how important it is to apply good animal husbandry and provide proper feed for pigs at all stages of their growth and development.

When pigs are heavily infested with worms and become unthrifty it is necessary to procure worm remedies and treat them. Following treatment the pens should be thoroughly cleaned out and then washed down with scalding hot water and lye (one pound of lye to 30 gallons of water). This will destroy any worm eggs and larvae with which the pens may be contaminated and prevent reinfestation. If the pigs have been allowed out in a pig yard it is necessary to provide a new run for them because the former yard will be contaminated with the eggs and larvae of the worm.

When treatment for the removal of the parasites is undertaken the remedy should be administered by a veterinarian for the drugs used are rather poisonous. Drugs that destroy living worms may be injurious to the pig and doses of the various agents used must be properly adjusted. In the treatment two methods are used. One in which each pig is dosed individually, the other is referred to as mass treatment and is accomplished by mixing some worm-killing drug with feed and allowing the pigs to eat it. This latter method is not so effectual but has some value, is less expensive and does not require so much time to apply.

The drugs most effective are the oil of chenopodium and phenothiazine. Oil of chenopodium is given in a fluid drachm (a teaspoonful) dose for a hundred-pound pig. A smaller dose will suffice for a smaller pig while larger animals will need a larger dose. When given with a dose syringe each dose is diluted in two fluid ounces of castor oil or mineral oil. The pigs to be treated should not be fed any solid food for two meals before dosing. Phenothiazine can be given in capsule or mixed with about eight times its weight of dry ground feed. An ounce of phenothiazine would be sufficient to dose three one-hundred-pound pigs.

Lung worms are whitish threadlike round worms that may attain the length of two inches. They are found in the smaller air passages at the ends of the lobes of the lungs. In heavy infections they may be found in the larger air passages. The presence of these lung worms in the air passages and tissues of the lungs gives rise to irritation, interferes with breathing and causes coughing. The coughing is more pronounced after exertion of any kind. In some instances pneumonia occurs and in all cases the pigs do not thrive or make the gain they should.

Unfortunately there is but little that can be done in the way of treatment. Lung worms are situated in a position which cannot be reached by medicine. The best that can be done is to keep the pigs as healthy as possible by good care and proper feeding with the hope that they may become marketable. On farms where lung-worm infestation is widespread among the pigs it may be advisable to sell off all the herd, thoroughly clean out, disinfect and whitewash the pens and provide new hog lots before restocking.

THE INFECTIOUS DISEASES

In concluding this bulletin, reference is being made to several specific infectious diseases. They are Swine erysipelas, Hemorrhagic septicemia and Hog cholera.

Swine erysipelas is an infectious disease caused by a germ. It occurs most often in the late spring, summer and fall, but has been observed at all times of the year. Swine of all ages are susceptible to the disease. The causative organism has been found to affect a variety of birds, and animals, including man.

In swine the disease occurs in three forms, namely, an acute form in which the sick pigs are seriously affected and may die quickly. Another less severe form in which the skin over the back and along the sides show dark hemorrhagic spots which often assume a square shape and give rise to the term Diamond Skin Disease, and still another form, somewhat chronic in character, in which the joints of the legs are affected so that the pig becomes crippled.

Serious losses may occur in the acute form but in the diamond skin form most animals recover. Pigs which become crippled are usually unthrifty and seldom recover completely.

This is a serious disease and requires the services of a veterinarian to institute measures of control, to apply treatment and to advise as to the care and management of the herd.

Hemorrhagic septicemia, a disease commonly referred to as 'Shipping Fever,' is also caused by a germ. Outbreaks of the disease most frequently occur when pigs have been subjected to some experience which lowers their resistance to infection such as exposure, the exhaustion of shipping, poor housing, improper feeding, and irritation to the lung tissue as from excessive dust or parasites.

Generally the disease assumes the form of bronchitis and pneumonia. Upon occasions diarrhoea is observed. Very often it is associated with other infections which may be as important in the sickness manifested as the hemorrhagic septicemia organism. The symptoms observed are usually those of pneumonia. There is fever, difficult breathing and coughing. Discharges from the nose and eyes may be seen. The affected pigs are off feed. They lose flesh quickly and soon become weakened. Death may occur in from five to ten days. Those which survive usually have a chronic cough, continued difficult breathing and seldom thrive.

The definite diagnosis of the disease is rather difficult because this disease is so often complicated with other conditions and organisms. There is no cure for the disease. There are some biological preparations which have some value for treatment in the early stages of the disease and they may also be used as preventive agents. The most effective means of prevention, however, consist in practicing proper sanitation. Hog houses, and their surroundings, should be kept in reasonably sanitary condition at all times. The pigs should be warmly housed and guarded against excessive humidity in the pens. Fresh air and plenty of fresh drinking water should always be available. In all outbreaks it is advisable to consult your veterinarian in the handling of the disease.

Hog cholera is a highly infectious and contagious disease of swine caused by a virus. It affects swine at all ages and in acute outbreaks the death rate is very high, whole herds being wiped out in a short time. In countries where the disease is prevalent the cost of raising pigs is increased because of the necessity of vaccination to protect them.

In Canada this disease is under the control of the Health of Animals Branch at Ottawa and all outbreaks of the disease must be reported to the district Inspector at once. The policy is one of quarantine, slaughter and the indemnification of the owners for animals which have to be destroyed. This procedure has proven to be a wise one for no outbreaks of nation-wide proportions have ever occurred.

For advice regarding the rations which should be provided for pigs, the following pamphlets and bulletins published by the Statistics and Publications Branch, Parliament Buildings, Toronto, Ontario, are recommended: Handbook on Feeding and Management of Swine, by the Ontario Feed Board — July 1940. Bulletin 423 — 'Save That Litter,' by the Swine Committee of the Ontario Feed Board.