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BULLETIN 181.] [JUNE, 1910.

Ontario Department of Agriculture

WOMEN'S INSTITUTE BRANCH.

The Teeth and Their Care

Dental Hygiene and its Relation to Health.

FOREWORD.

This pamphlet is written with the object of showing (1) the importance of the teeth, (2) the advantages to be gained by an intelligent knowledge of these organs, and (3) how to care for them.

Air, water and food are the three requisites to human life. Air and water almost in the states in which they come from nature can be used to nourish life. Food, on the other hand, must undergo many complex processes before it can become a part of the human body. It follows that the organs which are provided to change food from that condition in which nature supplies it, into the condition in which it can be used to nourish the body and sustain life, must be able to do their work properly, otherwise health is impossible.

Therefore it is plainly seen that the condition of the teeth, standing at the very gateway of life and health, is a matter of vital importance.

In the following pages this subject is treated briefly in a general way. Should demand arise, the Department may issue further bulletins dealing more extensively with the various phases of the subject that are of particular public interest. The general subject of "Prevention of Decay," for instance might well be dealt with in a separate bulletin.

GOOD TEETH AND A SANITARY CONDITION OF THE MOUTH A NECESSITY TO HEALTH.

Few people realize how bodily health depends upon a clean, healthy condition of the mouth and teeth. When the world learns that neglect of the mouth turns the crevices of the teeth into foul receptacles for decaying matter, containing many disease-producing germs such as those of tuberculosis, diphtheria and pneumonia, then there will be a great awakening to the vital importance of hygiene of the mouth, and people will be properly trained to care for their teeth and to keep their mouths in a sanitary condition.

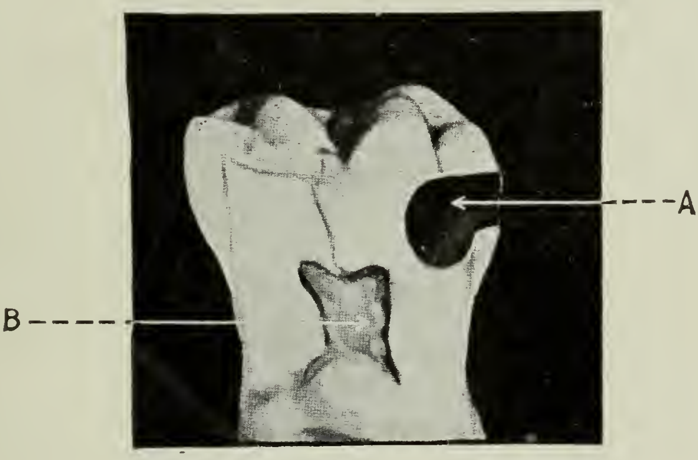
The mouth presents ideal conditions for the development of germs of disease. Here they find food, heat and moisture, and little crevices where they may remain quietly lodged, a myriad army, bent on their errand of disease and death. The opportunity for which they wait is the inevitable lowering of vitality which in many cases results from an unsanitary condition of the mouth. A healthy body possesses means by which to fight, conquer and destroy the germs of disease, which can only thrive on ground weakened to their attack. When germs are carried into the stomach and intestines and find the vitality already lowered through faulty digestion, they thrive and carry on their work of destruction. Tuberculosis, the Great White Plague, frequently ensues from the introduction of germs through the mouth as the direct result of uncleanliness. Proper sanitary care of the teeth and mouth will keep the oral cavity comparatively free from the germs of disease, and proper mastication will keep the vitality of the tissues such that the attack of the germs will be futile.

In the mouth solid particles accumulate from the breath, saliva and food. These deposits become cemented to the teeth by a viscid mucus which exudes from the glands of the oral cavity. To mouth-breathers this condition of the mouth becomes a source of infection to their lungs by means of the air drawn into the lungs through the mouth. The oral cavity, then, when improperly cleansed, becomes infected with bacterial formation, with particles of decomposing food, with unhealthy saliva, with pus from inflamed gums, also from decayed teeth, and other pathologic conditions. In this is presented a true picture of the innumerable sources of infection inseparably connected with diseased teeth. Incredible as it may seem, these conditions obtain, not in one class of society alone, but describe the average mouth conditions of the race.

DISEASES OF THE TEETH.

To some "disease" may seem too dignified a term to apply to decay of the teeth. Smallpox and pneumonia are widely recognized as diseases, but many people regard decay of the teeth as a purely local disturbance, distressing, but not alarming. It is because decay of the teeth seems only to be an indirect cause of other diseases that so many regard it lightly. Decay is caused by an acid destroying the tooth substance. The acid is produced by a micro-organism which becomes attached to the tooth.

Once the enamel or outer layer is penetrated, the dentine or softer tissue underlying the enamel dissolves rapidly in the presence of the acid. The decay gradually works its way towards the centre of the tooth, undermining the whole crown, and frequently leaving standing the apparently healthy enamel as a mere shell, while the destructive process is going on within. Thus it occurs that there often comes an unpleasant surprise when there is a sudden collapse of a tooth which was thought to be but slightly decayed.



Molar tooth showing the progress of decay toward the pulp (nerve).
A. Cavity of decay.
B. Pulp.

In the centre of the tooth is a very sensitive organ, the pulp (popularly called the nerve), which normally is covered on all sides with tooth substance. When the tooth is penetrated by decay, heat, cold, or simple pressure (as in eating) irritates the insufficiently protected pulp and causes pain. Such a condition interferes with the function of the teeth for mastication.

THE IMPORTANCE OF PROPER MASTICATION.

The process by which food is changed into nourishing material, and rendered capable of being absorbed and built into the different tissues of the body, is called digestion.

The first process necessary to digestion is mastication, which is performed chiefly by the teeth. Mastication consists in breaking up the food into small particles, and mixing it with saliva until it is a thick, creamy fluid, and in condition to be swallowed without effort.

It is necessary for the food to enter the stomach in this condition, otherwise the stomach cannot take up its work at the right stage and continue the process of digestion in a proper manner, but rather is forced to pass the unwholesome mass into the intestines, where proper absorption is impossible, and hence nourishment is not attained. Intestinal irritation, and a process of slow starvation, frequently results, with a lowering of vitality and a consequent predisposition to disease.

The food reaching the stomach in a more or less lumpy condition also acts as an irritant on the delicate lining membrane of that organ, causing dyspepsia or indigestion; if the irritation continues chronic catarrh of the stomach and dilatation of that organ may occur, leading to wasting chronic indigestion and invalidism. A very large number of such cases may be traced to deficient mastication due to diseased teeth.

All food should be masticated until ground to the finest consistency, not alone for the purpose of reducing it to fine particles, but to have it thoroughly incorporated with the salivary secretions. These secretions have a profound chemical action upon the food in its preparation for the stomach. The saliva enters the mouth through tiny canals leading from special glands. Of these openings some are found on the floor of the mouth under the tongue; and two larger openings, one on each cheek opposite the first molar teeth. Hence it is important to use both sides of the mouth in chewing the food, not only to secure the maximum of masticatory surface, but also to insure a perfect incorporation of the saliva with the food.

The proper mastication of food is such an important factor in the maintenance of good health, that Horace Fletcher, a man who has demonstrated its value by practical methods, has been granted high scientific merit merely for directing the thought of the world toward the importance of the thorough mastication of food.

Proper mastication will not only correct many diseased conditions of the general system, but will have a marked local effect on the teeth themselves, for exercise is just as necessary for growth and strength in the jaw and teeth as in any part of the body. Use develops strength—disuse results in an atrophy or wasting of the parts. To maintain a sufficient blood supply to the teeth they must be exercised regularly.

There are two public monuments to decayed teeth in our land, built by our new-world civilization, " Prepared Foods " and the " Quick Lunch Counter." For the sake of your teeth, for the sake of humanity, and for the sake of a longer length of life, avoid prepared foods, and chew your own food. It does not so much matter what you eat as how you eat it. Chew your food to a creamy consistency, and your breath will be sweeter and your stomach lighter. Your appetite will not be an enemy of digestion. Do not expect the stomach to do the work of the teeth.

SOME FURTHER RESULTS OF DENTAL DECAY.

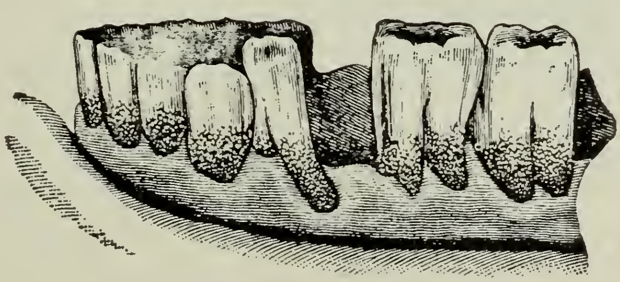
The serious results of decayed teeth do not stop with the harboring of germs, nor with faulty mastication. The decay penetrates the tooth toward the nerve, and the resulting irritation causes the pulp to die, and with its death pain, for a time, ceases. The pulp soon decays, becomes putrescent and sets up an inflammation in the adjacent tissue, most frequently resulting in an abscess. The result is a swelling of the surrounding parts, throbbing pain, feverishness and loss of appetite. The tooth becomes very sensitive to pressure, the mere act of closing the teeth together causing intense pain.

The abscess thus formed is commonly known as a "gumboil," but is more properly called an alveolar abscess. The pus makes, through the bone of the jaw, a small channel which usually opens into the mouth. Although the pain and swelling now subside, yet the pus continues constantly to drain into the mouth, and so affects the whole system. People with decayed teeth and diseased roots are thus frequently subjected to slow poisoning, the health being undermined before the source of trouble is located.

Many cases of pernicious anæmia are found to originate in the constant draining of pus into the mouth from abscessed teeth. Other ailments resulting from the presence of these poisons are chronic tonsillitis and persistent inflammation of the membrane of the throat.

THE LOOSENING OF TEETH.

There are some people whose teeth decay very little who are often victims of a worse trouble. Their teeth become loose and drop out. One cause, among others, of this loosening is a deposit of tartar on the teeth which encroaches on the gum tissue, acting as an irritant and causing the gum to recede. The tooth becomes loose and sore to pressure.

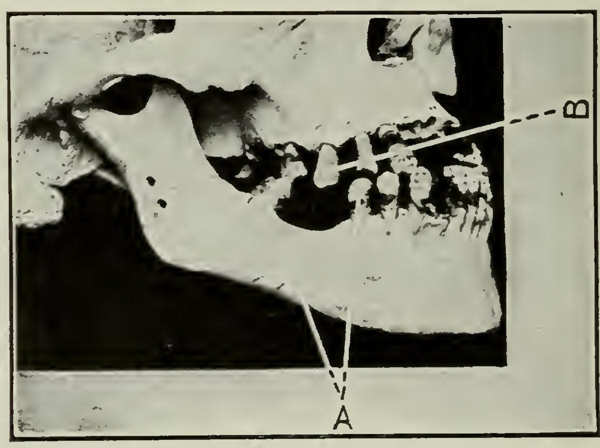


Showing tartar on the teeth, resulting in a recession of the gums and the ultimate loss of the tooth.

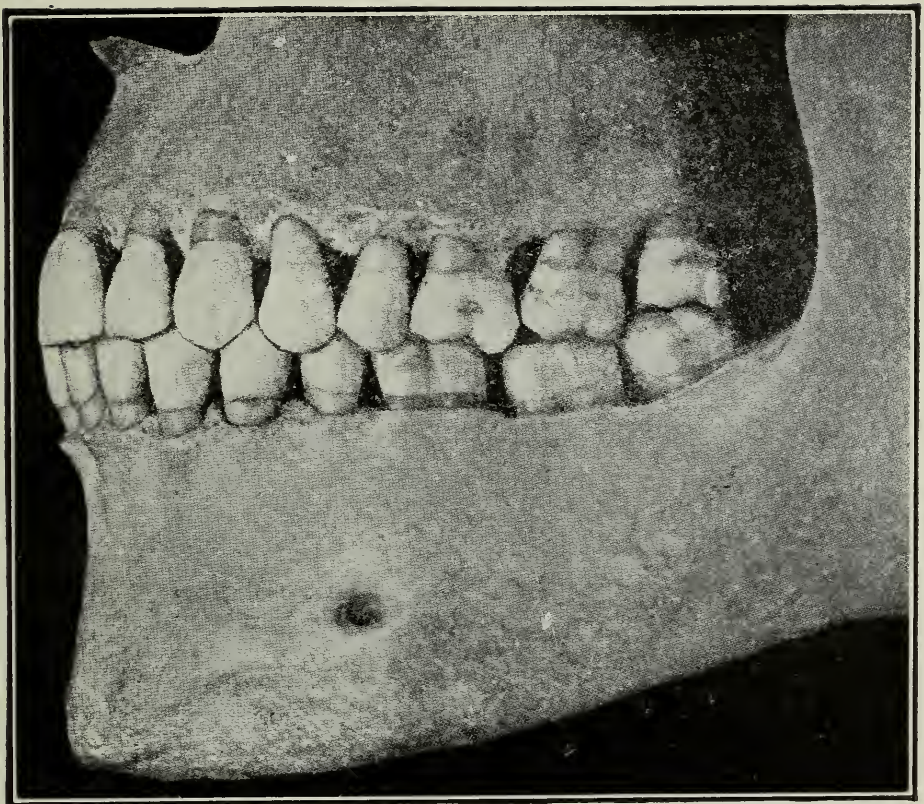
Pus pockets frequently form under the free margin of the gum, and the consequent discharge of pus is not only offensive but dangerous. This condition is technically known as *Pyorrhœa-Alveolaris.* Its progress is gradual and not accompanied by pain, and consequently its presence is not usually recognized until it has progressed to an advanced stage. This disease is amenable to treatment, and the tartar should be thoroughly removed at regular intervals.

WHEN A TOOTH IS LOST.

Teeth may be lost through decay, or loosening, but from either cause the loss of one or two teeth seriously impairs the power of mastication, and the more extensive this loss the greater should be the time spent in chewing the food. When, for instance, a lower tooth is lost, the service of the upper opposite tooth is lost as well, for want of an antagonizing surface. But this is not all, as there is a constant inclination of the teeth on either side of the resulting space to tip toward one another, and the result is, that instead of the whole broad surface of the teeth being used in mastication only the corners of the teeth are used.



Showing results of loss of tooth:
A. Remaining teeth on either side of space tipping over.
B. The elongation of the tooth in the opposite arch, and its ultimate loss.



The permanent teeth in normal occlusion, showing a perfect masticating apparatus.

Thus the loss of a single tooth greatly impairs the amount of grinding surface for crushing food, and it follows that more time and care is necessary to reduce the food to a proper consistency for digestion.

THE TEETH OF THE CHILD.

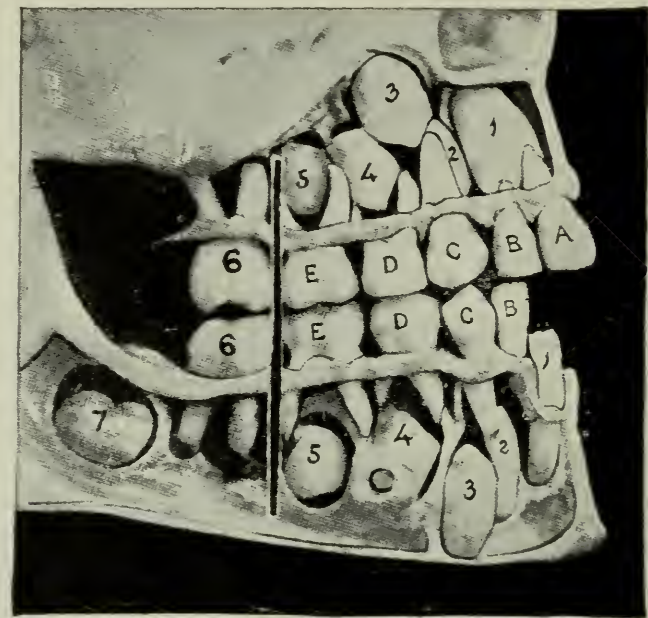
The conditions that have just been described are applicable to the case of the child.

As a rule a child's mouth is a hotbed for disease germs. Fully ninety per cent. of school children have been found to have decayed teeth. Such statistics should impress upon thinking people the great need for dental inspection of school children.

The average child begins to clean its teeth about the time its vanity is awakened, usually after all the permanent teeth have erupted, at twelve or thirteen years of age. It is not a wonder the teeth decay. It is a marvel they ever escape. The best results in properly caring for the teeth are obtained by teaching the child at an early age how to keep the mouth in a clean condition.

It is commonly considered that the temporary teeth of a child are not worth caring for, or filling, if decayed, because a set of new ones will soon take their place.

This attitude towards the temporary teeth is very universal, and also very inconsistent with the best interests of the child.



A diagram showing the method of eruption of the permanent set of teeth and the way they replace the temporary ones. Note particularly that the tooth 6 (behind the black line) is the most important tooth in the mouth. Notice also it erupts independently at 6 years of age and does not replace a temporary one.

THE TEMPORARY TEETH:

A. Central } Incisors.
B. Lateral }
C. Cuspid.
D. 1st Molar.
E. 2nd Molar.

PERMANENT TEETH:

1. Central } Incisors.
2. Lateral }
3. Cuspid.
4. 1st Bicuspid.
5. 2nd Bicuspid.
6. 1st Permanent Molar.
7. 2nd Permanent Molar.

There are twenty temporary teeth and thirty-two permanent. Thus a normal adult has twelve more teeth than a child. These come in back of the temporary teeth, three on each side below, and three on each side above, and are known as the molars of the permanent set, which erupt at the ages of six, twelve and twenty respectively. The first permanent molar (and let it be urged to remember that it appears when the child is only six years old) is the most important of the permanent set, and yet, because it does not displace a temporary tooth, parents seldom recognize it, and it is allowed to decay. The fact that it erupts painlessly behind the last temporary tooth makes its chance of observation all the less. The neglect of this tooth is a serious mistake. It may be located by counting from the median line, and will be found to be the sixth tooth. This first permanent tooth frequently decays about the time of its eruption because of defects in the enamel, and so it is badly decayed before its presence is realized. The temporary teeth should be given the same strict attention the permanent ones demand. The child should be supplied with a child's size tooth brush that it may early learn to keep the teeth clean. With proper dental attention there is no reason why the temporary teeth should not be preserved for their natural length of time.

The order and time of eruption of the teeth is as follows:

TEMPORARY TEETH.

Central Incisors	from	6	to	8	months.
Lateral "	"	7	"	9	"
First Molars ...	"	14	"	16	"
Cuspids	"	17	"	18	"
Second Molars .	"	18	"	24	"

PERMANENT TEETH.

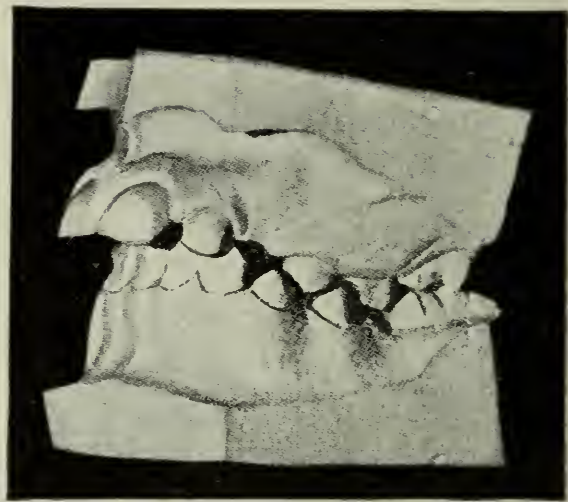
First Molars	$5\frac{1}{2}$	to	$6\frac{1}{2}$	years.
Central Incisors from	6	"	8	"
Lateral Incisors	7	"	9	"
First Bicuspids	9	"	10	"
Second Bicuspids ...	10	"	11	"
Cuspids	11	"	12	"
Second Molars	12	"	14	"
Third Molars ...... (wisdom teeth)	17	"	23	"

These periods may vary slightly. As a rule, the upper teeth erupt a little later than the corresponding lower ones.

IRREGULARITY OF THE TEETH.

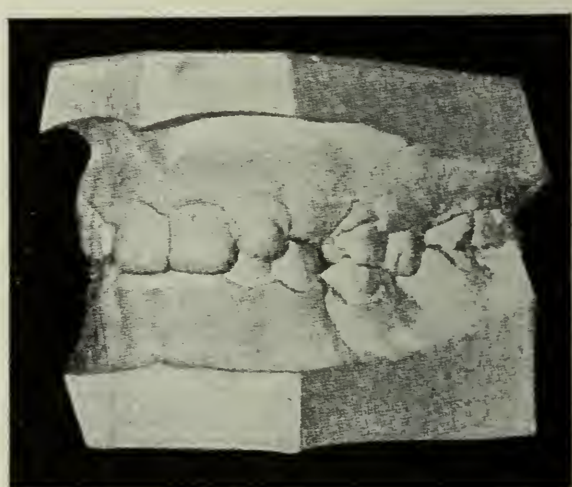
The appearance of many people is marred, amounting in some cases to positive deformity, as a result of the teeth being out of place, or the jaw distorted by irregularity. One of the most frequent causes of irregularity of the teeth is the premature loss or extraction of a temporary tooth, thus allowing the remaining teeth to close up the space that ought to have been retained for the permanent one. The correct time for the removal of a temporary tooth is precisely the period of eruption of the permanent one which is to replace it.

When the temporary teeth are properly retained, not only are places reserved for the permanent ones, but the development of the jaw is not interfered with, as the permanent teeth, being larger than the temporary ones, are then compelled to literally force their way into the arch, and it is this lateral pressure that causes a proper development of the dental arch, and without which the jaw is usually undersized for the teeth, with consequent irregularity. The teeth, unlike other organs of the body, are fully developed as to size at the time of their eruption. The pressure exerted by these large permanent teeth is nature's method of forcing the jaws to that state of development which is necessary to accommodate without irregularity the teeth of the adult. Another frequent cause of irregularity is the loss of the "sixth year" or first permanent molar. This tooth is the most important tooth in the arch, being frequently referred to as the "King Tooth." It locks the other teeth in position, and its absence or loss results in an irregularity which is difficult to overcome.



Profile of child before treatment. Teeth of child before treatment.

Deformity frequently results from the pernicious habit of breathing through the mouth, owing to some obstruction in the nasal passages. Mouth-breathing causes the upper anterior teeth to protrude and the lower ones to recede, giving a weak and undeveloped appearance to the



Profile of same child as above after treatment. Teeth of same child as above after treatment.

BAD DENTAL HABITS.

The avoidance of bad habits is of as much importance as the formation of good ones. Bad dental habits formed in youth yield evil results which may persist throughout life.

Biting Thread.—The habit of biting hard substances, and grinding the teeth together as in biting thread, is very injurious.

Mouth Breathing.—Breathe through the nose. Nature never intended people to go about with their mouths open. An open mouth exposes the teeth to cold and the throat to disease. Do not take extremely hot or extremely cold substances into the mouth, as sudden changes of temperature are injurious to the teeth.

Gum Chewing.—Gum chewing is another bad habit which can bring on a chain of very serious results. It injures the expression of the face and distracts the mind. Teachers know well that gum-chewing children are the poorest students.

The Candy Habit.—There is no doubt that sugar is a valuable food, but its excessive use produces a surplus of acidity which is injurious to both the teeth and the stomach. The evil of candy eating is increased when the particles of sweet matter are allowed to remain in the crevices and between the teeth, especially during the night. It is not necessary to be continually chewing and eating to maintain the strength of the body.

GOOD DENTAL HABITS.

The importance of proper care of the teeth becomes manifest when it is remembered that tooth tissue does not repair itself. The old adage that "Prevention is better than cure" is particularly applicable to Dental Caries.

Use the Teeth.—One of the very best ways of taking care of the teeth is by using them. In the present day and generation this is probably one of the most difficult things to do. It is the old question of soft and prepared foods. Hard substances that require mastication preserve the teeth best, because the hard substances act as abrasives which clean the teeth and massage the gums.

Cleanse the Teeth.—Clean the teeth properly twice a day, that is to say, before breakfast in the morning and before retiring at night. In most cases it is a distinct advantage to cleanse them as well after each meal. It is during the night (a period of quiescence) that the beginnings of decay occur if the mouth be not properly cleansed.

Selection of a Tooth Brush.—Select a small tooth brush, so that as much space as possible may be left between the cheek and teeth for the movement of the brush. The brush should reach the last tooth. It should have short bristles with serrated tufts arranged in rows. The handle should have rounded corners. It is not necessary to use a dentifrice more than once a day; use plenty of water and rely upon the mechanical cleansing of the brush as well as upon the dentifrice. Avoid soaps, acids, and harsh, gritty substances. Use a tooth paste, or preferably a powder, that is a standard preparation, and remember that your object is not alone to clean your teeth, but to clean them without injury either to themselves or the gum tissue.

There is a common-sense method of using a tooth brush which will give the best results. When a good housewife sweeps the floor, she does not sweep across the cracks, but with them; so in brushing the teeth, do not brush across the crevices, but with them. This permits the bristles to pass between the teeth and cleanse the spaces. The best method is to place the bristles on the gum and with a rolling motion brush towards the crowns of the teeth. This is done on the surfaces of the teeth exposed to the cheek as well as those exposed to the tongue. A faithful practice of one week will demonstrate the utility of this method.

Care of the Gums.—The health of the tooth is vitally dependent upon the health of the gum tissue. Therefore do not injure the gums by crowding large toothpicks between the teeth, or by using coarse tooth powder. If a toothpick must be used, a small quill is best. Do not use a mouth wash as a substitute for brushing the teeth.

Periodical Examination of the Teeth.—A periodical examination of the teeth is indispensable. It will lead to the discovery of decay in its initial stages. By far the greater factor in the fight for good teeth is the daily faithful care on the part of the individual.

Preservation of the Teeth.—The preservation of the teeth depends more upon tooth environment than upon any inherent quality in the tooth itself; therefore abstain from dissipation, that the saliva may be kept in a healthy, normal condition. The teeth are among our most precious natural possessions and can only be saved by persistent care and attention in the maintenance of a sanitary condition in the oral cavity.

It is a truth, that the beauty, vigour and health of the human body and mind are greatly dependent on the possession of a sound, useful masticating apparatus.

BULLETIN 182.] [JULY, 1910.

Ontario Department of Agriculture

FRUIT BRANCH.

Bee-Keeping in Ontario

ARRANGED BY MORLEY PETTIT, PROVINCIAL APIARIST.

The information contained in this report has been taken from answers to questions sent out in a circular, dated May 15th, 1910, to our mailing list of bee-keepers in Ontario. This list is by no means complete; but it is being added to from time to time as names come in from various sources. We hope that bee-keepers who may not have received blanks for report in May will send their names to this department asking that they be added to the mailing list. For this purpose one who has only one hive of bees is quite as much a bee-keeper as one who has a hundred hives.

Report blanks were sent to two thousand one hundred and seventy-five bee-keepers. Reports were received from four hundred and eighty-eight. Seventy-eight per cent. of those who received blanks did not take the trouble to fill them out. The result is that the status of bee-keeping can be only very roughly estimated. While we have inadvertently failed to send blanks to some of the most extensive bee-keepers owing to the incompleteness of our lists, and a reorganizing of this part of the work, the value of this report is much less than it would be if the rank and file of the bee-keepers would take the trouble to supply a little information when requested.

The counties which have local associations have almost invariably sent in the most and best reports, showing the value of the spring meetings in arousing interest.

The information obtained with reference to local soil and drainage conditions will not be given in this report. It is being reserved until fuller information can be secured, when a special bulletin will likely be prepared. The relation between the nature of soil and the honey produced by plants growing on it is very marked, and presents a problem for careful research.

The summer honey plants reported are uniformly white and alsike clover. Basswood is reported from many of the counties although it does not form the staple source of nectar that it did some years ago. Raspberry bloom is reported as a honey plant in the counties of Bruce, Muskoka, Glengarry, Perth, Prescott, Renfrew, and York. Alfalfa is being introduced into many of the counties, but its value as a honey plant in Ontario is very problematical. It does not seem to yield nectar to any extent outside of the irrigated lands of the West. Even if it did the custom of cutting for hay when only one-tenth in bloom would practically destroy its value as a honey plant. Thistle bloom is one of the ill winds of the careless farmer which blows the bee-keeper some good, but improved methods of farming are limiting this source—fortunately for the general good. Withal, our most dependable source of white honey is alsike. Where this is grown extensively for seed on a good stiff clay, well-kept apiaries are practically certain to yield a splendid average income from year to year.

The prospects for honey this season so far as the honey flora is concerned are almost uniformly fair to good all over Ontario. The following counties report prospects "Poor to Fair": Carleton, Dufferin, Durham, Essex, Grenville, Haldimand, Kent, Lennox, Middlesex, Muskoka, Prescott, Simcoe, Stormont, Welland, Wentworth, York.

There is a variety of fall honey plants. Buckwheat, of course, is the staple, and is growing in popularity from year to year. Next to it is goldenrod, boneset, and some aster. Second crop red clover yields surplus gathered by some strains of Italian and Carniolan bees. Sweet clover gives considerable surplus in some sections.

The total number of colonies reported for the fall of 1909 is 18,445, for June 1st, 1910, it is 16,729. Roughly calculating from the percentage of bee-keepers who sent reports, one would be well within the limit in stating that there are 100,000 colonies of bees in Ontario this spring. The average number of colonies owned by those who reported is 34.3 each, spring count. Bees have wintered very well. The 9.3 per cent. loss given by those who have reported is quite light, as some of the most extensive specialists count on an annual 10 per cent. loss in wintering.

Much of the winter loss is not definitely understood, owing to the limitations of our actual knowledge of bee-nature. The reasons given in the report are loss of queens, late weak swarms, starvation, dysentery, foul brood, poor ventilation of the hive or cellar, dampness in hive or cellar, honey dew, robbing, mice, and that indefinite term "spring-dwindling." Other cases are covered by the term "winter killed," which is quite true even though of uncertain definition. The whole wintering problem is one of the most frequently stated "difficulties" in the reports.

The condition of bees is very similar all over Ontario. The very warm weather early in March set up breeding and made the colonies strong early in the spring, but very short of stores. This shortage of supplies and the unfavorable weather later cut down breeding, much brood and even whole colonies starved, but not until in some cases a little epidemic of swarming sent many premature swarms out to suffer or starve in their new hives. Those who gave their bees one-quarter as much attention as they would give other live stock fed them sugar syrup, and will probably reap dollars for dimes in the clover honey season. In many cases it will take bees at least two weeks into the clover flow to get ready for work.

The proportionate number wintered in cellars and outdoors varies greatly with the latitude. In all the southern and western counties outdoor wintering predominates, while in the north and east cellars are more popular. Some few repositories built above ground are used, but these do not as a rule give as good satisfaction as the underground cellar well darkened and ventilated. Bees were removed from cellars earlier than usual this year because the excessive heat in March made it impossible to keep them comfortably cool in the cellars This matter of maintaining a proper temperature is one of the chief difficulties in cellar wintering. A few warm days in March make it necessary to set the bees out, then they suffer in their unprotected hives through weeks of bad weather afterward. The only way to winter bees in the average cellar is to pack and shelter them warmly after setting them out. This the vast majority of bee-keepers will not do, so we recommend packing them warmly on their summer stands in October, for all except the more northerly counties.

Without knowing what extenuating circumstances there may have been in some cases, we would judge that many who wintered outdoors unpacked their hives too early. There seems no reason why bees comfortably packed on their stands should be stripped and exposed to the inclement weather of April and the first half of May. Packing cases should be made so that a super could be put in the hive if necessary before it is unpacked. In fact, many leave the hives in the wintering cases all summer. If the cases are individual this method has some advantages, but where six or eight are in a case it is decidedly objectionable, both from the standpoint of convenience of handling, and the distribution of disease which may be in the yard. Bee-keeping in some of the best counties of Ontario is greatly hampered by men clinging to these antiquated hives, when a single honey crop would more than pay for convenient modern appliances.

Very little disease was reported. Men are not usually proud of its presence in their apiaries, although the disgrace is not in finding it present but only in failing to seek to get rid of it. The Ontario Department of Agriculture is spending $3,000 this year in a continuation of the fight against Foul Brood. There are sixteen district inspectors in the field and their reports show that there is plenty of work for them to do. All suspected apiaries are being visited first, and any bee-keepers wishing to clear up doubts as to the presence of this disease in their neighborhoods should send word to the Department of Agriculture at an early date. It is quite natural that those who send a special request for the services of the inspector will be more apt to get them than those who do not.

The report on the races of bees shows far too great a percentage of black or German bees kept throughout the province. While these bees have many good qualities they are no better than the Italians in any respect except possibly in the whiteness of capping on comb honey, and they are a sure prey to the European Foul Brood which has swept so disastrously over many parts of the United States and has done great damage in some parts of Ontario. It is impossible to cure this dread disease so well in any except Italian bees. On this account, as well as for other reasons, we would urge strongly that all apiaries in Ontario be Italianized as soon as possible.

All kinds of hives are used, from the " barn " down through the list of the twelve-frame, ten-frame, eight-frame Langstroth, the Jones, Richardson, Gallup, Quinby, and home-made. Only one man was brave enough to say he used box hives, and the number of combs, he said, was " Goodness knows how many, I don't." After all, the kind of hive for one to use is the kind he has the best success with, but when one is just starting or is seeking uniformity of fixtures there seems nothing to gain and much to lose by adopting a hive which is a little different from everything under the sun.

The chief difficulties which bee-keepers have can be summed up in the two great problems of apiculture—swarm control and wintering. In many cases the trouble is summed up in the words of one man who said his chief difficulty was to " get the old woman to watch for swarms." The interest that is taken in this problem of swarm control is shown by the fact that when the Department of Bee-keeping at the Ontario Agricultural College sent out notices that instructions would be supplied to all who cared to conduct an experiment in the control of swarming, more than three hundred and twenty-five men and women from every county of Ontario, and from other provinces from the Atlantic to the Pacific, made application for the circular of instructions on this important subject.

A great many stated that they had not time to give the bees attention because their busy time came at the same time as the heavy work on the farm. The solution to this difficulty is to have plenty of store combs and supers. Stack these on the hives from time to time as needed, and systematically keep the bees busy and contented so they will not think of wanting to swarm, then neither the " old woman " nor the old man will be worried getting swarms down from high trees, or seeing them go to the woods.

The wintering problem needs to be just as carefully studied. No colony ever dies without a definite cause, which should be carefully sought out and prevented next time. Plenty of good stores, good queens, warm packing, shelter from winds, all these and many others are factors in successful wintering. If the bees are always prepared for the hardest kind of winter they will get through the easy ones all right.

Prospects are right for prices this year as the markets are bare and honey has become a staple which dealers look for regularly. Blanks will soon be sent out by the Committee on crop reports and prices. It is to be hoped they will meet with a hearty and prompt reply by all who receive them.

The following reports are summarized directly from the statements received:

County.	Per Cent Winter Losses.	Causes.	Per Cent Cellar Wintered.	Dates Removal from Cellar.	Per Cent Outdoor Wintered.	Dates Removal of Packing.	Nature of Winter Stores.
Brant	3-5	Mice and starvation.	34	March 22.	66	May 5.	Some sugar syrup.
Bruce	8	Poor queens, weak swarms, starving.	67	March 15 to April 13.	33	May 16 to May 20.	42 per cent fed sugar syrup.
Carleton	9	Starving and foul brood.	83	March 28 to April 10.	17	....	40 per cent fed sugar.
Dufferin	11	Poor queens.	82	March 25 to March 28.	18	....	Honey and some syrup.
Dundas	4	....	79	March 20 to April 15.	21	....	....
Durham	10	....	60	March 20.	40	....	60 per cent fed sugar syrup.
Elgin	21	Robbing, poor queens, and starvation.	33	March 20 to April 1.	77	April 1 to June 3.	34 per cent fed sugar syrup.
Essex	13	Starving, honey dew, dysentry late swarms.	....	....	100	April 15 to May 17.	Fed sugar syrup.
Glengarry	6	Poor queens and starving.	100	March 20 to April 22.	....	....	....
Grenville	14	Robbing	100	April 15.	....	....	Honey.
Grey	9	Poor queens.	37	March 23 to April 23.	63	March 8 to March 25.	50 per cent fed sugar syrup.
Haldimand	10	Starvation.	7	April 4.	93	May 1 to May 17.	8 per cent fed sugar.
Halton	10	....	....	....	....	....	....
Hastings	14	Old queens and late swarms.	100	March 28 to April 1.	....	....	Honey.
Huron	7	Poor queens, starving, entrance clogged with dead bees.	26	March 24 to April 5.	74	April 20 to May 23.	....
Kent	3	Starving, winter killed.	....	....	100	May 20.	Syrup and honey.
Lambton	8½	Starvation, late swarms, dysentry, poor ventilation.	9	....	91	April 15 to May 24.	....
Lanark	8	Poor queens, late swarms, spring dwindling.	100	March 25 to April 15.	....	....	Honey and syrup.
Leeds	5	Poor queens and starvation.	100	April 1 to April 20.	....	....	....
Lennox	4	Robbing.	....	....	100	May 6 to May 12.	Honey.
Lincoln	20	Poor queens and spring dwindling.	....	....	100	May 20.	....
Middlesex	12	Poor queens. starving, mice.	43	March 1 to April 12	57	May 1 to May 25.	....
Muskoka	15	Starvation and queenlessness.	100	March 28 to April 8.	....	....	Syrup.
Nipissing District	....	....	100	March 28.	....	....	Honey.
Norfolk	16	Poor queens, honey dew, late spring.	27	March 5.	73	May 1 to May 25.	Mostly honey.
Northumberland	14	Late swarms, poor queens.	100	March 20 to April 15.	....	....	64 per cent sugar syrup.
Ontario	5	Moths, starving, poor queens. foul brood and smothering.	54	March 25.	46	April 15 to May 15.	26 per cent fed sugar syrup.
Oxford	14	Starving, late swarms, spring dwindling, poor queens.	63	March 25 to April 1.	37	April 28 to May 9.	39 per cent fed sugar syrup.

County.	Per Cent Winter Losses.	Causes.	Per Cent Cellar Wintered.	Dates Removal from Cellar.	Per Cent Outdoor Wintered.	Dates Removal of Packing.	Nature of Winter Stores.
Peel	7	Starving, spring dwindling, poor queens, robbing.	69	March 22 to April 1.	31	May 20 some packed all summer.	47 per cent fed sugar syrup.
Perth	9	Starving, spring dwindling, poor poor queens.	65	March 19 to April 1.	35	May 1 to May 15.	50 per cent fed sugar syrup.
Prescott	8	Poor queens, starving.	100	March 24 to April 8.	....	....	39 per cent fed sugar.
Prince Edward	5	Starving and poor queens.	100	March 24 to April 1.	....	....	68 per cent fed sugar syrup.
Renfrew	7	Starving, disease, poor queens.	99	March 27 to April 15.	1	....	50 per cent fed sugar syrup.
Russell	11	Poor queens, robbing.	100	March 28 to April 10.	....	....	54 per cent fed sugar syrup.
Simcoe	10	Poor queens and starvation.	33	March 19 to March 26.	67	Mostly left packed all summer.	45 per cent fed sugar.
Stormont	10	Robbing.	100	March 23 to April 25.	....	....	54 per cent fed sugar syrup.
Temiscaming.	13	Too weak in fall.	100	April 15.	....	....	Honey.
Victoria	7	Poor queens, starving, moths.	31	March 28.	69	Mostly left packed.	18 per cent fed sugar syrup.
Waterloo	6	Poor queens and spring dwindling.	16	March 15 to April 1.	84	May 15 to May 26.	87 per cent fed sugar syrup.
Welland	14	Starving and poor queens.	90	March 26 to March 28.	10	May 15.	10 per cent fed sugar syrup.
Wentworth ..	5	Starving.	43	March 21.	57	May 3 to May 15.	96 per cent fed sugar syrup.
York	6	Foul brood, starving, queenlessness.	28	March 12 to March 28.	72	May 10 to June 1.	26 per cent fed sugar syrup.

County.	No. of Beekeepers on list.	No. of Returns.	Summer Honey Plants.	Fall Honey Plants.	Crop Prospects.	Conditions of Bees.
Brant	38	6	Clover, basswood.	Buckwheat, lucerne.	Fair to good.	Good.
Bruce	115	32	White and alsike clover, basswood, raspberry.	Buckwheat, goldenrod.	Fair to good.	Fair to extra good.
Carleton	24	7	Clover, basswood.	Buckwheat, goldenrod,	Poor to fair.	Good.
Dufferin	11	3	Clover.	Buckwheat, goldenrod.	Poor to good.	Fair to good.
Dundas	24	7	Clover.	Aster, goldenrod, fireweed, buckwheat.	Fair to good.	Good.
Durham	3	2	Alsike, basswood.	Buckwheat, goldenrod.	Good.	Good.
Elgin..........	59	18	White clover, alsike, basswood, blueweed, chestnut, fruit bloom.	Buckwheat, goldenrod.	Fair to good.	Strong but short of stores.
Essex	61	17	White and alsike clover, basswood.	Goldenrod, aster, buckwheat.	Poor to fair.	Only fair to good.
Glengarry	73	15	Clover, basswood,	Buckwheat.	Only fair to good.	Fair to good.
Grenville......	4	1	Clover.	Buckwheat.	Fair.	Fairly good.
Grey	71	20	Clover, basswood, alsike.	Buckwheat, goldenrod, red clover.	Only fair to never better.	Fair to best ever.

County.	No. of Beekeepers on list.	No. of Returns.	Summer Honey Plants.	Fall Honey Plants.	Crop Prospects.	Conditions of Bees.
Haldimand ...	39	7	Alsike, white clover, basswood	Buckwheat, golden-rod.	Fair.	Good.
Halton	6	1	Clover, basswood.	Buckwheat.	Good.	Good.
Hastings......	21	4	Alsike, white clover, sweet clover.	Buckwheat.	Fair to good.	Good.
Huron	39	13	Clover, basswood.	Buckwheat, golden-rod.	Only fair to good.	Fair to very good.
Kent	31	5	Alsike, basswood, white clover.	Buckwheat.	Poor to fair.	Poor to very good.
Lambton	70	21	White Alsike clover, basswood.	Buckwheat, golden-rod.	Only fair to good.	Fair to very good.
Lanark	20	6	Clover, basswood.	Buckwheat, golden-rod.	Fair to good.	Good to very good.
Leeds	79	12	White and alsike clover, basswood.	Buckwheat.	Fair to good.	
Lennox	4	1	Clover, basswood.	Buckwheat.	Fair.	Excellent.
Lincoln	22	5	White and alsike clover, basswood.	Goldenrod.	Good.	Fair to good.
Middlesex	188	57	Alsike and white clover, basswood.	Buckwheat.	Poor to fair.	Fair to good.
Muskoka	2	2	Wild raspberry, clover.	Goldenrod, wild aster.	Fair.	Fair.
Nipissing	2	1	Clover, dandelion, wild flowers.	None.	Fairly good.	Good.
Norfolk	219	24	Alsike and white clover, chestnut, basswood.	Buckwheat, golden-rod.	Fair to good.	Poor to fair.
Northumberland	100	15	Clover, basswood, alsike, thistle.	Buckwheat.	Fair to good.	Fair to good.
Ontario	92	14	Alsike and white clover, basswood.	Buckwheat.	Only fair to good.	Fair to good.
Oxford	81	27	White and alsike clover, basswood.	Goldenrod, buckwheat.	Good.	Fair to excellent.
Peel	37	15	White clover, alsike, basswood.	Buckwheat, golden-rod.	Only fair to good.	Fair to good.
Perth	111	29	Alsike, alfalfa, clover, raspberry, basswood.	Buckwheat.	Fair to good.	Fair to good.
Prescott	33	10	Clover, basswood, raspberry.	Goldenrod.	Fair.	Fair to good.
Prince Edward	11	6	Clover, basswood, alsike.	Buckwheat.	Fair to good.	Good.
Renfrew	34	12	Alsike, raspberry, clover, basswood.	Buckwheat, golden-rod, late clover.	Fair to good.	Fair to good.
Russell........	29	5	Clover, basswood.	Goldenrod, buckwheat.	Fair to good.	Good.
Simcoe........	56	16	Clover, basswood, thistle.	Buckwheat.	Poor to fair and good.	Fair to good.
Stormont	28	8	Alsike and white clover, basswood.	Buckwheat.	Fair.	Good.
Temiscaming.	..	1	Clover.	None.	Good.	Good.
Victoria	28	15	Alsike and white clover, basswood.	Buckwheat.	Fair to good.	Fair to very good.
Waterloo	33	6	White and alsike clover, basswood.	None.	Fair to good.	Fair to good.
Welland	15	3	Alsike and white clover.	None.	Poor to fair.	Good.
Wellington ..	..	..	Clover.	A little buckwheat.	Fair to good.	Fair to good.
Wentworth...	66	6	Alsike, white and sweet clover, basswood.	None.	Fair.	Good but short of stores.
York	198	21	Clover, basswood, raspberry.	Buckwheat.	Fair.	Fair to good.

BULLETIN 183.] **[AUGUST, 1910**

Ontario Department of Agriculture

DAIRY BRANCH.

Notes on Cheddar Cheese-Making

By Frank Herns and G. G. Publow.

INTRODUCTION.

The Ontario Department of Agriculture maintains a staff of thirty-five Dairy Instructors, whose duty it is to give instruction to the individual maker in methods of manufacture. Thirty of these men devote their time to instruction in cheese-making, two to butter-making, one to both cheese and butter making, while the two chief instructors have general supervision of the work. All Instructors devote more or less time to visiting the individual producers to give them instruction in sanitary methods of producing and handling milk and cream upon the farm until it is delivered to the factory or creamery. Leaflets giving information as to the care of milk and cream are issued each year, and distributed through the Instructors and factorymen to the producers. We have pleasure in presenting herewith some suggestions and information of special value to the makers. The Department expects a hearty co-operation on the part of the men who have direct charge of the manufacturing in making general the methods outlined.

Geo. A. Putnam, *Director of Dairy Branch.*

Toronto, August, 1910.

Branding Cheese Boxes.

There are still some factorymen who evidently fail to recognize the importance of properly stencilling the weights of cheese uniformly on the boxes by the use of a brand or preferably a rubber stamp instead of a lead pencil. If the weights are put on with pencil they are often hardly distinguishable on arrival at point of delivery, especially if handled in wet weather. The cost of rubber stencils is very little, and their use often avoids serious misunderstandings between buyer and seller as to differences in box weights. Not only this, but the style, appearance and quality of the cheese box has an influence on the sale of cheese. In fact it has been said that a fastidious buyer in the Old Country will sometimes refuse to even examine a lot of cheese when the boxes present a slovenly appearance, preferring to take some other lot which has a neat, trim appearance. The accompanying cut (Fig. A) is intended to indicate how the weights may be stencilled on the cheese box. The factory brand may be put on the left of, or just below, the stencilled weight.

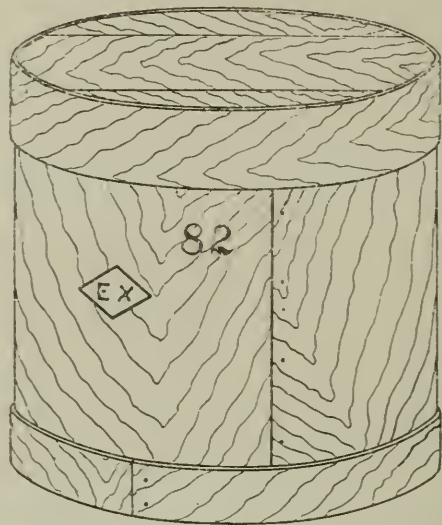


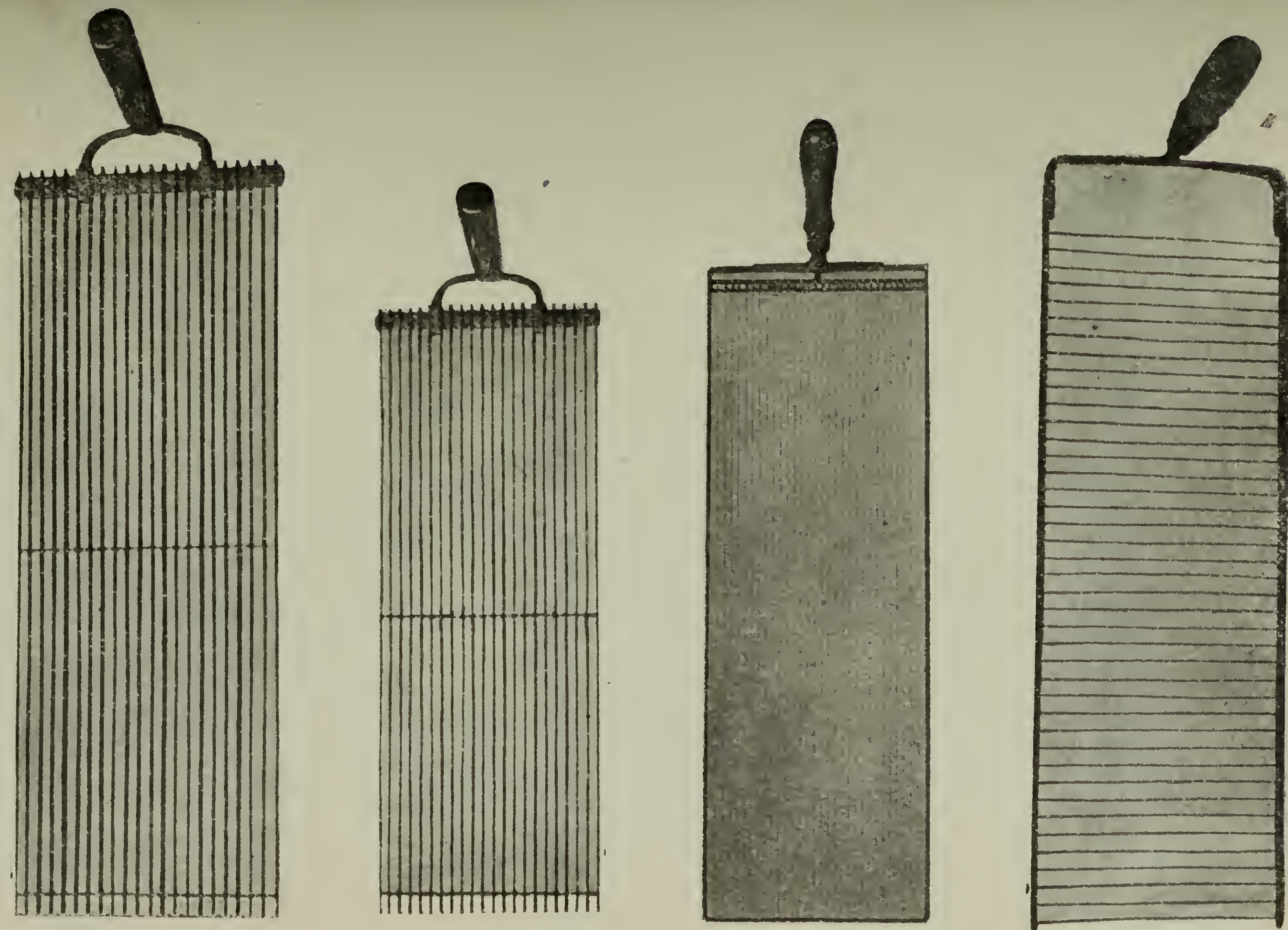
Fig. A. Represents proper stenciling of Cheese Box.

Importance of the Finish of the Cheese.

The finish and stylish appearance of the cheese itself also has a great deal to do with a ready sale. Buyers of cheese will sometimes overlook slight defects in the cheese, provided the outside appearance shows careful and painstaking workmanship on the part of the manufacturer. Note the attractive way in which nearly all food products and other manufactured goods are being put up for sale these days. The inside of a cheese may be ever so good, but if the outside appearance does not appeal to the eye, the enthusiasm of the buyer is dampened and he looks for other possible defects, which otherwise he might not notice were the outside appearance neat, stylish and attractive. The cheese should be uniform in size so far as possible, neatly finished on both ends, taken from the hoops in the morning, squared up, then put back in the press with the ends reversed. This will improve the finish as well as assist in making a closer cheese.

Quarter-Inch Wire Curd Knife.

The quarter-inch perpendicular wire curd knife for fast working milk is giving good satisfaction. Curds usually have only to be cut once with a three-eighth inch horizontal and twice with one-quarter inch perpendicular wire knife. Cubes of curds are thus obtained one-quarter by three-eighths inch in size, which



$\frac{3}{8}$-Inch Blade. $\frac{3}{4}$-inch Blade. $\frac{1}{4}$-inch Wire. $\frac{3}{8}$-inch Blade.

Fig. B.

Perpendicular Curd Knives. Horizontal Curd Knife.

are easily firmed, even with fairly fast-working milk, without rough handling, and insure, under average conditions, a curd properly firmed before sufficient acid has developed for dipping. With the old style coarse half-inch curd knives, the curd often had to be cut several times to get it fine enough to be able to secure sufficient firmness, particularly if the milk was working fast, thus, no doubt, causing some loss of cheese solids, and in many cases the curds retained excessive moisture, resulting in acidy cheese. For normal milk the three-eighths-inch wire curd knives give good results.

We wish to point out that in some cases when the wires break they are not replaced soon enough; and, through this neglect, the curd cannot be cut uniformly, bringing about conditions that are likely to result in open cheese. Wire necessary for repairing these knives should always be kept on hand; and, immediately a wire breaks, it should be replaced with a new one if best results are to be expected from the use of the wire curd knife. The accompanying cut is intended to illustrate the one-quarter inch perpendicular wire curd knife and the three-eighth horizontal blade knife. The horizontal knives should always be kept sharp.

The Pure Culture.

A pure culture made by using pasteurized milk is now recognized as almost a necessity in cheese making and is a great improvement over the old ordinary milk starter or none at all. Cheesemakers are each year becoming more familiar with pure cultures and are using good judgment in handling them. However, it is just possible that occasionally some makers may get a little careless in handling this culture, allowing it to become overripe and of poor flavor. If such culture is introduced into the milk the result will certainly be off-flavored cheese, perhaps not showing at the time of shipment, but in the buyer's hands later on, if the cheese are held. Impure cultures introduced into the milk will sow the seeds which are almost sure to cause off-flavored cheese. We would urge that particular attention be paid to the cultures. As soon as signs of off-flavor are observed secure another. Cultures with an acidity of about .7 per cent. to .75 per cent. are usually in the best condition. All utensils which come in contact with the culture should be sterilized, as it is useless to pasteurize the milk for a culture and then allow it to become contaminated by coming in contact with unsterilized utensils. Dippers with holes in the handles, or wooden paddles, should never be used for stirring a culture. A wire-handled solid dipper is best. The thermometer should be sterilized by dipping in boiling water before coming in contact with the culture. The accompanying cut is intended to illustrate a good style of culture can and a wire-handled dipper. The starter box may be made of galvanized iron or of wood and lined. If the water supply is short the culture may be cooled by suspending the can in the well.

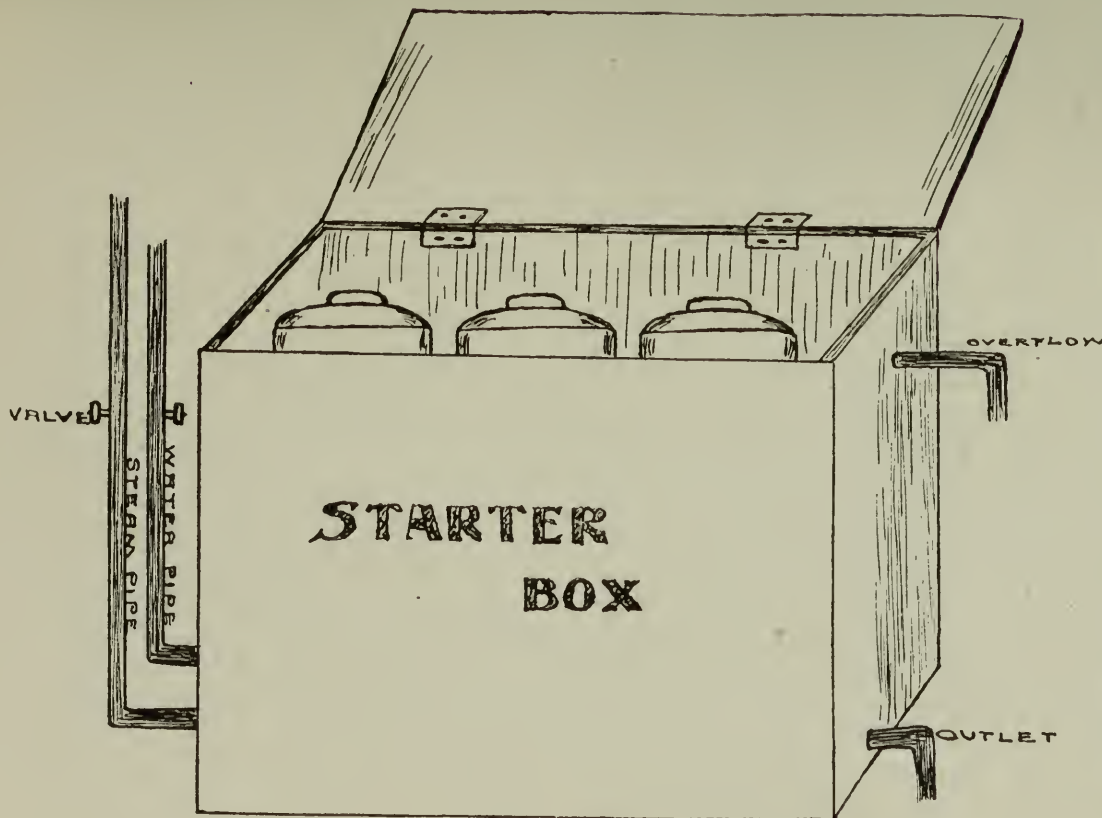

VALVE
STEAM PIPE
WATER PIPE
STARTER
BOX
OVERFLOW
OUTLET

Fig. C (1).

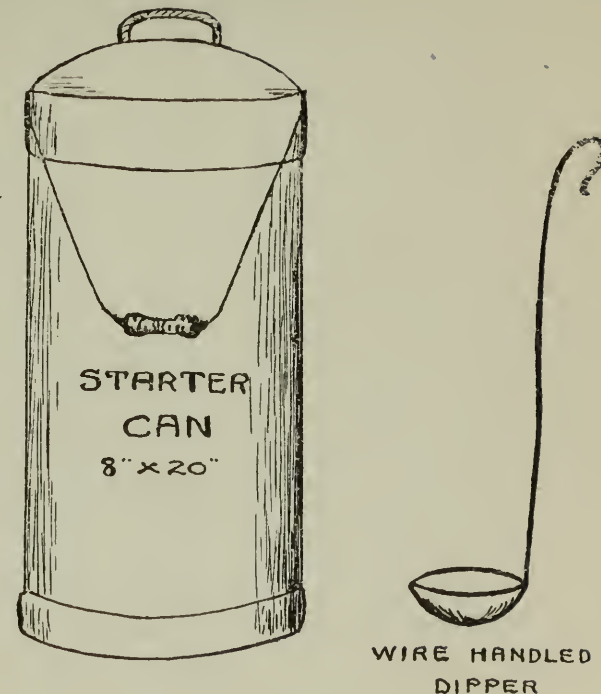

STARTER
CAN
8" x 20"
WIRE HANDLED
DIPPER

Fig. C (2).

Late Fall Cheese.

Proper provision should be made for curing the late fall cheese. The percentage of factorymen whose attention should be called to this matter may be small, but there are enough fall cheese neglected in this way to have considerable effect on the reputation of our November and later made cheese. The press rooms in some cases are not kept warm enough. The cheese, after being taken from the press, are placed in curing rooms, the temperature of which goes far too low, and not sufficient care is taken to keep the cheese at an even temperature. Even after two weeks, the cheese in some cases are not broken down. The color does not develop properly, the texture shows pasty, and the flavor in some cases turns bitter. Cheese of this character do not by any means come up to the high standard expected of Ontario cheese, and it is to be hoped that makers who may be guilty of neglect in this connection will make a special effort to take proper care of the late fall cheese and see that an even temperature of about 60 degrees is maintained in the curing room until the cheese are broken down.

The Acidimeter Test.

This test is coming into use generally among cheese makers; and we would point out the necessity for having the alkaline solution and the indicator of uniform strength. We would here mention that we think it a good plan for the makers, particularly the younger makers, not to entirely discard the hot iron or rennet tests but use them occasionally along with the acidimeter and keep perfectly familiar with these tests, as they come in very handy at times. Directions for making alkaline solution may be found in Dairy School Bulletin No. 172, of the Ontario Department of Agriculture. A standard alkaline solution, such as is used in dairy work, is known as .111 normal, sometimes expressed as 1.11 deci. normal or a one-ninth solution.

Pasteurization of Whey.

"Pasteurization of whey (which is to be returned to the patrons in the milk cans) is being recommended by many dairy authorities. The term "pasteurization" is derived from the name of a distinguished French scientist, Louis Pasteur. Whey is pasteurized to partially or entirely get rid of the germ life present, to secure an even distribution of the whey fat, to keep the whey tanks at the factory in better condition, and to return the whey to the farm comparatively sweet, and as nearly as possible in the condition in which it was drawn from the vats. This is done by heating the whey with steam to a temperature of about 155 degrees F., and allowing it to remain at or near this temperature for some time. The time of exposure to this, or near this, temperature is an important factor in destroying the minute plants known as bacteria. If the whey is exposed to a temperature of 155 degrees F.. for a length of time, as is the general practice in the present system of pasteurizing whey, it is supposed to be as effective in relieving the whey of germ life as a higher temperature for a more brief period. If the whey tanks are kept reasonably clean and covered, in order that the heat may be kept up as high as possible during the night, the whey should go into the patrons' cans the following morning in almost a sterile condition. Through this method the danger of spreading bad flavors to the milk from the whey tank or germs of disease to the stock on the farm through the medium of the milk can in which the whey is returned, should be almost eliminated. The composition of whey is about as follows: Water 93 per cent., fat .25 per cent., casein and albumen .85 per cent., sugar 5.2 per cent., ash .7 per cent. Pasteurization properly done prevents the fat separating and rising to the top of the whey in the tank, thus insuring an even distribution of the fat contained in the whey among all the patrons and preventing an accumulation of decomposing material in the whey tank and the probability of introducing in one or more patrons' cans this greasy mess, which is not only difficult to wash from the cans but also from the whey tanks. When whey becomes sour, more or less of the sugar has been changed to lactic acid. We know of no claim made that the latter is of any direct food value. Some benefit may be derived from its effect on digestion in older animals.

Much of the ordinary unpasturized factory whey returned to the farm under average conditions is shown to be not only sour, but practically gravity skimmed. The fat which is returned in pasteurized whey is shown to be one of the chief valuable constituents for feeding. Recent experiments with sweet whey direct from the cheese vats show a difference of from 25 to 33 per cent. in favor of unskimmed whey as a food for stock. For young animals, comparatively sweet whey is no doubt to be preferred. Were no whey returned in the cans it would be better for the quality of the cheese, but conditions as they exist compel us to recognize the fact that in the majority of cases the patrons wish to have the whey returned.

Some Other Advantages.

Whey properly pasteurized should go into the patrons' cans each morning from the whey tank, provided the tanks are kept reasonably clean, with an average acidity of not more than .3 per cent., and an average fat content of about .2 per cent., while unpasteurized whey will have an acidity of from .9 to 1.7 per cent. average about 1.15 per cent., and a fat content as low in many cases as .03 per cent., average about .09 per cent. Less of the sugar is converted into lactic acid, and the fat is more evenly distributed in all the whey where properly pasteurized.

Yeasty or bitter flavors may develop in the milk of one or more patrons through rusty or unclean cans, or through certain conditions at the farm, but heating the whey to the proper temperature and doing the work as it should be done, will prevent to a great extent the infection of other patrons' cans and the bacteria from being seeded at many other farms. Therefore the patron who is guilty of sending yeast infected or bitter milk may be detected by the curd test and dealt with accordingly. The cans in which pasteurized whey is returned are no doubt easier to wash, *but it is absolutely necessary that the cans be scalded with boiling water whether the whey is pasteurized or not.* Pasteurization prevents to some extent at least the tin from being taken off the can, since less acid is present; therefore, the cans should last longer.

Pasteurization keeps the whey tanks at the factory in a condition that they can be readily and easily kept clean, no fat floating on top of the whey and leaving no excuse for not keeping them clean.

Precautions.

Pasteurization should begin as soon as possible after the first whey reaches the tanks to prevent the development of acid and take advantage of the temperature of 98 degrees before it begins to cool. *Care must be taken that the temperature does not rise much above* 160 *degrees. A higher temperature will precipitate the albumen and cause the whey to be flocculent and slimy. A uniform temperature of* 155 *degrees each day will give good results.*

If possible to avoid, small or large quantities of whey should not be left over in the tank from day to day as this will eventually become sour and act as a culture in the new whey, rapidly raising the acidity.

The boiler should be large enough to furnish economically the steam required. Inexpensive results cannot be obtained otherwise. The tanks should be close to the boiler and the pipes insulated to prevent condension of steam before it reaches the whey.

Pressure as high as practicable should be carried on the boiler during the time the pasteurizing is being done and the steam not given too much vent into the tank, or the boiler will rapidly be emptied of water. Heat under steam pressure, by keeping the live steam as it is generated by the fuel going gradually into the whey. Begin with good steam pressure and maintain this pressure during the time required for pasteurization. It is not wise to attempt to pasteurize unless it can be done properly. It will be a waste of steam and the results will be disappointing.

Pasteurization of whey is advocated for the purpose of overcoming many of the difficulties of the whey question, and *not as a panacea for the evils of improperly cared for milk, rusty, old, or carelessly washed cans.*

The wash water should not be run into the whey tank, as it dilutes the whey and introduces undesirable bacteria. Septic tanks or other means should be employed to dispose of wash water and other factory refuse. The patrons should co-operate with the maker in emptying the tank each morning so that only the fresh whey will be in the tank from day to day. One of the methods adopted at many of our larger factories is to have a man hired to measure out the whey each morning; cost about 50 cents per day.

From data secured in 1908-1909 it is shown that during the summer months, say, 20,000 lbs. of whey in average covered tank, if heated to 155 degrees, will remain above 150 degrees from one hour to one and a half hours, and above 140 degrees from one and a half to two hours, and above 130 degrees from two to three hours and twenty minutes, and in many cases much longer, and delivered in the patrons' cans after twenty hours at a temperature of from 110 to 120 degrees. During the cool weather of spring and fall, with smaller amounts of milk, these temperatures will be more difficult to maintain, but every precaution should be taken by covering and insulating the tanks.

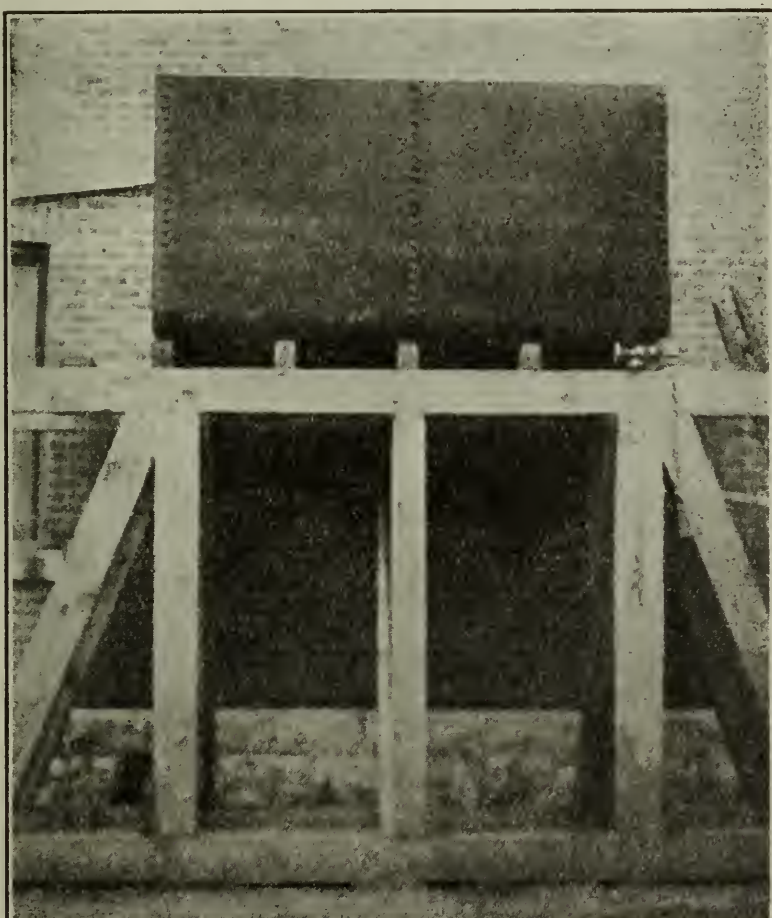


Fig. D. Steel Whey Tank—9 feet long, 4 feet wide, 4 feet deep. Bottom of Tank 7 feet from cement platform.

Whey Tanks.

Steel whey tanks so far as we can learn are giving excellent satisfaction, are easily kept clean, and give every evidence of lasting for years. Cement whey tanks are not in the majority of cases giving good satisfaction, and it is not thought advisable to build these tanks, as the acid in the whey seems to dissolve the cement surface, and as soon as the rough face is exposed all kinds of trouble begin. Badly constructed and unclean whey tanks certainly have a detrimental effect on the flavor of the cheese.

The accompanying cut is intended to illustrate an elevated steel whey tank properly supported, showing a cement platform (with drain) on which the waggons stand while loading. Any whey which may be spilled can readily be flushed off the platform and everything around the tanks kept clean, with no unsightly, bad-smelling mud holes. The whey is delivered to cans through a 2-inch pipe.

The accompanying illustrations show five different systems of heating whey, some one of which can be arranged to suit nearly all conditions. The plan of heating all the whey in the lower tank before raising to upper tank seems to give best results, particularly in cool weather (spring and fall), as it is desirable at all times to maintain a high temperature (150 degrees or over) as long as possible, in order that the greater number of germs may be destroyed, and to have the whey go into the patrons' cans after 20 hours not lower than 110 degrees.

If a single tank is elevated and the whey ejected directly from the vats, a steam pipe may be introduced into the pipe above the ejector and sufficient steam turned on to raise the temperature to 155 degrees. This is illustrated in Figure 2.

Experience has shown that the pipes B1 are more satisfactory than B2, as the small holes in B2 are likely to clog. Some factories have adopted the system of two elevated tanks, using one each alternate day. Each tank is cleaned the day it is not in use.

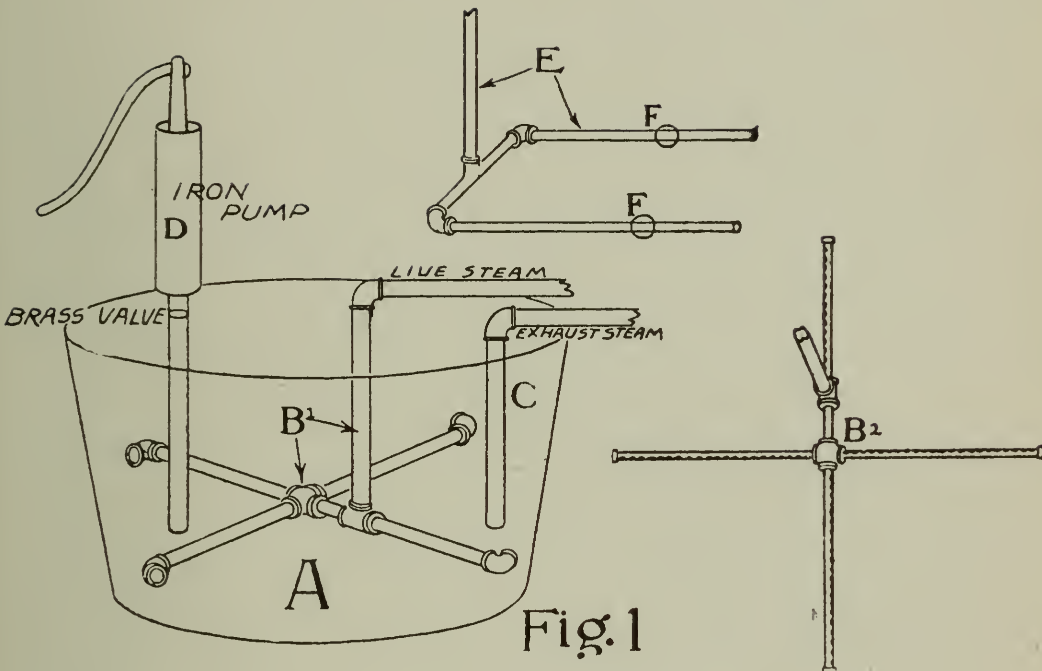


Fig. 1

FIG. 1 represents conditions where only one ground whey tank is used (close to boiler), whey being pumped in cans by hand. This single tank can be elevated if desired and the whey ejected directly from the vats, delivered to elevated tank at temperature of about 122 degrees. One of the systems of pipes shown can be put in and whey heated to 155 degrees with live steam. When engine is in use exhaust may be used in ground tank. (A) Tank; (B 1) three-quarter inch live-steam pipes as shown, with open elbows; (B 2) another three-quarter inch system of live-steam pipes, ends plugged and holes drilled as shown, holes turned same angle (either system will keep whey in circulation and assures even heating); (C) exhaust steam; (D) iron hand pump, with brass valve (leather valves wear out quickly with hot whey); (E) another method of arranging live-steam pipes in tank; (F) noiseless heaters. Four noiseless heaters may be placed on (B 1) if desired, instead of elbows.

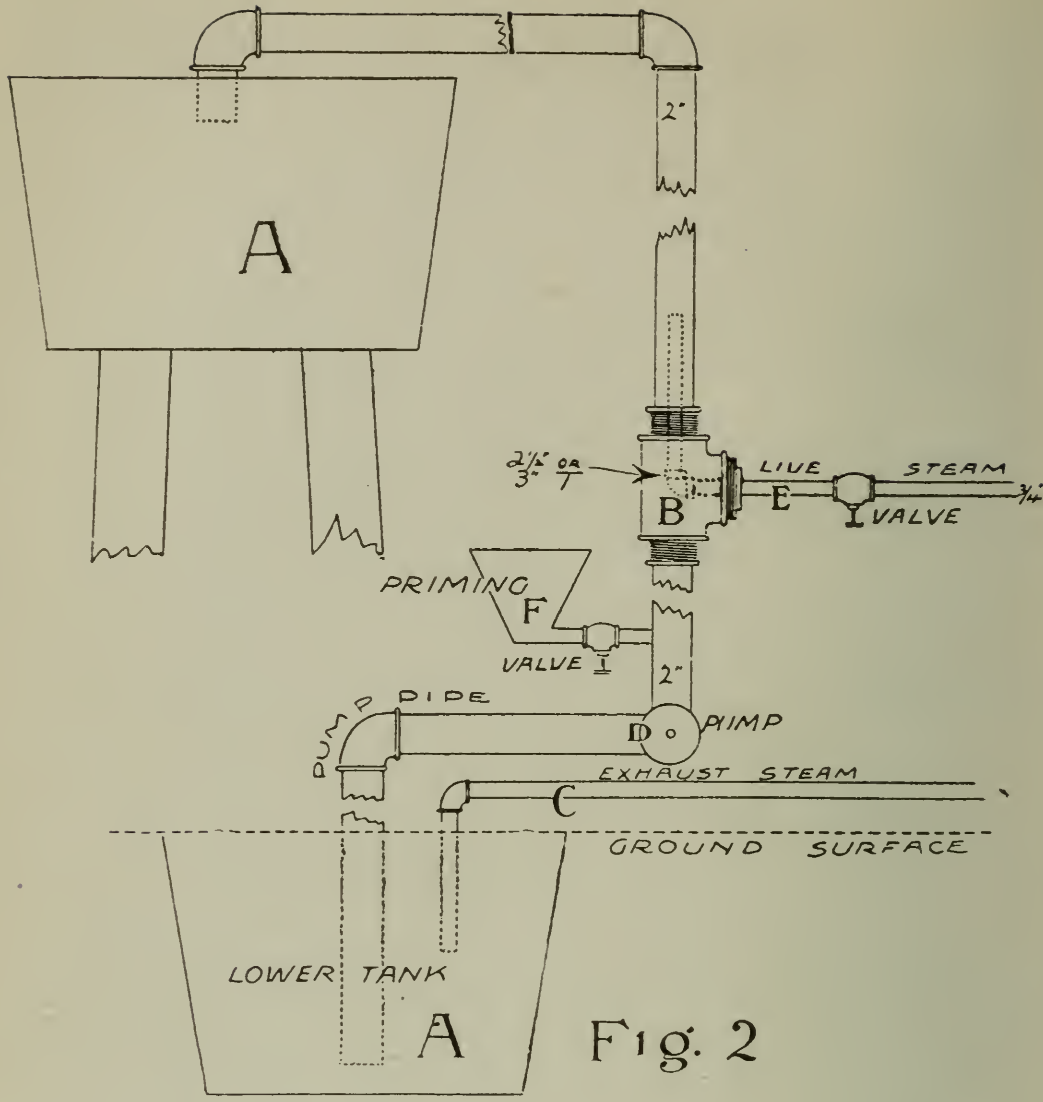


FIG 2.—(A A) Lower and upper tank; (B) 2 1-2 inch or 3 inch T; (C) exhaust steam; (D) pump or ejector; (E) live steam turned up 8 inches inside T (B), as shown by dotted lines. When pump or ejector is started sufficient live steam is turned on through (E) to deliver whey in elevated tank at 155 degrees. (F) Priming valve for pump. Pump pipe two inches, the T (B) reduced to fit. If ejector is used, 1 1-2 to 1 1-4 inch pipe, instead of 2 inch. Exhaust steam (C) will be heating whey in lower tank while pump is running. Exhaust steam (C) can, if desired, be turned in the T (B) instead of tank, but would not keep lower tank in as good condition. Will probably cost less to pasteurize whey when elevated with this system than any other. Using an ejector instead of pump with this system has been found fairly satisfactory. Instead of the 2 1-2 or 3 inch T (B) a piece of 3 inch pipe about 3 feet in length may be used. Each end of this pipe is reduced to fit the pump or ejector pipes. This large pipe is tapped near the bottom. The steam is carried into the side in the same way that it is taken into the T (B). The live steam turned up as shown in the cut. The advantage claimed is that it allows a larger volume of whey to be heated by the live steam before passing on through the pipes to the tank.

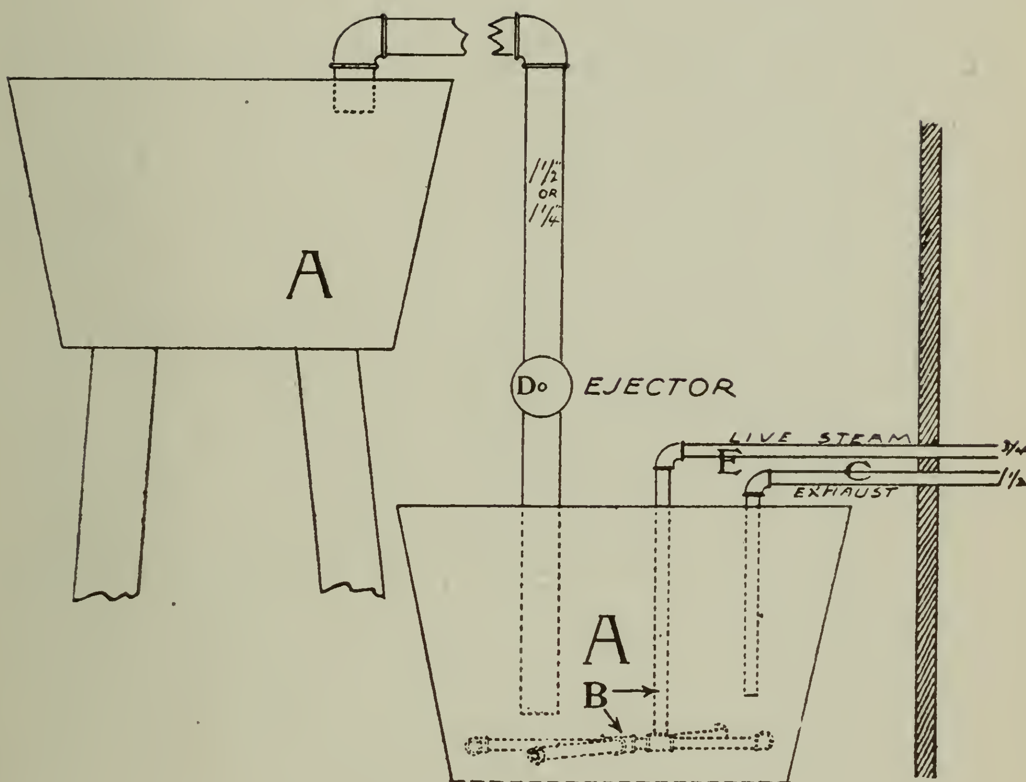


Fig. 3.

FIG. 3.—(A A) Lower and upper tanks; (B) (E) live-steam pipes; (C) exhaust steam; (D) ejector or pump. If ejector is used, heat to about 125 degrees to 130 degrees in lower tank; ejector will then deliver to upper tank at about 155 degrees. If pump used, heat to 155 degrees in lower tank.

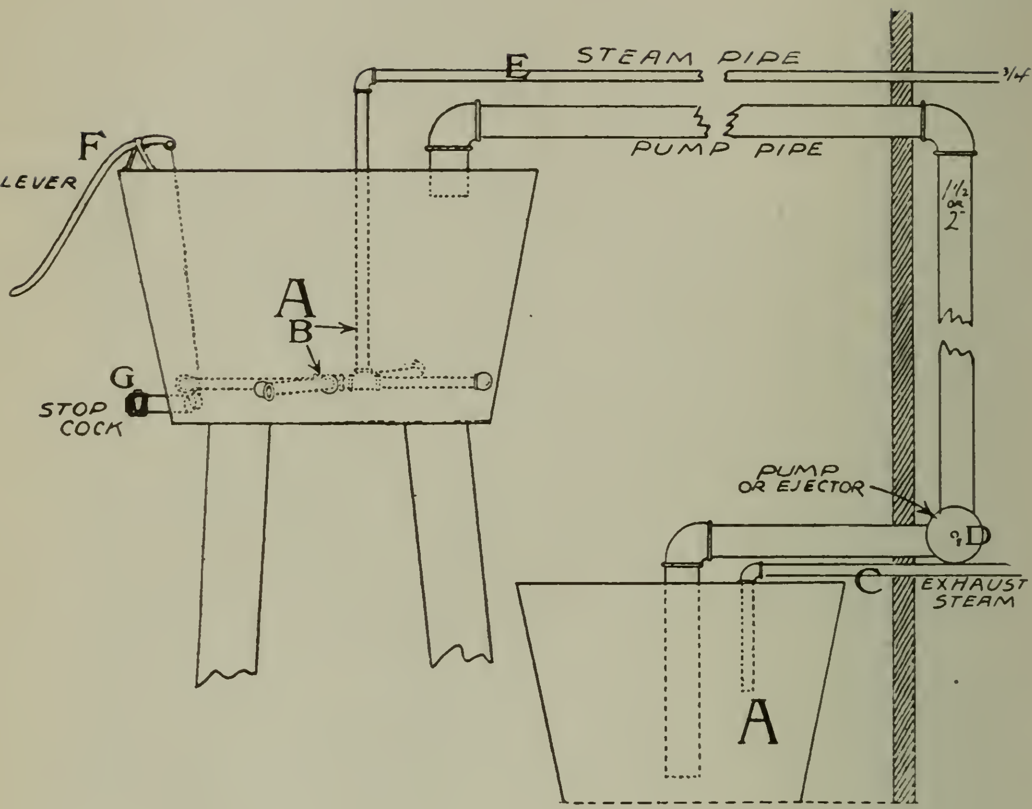


Fig. 4

FIG. 4.—(A A) Lower and upper tank; (B E) live steam in upper tank instead of lower; (C) exhaust steam; (D) pump or ejector; (F) to close valve inside of tank to prevent leaking (can be put on any tank); (G) stopcock; (B E) can be put into lower tank if desired.

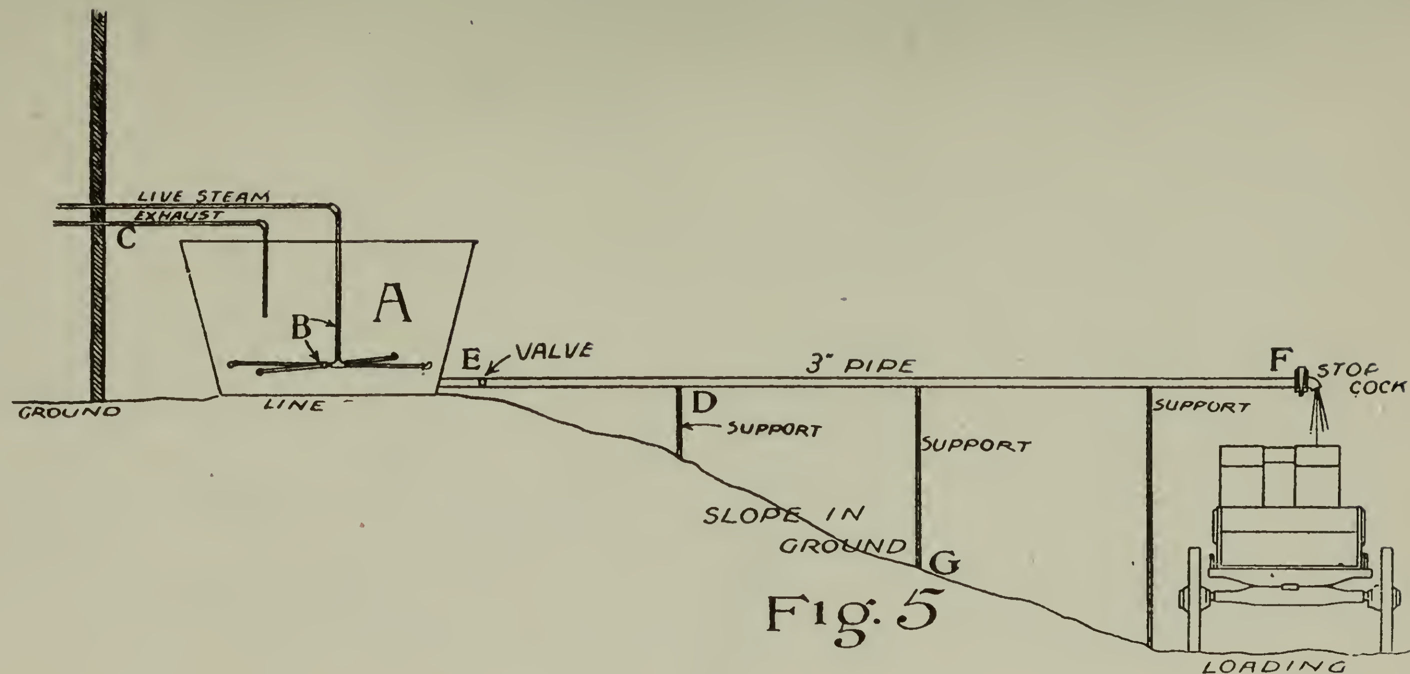


FIG. 5.—(A) Single tank near boiler; (B) live-steam pipe; (C) exhaust steam; (D) 3-inch pipe to carry whey to loading point; (E) valve; (F) stopcock; (G) sloping ground line. This system used where formation of ground makes it necessary. No pumping.

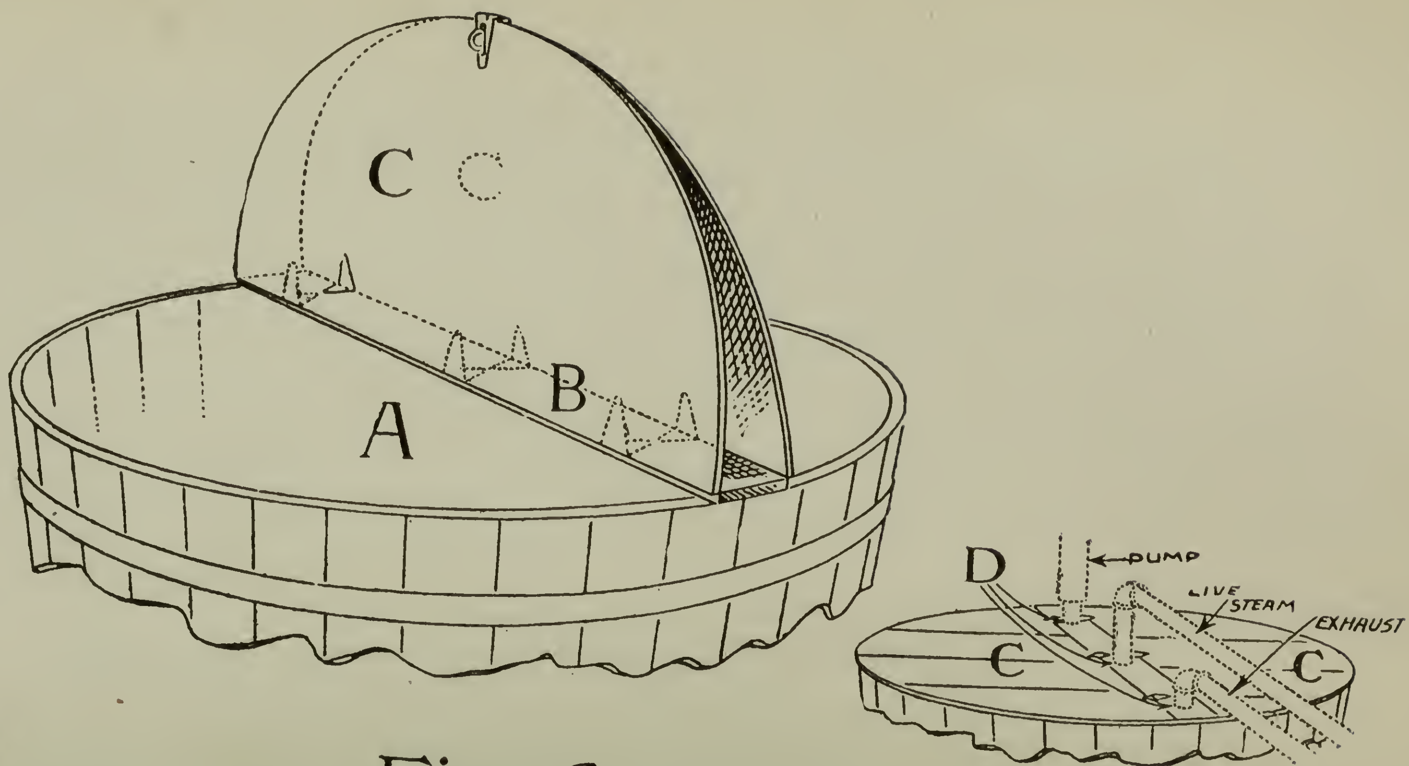


Fig. 6

FIG. 6.—(A) Tank; (B) 8- or 10-inch cross piece, 1 1-4 inch thick, over centre of tank; (C C) cover raised for cleaning; (D) showing arrangements of pipes through cross piece (B) in order not to interfere with covers when raised; (C C) shows covers lowered over tank. If a very wide tank is used the cross piece may be increased to 2 or 3 feet, making the covers more narrow and easier to handle.

In any of the above systems to get the best results with the least amount of time one tank, either upper or lower, preferably both should be large enough to hold one day's whey. *Best results can no doubt be obtained by pasteurizing all the whey in the lower tank and then elevating to upper tank.* The lower tank may then be easily cleaned. A tight valve is required between the boiler and tank, or the whey may siphon back to boiler after steam goes down. A small hole drilled in pipe will prevent suction.

To install any of the above systems (outside cost of tank, pump, or ejector and delivery pipe, practically all of which are always in use) should cost from $5.00 to $15.00, depending on distance steam has to be carried.

Experiments on Cost of Pasteurizing Whey.

Amount of Milk, Whey and Cheese—lbs.				Temperature and Time.			Acidity.		
Date. — 1909.	Amount Milk.	Amount Cheese.	Amount Whey.	Of Whey when heating begins.	Of Whey when heating is finished.	Time for heating.	When heating begins.	When heating finished.	17 hours after heating.
June 9	14,000	1,272	12,600	96°	155°	60 min.	.19 %	.2 %	.28 %
10	13,700	1,245	12,330	96°	155°	59 min.	.18 %	.2 %	.26 %

Cost of Fuel.

June 9, 143 lbs. of coal at $4.00 per ton ...	28.6 cts.	
2 cord wood sticks	5 cts.	
	33.6 cts.	33.6 cts.
June 10, 122 lbs, coal at $4.00 per ton	24.4 cts.	
4 cord wood sticks	8 cts	
	32.4 cts.	32.4 cts.

June 9.—To heat 12,600 lbs. of whey cost 33.6 cts. To heat 20,000 lbs. of whey (amount from one ton of cheese) cost 53.3 cts.

June 10.—To heat 12,330 lbs. of whey cost 32.4 cts. To heat 20,000 lbs. lbs. of whey (amount from one ton of cheese) cost 52.5 cts.

Note.—In the above calculations note the following:—

1. 11 lbs. of milk allowed to make one pound of cheese.
2. 90 per cent. of the milk allowed for whey.

3. Boiler pressure on June 9th, when beginning to heat whey, 85 lbs.
Boiler pressure on June 9th, when heating was finished.... 75 lbs.
Average boiler pressure during the time of heating, about.. 80 lbs.
4. Boiler pressure on June 10th, when beginning to heat whey. 70 lbs.
Boiler pressure on June 10th, when heating was finished... 95 lbs.
Average boiler pressure during time of heating, about..... 90 lbs.
5. On June 9th, flues not very clean. On June 10th, flues clean.
6. Size of boiler, 20 horse power.
7. Distance from boiler to whey tank, 75 feet. Size of pipes conveying steam, 25 ft., 1 1-4 in. pipe; 50 ft., 1-in. pipe.
8. A four-way 3-4 inch pipe at bottom of tank, as in figure 1 (B2). The pipe shown in figure 1 (B1) with elbows would no doubt be better, as they would keep the whey in better motion during the time of heating.
9. Boiler pressure was maintained as even as possible during test.
10. Tank was covered with loose boards.
11. Enough pressure was left on boiler after pasteurizing was finished to elevate the whey and fill the boiler with water without extra cost.
12. Best results can be obtained by beginning the heating at once after first whey is run off the vats rather than waiting until all whey is in the tank.

Cost of Elevating Whey with One and One-Half Inch Rotary Pump.

Milk 13,700 lbs., whey 90 per cent. allowed, 12,330 lbs.

Time required to elevate, 50 minutes. Revolutions of pump per minute, 200.

Capacity, 1 1-2 inch pipe, 14,800 lbs. per hour. Pounds pressure on boiler at the time of starting to elevate, 95 lbs.; when elevating was finished, 100 lbs.

Required 33 lbs. of coal at $4.00 per ton, 6.6 cts.

To elevate 12,330 lbs. of whey cost 6.6 cts. To elevate 20,000 lbs. of whey cost 10.7 cts.

Temperature of the air outside 65 degrees.

Conclusions *re* Cost of Pasteurizing Whey.

Although the above experiments seem to indicate that the actual heating of the whey from 98 degrees up to 155 degrees may be done under the very best conditions for about 55 cents per ton of cheese, still when we take into consideration the difference in the cost of fuel and other conditions which exist in different localities and the repairs from time to time, we believe the average cost for heating will be about 75 cts. per ton of cheese (20,000 lbs. of whey). In no case have we known the cost of heating to be greater than $1.00 per ton of cheese.

As the patrons receive the greatest benefit from proper pasteurization of whey, they should in all cases pay the cost which is very small considering the benefit derived, and it is pointed out that when makers receive pay for the work they should in every case use their best efforts to see that the very best possible results are obtained, anl the work properly performed.

Whey Barrel.

Attention is also called to the fact that patrons should be careful in the matter of keeping the vessels in which the whey is emptied at the farm sweet and clean, if they are to secure best results from the feeding of whey. It is quite evident that in many cases the feeding value of whey has been underestimated in past years owing to the condition in which it was kept at the factory and at the farm before being fed to stock.

BULLETIN 184.] **[NOVEMBER, 1910**

A REVISED EDITION OF NO. 146.

Ontario Department of Agriculture

WOMEN'S INSTITUTES.

Uses of Vegetables, Fruits and Honey

VEGETABLES

(The information on Vegetables has been prepared by the staff of Macdonald Institute, Ontario Agricultural College, Guelph.)

Vegetables, as they are ordinarily spoken of, may be classified as:—

1. Fresh:
   (*a*) Starchy, viz., potatoes, parsnips.
   (*b*) Non-starchy, as beets, carrots, cabbage, etc.
2. Dried:
   The ripened condition of some seeds, as peas, beans and chestnuts.

Fresh vegetables, although chiefly water (they contain over 80 per cent. water) are very valuable to the body on account of the large amount of mineral matter they contain, which goes to purify the blood and regulate the body. Besides this valuable mineral matter, the fibrous framework of the vegetable gives bulk to the food, which assists in eliminating the waste from the body, thus helping to keep the body in a healthy condition. Some of the fresh vegetables, such as potatoes, beets, carrots, etc., contain starch or sugar, which produce heat and energy in the body; but it is not for these substances that they are chiefly valuable as a food. The starch and sugar necessary for the body may often be more cheaply obtained from other sources, such as bread, cereals, etc. Therefore the chief value of the vegetable is in the mineral matter it contains.

Dried vegetables contain more nourishment than the fresh vegetables, for they contain all the mineral matter they had when fresh, and also a fair amount of building material and starch stored in them for the nourishment of the young plant. This building material goes to repair the daily wear and tear of the body, and the starch furnishes a certain amount of energy.

The Cooking of Vegetables.

The great value of vegetables as a food makes it desirable to prepare and serve them in as digestible and appetizing a condition as possible. There are four methods of cooking commonly applied to vegetables: boiling, simmering, steaming and baking, and the nature of the vegetable determines the method of cooking.

Steaming is an expensive method of cooking vegetables, as a stronger fire is necessary to create steam, yet for watery vegetables steaming is to be preferred, less water being absorbed by the vegetable in the cooking. Baking is suitable for only a few of the vegetables, for instance, potatoes and squash.

Strong-smelling vegetables, for example, cabbage, onions, cauliflower, etc., should be simmered or cooked below boiling point and should be closely covered. There is a difference of opinion about this method of cooking strong-smelling vegetables, some authorities claiming that they should be boiled uncovered, but after experimenting with both methods, Macdonald Institute has decided that for the average household it is better to simmer them, closely covered. By this method less odor is carried through the house and there is little difference in the flavor.

To obtain good results in cooking fresh vegetables it is important that they should be crisp and firm. If not taken directly from the garden they should be crisped in cold water before cooking. Soak cabbage and cauliflower by inverting them in salted water to remove grubs or other insects which may be encased in them. When boiling or simmering vegetables they should be put on to cook in boiling, salted water, using two level teaspoonfuls of salt to one quart of water, and having enough water to entirely cover the vegetables. In the case of potatoes better results are obtained by sprinkling the boiled potatoes with salt immediately after they are thoroughly drained. The salt tends to draw out the moisture, making them drier.

It is very important that vegetables should be cooked until tender, but overcooking breaks up and wastes the vegetables and, in some cases, develops undesirable flavors. As soon as the vegetables are tender, whether boiled or simmered, they should be thoroughly drained and seasoned. They may be served with butter or a sauce. A large amount of the mineral salts and other substances contained in the vegetable are dissolved out by the boiling or simmering, and, if cut in small pieces, more is dissolved out. Therefore the water drained from the vegetables should be used for sauces and soups. All measurements used in the following recipes are level.

Vegetable Sauce.—One cup vegetable water, 2 tablespoons butter, two tablespoons flour, one-quarter teaspoon salt, sprinkle pepper. Melt butter, add flour and stir over the fire until frothy. Add vegetable water and stir constantly until it thickens and boils a minute. Pour over the vegetable, allowing one cup of sauce to two cups of vegetable pulp.

The water drained from vegetables may take the place of the water and some of the vegetables used in meat soups. The vegetable water saved at dinner time may be made into a nourishing soup for supper, by the addition of milk and any of the left-over vegetable, using the following proportions:—Two cups vegetable water, two cups milk, one cup cooked vegetable, two tablespoons butter, four tablespoons flour; salt and pepper. Mix the flour with one-half cup of the cold vegetable water or milk. Add this to the heated vegetable water and milk, stirring constantly until it thickens. Add the butter and vegetable finely divided. Season and simmer ten minutes.

This is one way of using left-over vegetables. Another way is to scallop the left-over vegetables, using the following method:—

Make a cream sauce, using the same ingredients as for vegetable sauce, substituting milk for the vegetable water. To each cup of cooked vegetable use one cup of cream sauce. Place in alternate layers in a baking dish, having the top layer sauce. Sprinkle with crumbs that have been mixed with a small quantity of melted butter. Brown in the oven. The food value of the scallop may be increased by sprinkling grated cheese over each layer.

The fresh vegetables also include the salad greens or the green vegetables that are eaten raw; for example, lettuce, celery, cucumbers, watercress, radishes, etc. These may be used alone for salads or in combination with fresh meat or cooked vegetables. The salad greens should be thoroughly washed and put in cold water to become crisp. After they are crisp they may be folded loosely in a clean damp towel or put into a covered granite pail and kept in a cool place until needed. In this way they may be prepared some time before using, and with a salad dressing prepared before hand, a salad for supper can be prepared in a very short time. The oil or cooked dressings may be served with the salad. The dressing adds to the nourishment and flavor of the salad. French dressing is largely used for vegetable salads, but none of the dressings except the French dressing should be added to the salad until just before serving time. If added too soon they tend to wilt the crisp vegetables and the dressing becomes watery.

French Dressing.—One-half teaspoon salt, one-quarter teaspoon pepper, 2 tablespoons vinegar, four tablespoons olive oil. Put ingredients in a bottle and shake well. Or mix the seasoning with the oil; gradually stir the vinegar into the mixture and thoroughly blend all.

Cooked Dressing.—One-half tablespoon salt, one teaspoon mustard, one and one-half tablespoons sugar, one-half tablespoon flour, three-quarter cup of milk, few grains cayenne, yolks two eggs, or one whole egg, one and one-half tablespoons melted butter, one-quarter cup vinegar. Mix dry ingredients, add yolks of eggs or whole egg slightly beaten, milk and vinegar very slowly. Stir over boiling water until mixture thickens, and butter, strain and cool. One-half cup of whipped cream may be added to the dressing before serving. If cooked too long the mixture will curdle.

Foamy Salad Dressing.—One tablespoon sugar, one-half teaspoon salt, one-half teaspoon mustard, one-eighth teaspoon white pepper, one-quarter cup vinegar, two tablespoons water, two eggs, one tablespoon butter. Mix dry ingredients with water and vinegar, and heat. Beat the eggs in a round-bottomed bowl until very light, stir in the vinegar mixture and stand the bowl in a kettle of boiling water. Beat constantly until it thickens and coats the spoon, then remove at once from the hot water, stir in the butter and stand away to get perfectly cold. One-half cup whipped cream may be added to the cold dressing before using.

The Cooking of Dried Vegetables.

The important point in cooking dried vegetables, ripe peas, beans and lentils, which are rich in muscle-making materal, is not to cook them at too high a temperature. This tissue-building substance, or legumin, is similar to egg white or meat, and like these it is toughened by strong heat. To avoid this they should be cooked below boiling point or simmered. On account of the dense, tough texture of these vegetables and the small amount of water they contain, the time required for cooking may be shortened by soaking them over night. The soaking also improves the flavor by dissolving out a bitter substance from them. If they are soaked or cooked in hard water the lime has a tendency to harden the legumin, thus making them less digestible. Therefore, if only hard water is obtainable soften it by boiling and allowing it to cool before using or by the addition of baking soda, one-quarter teaspoonful to one quart of water.

If the tough outer covering of beans is removed before serving it makes them more digestible.

The dried vegetables may be served as a vegetable to accompany meat or they may be made into a soup, the latter being the more digestible way of serving them, for in the preparation the tough outer skin is removed and the pulp finely divided.

Dried Pea or Bean Soup.—One-half pint peas or beans, two quarts water, four tablespoons minced onion, one tablespoon minced carrot, one tablespoon minced celery, one tablespoon dripping or butter, one ounce ham or salt pork, or a ham bone, one-half pound cold meat, one tablespoon flour, one tablespoon salt, one-quarter tablespoon pepper, one bay leaf. Soak peas or beans over night in one quart cold water. In the morning pour off the water and put the peas with the two quarts water and meat in a kettle over the fire. Cook slowly for two hours. Put the fat and vegetables in a small saucepan and cook slowly for one-half hour. Drain them from fat and add them to soup. To the fat add flour and stir until smooth, then stir this into soup. Add salt, pepper and bay leaf; cover and cook slowly for two hours, strain through a coarse wire strainer, re-heat and serve. Stock may be used instead of water when meat is omitted.

Baked Beans.—One quart beans (Lima or white beans or yellow-eyed), one-half pound salt pork, two tablespoons molasses, one cup boiling water, one tablespoon salt, two tablespoons sugar, one-half tablespoon mustard, one-eighth teaspoon pepper. Wash beans and soak over night. In the morning pour off the water and rinse well. Cover with fresh water, bring to boiling point and simmer until skins will burst. This is best determined by taking a few in the hand and blowing on them—if skins burst beans are cooked. Drain beans and throw away the water. Scald rind of pork, scrape and cut in two. Half of it put in bottom of bean crock, the other half reserve for the top. Put beans in the crock and over them pour the seasonings mixed with the cup of boiling water. Add enough more boiling water to cover beans. Bake in a covered bean pot in a slow oven six or eight hours, uncovering the pot the last hour that pork rind may become brown and crisp. It may be necessary to add water while cooking.

Creamed Lima Beans.—One cup dried Lima beans, one-half teaspoon salt, three-quarters cup cream, one-half tablespoon butter, sprinkle pepper. Soak over night, drain and cook slowly in salted water until soft; drain, add cream, salt and pepper. Re-heat before serving. When cooked they may be popped from their skins before adding the cream.

Succotash.—Cut hot boiled corn from cob, add an equal quantity of hot boiled shelled beans. Season with butter and salt and re-heat before serving.

Corn Oysters.—One cup corn pulp, one-quarter cup flour, one egg well beaten, pepper and salt. Mix the ingredients together and fry by spoonfuls in deep fat or on a hot greased griddle. Drop by spoonfuls into the fat.

Creamed Cucumbers.—Pare, cut lengthwise, remove the seeds and cut pulp of ripe cucumbers into sections. Cook gently in salted water until soft. Drain and serve in a cream sauce.

Baked Squash.—Cut squash in halves, remove seeds and stringy portion, place in a dripping pan, cover and bake two hours or until soft, in a modern oven. Remove from shell, mash and season with butter, salt and pepper.

Baked Tomatoes.—Wipe and remove a thin slice from stem end of six medium-sized tomatoes. Take out seeds and pulp and drain off most of liquid. To seeds and pulp add an equal quantity of bread crumbs, season well with salt, pepper, a little sugar and melted butter and a few drops of onion juice. Refill skins, place in a buttered pan, sprinkle with buttered crumbs and bake twenty minutes. Cold minced meat may be used in stuffing the tomatoes.

POTATOES

Baked.—Select medium-sized potatoes, wash well and place on a pan in the oven. Bake in a hot oven until soft. Remove from oven, burst the skins to allow steam to escape and thus prevent potato from becoming soggy. Serve at once.

Potatoes Baked in the Half Shell.—Bake six medium-sized potatoes, remove from oven, cut slice from top of each and scoop out inside. Mash, add two tablespoons butter, three tablespoons of hot milk, salt and pepper to taste; then add whites of two eggs well beaten. Refill skins and brown in a hot oven. Grated cheese may be sprinkled over the top or finely chopped ham may be added to the potato mixture.

Escalloped Potatoes.—Wash, pare, soak and cut six potatoes into thin slices. Put in layers in a baking dish, adding to each layer small pieces of butter, pepper and salt and a sprinkling with flour. Cover with hot milk and bake in a moderate oven until potatoes are soft. A few drops of onion juice may be added. Cover during the first half of the cooking.

Sweet Potatoes (Baked).—Select medium-sized potatoes and wash well. Boil five or ten minutes, then bake in a hot oven until soft.

Glazed Sweet Potatoes.—Boil and cut in halves medium-sized potatoes. Lay evenly in a baking pan. Bake in a hot oven until tender and nicely browned. Baste while baking with a syrup made by boiling sugar, butter and water together for a few minutes.

Potato Puff.—Two cups mashed potato, two tablespoons butter, one cup milk, salt and pepper, two eggs. Mix the milk, butter, salt and pepper with the potato. Beat the eggs very light and beat them into the potato mixture. Bake in a buttered baking dish until well puffed and a golden-brown color.

Potato Omelet.—One cup mashed potato, three eggs, two-thirds cup milk, salt and pepper. Add the milk and seasoning to the potato. Then beat in the well-beaten eggs. Melt a tablespoon of butter or good dripping in a frying pan, when quite hot, turn in the mixture and cook until nicely browned on the bottom. Then set the pan in a moderately hot oven and cook until puffed, and set on top. Fold and serve on a hot platter.

Sauted Parsnips.—1. Soak the parsnips in cold water. Scrape them and cut in sections or thick slices. Boil in salted boiling water until tender. Drain them. Put a little butter or sweet dripping in a hot frying pan and saute the parsnips until nicely browned. 2. Mash the boiled parsnips until very smooth. Season with salt, pepper and butter, or a little cream. Form into cakes and saute them.

Baked Parsnips.—Pack the mashed, seasoned parsnips into a buttered baking dish. Bake until well heated and browned.

Spinach.—One-half peck spinach, two tablespoons butter, one tablespoon salt. Have two pans filled with cold water. Pick over the leaves carefully and drop them into one pan of water. Shake them well in the water and lift them into the other pan. Empty the water from the first pan and fill it again with cold water. Wash the spinach in this way until not a grain of sand is left in it. Put the leaves in a granite kettle, cover closely and cook gently for half an hour. The water that clings to the leaves together with the water contained in them is sufficient to cook them. Add the salt when about half cooked. When tender, turn into a colander, chop with a knife and drain well. Put into a hot vegetable dish, add the butter.

Boiled Green Beans.—Green beans that are too hard to be cooked in the pods may be shelled. Cook them in boiling salted water, drain well and serve with butter or cream sauce.

Asparagus on Toast.—Cut the tough, hard end from the asparagus. Wash carefully. Tie in bunches. Set the bunches on end in a saucepan of boiling, salted water, having the tender ends above the water. Cover and boil gently for half an hour. Drain. Slightly moisten pieces of toast with a little of the water in which asparagus was cooked, spread with butter. Arrange these on a hot dish. Untie the bunches of asparagus and place them on the toast; put a little butter over the tender ends of the stalks and serve very hot.

Note.—The cooked asparagus may be served in a cream sauce, or a sauce made with some of the water in which it was cooked.

SUMMARY.

The preparation and cooking of vegetables may be summed up in the following general rules:—

A. Preparation.

1. Unless fresh vegetables are taken right from the garden they should soak in cold water fifteen minutes to one hour before cooking.

2. Wash and pare, peel or scrape the vegetable and cut to a convenient size.

3. Dried vegetables should soak in cold water at least twelve hours before cooking.

B. Cooking.

1. All fresh vegetables should be put on to cook in boiling, salted water—one level teaspoonful to a pint.

Potatoes are made drier by sprinkling the salt on them immediately after they are drained.

2. Strong-smelling vegetables should cook at simmering point; the others may boil gently.

3. All dried vegetables should be put on to cook in cold, soft water, and simmered until tender.

4. All vegetables should be cooked until tender to the centre, but no longer.

5. Drain thoroughly as soon as tender.

6. The vegetable water, excepting from potatoes and dried vegetables, should be saved for soups and sauces, as it contains most of the valuable mineral matter of the vegetable.

FRUITS

Food Value.

While fruits may be said to have a low nutritive value, they are not, as a rule, estimated at their real value as food. They supply a variety of flavors, mineral substances, some carbo-hydrates and a necessary waste or bulky material for aiding in intestinal movement. The flavors of fruits, while they elude chemical analysis, are their most valuable possessions as stimulants to the appetite, and aids to digestion. The mineral substances consist mainly of potash united with various vegetable acids. These acids are converted in the body into the corresponding carbonates and so help to render the blood more alkaline. In some diseases, such as scurvy, this property is turned to good account.

When to Eat.

Fruit is best eaten at breakfast or between meals. A good apple first thing in the morning and the last thing at night is a standard specific for indigestion. After a heavy dinner it is not so valuable in the diet.

Exposure of Fruit in Stores.

Since the softer fruits decompose so readily, they should be eaten as fresh as possible. When fruits are exposed to the air and the dust of the streets, as is so often the case, they are exceedingly apt to decompose and suffer fermentative changes which are very dangerous, and are a fruitful source of digestive derangements.

As may be inferred, it is of the first importance that fruits be ripe and in good condition. They must also be delicately handled, as their great value may be readily lost in careless handling. Luscious fruits are so particularly liable to putrefactive changes, that we must have recourse to some of the various methods of preserving them.

Selection and Preparation.

The selection of fruit is the first step in obtaining successful results. The flavor of fruit is not developed until it is fully ripe, but the fermentation stage follows so closely upon the perfectly ripe stage that it is almost safer to use it a little under-ripe than over-ripe. For the making of jelly, the fruit should always be under-ripe. Fruits should, if possible, be freshly picked for preserving; no imperfect fruit should be used.

Principles of Canning and Preserving.

In the preservation of fruits by canning, preserving, etc., the essentials in the process are sterilization of the fruit, of all utensils used, and the scalding of the fruit to prevent all germs entering, so keeping it sterile. The work should be done in a well swept and dusted room, and the clothing of the workers and the towels used should be clean. The fruit used should be sound and clean.

CANNING FRUITS AND VEGETABLES.

(Extracts from a paper read by Mr. J. A. Morton, before the Wingham Women's Institute at one of their regular monthly meetings.)

Most ladies are doubtless familiar with the operation of canning and know its details far better than I can tell, therefore an attempt on my part to instruct you concerning the practical side of the question savors of presumption. But, possibly, some of you may never have considered or perchance you have forgotten the "Why" of the matter, "Why" (if success is to be obtained) certain steps in the process must be done in certain definite ways; and it is this phase of the question which I wish to emphasize, in the hope that my remarks may assist you to a more thorough understanding of "Why" these acts are always done in these particular ways.

To keep perishable foods in the fresh natural condition produced by nature, and as perfect as possible in form, appearance and flavor has been the aim of people for many ages. Many different ingredients and combinations of substances have been tried for this purpose. I shall not now discuss the efficiency of such preservatives, but simply say that they are all more or less injurious to the human system, incorporated as they must be by the food they aim to preserve. Besides the fact that many of these act directly in an injurious manner upon our digestive faculties, it should not be forgotten that the same preservative which is used to prevent fermentation in the canned goods, will, taken into the stomach, hinder and obstruct the process of digestion, which is simply the operation of other ferments.

The application and employment of heat is a most effective preservative, and the best one, consistent with safety to the user of the food.

Providence has provided certain agents whose part in the general economy of nature is an important one, namely, the reduction of organic matter into the soluble mineral substances from which it was originally built, and which returning again to the soil, serve afresh for the nourishment of a new generation of vegetable life. In this way, the surface of the earth is cleared of dead bodies and fecal matter, the dead and useless substances which are the refuse of life. These scavengers of nature are very small, so small that many of them are invisible to the unaided vision, but they are none the less very active agents in the process of decay—too willing helpers in the process of disintegration. Floating in myriads in the air we breathe, carried hither and thither by the passing breeze, are the spores or seeds of these microbes, anxiously seeking what they may devour. They are present everywhere; in the water we drink, upon every leaf, branch and fruit, and every clod of earth. Yes, even our clothing and persons are the involuntary carriers of these microscopic foes of mature fruit, and other foods, and woe betide the ripe fruit whose ruptured skin affords an entrance to the eager foe. To baffle and circumvent these microbes is the result aimed at in the canning of foods. The enemies we seek to overcome by this process may be classed generally as Ferments and Moulds.

Many of you have no doubt had the following experience. You had put up your fruit very carefully as you thought, but on going subsequently to the cellar to examine your collection of fruit, you find to your annoyance that notwithstanding all the care bestowed, mould has appeared on the top of the contents of one or more jars. The jars are apparently hermetically sealed; the top is just as solidly on as upon the other jars and it takes just as much exertion to remove the glass top. You say, "I don't see how that can be; it is air tight, and I don't believe that mould ever worked its way in there." You are right, it did not work in. Then how does it come to be there? There were resting-spores inside the jar which had not been killed by the heat applied. It may be that you had used fruit so over-ripe that mould plants had a chance to grow thereon and ripen their spores which it does not take them long to do; it may be that you had used jars which, in the hurry of the season before, had not been carefully cleansed on their being emptied of the former contents, or what is a more common case, you may have used jars which contained mouldy contents without a most thorough cleansing of the jars, and which therefore contained a plentiful supply or resting-spores.

See that the jars are perfectly clean, thoroughly scalded with boiling water, filled to the top and left in them for a considerable time; boil your rubbers and covers, see that the rubbers are soft, not in the least hard, and are free from grooves or cracks. The best rubbers only cost about a cent a piece, and it is poor policy for the sake of a cent's expenditure to run the risk of spoiling a jar of good food worth at least 50 cents. Examine the rim or part of the glass top which rests on the rubber to see that it is sound, the edge of a knife or your finger nail run over this rim will detect any flaw probably easier than any other way. Small bubble checks are often found on the edge of this rim of sufficient depth to prevent closing the jar tight. See that you pay particular attention to and especially clean, jars which formerly contained mouldy fruit or which had been put away imperfectly cleaned. With them the greater danger lies.

Another important point is the use of only sound fruit. It is false economy, because you can obtain it cheaper, to put up over-ripe food; such is very apt to ferment and requires a great deal of care in the sterilization. I admire the principle of the French, who want the best of everything and who will forego the use of a cheaper, inferior article of food for the satisfaction of enjoying at much longer intervals, choicer pieces of that kind of food. And what is not too good for a Frenchman should not be too good for a Canadian. The best in the land for the best in the world (and that is what we are) should be our motto.

A question which suggests itself right here is this:—Should sugar be used or not? A great many people still cling to the old idea that fruit cannot be kept without the addition of sugar in the process of canning. This is entirely and surely a mistake. Sugar, as ordinarily employed, takes no part in the preservation of the fruit from deterioration. If made into a thick syrup it acts as an antiseptic, keeping perfectly sound fruit from decay even without heat.

Many of us like fruit put up without any sugar in the jars, the sweetening being added when the jar is opened to be used. In the first place the addition of sugar and subsequent heating affect the delicate flavor of some fruits and give others a distinctly different taste, and in the next place, it is not an economical way of employing the sugar. Our ordinary white granulated is a pure cane sugar and is the sweetest of the sugars, for there are more kinds than one. Some are crystallizable, others are not. Now note this, when cane sugar is heated in the presence of an acid it gradually changes into other forms of sugar possessing much less sweetening power. One form, glucose, has only about 30 per cent. of the sweetening power of pure cane sugar. All fruits contain more or less acid, without it they would be very insipid. Any observant housekeeper knows that it takes more sugar to sweeten a given weight of rhubarb when added before cooking than when added after the cooling of the cooked rhubarb, also that when sugar has been added before cooking, the longer it is cooked the less sweet the mixture becomes. Why is this? Simply because the acid of the pie plant has converted a considerable portion of the cane sugar into inverted sugar, which is much less sweet. The only objection heard, which appears to be worth considering against the putting up of fruit without sugar, is that in the case of thick-fleshed fruits such as peaches, pears, plums and the like, to add the sugar either in the solid form or as thick as syrup when you go to use the fruit, does not give an opportunity for the sweetening property to penetrate the fruit. This is an objection worth considering, and it is left with you to act as you please, only remember that sugar when cooked with the fruit in the jars is changed into a much less sweet form of sugar, and it also affects the natural flavor of the fruit.

There are two methods of filling the jars in general use among housekeepers. One is to fill the jars with the cold uncooked food and cook it in the jars; the other is to cook the food first, fill and seal the jars. One method will suit some; others will prefer the other. Either way is good and I do not pretend to recommend one as being better than the other; whichever suits you the better, adopt it. A lady friend asked me how I ever came to know so much about canning. It is simply the outgrowth of my study of Botany. These microbes are minute plants, and the investigation of their life history naturally brought also a knowledge of them from an economic point of view—how they could be used, and how they could be curbed and controlled.

With regard to the practical part of the subject, I do not know that I can do better than describe as best I can how it is done by the lady who superintends the canning industry in our home.

All fruit and vegetables are put into the clean jars, cold and uncooked; when sugar is to be added it is in the form of syrup; the jars are filled nearly to the top, not too full, so that as the contents swell with the heat there is no danger of small portions of the canned goods getting between the cover and the rubber, thus preventing the lid being fastened down air-tight. The jars must not be too empty, lest the oxygen in the air within the jar give any resting-spores which may not have been killed by the heat, opportunity to germinate, and mould might then result. Sound, selected rubbers are adjusted in their places, the tops put on, partly fastened or screwed down but not perfectly tight to admit of expansion of the contents of the jar. The filled jars are cooked in the wash-boiler, which ordinarily will hold 13 to 15 quart jars or 15 to 18 pints. We use a false bottom in the boiler made of wooden slats. The boiler being put on the stove with the jars standing upright on this bottom, cold water is poured into it until two-thirds of the way up the jars, the cover is put on the boiler, and the water therein brought to the boiling point. How long it should be kept there depends on the kind of food being canned. Keep it boiling long enough so that when the jar is opened the food will be palatable without further cooking. Strawberries, raspberries, blackberries and huckleberries will do if removed when the boiling point is reached. Take the jars out of the boiler, fasten down at once. If, while cooling, you find that the air is getting into the jar, which you will be able to detect easily by bubbles forming on the inside of the jar, it is caused probably by poor rubber or a defective top; replace it by a good one, of which you should have two or three ready to use, and put back the jar in the boiler for a few minutes longer.

Larger fruits, such as peaches, pears, plums, cherries and the like, should get 20 or 30 minutes' boiling, the time depending on the firmness of the fruit. A hard peach requires longer than a mellow one. Pineapples should never be put up with sugar; it does not keep well that way. Grated with a Gilmore grater, packed in solid without any sugar, and treated as indicated for strawberries, it should keep forever if it gets the chance. Try some this way, you will find it does not get the chance to keep long.

Tomatoes are a fruit easily canned. Scald, peel, cut in half, remove the hard core, pack in jars as solid as possible without the addition of an extra fluid, add a teaspoonful of salt in the mouth of each quart jar, adjust rubbers and covers, place the filled jars in the boiler and give them five minutes after the boiling point is reached.

Certain vegetables are very nice put up this way. Beets, care for them as you please, when stored in the cellar for winter use, soon become woody. By canning half-grown beets you may have a supply of most deliciously tender vegetable all the year round. Wash young beets, put them into boiling water, cooking them only long enough to loosen the skins; slip these off; pack the beets either whole or divided as desired into the jars and fill up the jars with a mixture of vinegar and water in the proportion of one part vinegar to four of water, cover the jars as before described, and give them three-quarters of an hour after the boiling point is reached. The principal object in adding the vinegar is to preserve the fine red color of the beets, without it you can never tell what will be the color of the finished article, red, brown, cream, black, grey, or dirty purple.

Young turnips and carrots may also be canned. Peel them, boil first in water for 15 minutes; pack in jars and give turnips half an hour after boiling point is reached; carrots should have an hour. Canning peas is not recommended; we never made a success of them, and the delicate flavor of the pea is lost in the cooking. If, however, you want to try them, 3 hours' boiling is the time laid down to ensure success.

To can corn, we boil it on the cob about 5 minutes to simply set the milk, then cut if off the cob, pack solidly in jars without any water and proceed in the way already described for other foods, but boil for 4 hours. The greater quantity of sugar and starch in corn and peas renders them especially liable to ferment, hence the long time of boiling in their case. Some people do not boil their corn first, but cut it off the cob, pack it raw, solidly in the jars and boil the jars in the usual way. If you want an extra nice article in canned corn, after the preliminary boiling, split down with a sharp knife each row of the corn lengthwise and with the back of the knife press or scrape out the kernel, pack this into jars and can as before directed. You thus get nothing but solid pulp.

Green or string beans are cut into pieces, packed in jars, these filled with cold boiled water, a little salt added and treated as before described, giving them 1½ hours' boiling.

Asparagus requires exactly the same treatment.

In boiling the filled jars, always begin with cold water in the boiler; the object is to bring the whole gradually to the boiling point so that the contents of the jar are thoroughly heated through.

If you want to can only one or two jars at a time, use a tall tin pail with a slat bottom instead of the boiler. You will find it more convenient.

Be sure that the vessel in which you boil your filled jars is closely covered, so that the top part of the jars is as well heated as the lower part.

NOTE.—The syrups used for preserving vary according to the kind of fruit you wish to preserve, and the richness desired. The following list is one given by Miss Parloa:

For preserving use three-quarters lb. sugar to 1 lb. fruit.
For making jam use 1 lb. sugar to 1 lb. fruit.
For canning use one-third to one-half lb. sugar to 1 lb. fruit.
For jelly use 1 lb. sugar to 1 pt. fruit.

The process of making syrup is very simple. Put the sugar and water into a sauce-pan and stir on the stove until all the sugar is dissolved. Heat slowly to the boiling point and boil gently without stirring. The length of time that the syrup should boil depends on the richness desired. Put the prepared fruit into the syrup and simmer until tender.

In stewing fruit, put the prepared fruit into a sauce-pan with enough water to keep it from burning. Cover closely and stew until tender, stirring often, add the sugar and let it boil a moment longer.

JELLY MAKING.

It is rather surprising to find that jelly is not made generally. It is a tasty kind of preserve, but the fact that it is not made more frequently is probably due to the fact that housekeepers suppose it rather difficult to make.

Jelly is made of cooked fruit juice and sugar, usually in the proportion of one pound of sugar to one pint of the fruit juice. Many of the jelly fruits may, however, be made with less sugar, some being made with as little as one-half pound of sugar to one pint of juice. The acid fruits require more sugar, so we use the sugar to suit the fruit. Sugar tends to destroy the flavor of the fruit, so the less sugar used the better the flavor of the jelly.

The object in making jelly is to preserve the original flavor of the fruit as far as possible; to have the juice well jellied but not too thick, leathery, or tough; and also to have a good clear color. Jelly differs from canned fruit in that the juice alone is used, while in canning we use the pulp as well as the juice. The majority of the fruits contain a jellying substance, so if the juice were boiled down sufficiently, it would jell without the aid of sugar. This would be rather expensive, however, for we should have a very small quantity of jelly from a basket of fruit. The sugar assists in the jellying process.

The preparation of the fruit is the first step. All fruit should be carefully washed. Grapes should be removed from stems. Apples should be cut in pieces but not cored unless wormy. The core of the apple contains a lot of jellying properties and the seeds impart a delicious almond flavor. In making quince jelly it is well to remove the cores, as some varieties give a stringy jelly if the cores are left in. Do not pare the fruit with skins, because there is much good material coming from the skins.

We now have our fruit prepared for cooking. We require the juice only, so if it is possible, as in grapes, we cook the fruit until soft without any water at all. Apples must have sufficient water to cover them. Use as little water as possible. We also use as little heat as possible, so if much water is added it will require longer boiling and thus more heat. Heat tends to destroy the flavor of fruit. Do not stir except enough to keep from burning. Some fruits, such as red currants, may be mashed while raw with a potato masher. Do not let juice for jelly stand over night, as it loses some of its true color and flavor by being exposed to the air so long.

The extraction of the juice follows. We now have the juice and the fruit pulp together. The juice we require; the pulp we do not; so we proceed to discard the pulp and save the juice. This is done by pouring into a jelly bag and allowing the juice to drain out, in a place free from dust. A jelly bag rarely drips much longer than an hour, and it is much better to make the jelly up quickly. It is usually supposed that a flannel jelly bag is best but good results are obtained from a bag made of two plies of cheese cloth. The latter is more easily cleaned and does not thicken up like the flannel bag. A pointed bag is the best, for the juice drains out at the point only. Spread papers over the floor as a protection, for grape juice especially stains the floor badly. The juice may be caught in a granite pot; do not use tinware.

It is usually best to boil down the juice before adding the sugar for from seven to twenty minutes, according to the quantity of juice. Measure the juice before boiling down and weigh out the sugar using, as a usual thing, from three-quarters to one pound sugar to one pint of juice. Heat the sugar in the oven, but do not let it turn brown. When the juice has boiled down sufficiently, add the heated sugar to the juice and allow both to boil together for from three to five minutes. Test on a cold plate to see if it jells. If not boiled down enough before adding sugar, it may be necessary to boil longer than the five minutes. If boiled too long after sugar is added, the jelly becomes tough and leathery.

Put the jelly in sterilized jelly glasses and allow it to stand uncovered over night. If sealed at once, steam would be shut in, which would tend to prevent jellying. If it does not jelly as well as one would wish, try placing the jars in the sunlight for a time. When cooled, cover with paraffine.

Many delicious combinations may be made. We may have pure grape jelly, or we may combine apple, cranberry or crab-apple juice with the grape juice. Pine-apple and apple juice (one-half cup pine-apple to one cup apple juice) combine very nicely. Cranberries and snow apples also combine well, while the juice of the snow apple alone makes a nice jelly. The quince is a good jelly fruit, and either alone or in combination with other fruit juices, makes a good jelly.

SOME RECIPES.

Apples.

Apple Tapioca.—Three-quarters of a cup of tapioca; seven sour apples; one-half teaspoonful of salt; cold water; one-half cup of sugar; two and one-half cups of boiling water.

Soak tapioca one hour in cold water to cover, add boiling water and salt; cook in double boiler until transparent, pare and slice apples, place in a buttered pudding dish, sprinkle sugar over apples, and pour over tapioca, and bake in a moderate oven until apples are soft.

Apple Batter Pudding.—One cup flour; one egg; one-half cup milk; one-half cup sugar; two tablespoons butter; one teaspoon baking powder; one-quarter teaspoon vanilla; six sour apples.

Cream, butter and sugar, sift flour and baking powder together, beat egg and milk together, add the milk and egg alternately with the flour to the creamed butter and sugar, add flavoring. Pare and slice apples, place in a buttered baking dish and pour over batter. Bake fifteen to twenty minutes.

Sago and Apples.—Cook one-half cup of sago in about five times its bulk of water for half an hour. Add half a teaspoonful of salt, a small piece of butter, and a heaping tablespoonful of sugar. Pare and core as many apples as will cover the bottom of the baking dish, and pour the sago over them. Cook in a moderate oven until the apples are done.

If the apples are large they can be quartered, and the baking dish can be about half filled with them, and the sago put over them the same way.

Apple Float.—Make the old fashioned apple sauce by stewing the apples until soft, sweeten and beat, then add the beaten whites of eggs, and pile on nice white dish. This can be served with a soft custard made from the yokes of the eggs.

Scalloped Apples.—Two cups stale bread crumbs; two tablespoons butter; two cups sliced apples; two tablespoons sugar; grated rind and juice of one-half of a lemon.

Butter pudding dish and cover with bread crumbs, then put in a layer of apples, sprinkle with sugar, lemon rind and juice and dot with butter, repeat till dish is full, finishing with bread crumbs. Cover when first put in the oven to prevent crumbs browning too rapidly.

Steamed Apple Pudding.—Two cups of flour; four teaspoons baking powder; one-half teaspoon of salt; two tablespoons butter; three-quarters of a cup of milk; four apples cut in eighths.

Mix and sift dry ingredients; work in butter with tips of fingers, add milk gradually, mixing with knife; toss on floured board, roll out, place apples on middle of dough and sprinkle with sugar, bring dough around apples and carefully lift into buttered mould, cover closely and steam one hour and twenty minutes.

Jellied Apples.—Pare and slice thin a dozen or more tart apples. Place in a pudding dish alternate layers of apples and sugar, add a dust of cinnamon. When the dish has been filled in this way, pour over it half a cup of water. Lay a buttered plate over the top and cook slowly for three hours. Set in a cool place, and when ready turn out in a glass dish. Served with whipped cream or boiled custard.

Brown Betty.—Alternate layers of sliced apples and dry bread crumbs; put enough crumbs to cover the apples, add wee bits of butter, sugar and ground cinnamon; repeat this until the pudding dish is full, having crumbs on the top; pour half cup molasses or milk and half cup water over. Set the dish in a pan of boiling water and bake in a moderate oven for an hour. Serve with cream.

Apple Custard.—Take one pint stewed apples, sweetened and cooled: one pint sweet milk, four eggs beaten well. Mix the apples, milk and eggs, put in baking dish, grate a little nutmeg over the top and bake one-half hour.

Note.—A very plain custard can be made with one egg to a pint of milk and a good one with three eggs. One tablespoon of sugar is allowed to each egg. Various dishes can be made by pouring boiled custard over bananas, oranges, raspberries, peaches.

Baked Apples.—To bake in their skins, wash and wipe, and place in earthenware or graniteware baking dishes, as tin or iron injures the flavor of the fruit. They should be baked until they form a frothy, pulpy mass, and if there is any danger of the juice burning on the baking dish, add a little water. Eaten with cream they form a delicious dessert.

Or they can be peeled and cored and the centres filled with spiced sugar and a small piece of butter. Pour a little water in the baking pan, and a rich juice is formed, which can be used for basting them.

Baked Apple Sauce.—Pare, quarter and core large apples and pack in an earthen jar with brown sugar, cover closely and bake slowly in a moderate oven until the contents have been shrunken to about half their original bulk and are rich, red and luscious.

Apple Compote.—Core and peel as many apples as are wanted and cook slowly in a syrup made by boiling one cup of sugar to one cup of water. When done lift to a dish and fill the spaces where the cores were with apple jelly and sprinkle with granulated sugar. Pour the syrup around them.

Nice red apples can be quartered and cored and the skins left on them and cooked slowly in the same way, turning them in order that both sides may be cooked alike. They make a nice dish for breakfast or tea.

Apple Jam.—Core and pare the apples; chop them well; allow equal quantity in weight of apples and sugar; make a syrup of sugar by adding a little water, boiling and skimming well, then throw in a little grated lemon peel and a little white ginger. Boil until the fruit looks clear.

Pickled Apples.—Apple pickles are delicious. Pare and halve the apples, removing the cores carefully to keep them in good shape, steam till soft. Put spiced vinegar over them.

Preserved Apples.—Pare and core ripe sour apples. Strew the bottoms of two Mason jars with granulated sugar an eighth of an inch thick; cover with a layer of thinly-sliced, very ripe apples, sprinkle freely with sugar in alternate layers of apples and sugar until the cans are full. Set the jars up to the neck, placing underneath a plate or board, in water as hot as can be borne without danger of cracking the jars, and increase the heat until the sugar is dissolved half an hour. Take from the fire, fill one can from the other and seal closely as in canning.

New England Apple Sauce.—Pare, core and quarter nice tart apples. Put them in an earthen dish, sweeten and spice to taste. Cover with water; lay a cover on the dish and bake the apples till tender.

Fried Apples.—Wash and wipe large tart apples. Slice in thick rounds. Have a skillet with hot butter in it; put the apples in; sweeten; cover and cook slowly until brown. Watch carefully or they will burn.

Apple Custard Pie.—Two well-beaten eggs; one cup grated apple; one pint sweet milk; two large spoons sugar; salt and flavor.

Apple Snow.—Pare two good sized apples. Take the white of one beaten egg and three tablespoons of granulated sugar whipped together until quite firm. Grate the apples and stir into the egg and sugar. Beat well, without stopping, to a stiff snow, and serve heaped up in custard glasses with a star of red currant jelly on top. This is excellent served with a thin boiled custard made with the yolk of the egg, half pint of milk, two tablespoons sugar, a pinch of salt. Cook in a double boiler until it thickens slightly. When cold it should pour as thick as a 32 per cent. cream. Add a few drops of vanilla.

Apple or Raspberry Dumpling.—Two cups of sour cream, even spoon baking soda to each cup cream, salt, just sufficient flour to roll. Lay fruit on and roll. Leave space in pudding bag for expansion. If there is no cream use one-half cup shortening, or a little better than one-quarter cup and two cups sour milk. Boil to two and one-half or three hours.

Apple Icing.—White of one egg; three-quarters of a cup of granulated sugar; one apple (grated). Beat all together for half an hour; flavor with almond.

Jellied Apples and Cream.—Peel some large apples and core, but do not quarter; boil a pint of water with a large cup of sugar; put in the apples and cook till they are transparent, but do not let them break. Arrange these in a deep dish; measure the syrup, and to the pint add a heaping dessert spoon of gelatine dissolved in a little cold water; strain and when cool pour a little at a time over the apples till they are covered with jelly. Turn out and invert so that they will be right side up on a glass dish. Serve with whipped cream.

Apple Snow Frosting.—Peel and grate a large sour apple. Add one cup white pulverized sugar and white of one beaten egg. Continue beating one-half hour. Use for a filling. Will keep two days only.

Crab Apple Preserve.—Six quarts apples; one and a half quarts sugar; two quarts water. Put the sugar and water into the preserving kettle, stir over the fire until the sugar is dissolved; when the syrup boils skim it; wash the fruit, rubbing the blossom end well; put it in the boiling syrup and cook gently until tender.

It will take from twenty to fifty minutes, depending upon the kind of crab apple.

Pears and Peaches.

The general directions given for canning and preserving are applicable to pears and peaches. These fruits should not be long exposed after the skins have been removed, as the air has the effect of discoloring.

Sweet Pickles.—Half a peck of pears, one pint of vinegar, two pounds of brown sugar, one ounce stick cinnamon, cloves. Boil sugar, vinegar and cinnamon twenty minutes. If small pears are used, pickle whole; if large, quarter. Stick each pear with four cloves. Put into syrup and cook until soft.

Peach Tapioca.—One cup tapioca, soak one hour in cold water and drain. Add enough water to the syrup poured from a can of peaches to make in all three cups; add the soaked tapioca and one-quarter cup sugar and a little salt to this liquid. Cook till thoroughly clear, line a mould with the peaches, dust with sugar, and fill with the tapioca; serve with whipped cream.

Peach Cream.—Chop three large peaches fine. Add one cup icing sugar. Beat white of one egg stiff; mix together and beat one-half hour.

STRAWBERRIES AND RASPBERRIES.

Preserves.—Cover four pounds of fine ripe strawberries with three pounds of granulated sugar, and allow them to stand over night in a cool place. Strain off the juice, pour it into a granite saucepan, and let it boil fifteen minutes, removing all the scum. Add the berries, boil two or three minutes, then pour into hot jars and seal immediately.

Fresh raspberries crushed together with sugar—one pound of sugar to one pound of fruit—and sealed in jars without cooking will keep for a long time and make a most refreshing dish for the winter. It is important that every berry be well crushed. The mixture should stand in a covered dish for twenty-four to thirty-six hours to allow the sugar to thoroughly dissolve and air to escape before putting in jars. Red currants may be treated in the same way. Red currants and raspberries make a pleasing combination.

Strawberry Whip.—Crush one cup strawberries in one cup fine granulated sugar. Beat the white of one egg stiff; mix together and beat twenty minutes. Sprinkle with strawberries. Raspberries may be used in the same way.

QUINCES.

Preserves.—Pare, core and quarter quinces, then weigh them. Put parings, cores and seeds into a preserving kettle, cover with water and boil slowly twenty minutes, then strain them, put the water back and put in quinces a few at a time and simmer gently till tender; lay them on a dish. When all are done, add sugar and a little warm water. Let them boil for a few minutes until clear, then put in all the quinces and boil without stirring until they become a clear garnet. Have ready two lemons sliced thin and seeds taken out. Put in a few minutes before taking off the fire.

Marmalade.—Peel and core fruit, cut in small pieces, cover with water and boil until soft (like apples) and drain. Take one cup of sugar to one cup of the juice and boil about fifteen minutes slowly, add fruit and boil slowly for one hour. This is much nicer than preserved quince.

GRAPES.

Canned Grapes.—Pulp the grapes; boil the pulp five minutes; strain to take out seeds; put skins and pulp together; put pound for pound of sugar; boil half an hour, then add a little nice apple sauce that has been strained and cook for ten minutes.

Canned Grapes.—Pick the grapes off the stem and fill jar with the fresh fruit. Make a syrup, allowing two cups sugar and one and a half cups water to each jar. Boil syrup for ten minutes, then pour over the fruit and seal. This is one way of getting the real fresh flavor of the fruit.

Grape Jelly.—To one basket of grapes picked off the stems add one dozen tart apples cut in pieces. Cover with water and boil for twenty minutes. Suspend jelly bag (cheese cloth) over a crock or dish and let drip for one hour; squeeze gently to obtain all the juice.

To each cup of juice add one cup sugar. Boil for twenty minutes exactly and pour in jelly glasses. Do not cover until cold. This is a very easy way of making jelly, and one cannot have a failure if directions are followed.

Grape Catsup.—Six quarts of grapes off the stems; pulp, then boil the pulp until seeds come out; strain through colander. Take a ten-pound basket of apples and make into sauce. Use one quart water; one quart of vinegar; three pounds of sugar; all kinds of spices. Boil.

Spiced Grapes.—Pulp one peck of grapes; boil for five minutes; strain to take out seeds; put the skins and pulp together and add three pounds of sugar; one pint of vinegar; one teaspoon cloves; one teaspoon cinnamon; one teaspoon allspice. Cook until thick.

Grape Relish (to be used with fowl).—Take ten pounds of under-ripe grapes, boil for five minutes, strain, add one pound of sugar to one pound of fruit juice, also one teaspoon each of cinnamon, cloves and allspice. Boil five minutes; strain into moulds.

Unfermented Wine.—Stem and wash grapes, place in preserving kettle, add water to about one inch from top of grapes (the same as in making jelly), boil until all are broken, strain through a jelly bag, add one quart of sugar to two quarts juice and boil ten minutes; bottle and seal.

RHUBARB.

Cut the rhubarb when it is young and tender. Wash it thoroughly; cut into pieces about two inches long. Pack in sterilized jars. Fill the jars to overflowing with cold water, and let them stand ten minutes. Drain off the water and fill again to overflowing with fresh cold water. Seal with sterilized covers. When required for use treat the same as fresh rhubarb. Green gooseberries may be preserved in the same way.

Rhubarb and Orange Compote.—One-pint bottle rhubarb, three oranges, one cup sugar. Peel the oranges, removing as much as possible of the white pith; divide into sections; put all the ingredients together into a preserving kettle and simmer gently for about an hour.

Rhubarb Jelly.—One pint of " cold water " rhubarb; put into double boiler with half a cup of sugar; small grating of lemon rind; small piece of ginger. When quite cooked set aside to cool; remove ginger. Soak half ounce of gelatine in quarter cup of cold water; add, when softened, quarter cup of hot water to dissolve; add to rhubarb with one tablespoonful of lemon juice. Pour into a mould when nicely set. Serve with whipped cream.

MISCELLANEOUS RECIPES.

Banana Whip.—One cupful of cut-up banana, one cupful granulated sugar, the white of one egg. Whip together with a silver fork about fifteen minutes or until it is firm and white. This is an excellent substitute for whipped cream, and can be used in a great variety of ways. Strawberries will whip in the same way and make very delicious filling for strawberry shortcake.

Carrot Pudding.—Two cups grated potatoes, one cup grated carrot, one-half cup shortening or one cup suet, flour, salt, one cup sugar, one cup raisins, one teaspoonful soda. Steam.

Orange Souffle.—Peel and slice six oranges; put in a glass dish a layer of orange and a layer of sugar; have two or three layers of each; place over this a cold custard.

Snow Pudding.—Let the following come to a boil: Two cups hot water, two tablespoons corn starch (cream the starch before putting in water); one-half cup white sugar, salt. Then stir in whites of three eggs beaten stiff, and, removing from stove, continue to beat well. Cool.

Sauce.—One and one-half cups of milk. Heat but do not boil; yolks of three eggs well beaten, one-half cup white sugar. Season with lemon or vanilla. Pour over pudding. Serve cold.

Spiced Tomatoes.—Peel and slice the tomatoes and put them in the preserving kettle with sugar (half as much sugar as fruit by weight). A quart of vinegar and an ounce each of ground mace, cloves and cinnamon. Mix and cook slowly for three hours. Put in glass jars and seal.

Tomato Jelly.—Cover one-half box gelatine with one-half cup cold water for one-half hour. Put in saucepan one-half can tomatoes, a stick of celery, two bay leaves, one small onion, cayenne, salt. Let boil. Add gelatine. Pour through fine strainer. Add one teaspoon lemon juice, one tablespoon vinegar, serve on lettuce leaf with mayonnaise dressing.

Red Currant Snow.—Use two cups boiling water, two tablespoons of corn starch and one cup sugar; when cooked thick remove from fire and add the juice of two cups of red currants crushed and pressed through the colander. Beat the whites of two eggs, add a little sugar and pour over all.

Note.—Raspberries, strawberries and other fruits can be used in the same way.

SALADS.

French Dressing.—One-half teaspoon salt, one-quarter teaspoon pepper, four teaspoons vinegar, four teaspoons olive oil. Mix ingredients and stir till well blended.

Boiled Salad Dressing.—One teaspoon salt, one teaspoon mustard, cayenne, one tablespoon sugar, 1 egg or yolks of eggs, 1 tablespoon butter, one-half cup milk, one-quarter cup vinegar. Mix dry ingredients; add eggs (slightly beaten), butter and milk. Cook over hot water until mixture begins to thicken, then add vinegar very slowly. Cook for a minute or two longer.

Mayonnaise.—One egg yolk, one-half teaspoon salt, one cup olive oil, cayenne, one tablespoon lemon juice, one tablespoon vinegar, one-half tablespoon mustard. (N.B.—Have everything cold.) Mix together and when well blended add the oil, drop by drop, beating constantly. After mixture thickens add alternately the remainder of the acid and oil. If mixture curdles beat into it another egg yolk.

Wash leaves of plants to be used in salads; stand in cold water an hour before using, then dry by placing leaves in or between towels and shake gently. Leaves should be fresh and crisp.

Lettuce Salad.—Wash, freshen and dry lettuce. Dress with French or mayonnaise dressing.

Cold Slaw.—Freshen cabbage, shred fine; dry in towel. Serve with boiled dressing.

Waldorf Salad.—Mix equal parts of apple and celery cut in small pieces. English walnuts may be used with apple or celery, or with apples and celery. Serve with cream dressing or with boiled dressing. Salad may be served in apple cups.

Banana Salad.—Peel bananas and cut in two lengthwise; then cut across in quarters. Roll each quarter in boiled dressing—then in finely chipped walnuts. Serve on lettuce leaves.

Fruit Salad.—All kinds of fruit in season may be used. If oranges and bananas are used cut in small, uniform pieces. Mix oranges, pineapple, strawberry, bananas. Put a layer of fruit in dish, then sugar and continue until dish is full. Serve with whipped cream (sweetened and flavored) or a sweet salad dressing.

Sweet Salad Dressing.—One-half cup sugar, one-quarter cup water, three tablespoons lemon juice, thin shaving lemon rind, yolks of two eggs. Make a syrup by boiling water, sugar and lemon rind three minutes. Add to yolks of eggs and cook as a soft custard.

HONEY

One of Nature's Best Foods. It is only within the last few centuries that sugar has become known, and only within the last generation that refined sugars have become so low in price that they may be commonly used in the poorest families. Formerly honey was the principal sweet, and it was highly valued three thousand years before the first sugar refinery was built.

It would add greatly to the health of the present generation if honey could be at least partially restored to its former place as a common article of diet. The almost universal craving for sweets of some kind shows a real need of the system in that direction; but the excessive use of sugar brings in its train a long list of ills. When cane sugar is taken into the stomach it cannot be assimilated until first changed by digestion into grape sugar. Only too often the overtaxed stomach fails to properly perform this digestion, then comes sour stomach and various dyspeptic phases.

Now, in the wonderful laboratory of the hive there is found a sweet that needs no further digestion, having been prepared fully by those wonderful chemists, the bees, for prompt assimilation without taxing stomach or kidneys. As Prof. Cook says: "There can be no doubt but that in eating honey our digestive machinery is saved work that it would have to perform if we ate cane sugar; and in case it is overworked and feeble, this may be just the respite that will save from breakdown." A. I. Root says: "Many people who can not eat sugar without having unpleasant symptoms follow will find by careful test that they can eat good well-ripened honey without any difficulty at all."

Not only is honey the most wholesome of all sweets, but it is the most delicious, and its cost so moderate that it may well find a place on the tables of the common people every day in the week.

Indeed, in many cases it may be a matter of real economy to lessen the butter bill by letting honey in part take its place. One pound of honey will go as far as a pound of butter; and if both articles be of the best quality the honey will cost the less of the two.

Give Children Honey. When children are allowed a liberal supply of honey it will largely do away with the inordinate longing for candy and other sweets.

Ask the average child whether he will have honey alone on his bread, or butter alone, and almost invariably he will answer, "Honey." Yet seldom are the needs or the taste of the child properly consulted. The old man craves fat meat; the child loathes it. He wants sweet, not fat.

He delights to eat honey; it is a wholesome food for him, and is not expensive. Why should he not have it?

Honey may be used to sweeten hot drinks, as coffee and tea. German honey-tea—a cup of hot water with one or two tablespoonfuls of extracted honey—is a pleasing and wholesome drink.

Care of Honey.

The average housekeeper will put honey in the cellar for safe keeping—about the worst place possible. Honey readily attracts moisture, and in the cellar extracted honey will become thin, and in time may sour; and with comb honey the case is still worse, for the appearance as well as the quality is changed. Instead of keeping honey in a place moist and cool, keep it dry and warm, even hot. It will not hurt to be in a temperature of even 100 degrees. Where salt will keep dry is a good place for honey. Few places are better than the kitchen cupboard. Up in a hot garret next the roof is a good place, and if it has had enough hot days there through the summer it will stand the freezing of winter; for under ordinary circumstances freezing cracks the combs and hastens granulation or candying.

Candied Honey. If honey be kept for any length of time, especially during cold weather, it has a tendency to change from its original beautiful liquid transparency to a white, semi-solid, granular condition; and when it is thus changed, bee-keepers call it "granulated" or "candied." Sometimes it is candied so solid that when in a barrel the head has to be taken off, and the honey removed by the spadeful. But its candied condition is not to be taken as an evidence against its genuineness or purity, but rather to the contrary, for the adulterated honeys are less liable to candy than those that are pure. Some prefer honey in the candied state; but the majority prefer liquid.

It is an easy matter to restore it to its former liquid condition. Simply keep it in hot water long enough, *but not too hot.* If heated above 160 degrees there is danger of spoiling the color and ruining the flavor. Remember that honey contains the most delicate of all flavors—that of the flowers from which it is taken. A good way is to set the vessel containing the honey inside another vessel containing hot water, not allowing the bottom of the one to rest directly on the bottom of the other, but putting a bit of shingle or something of the kind between. Let it stand on the stove, but do not let the water boil. It may take half a day or longer to melt the honey. If the honey is set directly on the reservoir of a cook-stove it will be all right in a few days. In time it will granulate.

Various Uses of Honey.

Aside from its use in an unchanged state as a direct accompaniment of bread or biscuit, honey is used by bakers in manufacturing some of their choicest wares. An advantage in using honey for anything in the line of cake is its keeping qualities. Even if the cake should become dry, close it up in a bread-can for a time and its freshness will return.

Honey is used in medicines, and is the base of many of the cough cures and salves. For candy, honey is far more wholesome than cane sugar.

Very many of the so-called honey cooking recipes are valueless, for when the ingredients are put together and made into a cake the result is simply vile. The recipes given below have been tested, and every one is guaranteed to be good. The honey-jumble recipe, for instance, is especially good, as is the honey-cake recipe by Maria Fraser.

Honey Cooking Recipes.

Honey-gems.—Two quarts flour, three tablespoonfuls melted lard, three-quarters pint honey, one-half pint molasses, four heaping teaspoonfuls brown sugar, one and a half level tablespoonfuls soda, one level teaspoonful salt, one-third pint water, one-half teaspoonful extract vanilla.

Honey-jumbles.—Two quarts flour, three tablespoonfuls melted lard, one pint honey, one-quarter pint molasses, one and a half level tablespoonfuls soda, one level teaspoonful salt, one-quarter pint water, one-half teaspoonful vanilla.

These jumbles, and the gems immediately preceding, are from recipes used by bakeries and confectioners on a large scale, one firm in Wisconsin alone using ten tons of honey annually in their manufacture.

Honey-cake or Cookies without sugar or molasses.—Two cups honey, one cup butter, four eggs (mix well), one cup buttermilk (mix), one good quart flour, one level teaspoonful soda or saleratus. If it is too thin, stir in a little more flour. If too thin it will fall. It does not want to be as thin as sugar-cake. I use very thick honey. Be sure to use the same cup for measure. Be sure to mix the honey, eggs and butter well together. You can make it richer if you like by using clabbered cream instead of buttermilk. Bake in a rather slow oven, as it burns very easily. To make the cookies, use a little more flour, so that they will roll out well without sticking to the board. Any kind of flavoring will do. I use ground orange-peel mixed soft. It makes a very nice gingerbread.—*Maria Fraser.*

Aikin's Honey-cookies.—One teacupful extracted honey, one pint sour cream, scant teaspoonful soda, flavoring if desired, flour to make a soft dough.

Soft Honey-cake.—One cup butter, two cups honey, two eggs, one cup sour milk, two teaspoonfuls soda, one teaspoonful ginger, one teaspoonful cinnamon, four cups flour.—*Chalon Fowls.*

Ginger Honey-cake.—One cup honey, one-half cup butter, or drippings, one tablespoonful boiled cider, in half a cup of hot water (or one-half cup sour milk will do instead). Warm these ingredients together, and then add one tablespoonful ginger and one teaspoonful soda sifted in with flour enough to make a soft batter. Bake in a flat pan.—*Chalon Fowls.*

Fowls' Honey Fruit-cake.—One-half cup butter, ½ cup honey, one-third cup apple jelly or boiled cider, two eggs well beaten, one teaspoonful soda, one teaspoonful each of cinnamon, cloves and nutmeg, one teacupful each of raisins and dried currants. Warm the butter, honey, and apple jelly slightly, add the beaten eggs, then the soda dissolved in a little warm water; add spices and flour enough to make a stiff batter, then stir in the fruit and bake in a slow oven. Keep in a covered jar several weeks before using.

Fowls' Honey Layer-cake.—Two-thirds cup butter, one cup honey, three eggs beaten, one-half cup milk. Cream the honey and butter together, then add the eggs and milk. Then add two cups flour containing one and one-half teaspoonfuls baking powder previously stirred in. Then stir in flour to make a stiff batter. Bake in jelly-tins. When the cakes are cold, take finely flavored candied honey, and after creaming it spread between layers.

Fowls' Honey-cookies.—Three teaspoonfuls soda dissolved in two cups warm honey, one cup shortening containing salt, two teaspoonfuls ginger, one cup hot water, flour sufficient to roll.

Honey Nut-cakes.—Eight cups sugar, two cups honey, four cups milk or water, one pound almonds, one pound English walnuts, three cents' worth each of candied lemon and orange peel, five cents' worth citron (the last three cut fine), two large tablespoonfuls soda, two teaspoonfuls cinnamon, two teaspoonfuls ground cloves. Put the milk, sugar and honey on the stove, to boil fifteen minutes; skim off the scum, and take from the stove. Put in the nuts, spices, and candied fruit. Stir in as much flour as can be done with a spoon. Set away to cool, then mix in the soda (don't make the dough too stiff). Cover up and let stand over night, then work in flour enough to make a stiff dough. Bake when you get ready. It is well to let it stand a few days, as it will not stick so badly. Roll out a little thicker than a common cooky, cut in any shape you like.

This recipe originated in Germany, is old and tried, and the cake will keep a year or more.—*Mrs. E. Smith.*

Honey-drop Cakes.—One cup honey, one-half cup sugar, one-half cup butter or lard, one-half cup sour milk, one egg; one-half tablespoonful soda, four cups sifted flour.

Honey Short-cake.—Three cups flour, two teaspoonfuls baking-powder, one teaspoonful salt, one-half cup shortening, one and one-half cups sweet milk. Roll quickly, and bake in a hot oven. When done, split the cake and spread the lower half thinly with butter, and the upper half with one-half pound of the best flavored honey. (Candied honey is preferred. If too hard to spread well it should be slightly warmed or creamed with a knife). Let it stand a few minutes, and the honey will melt gradually, and the flavor will permeate all through the cake. To be eaten with milk.

Honey Tea-cake.—One cup honey, one-half cup sour cream, two eggs, one-half cup butter, two cups flour, scant one-half teaspoonful soda, one tablespoonful cream of tartar. Bake thirty minutes in a moderate oven.—*Miss M. Chandler.*

Honey Ginger-snaps.—One pint honey, three-quarter lb. butter, two teaspoonfuls ginger. Boil together a few minutes, and when nearly cold put in flour until it is stiff. Roll out thin, and bake quickly.

Honey Fruit-cake.—One and one-half cups honey, two-thirds cup butter, one-half cup sweet milk, two eggs well beaten, three cups flour, two teaspoonfuls baking-powder, two cups raisins, one teaspoonful each of cloves and cinnamon.

Honey Pop-corn Balls.—Take one pint extracted honey; put it into an iron frying-pan, and boil until very thick; then stir in freshly popped corn, and when cool mould into balls. These will specially delight the children.

Honey Caramels.—One cup extracted honey of best flavor, one cup granulated sugar, three tablespoonfuls sweet cream or milk. Boil to "soft crack," or until it hardens when dropped into cold water, but not too brittle—just so it will form into a soft ball when taken in the fingers. Pour into a greased dish, stirring in a teaspoonful extract of vanilla just before taking off. Let it be one-half or three-quarter-inch deep in the dish; and as it cools cut in squares and wrap each square in paraffine paper, such as grocers wrap butter in. To make chocolate caramels, add to the foregoing one tablespoonful melted chocolate, just before taking off the stove, stirring it in well. For chocolate caramels it is not so important that the honey be of best quality.—*C. C. Miller.*

Honey Apple-butter.—One gallon good cooking apples, one quart honey, one quart honey vinegar, one heaping teaspoonful ground cinnamon. Cook several hours, stirring often to prevent burning. If the vinegar is very strong, use part water.—*Mrs. R. C. Aikin.*

Honey and Tar Cough-cure.—Put one tablespoonful liquid tar into a shallow tin dish and place it in boiling water until the tar is hot. To this add a pint of extracted honey and stir well for half an hour, adding to it a level teaspoonful pulverized borax. Keep well corked in a bottle. Dose, teaspoonful every one, two, or three hours, according to severity of cough.

Summer Honey-drink.—One spoonful fruit juice and one spoonful honey in one-half glass water; stir in as much soda as will lie on a silver dime, and then stir in half as much tartaric acid, and drink at once.

Honey Vinegar.—Honey vinegar can be made by using one and one-half ounces of honey to one gallon of clear soft water. Store in a barrel or other vessel. It should be kept in a warm place, with an opening in the vessel to allow the air to circulate freely, thus causing it to come to perfection more quickly. At the end of the year it will be ready for use. Its keeping qualities are excellent, and the best of pickles can be made with it. There is, perhaps, nothing superior for using with vegetable and meat salads.

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Ontario Department of Agriculture

ONTARIO AGRICULTURAL COLLEGE.

Little Peach Disease

By Lawson Caesar, Department of Biology.

The object of this Bulletin is to give peach growers the most up-to-date information that I have been able to obtain on the disease known as Little Peach, and at the same time to warn them of the danger of allowing trees attacked by it to remain in their orchards. Some do not need any warning, because they take no chances with diseased trees, but by far the majority are careless, largely because they have not yet realized that *Little Peach is a very destructive disease, much more destructive than Yellows.*

Trees attacked by Little Peach can probably be found here and there throughout the entire Niagara district and the other peach-growing districts of the Province. If there are any districts where the disease does not occur to-day, it may be expected to make its presence known in a few years. Hence this subject concerns every peach-grower in the Province. In some districts the disease has already made such progress that whole orchards have become diseased and worthless and many trees in orchards nearby attacked.

To make the symptoms of Little Peach clearer by comparison, I shall first mention those of Yellows.

Symptoms of Yellows.

(1) The most characteristic symptoms of Yellows are the premature ripening and red spotting of the fruit. It may ripen from a few days to several weeks before the normal time. The surface of such fruit is regularly highly colored and mottled or spotted with red. Inside, reddish streaks extend through the flesh from the skin to the pit, and the flesh around the pit itself is redder than normal. Sometimes only one branch or even one twig will show these symptoms, but the presence even of a single fruit is enough to prove that the tree has the disease. Cutting off such branches will not save the tree. The first year the fruit is often somewhat larger than usual, but after this, as the tree becomes weakened with the disease, the fruit tends to become smaller.

(2) The appearance on the trunk and main branches of upright, tufted growths composed of small, slender shoots with narrow, pointed, yellowish leaves. These wiry, bushy growths are by no means always present, especially in the early stages of the disease.

(3) The premature bursting of buds in the axils of the leaves that should remain unopened until next year.

(4) In well-advanced stages of the disease the leaves become a sickly, yellow color, roll upwards somewhat, and droop. In early stages, however, the foliage is a rich green and looks perfectly healthy, so that were it not for the characteristic appearance of the fruit one would not suspect the presence of the disease.

Symptoms of Little Peach.

(1) As the name indicates, the fruit is usually considerably smaller than normal, though sometimes the difference in size is not very great. Unlike Yellows, however, it does not ripen prematurely, nor have the red mottled appearance outside or the streaking inside and the abnormal reddening around the pit. On the contrary, it ripens from one to several weeks later than usual, and has the color of a healthy peach both outside and inside. The flavor may be poor, as in the case of Yellows, or it may be fairly good, differing but little, if any, from that of healthy peaches.

(2) The wiry, bushy, vertical outgrowths of shoots, with small, narrow, sickly, yellow leaves found frequently on the trunks and lower main branches of trees attacked by Yellows, are very seldom seen in the case of Little Peach.

(3) Just as in the case of Yellows, there is not uncommonly a considerable amount of premature bursting of buds in the axils of the leaves, and some pushing of concealed buds on the main branches, such buds, however, not growing out into the bushy growths referred to above.

(4) The leaves in the lower and central parts of diseased trees regularly assume a sickly, yellowish or reddish-yellow color, while those further out on the tree remain green. As the disease advances the yellowish coloring of the leaves gradually extends outwards towards the tip of the branches, and in severe cases the whole of the foliage becomes affected in this way.

(5) The leaves, especially in the inner and lower parts of the tree, commonly roll somewhat upwards, then by the gradual bending of the midrib droop, so that they appear to be curling downwards around the branch or twig. This gives a clustered appearance to the leaves on many branches and twigs, and when accompanied by the sickly yellow appearance or cast of the inner foliage is an excellent means of identification.

Note.—While the *fruit* is chiefly relied upon for the identification of Yellows, it is the FOLIAGE that must be our guide in identifying Little

Peach. The fruit in this case often helps, but everyone should study the characteristic appearance of the foliage, especially as described in 4 and 5 above. By careful comparison of diseased trees with healthy ones, a grower can learn more about the disease in half a day than any amount of printed descriptions can teach him. Most cases of Little Peach are easily identified with or without the fruit. Some cases, however, take a good deal of study. Frequently one is at a loss to know whether trees without fruit are attacked by Yellows or Little Peach, and sometimes it seems impossible to distinguish between them. But this need not be a cause of worry because trees attacked by either disease must be removed.

Other Troubles Likely to be Confused With Little Peach and Yellows.

(1) When root aphids (tiny, shining, black insects, found on the roots) attack a young tree they cause the foliage to turn reddish-yellow. Such attacks, however, can be fairly easily distinguished from Little Peach by the fact that the foliage in the former case shows the reddish-yellow color on the outer or terminal part of the trees first and the central part still remains green, while in the latter case the reverse of this happens. So far, however, as I know, there are very few examples of root aphis attacks in Ontario.

(2) Leaving the wire to which the tag was attached on young trees will girdle them and cause them to turn yellow.

(3) Borers at the base of trees frequently girdle them and cause the foliage to turn yellow.

(4) The foliage of trees turns yellow whenever there is lack of available plant food in the soil. This is nearly always the case in sod orchards and in poor soil that is not manured or fertilized in some way. Careful study of the leaves will show, however, that they lack several of the characteristics of Little Peach and also of Yellows.

(5) On trees that have been severely attacked by Leaf Curl and have lost most of their foliage, numerous concealed buds on the main branches will burst and form little rosettes of leaves. These leaves, however, are quite green and need not be mistaken for either Little Peach or Yellows, especially when one observes the traces of Leaf Curl still on the trees.

(6) Powdery Mildew often attacks the terminal leaves and gives them a peculiar rolled appearance, sometimes causing them to have a rosetted look. This should not confuse anyone if they examine the leaves and see the white, powdery substance formed by the Mildew. Wherever the Mildew works on the leaf, development is retarded and the leaf, in consequence of growth in other parts, becomes distorted.

(7) Sometimes imperfectly fertilized peaches are found along with normal peaches on a tree even as late as August. These may possibly be mistaken for Little Peach because of their small size. If, however, they are cut through with a knife it will be seen that the pit is soft and the blade can be forced through it. The kernel inside is not developed. Little Peach pits, on the contrary, cannot be cut through in this way, and, when broken, the kernel is found to be developed normally.

Little Peach in Michigan.

At the request of a number of growers, I was given permission to visit the peach districts of Michigan this autumn with a view to gaining further information on the disease than was known in Ontario and to seeing the methods taken to hold it in check and the degree of success obtained. Michigan was selected because the disease has been known in that State for a very long time and more has probably been done there in the way of combating it than in any other place.

On the way I called at Lansing, where I interviewed several of the professors of the Agricultural College and got what information they could give me. On their advice I then proceeded to the Township of Saugatuck, about 40 miles west of Grand Rapids. Here, they said, I should find out more about the disease than in any other part of the State. It was in this district that Prof. Waite, of Washington, D.C., carried on an eradication experiment in the control of Little Peach, an experiment continued over several years and covering an area of several square miles in extent. Mr. Horace Welch, who assisted Prof. Waite in this experiment and who is believed to be the best authority in Michigan on the disease, lives in the district. On my arrival I at once called on Mr. Welch and was fortunate enough to find him at home. He very kindly volunteered to drive me around through the orchards and to help me in every possible way to gain the knowledge I was in search of. The greater part of two days was spent with him visiting orchards, observing the degree of the prevalence of the disease, its peculiar symptoms, the methods employed in controlling it, the degree of success obtained, and other points of importance.

What is Known About the Disease in Michigan.

The following information applicable to Ontario peach growers was obtained:—

(1) Little Peach is a very destructive disease; in the opinion of the majority of Michigan growers it is several times more destructive than Peach Yellows. Wherever affected trees have been allowed to remain,

the whole orchard, as a rule, has become hopelessly diseased in four or five years. Mr. Welch has himself seen more than 100 orchards thus destroyed.

(2) So far as known no variety of peach tree is exempt.

(3) Japanese plums are quite subject to the disease. I myself saw three plum orchards with several of the trees attacked by Little Peach. It is clear, therefore, that they must not be overlooked when taking measures for the control of the disease.

(4) Little Peach attacks trees from two years of age upwards. (This is also, of course, true of Yellows.)

(5) The disease has been successfully controlled in Michigan and other places, but only by the removal each year as soon as possible of all clearly diseased trees and also all *suspected ones.* It is absolutely necessary to remove the suspicious cases as well as the clearly diseased.

(6) Co-operation in control measures is necessary, and, where orchards are close together, as in Ontario peach districts, is imperative; for no person can thoroughly control the disease in his own orchard by the removal of diseased trees if his neighbor only a few rods away fails to remove his. If, however, the orchards are half a mile or more apart, one may hope to be able to keep his own orchard fairly free from the disease, even independently of his neighbors.

(7) Where trees have been removed because of the disease, young trees may, if desired, be set in the same place next spring. Such trees are not any more subject to Little Peach and Yellows than any other trees in the orchard. Prof. Waite, of the Department of Agriculture, Washington, D.C.; Prof. Blake, of New Jersey, and several others, agree with this statement.

(8) The cause of Little Peach (or of Yellows) is not yet discovered.

(9) It is not definitely known in how many ways the disease may be spread. It is probably first brought into a district on nursery stock, and once in the orchard it certainly spreads from one tree to another, but just how no one knows. Many think that the time of infection is during the blossoming season. A number of things point that way, but the evidence is not conclusive.

(10) The disease can be propagated by budding, as has been proven by Dr. Smith and Prof. Waite in the case of Yellows. Mr. Welch took more than 200 buds from trees showing symptoms of Little Peach and inserted some in young seedlings and others in older trees. These buds took just as well as those from healthy trees, and in every case the disease developed, but not until the second year, and in some cases the third.

(11) Whether the pits from Little Peach will grow and produce the disease is not yet proven. (Prof. Phillips, of Virginia, believes a small percentage of them will do so.)

(12) The ordinary system of inspection for Yellows (as practiced in Ontario) is not sufficient for Little Peach, as this disease often does not show in trees until the latter part of September. Therefore inspection work should continue up to the coloring of the leaves by frost.

(13) It is not an infrequent occurrence to find trees with all the symptoms of Little Peach except that the fruit ripens somewhat prematurely or at the latest at the normal time. Such fruit shows no signs of Yellows. This is possibly an abnormal case of Little Peach, though some think it is due to both Little Peach and Yellows attacking the tree at the same time. Whatever be the cause, these trees must be destroyed just as if they had typical Little Peach or Yellows.

Recommendations.

Keeping in mind what has been mentioned above in regard to Little Peach, the following recommendations seem desirable:—

(1) That the present system of inspection of orchards for Peach Yellows and Little Peach be improved (*a*) by appointing more inspectors, so that each man will have a smaller area to cover and therefore be able to do his work more thoroughly; (*b*) by having each orchard inspected at least twice and preferably three times a year, the first beginning about August 1st or the last week in July, and the last continuing into October until the frosts color the leaves. This late inspection will be found most valuable in discovering trees that are very late in developing the symptoms of the disease; (*c*) by giving inspectors every encouragement to be thorough both in marking diseased and suspicious trees and in enforcing their removal within a reasonable time, in no case permitting such trees to remain until the next season.

(2) That if it is not found possible to enforce the removal of trees under the present method of appointing inspectors, the peach-growers should hold a conference and endeavor to get such changes made as will overcome this difficulty.

(3) That each peach-grower make himself familiar with the symptoms of the disease and help his neighbor to learn them, and by his own inspection supplement the work of the regular inspector. This is the way the best men are doing to-day in every district where Yellows or Little Peach is to be found.

(4) That nurserymen, recognizing the importance to the peach industry and to their own reputation of supplying perfectly healthy stock, take every precaution in their power to secure buds from trees that are undoubtedly free from the disease. To do this means that they must entrust the work only to very reliable and intelligent men. It is not safe to take buds from trees in orchards where there is a considerable amount

of the disease, because some of the trees from which they are taken may be just contracting it and not show the symptoms until later. It is necessary to go to orchards that are known to be free from this disease and Yellows. In this connection it should not be forgotten that the disease seldom shows up in the nursery rows and that it is not until the trees are set out in the orchards that it begins to make its appearance. This is because it takes from two to three years from the time the buds are inserted before Little Peach has sufficiently developed to show in the foliage.

(5) That nurserymen, moreover, should endeavor in every way to assist the inspector in keeping all the orchards within a radius of a mile or more on each side of their nursery grounds specially free from the disease so as to insure the health of their own stock.

(6) That, since there is suspicion of the disease coming from pits taken from trees that have the disease but do not show it until after the fruit is gathered or until the next year, nurserymen look into the practicability of securing pits from such States as Georgia or California, where the disease does not occur, the pits being of course guaranteed as true Georgia or California pits, so that there may be no danger of their having been shipped in from canneries in outside States where Yellows and Little Peach prevail.

Note.—On this question of the danger of spreading the disease through nursery stock, I should recommend every nurseryman to write to the State Entomologist, Agricultural Experiment Station, Blacksburg, Virginia, and ask for a copy of the Seventh Report of the State Entomologist and Plant Pathologist. The report will, I believe, be forwarded free of charge to those desiring it.

Conclusion.

There seems to be no doubt whatever that Little Peach can be controlled with almost perfect success if growers and inspectors work hand in hand to get rid of all diseased trees and suspected ones each year, and if nurserymen take whatever precautions are in their power to send out none but perfectly healthy stock. *There is danger of growers attributing too much of the trouble to the nursery,* for it is clear that while a few diseased trees may be sent out without being known to be affected at the time, the main cause of the spread of Little Peach can clearly be proven to be due to the failure of the growers themselves to remove diseased trees in their own orchards.

In proof of the good results possible from eradication measures, let me quote what Prof. Waite says about his experiments in Saugatuck

Township. Mr. Welch, in my presence, corroborated these statements so far as they apply to his own State of Michigan.

* "*Eradication Tests.* About six years ago, when the writer's investigations led him to the conclusion that Little Peach belonged to the Yellows group, an eradication test was started in a definite area in Saugatuck Township, Michigan. This area contained about seven square miles, was thickly planted to peach orchards and had about one hundred and forty thousand peach trees. There were some four or five thousand trees diseased that were found the first season. A small proportion of these, however, were affected with Yellows. Three inspections were made and the diseased trees were removed with a fair degree of promptness after each inspection. The next year only between four and five hundred diseased trees were found, being only a small fraction of 1 per cent. A slight increase of somewhat over a thousand trees was found the third season, evidently due to a local outbreak in the neighborhood, but the total number of diseased trees in this area was less than 1 per cent. Only about one-fifth of these were affected with Yellows, the remaining four-fifths being Little Peach. Similar results were obtained by the local Yellows Commissioners in the fourth season, which was 1906, and the orchards in this area are still standing in good condition as far as the Yellows and Little Peach are concerned.

"A similar eradication test was started by the Department of Agriculture, in 1906, in an area of some six or seven square miles around Youngstown, New York, in co-operation with the Cornell State Experiment Station, through arrangements with Professors Bailey and Craig. In general it may be stated that from the eradication tests where careful records have been made over a considerable area, and from the experience of the best-worked orchards, of which there are a large number in Michigan and a good many in New York, it is considered that when ordinary conditions obtain, the annual loss from the Yellows should be reduced to less than 1 per cent. per annum where prompt and careful eradication is done."

Since this time, some of the peach-growers of Saugatuck Township have become overconfident and careless, with the result that these men's orchards are to-day again becoming diseased, while those who have kept up the fight are keeping their orchards healthy.

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*Taken from Prof. Waite's address before the Fruit Growers Association of Ontario, 1908.

BULLETIN 186.] [DECEMBER, 1910

Ontario Department of Agriculture

WOMEN'S INSTITUTES.

Children: Their Care, Training and Happiness as Future Citizens

J. J. KELSO, TORONTO.

A lecturer not long ago was speaking on the importance of conserving the health of the nation by taking proper care of the children, and in the course of his remarks he said that there was a well-founded belief that the Government was doing more to ensure a good breed of cattle and live stock on the farms than they were to maintain a healthy race of men and women. He mentioned an instance where a large appropriation had been made to stamp out hog cholera in a certain district. At the same time there was an epidemic of disease among children and not the slightest effort made to combat it. His moral was:

"If you want to be taken care of by your country be a hog."

This, of course, is a little overdrawn and yet it may point a moral, or at least emphasize the importance of doing everything possible to provide that the children, who are to be future citizens, shall be fully safeguarded in their rights, that every boy and girl will be certain to have a decent home, good food, adequate clothing, opportunities for education, and also that their physical health should be carefully enquired into by experienced persons so as to make certain that they will have good eyesight, good hearing, good teeth, open nasal passages that there may be good breathing, a straight spine and sound feet and limbs. *Health* means *happiness*, and both together mean clean, *useful citizenship*.

It was, therefore, with great pleasure that I accepted the invitation of the Minister of Agriculture to tell the people of the Province something about the Children's Protection Act, and the work that is contemplated under its provisions. It is important to the success of this movement that everyone should understand the law and the system under which it operates. Without this knowledge no one can give the proper kind of assistance and the more people who read this pamphlet and other such publications, the more prospect there will be of providing a friend for every friendless child, and doing useful public service.

CAUSES OF NEGLECT.

Neglect of children is rarely a wilful and premeditated evil. Poor people often become discouraged and despondent; they are frequently out of work and not able to earn much even when employed; rents are high and food seems to be getting dearer every day, and it is just as often as not that drinking results from the despair that comes to men and women unable of their own strength to battle against the ills of life. Therefore, the emphasis in this work is always laid on *prevention*. Wherever a family is found in which the children are destitute and unable to attend school, hearing constantly oaths and blasphemy, and witnessing scenes of drunkenness and immoral living, it is our duty to bring to the attention of such people in a kindly way the wrongs under which their children suffer, and persuade them by friendly advice, and not infrequently by practical help, that they can and should do better, rather than take chances on losing their most precious possessions, the boys and girls of the family.

The whole plan of the Children's Aid movement is founded on this principle and has in the past resulted in thousands of homes being improved and children's lives made cleaner and happier with little more than a visit and a warning.

CHILDREN'S AID SOCIETIES.

The Act provides for the organization of Children's Aid Societies in every centre of population. There are about seventy of these organizations in existence in Ontario at the present time in addition to numerous small committees and correspondents, and wherever there is no such Society or committee, it is our wish and desire that the friends interested in children should get together and form a society. The objects are as follows:

First.—To carry out the provisions of the Children's Protection Act of Ontario, in receiving and providing homes for neglected and dependent children.

Second.—To systematically agitate against all that tends to rob children of the right to grow up in an atmosphere of purity and moral cleanliness.

Third.—To prosecute parties who contribute towards the delinquency of children.

Fourth.—To create a sentiment for the establishment of wholesome uplifting influences, such as small parks, playgrounds, gymnasiums, free baths, social centres and the like.

Fifth.—To establish a personal service corps, so that individual attention may be given to children by interested men and women.

Sixth.—To maintain an educational campaign on subjects relating to child-protection.

A resolution can be passed agreeing to enter upon the work with these objects in view, officers elected and a request sent to the Provincial Office for recognition and other assistance.

If, as is sure to be the case in many cities and towns, a Children's Aid Society is already organized, then valuable assistance can be given by readers affiliating with the Society, helping to raise money for its support, offering a home to some friendless little boy or girl, in addition to that wide personal influence that can always be exerted for good by those who have the inclination.

ENQUIRE FOR NEGLECTED CHILDREN.

One of the first steps taken by any Children's Aid Society is to enquire throughout its constituency for any neglected children or any boys and girls who are growing up under conditions that would lead to criminal or immoral conduct on their part. When the facts are ascertained, every possible effort is made to bring about improvement, and to this end all the charitable and benevolent agencies of the town are called upon for help. The old-fashioned plan was to take such children and have them committed to reformatories and other public institutions. The effort of the Children's Aid Society is to surround the children as far as possible with good influences in their own homes, removing the evil instead of the children. Experience teaches that normal life is always the best. Public institutions may be well conducted and no expense spared, and yet the moral life of children brought up under this congregate and artificial plan is rarely of the type that will withstand the struggles and temptations of actual life when the world is to be faced as it must inevitably be sooner or later. Public sentiment is the mighty force that keeps the community clean, and the Children's Aid Society has and can exert great influence in creating a high standard of public morals so that young children may be saved from degraded associations and inspired by an elevated sense of duty that will lead them to emulate all that is best and noblest in our community life.

CHILDREN CAN BE TAKEN AWAY.

Where these preventive measures fail, and after repeated warnings parents and others cannot be induced to improve thier conduct for the sake of the children, then the law provides for the apprehension of such children and the submitting of all the facts to the judge or magistrate.

The court, after a careful review of all the evidence, can give the parents a further respite if they appear at all concerned, or a legal order can be made transferring the custody of the child or children to the guardianship of the Society.

THE CHILDREN'S SHELTER.

When this is done, or if a child has to be cared for pending a final decision, the Society cares for its wards in what is known as the Children's Shelter. This is the modernized form of the orphanage. It is simply intended to be a temporary children's home where boys and girls can come under refined and pleasant home influences and get some idea of right living. It is a clearing house, rather than a permanent home. Under the Act no child is supposed to be kept there longer than three months, and as a rule a month suffices to arrange for the child's future, either by return to its own natural parents, or transference to a foster home. Often a boy or girl who has been accused of petty theft or some other misdemeanor can, by a short stay in the shelter, be encouraged to avoid wrong-doing and settle down to steady, reliable conduct. The shelter can be of service in this direction only where the man and woman in charge are possessed of the gift of influencing child life. No one should be engaged in work for children anywhere unless they are constrained by that great love and sympathy for needy and erring children that can leave its indelible impress upon the child heart. Children are won to goodness, not by prison bars, nor by the plentiful use of the rod, but by those gentler and more effective weapons that appeal to the inner conscience, and the force of which is evidenced in tears of true repentance. Bad boys are merely good boys who have strayed into side paths and who may, in nearly every instance, be guided back to the main road if only the right persons do the leading. Our aim, not only in this pamphlet, but throughout the entire work, is to find the right persons and to impress upon every citizen that possibly he or she is possessed of all the necessary qualifications if only they would hear the appeal and us their talents for the reclamation and up-building of every boy or girl who may come their way.

MAINTENANCE OF CHILDREN.

While children are in the shelter as wards of the Society the municipality is under obligation to pay the board, the usual amount being $2.00 per week. This makes the work of the Society lighter and the funds raised from benevolent sources should be used for the employment of a wise and discreet agent, who would act as the executive officer of the Society in the daily and hourly routine that is necessary if the work is to be carried on efficiently. There is probably no work which should appeal more strongly to the liberality of the general public, especially those possessed of means, than the Children's Aid Society, and yet it has always been difficult to secure sufficient funds to carry on this work to the best advantage.

HARD TO GET MONEY.

While visiting a small town in our province I found that the Children's Aid branch had only been able to collect the sum of $12 during the year for the care and protection of neglected children, yet in one evening a children's mission band raised over $30 at a bazaar to send to a far distant part of the world to help a mission to lepers. In one of our cities which is blessed with much wealth and culture, the Children's Aid Society is quite discouraged because in the year less than $200 income could be secured, while at the same time a gentleman interested in a hospital for consumptives was able to raise $8,000 cash and secure promises of double that amount apparently with very little effort. One reason possibly is that things distant and things big carry a stronger appeal to the imagination and the pocket-book. The Children's Aid Society, by following the simple method of improving the home life, and placing homeless children as speedily as possible, is not able to present a grand spectacle, whereas a big orphanage or hospital is more easily understood and appreciated—and yet this work for our young Ontario-born children is a first duty, and the Children's Aid Society, as the organized expression of the people's desire that every child should be protected in its rights, should receive a generous response. While this thought is fresh in the mind of the reader, let the secretary or the treasurer of the Children's Aid Society be cheered by a voluntary subscription for a substantial amount. Money freely contributed to the Children's Aid Society means a diminution in the number and expense of maintaining reformatories, prisons, hospitals, refuges and poor-houses. Every criminal and every tramp was once a bright, winsome little fellow with high hopes and a clean, untainted mind. That they subsequently became outcasts and wanderers was due to somebody's neglect. Why not do more to save the boys and girls while there is yet hope instead of letting them drift until habits are formed, character hardened, reputation shattered, and they are unable, even when willing, to abandon their evil ways. If our Children's Aid Societies were better organized and people everywhere realized the importance of prompt and practical aid so that every young life might be hedged around with saving influences, this province of ours would prosper, not only agriculturally and commercially, but also morally, and the prophesied millenium would soon arrive!

CHILDREN'S FRESH AIR FUND.

Let us take this opportunity of thanking the many good men and women on the farms of our province who have invited the children of Toronto as fortnightly guests during the summer. Last year the Fresh Air Funds of Toronto sent over one thousand little boys and girls to spend delightful holidays in farm homes, and not one dollar was charged for maintenance. As delicate children are given the preference it can readily be understood what a health-restoring and joy-giving agency the Fresh Air Fund is. If anyone wishes to invite poor children to visit them during the summer vacation all they have to do is to send a letter with credentials to Miss Roberts, 21 Scarth Road, Toronto.

THE VILLAGE PLAYGROUND.

It may seem rather absurd to advocate the importance of a village playground when one can stand on the main street and see farms stretching out in either direction. Nevertheless, long experience and observation teaches that to give young people in the country some variety in life and relief from the monotony of existence, it is extremely important that more attention should be given to the social side of their natures. Too often the boys hang around the country hotel as their only resort, and form drinking habits from the simple and natural desire for sociability. The young girls do not do this, but they are equally in need of the joys of existence. The village playground, and above all a director, giving all his or her time to the work of recreation, would to some extent meet the social need. If there could in addition be a social centre building with club rooms and hall for concerts, dances, etc., such a building would exercise a healthy, pleasure-giving influence that would offset to some extent the deporable exodus to the cities. If the Women's Institutes would take this project up they would be doing the highest kind of service for the community.

AN IMPORTANT HEALTH PROVISION.

Not long ago a country doctor of long experience, in discussing work for children, mentioned a matter that should receive the attention of school trustees and the members of Women's Institutes. In many country schools the closets are located a considerable distance from the school building. Often the children in the early part of the winter leave the door open and the snow is allowed to drift in and this, soon forming into ice, makes it impossible to use the building. Then it is said that passage-ways are rarely cleaned of snow, with the result that the children, girls particularly, fail to attend to this important function at the proper time, and in this way completely upset their health. This doctor said he could without hesitation trace many of the diseases and chronic cases of ill-health to this cause, and he begged that in the public interest there should be less reticence on the part of parents and teachers in making the children acquainted with the vital necessity for regular habits and prompt response to nature's call.

ALL CAN HELP TO BEFRIEND CHILDREN.

There is probably no one of mature years, no matter how humble his position, who cannot help in some way to bring about an improvement in the condition of a neglected child, or in adding to the happiness of a boy or girl starting out in life, it may be without friends or influence and needing the kind word and the smile of encouragement. Some have exceptional opportunities for usefulness. For instance, editors control a mighty agency for good. The printing of items on child-saving work and the endorsation of the movement have a far-reaching effect. Clergymen also have the privilege of bringing before their people this work for our neglected and dependent children, referring particularly to the Christian duty of taking into their homes one of these children and giving him the benefit of Christian culture. The Crown Attorneys, Local Magistrates, County Constables, Governors of Gaols and other officials can do much by reporting cases of neglected children instead of allowing them to drift on in wrong-doing until the gaol becomes the only remedy.

Especially would the assistance of the Women's Institutes of the province be appreciated. They have exceptional opportunities for extending practical help to neglected children, poor families and children who are denied educational advantages. If they take up the work the whole attitude of the community toward the child will be improved.

City Children.
Needing a visit to the country to put color in their cheeks.

PRAISE THE CHILDREN.

The withholding of praise from children is a mistaken policy, for praise is the highest possible incentive to further good deeds. When children have struggled hard to win the kindly word of recognition and that word is not spoken they feel that their efforts are not appreciated and that there is no use in trying their best. Is it not true in the experience of each one of us that praise and the hope of praise has led us to attempt great things, and that a single word of commendation has sent us on our way rejoicing? Much more then can children be influenced in this manner, and always in right and worthy directions. The oft-repeated charge that praise leads to an unwholesome conceit is a false and groundless one, and has been the occasion of much unhappiness that could easily have been avoided.

EARLY CURE OF PHYSICAL DEFECTS.

It has often occurred to me on seeing persons afflicted with weak eyes, lame feet, etc., that many of these afflictions were preventable in early childhood. In poor homes where the struggle for existence is too keen to admit of much thought for anything else, or where a low standard of development makes people indifferent to the afflictions of children, defects that might readily be cured are neglected until they become too firmly established to admit of any material benefit from medical or surgical treatment. During the past years I have taken advantage of every opportunity that offered to encourage the sending of defective children to the Children's Hospital so that their ailments might receive prompt attention. I am glad to be able to say that the hospital has been most generous in receiving poor children without charge, and I have known quite a number of children who have received lifelong benefit from their sojourn in that institution. I would strongly recommend all Children's Aid Societies and charitable associations to look up cases of defective children and arrange for their admission to the Children's Hospital.

LEFT HIM TWO HUNDRED ACRES.

Several years ago a boy was placed with a farmer in the northern part of the province on a simple agreement providing for board, schooling and maintenance until he was old enough to be worth further remuneration. His progress was fairly satisfactory for a time but he developed a mischievous, thieving disposition that was a source of considerable annoyance to neighbors. The people did not wish to give him up but he was removed in order to preserve peace in the neighborhood. The farmer was so greatly attached to the lad that he came to Toronto and begged to have him back, promising that he would exercise greater care and endeavor to guide him aright in the future. He was allowed to take the boy home with him and matters went on smoothly after that. Later on the farmer died and left the lad a farm of about two hundred acres. It is not the richest kind of land but it served to show the bond of affection that had grown up between the two.

LOVED IN SPITE OF HIS FAULTS.

Another incident going to show that these children frequently ingratiate themselves into the affections of their foster-parents occurred quite recently. A boy who had been on a farm for about seven years was returned because he was restless and dissatisfied. The people had frequently spoken of returning him but when asked to do so would give him another trial. When the boy came to Toronto it was evident that he was in poor health and an examination by physicians revealed the sad fact that he had an incurable disease rapidly growing and likely to terminate his life before very long. The foster-parents were notified of this as a matter of courtesy. A day or two later the farmer arrived in town and said it was his intention to take the young man home with him and that he and his wife would do their best for him. If he could not recover they would at least give him the best care in their power and if he died would bury him in their family plot. He was asked, "Did not the boy try your patience a thousand times and were you not rather glad to get rid of him?" "Yes," he replied simply, "but if we do not forgive how can we expect our Heavenly Father to forgive us. Wife and I have missed the boy and now that he needs our care we feel that it is our duty to help him." For his part, the boy was simply overjoyed at the prospect of returning to the farm. He wept many tears of repentance and begged the farmer over and over again to forgive him for all the carelessness and indifference he had shown and promised that if he ever got better he would work hard and try to repay his kindness. After lingering bout two months the lad died and was given fitting burial in the village graveyard.

THE RESULT OF PATIENCE.

A lady having comfortable home surroundings applied for and received from the Society a little girl about six years of age. After two or three weeks she returned rather discouraged and stated that the child was not so bright or attractive as she desired. Although not fully resolved to give her up she wished to leave her in the Home until she returned from a visit to relatives in the States. The fact was impressed upon her that she was just the one person in the world to draw out all that was best in the child and make a fine girl of her, and that if the child was taken on the proposed trip the change of scene, etc., would brighten her up considerably and probably help to bring about the desired improvement. The result was that the lady took the child with her and before long became much attached to her. Patient and loving training has brought about a wonderful improvement and the girl is to-day in the same home and is one of the most attractive and well-mannered children in the entire district. In fact when the child and foster-mother were travelling on the train recently many of the passengers, although quite ignorant of the circumstances, commented on the nice appearance and ladylike bearing of the girl, comments which, of course, were very gratifying to the foster-mother.

RECLAIMING ONE AT A TIME.

There are many good people and even prominent Christian workers who do not realize any personal responsibility toward neglected or delinquent young people. While visiting a town to interest the public in child-saving effort, I was surprised when calling on the police officials to find a clergyman there asking for the arrest of a young servant of sixteen who had appropriated several small articles belonging to his wife. He evidently had not stopped to think what it all meant to the girl's future life—the arrest, publicity, degradation, and possibly future continuance in wrong-doing to the serious detriment of the community as well as the possible destruction of any good that might remain in the girl. I wondered if any effort had been made to bring the girl under personal religious influence, or to win her over by earnest entreaty to penitence and improvement. People are apt to forget that souls are saved not en masse but as units, and that the restoration of one individual is far more important than a whole series of brilliant sermons.

On another occasion I had an interview with a girl of fourteen whom quite a number of good people were anxious to have committed to a reformatory. She originally belonged to a village where any number of Christian people were pining away for some good work to do, and yet could not see that in the lives of such young people there were issues at stake calling more loudly for service than preaching the Gospel to the heathen, or making some great and heroic sacrifice, because it was the work near at hand that always should have first claim. The girl mentioned that she had been to a certain Sunday School on different occasions and that she thought a great deal of the minister. Here, I thought, is the very influence that can save her, and immediately the clergyman was written to and all the facts explained together with the opportunity that presented itself of materially benefiting a young girl whose home life had never been helpful to her. His reply, received a few days later, was almost brutal in its candor. He was too busy, he stated, to bother with such a matter and there were reformatories established for dealing with girls of her description.

From these and other experiences I am convinced that religion is with some people an outward habit and has very little of that yearning after lost souls that never yet has failed to save and redeem.

HOMELESS CHILDREN NOT NUMEROUS.

Many persons have an erroneous idea as to the number of children who are in need of foster-homes. They get the impression that all they have to do is to come to the city and pick out the most attractive child from a group of 20 or 30 submitted for their inspection. After travelling around six or eight institutions and meeting with the reply at each place that there is only one or two, if indeed any, children ready to go out, they get a different idea concerning this work. Sometimes, too, in writing, the description given of the class of child required is very minute and exacting. For instance, a letter received this morning from a lady in the country states as follows: "I would like to know something about the work for neglected children as I would be willing to adopt a girl about 12 or 13 years old, provided I could get one to please me—one who is healthy, bright, and intellectual and with a mild temper. Her work would be to help in the household and take care of three small children. A legitimate child preferred." It is the small children for whom homes are most desired, and we rejoice exceedingly when some good woman asks for a delicate child whom she can help grow strong and well.

These are the class of children for whom homes are desired. Friends west of Toronto willing to help might communicate direct with Rev. C. R. Miller, Berlin, Ont., or any Children's Aid Society.

And on each helpful spirit be
For this the children's charity
The children's benediction.

DO YOU KNOW ABOUT THIS?

Begging.—Any person sending children begging may be sent to gaol for three months or fined $100.

Liquor-Selling.—Any saloon-keeper who gives or sells liquor to a youth under twenty-one years of age, is liable on conviction to a penalty of $20.

Tobacco.—Any person found guilty by a justice of the peace of giving or selling tobacco to a boy under eighteen years, must be fined $10 and the sum may be increased to $50.

Pool Rooms.—The keeper of a licensed pool or billiard room who allows boys under sixteen years to frequent his premises, may be fined $10 by any justice of the peace, half the fine to go to the informant.

School.—Every child between the ages of eight and fourteen years must attend school, unless excused for some good reason.

Factory.—No child under fourteen years can be employed in any factory.

Indecent Conduct.—Any person found guilty by two justices of the peace of committing any indecent act, may be fined $50 and sent to gaol for six months.

Criminal Assault.—Any person who criminally assaults a girl under fourteen years of age is liable to imprisonment for life.

Pistols.—Any person who sells or gives a pistol or air-gun or sells ammunition therefor, to a boy under sixteen years of age, is liable on conviction to a penalty of $20.

Neglected Children.—Can be removed from the control of vicious or drunken parents if there is no likelihood of improvement.

DESCRIPTION OF A "NEGLECTED" CHILD.

The following definition is taken from the Ontario Act:

"Neglected Child" shall mean a child under sixteen who is found begging, receiving alms, thieving in a public place, sleeping at night in the open air, wandering about at late hours, associating or dwelling with a thief, drunkard or vagrant;

Or a child, who by reason of the neglect, drunkenness or other vice of its parents, is growing up without salutary parental control and education, or in circumstances exposing such child to an idle and dissolute life;

Or who is found in a house of ill-fame, or known to associate with or be in the company of a reputed prostitute;

Or who is a habitual vagrant;

Or an orphan and destitute;

Or deserted by its parents;

Or whose only parent is undergoing imprisonment for crime;

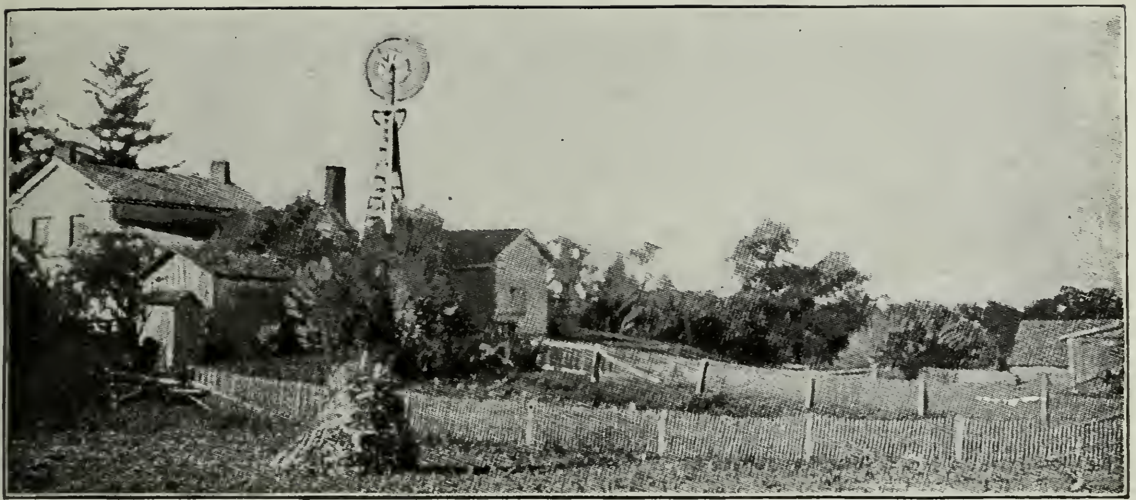
Or who, by reason of ill-treatment, continual personal injury or grave misconduct or habitual intemperance of its parents, or either of them, is in peril of loss of life, health or morality;

Or in respect to whom its parents, or only parent, have, or has been convicted of an offence against this "Act" or under the "Criminal Code";

Or whose home, by reason of neglect, cruelty or depravity, is an unfit place for such a child;

And "Neglected Children" shall mean two or more of such children. Sec. 2.—Children's Protection Act of Ontario.

A personal interview by the agent of the Children's Aid Society, or a warning notice is the first step towards bringing about an improvement, and if parents continue to show indifference, a Judge, Police Magistrate, or where these are not convenient, two Justices of the Peace, can place the child under the guardianship of the Society.



Where memory loves to linger.

THE OLD HOMESTEAD.

Many of our brightest and cleverest public men were born on the farm and spent their early years in the country. This is one reason why we desire to get our homeless boys and girls away from the crowded city institutions to the free and healthy life of the farm. The children in the country enter into all the social activities of the home and are happy in the feeling of companionship and equality. Their help is prized and learning to work they grow strong and self-reliant, able in later life to take their share valiantly in the world's great workshop. If our friends in the country will help the children while they are young they will in turn lend their aid when older. Remember, however, always to treat them justly, for a child's sense of justice is keen and unerring.

PARENTAL RESPONSIBILITY.

The responsibility of parents for the conduct of their children should never be overlooked. Often boys are arrested for wrong-doing and discharged or sentenced without the presence of the parents being required or proper enquiry made as to the contributory negligence of careless fathers. It is a rare case that children brought up in a normal home under reasonable control develop into law-breakers. It is the neglected child that becomes the delinquent, and it is the wrong conditions that should be dealt with rather than the unfortunate victim.

"Wish I had someone to love me."

ADOPTING A BABY.

One of the privileges of child-saving work is to be the medium in placing a tiny, helpless baby in the arms of a large-hearted woman who has been denied the blessing of a real-own baby. These little bits of humanity have a way of twining themselves around the heartstrings that is simply irresistible, and once taken into a home they are rarely ever returned. These are the genuine adoptions that stand the test of petty annoyances and disappointments. Not only do they grow like their foster-parents in character and disposition, but strange to say, even in facial expression. No one can make a mistake in adopting a baby at six months, and they will be amply repaid for their extra work in the long run.

"Oh, when at dawn the children wake
And patter up and down the stairs,
The flowers and leaves a glory take,
The rosy light a splendor shares,
That never more these eyes would see,
If my sweet ones were gone from me.

"And when at eve they watch and wait
To fold me in their arms so white,
My burdens, whether small or great,
Are charmed away by calm delight,
And shutting out the world, I live
The purest moments earth can give."

Stray Thoughts

Not alone reformation but regeneration should be our aim.

A small boy joined his companions one holiday with a sad expression of countenance. "Why don't you smile?" one of them asked. "I'm all dressed up," was his mournful reply. His mother had put on his new suit with the strict injunction not to get it soiled.

Parental neglect is the cause of seventy-five per cent. of juvenile delinquency.

Oh, little feet that such long years
Must wander on through hopes and fears,
Must ache and bleed beneath your load,
  I, nearer to the wayside inn
  Where toil shall cease and rest begin,
Am weary, thinking of your load!

The human soul without education is like marble in a quarry—showing none of its inherent beauties until the skill of the polisher brings out its colors.

A storekeeper went to a great deal of trouble in serving a boy who wanted to buy a jack-knife. When asked why he bothered with the lad, he replied, "I was anxious to give him a good bargain, knowing that if I sent him away well pleased he might deal with me for the rest of his life."

With Life All Before Them.

In looking through the belongings of a noted criminal, a scrap-book was found which was entirely filled with clippings from newspapers describing various crimes that had been committed. The man admitted that he gained a good deal of information for his business in reading over these items.

Instead of always trying to keep children out of temptation, they should be taught to withstand temptation when it presents itself, otherwise those who are at all weak will be sure to fall when left to their own guidance.

There is in every child a spark of the divine that can be kindled into a glowing flame of noble aspiration and heroic activity.

Children must be dealt with individually—they cannot be reformed in bulk.

If only the number of officials it requires to run an institution could be employed to prevent children from needing commitment what a great work could be accomplished!

The superintendent of an industrial school had a number of large boys who were hard to manage. He adopted the expedient of making them assistants at a regular wage and they were transformed at once into useful helpers.

It is the unexpected that influences children. If they are counting on a whipping for some offence, that is the time to treat them with greater kindness and consideration than before. Surprises in this direction are often influential in bringing about an entire change of conduct.

About ten years ago a wretched-looking girl of eleven, delicate and miserably clad, took up her stand on a crowded corner on King Street for several days and begged in a pitiful voice for a little help. A gentleman whose sympathy took a practical turn laid a complaint and as her relatives were shown to be worthless people, she was made a ward of the Society. To-day she is a respectable young woman, earning a comfortable living and grateful for the kindness that rescued her from a vagrant and destitute life.

Florence was a little orphan girl, seven years of age, who had been carefully trained in her religious duties. One custom frequently impressed on her was that she should always cover her eyes with her hands at meal times and keep them covered until grace was said. After a time she was adopted in a home where grace was only repeated when there was company. The little girl duly covered her eyes and could not be induced to open them until a blessing had been asked. This she continued to do until the family decided that to show proper respect for the child's feelings they would ask a blessing regularly instead of occasionally.

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Ontario Department of Agriculture

ONTARIO AGRICULTURAL COLLEGE

THE CODLING MOTH

(*Carpocapsa pomonella*, Linn.)

BY L. CAESAR.

SUMMARY.

The Codling Moth is the most destructive apple and pear insect pest in Ontario, and causes an annual loss of about $2,000,000.

It passes the winter as a larva (worm) in a cocoon in any good hiding place, such as under the loose bark on trees. In May, as a rule, these larvæ begin to transform into pupæ, and soon after the apple blossoms have fallen the moths begin to emerge, and continue to do so until about July 20. The eggs laid by these are placed chiefly on the leaves, and require on an average 9 or 10 days to hatch. Usually it is about 3 weeks after the blossoms fall before the earliest eggs have hatched.

On hatching the young larvæ seek an easy place to enter the apple. This the calyx furnishes, and 75 per cent. or more of these first brood larvæ enter the fruit by this part.

An average of about 25 or 26 days is spent by the larvæ in the fruit. Most of the wormy fruit falls before the larvæ emerge.

All larvæ, after emerging, make cocoons in hidden places. Most of them remain here unchanged till next year, but some of the earliest to emerge transform to pupæ and then to moths and produce a second brood. In the colder parts of the Province, such as Ottawa, only a very rare larva or even none transforms; in districts with a climate like Guelph, Collingwood and Whitby, from 2 per cent. to possibly 8 per cent. do so; in the warmer districts like Niagara a much larger percentage transforms and produces a second brood of larvæ.

First brood larvæ have all, as a rule, entered the fruit by August 1, and the second brood begin to enter about a week or ten days later, and continue to do so up into September, so that larvæ of this brood will

be found in the fruit until the end of the season. About 50 per cent. of the second brood enters by the calyx end.

The Codling Moth can be successfully controlled in any part of Ontario by spraying. One thorough application immediately after the blossoms fall is quite sufficient for any part of the Province, except Niagara and other districts of about the same temperature. In these districts a second application three weeks after the blossoms fall should be given.

The only successful way to combat the second brood is to destroy such a large percentage of the first that not enough will be left to produce more than a very small second brood. This can be done whether the neighboring orchard is sprayed or not.

In spraying, use as good an outfit as you can afford, build a tower on the wagon for tall trees, place an elbow of 45 degrees angle between the nozzle and the spray rod, use rather coarse disc nozzles of the Friend type, hold the nozzles about 2 feet from the calyx and spray directly into it with as high pressure as your machine will give up to 150 or 200 lbs., and never less than 100 lbs. Do not leave the tree till every calyx is thoroughly drenched.

Trees with no fruit may be neglected until the others are done, and then may be given a light spray.

Large trees with much fruit will require from 8 to 15 gals. of mixture each; smaller trees 20 to 30 years old require from 4 to 8 gals.

This application immediately after the blossoms fall is far the most important one. It must be completed before the calyces close, which usually takes place in about a week after the blossoms drop. Do not wait for every blossom to fall, but start to spray when about 90 per cent. of the bloom is off. If the calyx is well sprayed while it is open, when it closes the poison will remain inside all summer and kill any worms entering there.

The best spray mixture to use is 2 lbs. of arsenate of lead to 40 gals. of Bordeaux mixture, or dilute commercial lime-sulphur. The Bordeaux or lime-sulphur is added to control the scab fungus, as this is the most important time to spray for this disease. The Bordeaux need not be stronger than the 3.3.40 formula, and the lime-sulphur may be diluted 1 gal. to 40 gals.

Paris green or arsenite of lime may be used with Bordeaux mixture instead of arsenate of lead, but with lime-sulphur arsenate of lead is the only arsenical poison that is safe.

Do not be too economical with the mixture. Look after the spraying yourself or trust it only to very reliable helpers. Spray thoroughly as directed, and you will get from 75 to 95 per cent. of clean apples the first year and a higher percentage the next.

Spraying alone will give clean fruit and much more of it, but it will not make the fruit large. To secure this the trees must be pruned, the soil well cultivated in the early part of the season, a liberal amount of fertilizer used and sometimes heavily laden trees thinned.

THE CODLING MOTH.

(*Carpocapsa pomonella,* Linn.)

The Codling Moth—the insect which causes nearly all of our wormy apples—is the most destructive insect pest that attacks apples and pears in our Province. There is very little doubt that in most districts this insect does more injury to these fruits than all other insects combined. It is clear, therefore, that apple growers should be well informed about its history and habits and the most up-to-date methods of control.

Accordingly, the object of this bulletin is to set forth these points clearly and simply. All the time that the writer could spare from his other duties during the last two years has been devoted to studying the life-history of the insect, and to spraying orchards for its control. In this work he was much assisted in the season of 1910 by Mr. W. A. Ross, a fourth year student in Entomology at the O.A.C., Guelph. Several

Fig. 1. Adult Coddling Moths, natural size. (After Slingerland.)

points of considerable interest have not been so well investigated as we could wish, and the study of these will be continued.

Wherever our own study of any particular point in the life-history or habits of the insect has not been sufficiently extensive we have consulted the excellent bulletins on this insect by United States Entomologists. The chief writers thus consulted are Slingerland, Simpson, Sanderson, Jenne, Hammar and Quaintance.

Place of Origin and Extent of Spread of the Codling Moth.

References to the Codling Moth in the writings of the ancient Romans indicate that it was a trouble to fruit-growers more than two thousand years ago. Its original home is not definitely known, but is believed by good authorities to have been in South-Western Europe, where the apple originated. From here the insect has spread so widely that it is found to-day in almost every country where apples are grown. Here and there, as for instance in some valleys in British Columbia, it is still unknown; but there is no doubt that in a few years it will reach even these isolated districts. Entomologists report its presence to-day in almost all parts of Europe, North America, Australia, and New Zealand, and in at least some sections of Asia, Africa, and South America.

Means of Distribution.

The full grown insect, as the name indicates, is a moth and, therefore, can spread from orchard to orchard by flying, and yet it is certain that this method of distribution is slow and does not account for its spread from one district or country to another situated far away, or for its crossing the ocean. A little thought and observation will show that the chief means of distribution is by the shipping of wormy fruit from place to place. Everyone knows that where apples or pears are picked and placed in boxes or barrels for shipping there will be some of the fruit, especially in the poorer grades, that will contain worms. These will be carried wherever the fruit goes, and before it is consumed at least some of the worms will have matured, come out of the apples and spun their cocoons either in the barrels or in some other place nearby. Later on they will emerge as moths, which will lay eggs and start a new colony in the district. It was doubtless in this manner that the Codling Moth came to America from Europe.

How long it has been in Ontario.

In reading up the records of the Codling Moth in Ontario the earliest reference to it I have found is by Rev. C. J. S. Bethune in the first Report of the Entomological Society of Ontario. In this report Dr. Bethune says: "In 1868 the apple crop throughout the Province was very materially diminished by the depredations of this little worm; in some parts of the country fully one-half of the fruit was either completely destroyed or rendered unmarketable. Last year and this year, however, we are thankful to say its ravages have been very considerably diminished."

In the second Report of the same Society under the heading "Addenda to the Report of 1870," Dr. Bethune adds: "The ravages of this horrid creature, which burrows through the fruit and is often found, to the great disgust of the eater, at the core of the apple that he was enjoying, appears to be on the increase in this Province. A few years ago its depredations were very serious; indeed, so much so that at least a third of the yield of the apples was rendered unfit for market."

In the Report of the Society for 1877 Charles Arnold of Paris, Ont., stated that he had scarcely a worm-free apple in his orchard, and attributed this to the smallness of the crop that year—the smaller the crop, the greater the percentage of wormy fruit.

These references show that not only was the Codling Moth in Ontario as early as the year 1868, but that it was almost as abundant then as to-day. From this we must infer that the insect was introduced into the Province many years before that date, otherwise it could not have been nearly so widely distributed and numerous.

Turning to the records of the insect in the United States, Simpson says that in 1819 Burrell reared the first moths from wormy apples, but that it had been present for years before this, though its work had always been mistaken for that of the Plum Curculio. Slingerland says that wormy apples and pears were common around Boston in 1819. He thinks the possible date of the Codling Moth's introduction into America was about 1750—more than 150 years ago. We see, therefore, that this is not a pest of recent introduction into America, but one of the oldest that our fruit-growers have had to combat.

Kinds of Fruit Attacked.

Apples are the favorite fruit, but pears are also severely attacked. In addition to these the insect is frequently found in haws and occasionally in plums, cherries and peaches. A recent bulletin by the Bureau of Entomology, Washington, D.C., shows that in some localities and under favorable circumstances certain varieties of nuts may also be attacked. Very little damage, however, is done to anything but apples and pears.

Amount of Injury Caused.

In trying to estimate the amount of injury caused on an average each year by the Codling Moth we must not forget that it is not enough merely to take account of the percentage of wormy fruit at the time of picking, because throughout the season from about the middle of July up to the time when the last barrel is picked there is a continual dropping of wormy apples. Those that drop early have rotted and disintegrated long before the rest are ready for market. The amount of infestation varies in the different parts of the Province. This is chiefly because in the warmer parts, such as the Niagara district, there is a much larger percentage of second brood worms than in the rest of the Province. In the Niagara district it is not difficult to find unsprayed apple orchards in which 90 per cent. of the fruit has been attacked. In a district like Guelph from 40 to 50 per cent. of the unsprayed fruit is wormy, and this percentage will hold for a good many parts of the Province. Further east from about Newcastle to Ottawa the average seems to be about 25 per cent. For the Province as a whole one is probably underestimating the amount of the average yearly injury when he puts it at 45 per cent. of the total crop of apples and 25 per cent. of the pears. In years when the crop is light this percentage will be increased, and again when there is an abundant crop it will be diminished.

In estimating what this loss amounts to in dollars we should deduct a small percentage to make allowance for the number of wormy apples consumed at home in one way or another by the growers or sold for a small sum to the evaporators or to those who cannot afford to purchase good apples. If 5 per cent. be allowed for this we still have 40 per cent. of a dead loss. This means that instead of having about 3,000,000 barrels of No. 1 and No. 2 apples on the average to sell each year the fruit growers would, if it were not for the Codling Moth, have 5,000,000. At the very low price of $1.00 per barrel this would mean an extra sum of $2,000,000 a year. This does not take into consideration the extra amount that would come from pears, which would increase the total considerably.

Fig. 2. Eggs, natural size.

It is clear that the pest causes a great loss also in another way; namely, by the amount of discouragement it has given fruit growers, and therefore the influence it has exerted in preventing the setting out of more apple orchards and the greater development of this very profitable industry.

Life History of the Codling Moth.

In order to make what follows clearer, we shall mention here that the Codling Moth, in the course of its life-history, passes through four different stages. There is first the Moth itself, or adult (Fig. 1), which lays the eggs (Fig. 2). These eggs hatch into tiny worms, or as we should more correctly call them larvæ (Fig. 3), which do the damage to the fruit. When full grown they come out and make little cocoons in sheltered places, and after a time each changes in its cocoon into a brown cigar-shaped creature, called a pupa (Fig. 4).

In what follows we shall not discuss these stages in the order given above, but will start with the stage in which the winter is passed, and then proceed to the other stages in their proper order.

Fig. 3. Full grown larva, about natural size. The dark spots on the body should not be so conspicuous. (Reduced from Simpson.)

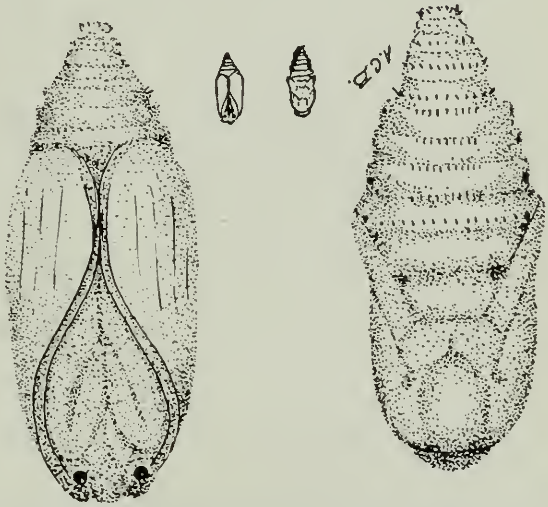

Fig. 4. Dorsal and ventral views of pupae very much enlarged and natural size.

How and Where the Winter is Passed.

If at any time in the winter we were to search beneath the rough bark on the trunks and larger branches of old apple trees, we should find here and there a larva or worm snugly tucked away in a cosy little nest known as a cocoon (Fig. 5). If one of these larvæ is removed from its cocoon and brought into a warm place it will soon begin to move about and leave no doubt in your mind that it is the same creature that causes the wormy apples. Nearly all Codling Moths winter in this manner, but a few of the immature larvæ are still in the fruit when it is picked late in the season and, if it is kept in a cold place, they remain in it over winter.

Where the Cocoons are Placed. Not all the cocoons are to be found under the rough bark, for we often find them in other places. The following are the places in which the writer has found them:

1. Under the rough bark on apple trees.
2. In holes or crevices on apple and other trees near wormy fruit.
3. In clusters of dead leaves under the trees and close to the trunk.
4. In hollows or openings in bones lying on the ground.

5. In a good sheltering crevice in a stone.

6. In apples on the ground that had been attacked by a dry rot, such as the Black Rot (*Sphæropsis malorum,* Pk.).

7. Under old sacks or coarse garments of any kind on or near the trees.

8. In boxes or barrels or similar things near wormy fruit.

9. In cracks or crevices in fruit-sheds or store-rooms where apples have been kept.

10. In similar places to No. 9, both inside and outside of evaporators or jam or cider factories where apples are used. Thousands may often be found around such factories.

Fig. 5. Unopened and opened cocoons on underside of loose bark. In each of the two opened cocoons a larva can be seen.

Fig. 6. Pupa in cocoon on underside of a loose piece of bark. (After Simpson.)

In short, one may say that the larvæ will spin their cocoons wherever they find comfortable hiding places. They do not, however, so far as we have observed, make them in contact with the damp earth, nor have we found them at the roots of grass or under clods, though some state they are occasionally constructed in such places.

The cocoons are usually some distance from each other, but we have found as many as 40 closely crowded together under one small piece of loose bark on an apple tree.

How the Cocoon is Made. The cocoon, as mentioned above, is the little nest or resting place where the larva remains after it has ceased feeding, and where it transforms sooner or later into the pupa. It is composed of silken whitish threads woven together into the desirable form by the larva itself. The silk comes from glands in the larva's body. When ready to make a cocoon the larva sends this silk out through a little spinneret situated just beneath its mouth parts. When the substance issues it is a liquid, but at once on exposure to the air it becomes a solid thread. The power to make at any time a silken thread is used by the larvæ for several other purposes besides the construction of its cocoon; for instance, by means of this it can let itself down from the tree to the ground, or it can make a little covering over the entrance hole when beginning to feed. In making the cocoon sometimes the crevice or place chosen is too cramped for comfort, and in such a case the larva has to use its jaws to enlarge the opening sufficiently.

Changes that Take Place in Spring.

Migration of Larvæ. Though nearly all of the over-wintering larvæ remain in their cocoons until they transform to pupæ and then to moths, a few, possibly because they find their cocoons too much exposed to the sun's rays, desert them and migrate to other places where they make fresh cocoons. This spring on one tree with a tanglefoot band around it 3 larvæ were found caught in the tanglefoot on April 4th, and 3 more on May 23rd and 24th. Previous to each date there was a period of very warm weather. A correspondent who had put fresh bands on trees this spring reported finding more than 50 such migrating larvæ under them.

Pupation. As the weather grows warmer in spring all the living larvæ, whether they have migrated or not, gradually change to the pupal stage, but do not all do so at the same time. In examining bands on apple trees in the early part of the season it was found that the earliest pupæ were regularly found on the south or south-west side of the tree. It is well known that larvæ in storehouses, where it is dark and cool, pupate much later than those outside, where the light and heat can reach them.

These facts show that, as a rule, those that receive the most heat and sunlight pupate first, though there may be a difference of a few days between individuals under the very same external conditions.

The following table shows the date of pupation of 42 larvæ that had wintered under bands:

Table I.—Showing Date of Pupation, Length of Pupal Stage and Date of Emergence of Moths in Spring of 1910.

Individual.	Date of Pupation.	Date of Emergence of Moth.	Number of days in pupal state.
*1	April 22	May 29	37 or more.
*2	“ 22	June 6	45 “ “
*3	“ 22	“ 17	56 “ “
*4	“ 22	“ 18	57 “ “
5	May 8	“ 15	38
6	“ 11	“ 25	45
7	“ 21	“ 21	31
8	“ 26	“ 23	28
9	“ 27	“ 22	26
10	“ 29	“ 23	25
11	“ 29	“ 23	25
12	“ 29	“ 25	27
13	“ 29	“ 25	27
14	“ 29	“ 27	29
15	“ 31	“ 21	21
16	“ 31	“ 22	22
17	“ 31	“ 25	25
18	June 1	“ 25	24
19	“ 1	“ 25	24
20	“ 4	“ 24	20
21	“ 4	“ 27	23
22	“ 5	“ 27	22
23	“ 7	“ 27	20
24	“ 7	“ 27	20
25	“ 8	“ 25	17
26	“ 9	“ 27	18
27	“ 9	“ 25	16
28	“ 10	“ 27	17
29	“ 10	“ 29	19
30	“ 13	“ 28	15
31	“ 13	“ 29	16
32	“ 13	“ 29	16
33	“ 14	“ 28	14
34	“ 18	July 5	17
35	“ 19	“ 6	17
36	“ 19	“ 7	18
37	“ 21	“ 8	17
38	“ 23	“ 12	19
39	“ 24	“ 9	15
40	“ 24	“ 10	16
41	July 2	“ 18	16
42	“ 3	“ 22	19

* These four were in pupal state when found (Niagara district).

This table shows that pupation took place in the spring of 1910 at least as early as April 22nd, and continued as late as to July 3rd, and possibly later—a period of more than two months. This was an abnormally warm spring in the early part and very cold later on. The warm weather of the early part hastened the transformation into pupæ. In a normal spring we believe the change would not take place until some time in May. In this connection it is interesting to note that while four pupæ were found at Stoney Creek on April 22, an examination of several bands on trees in an adjoining orchard on May 6 revealed only 9 pupæ, and a further examination in still another orchard nearby on May 13 showed only 4 pupæ. This would suggest that owing to the cold spell of weather in the latter part of April and early in May very few or almost no further transformations into pupæ had taken place from April 22 to May 13. The proportion of larvæ that had transformed up to May 13th was about 5 per cent.

The table also shows that the insect may remain a very long period in the pupal state—the longest period observed being 56 days. As the season advances and the weather becomes warmer, this period rapidly decreases until after the 7th of June the average becomes about 17 days. The shortest time was 14 days. These rearing experiments, except for a few at first in the greenhouse, were conducted in glass vials out-of-doors under the shade of a tree closely approximating to natural conditions of temperature.

Time of Emergence of the Spring Brood of Moths.

It is thought by many persons that the spring brood of Codling Moth adults must all emerge about the time the blossoms are out, and that they lay their eggs in the calyx end shortly after the blossoms fall. Both of these ideas are quite erroneous; for, as will soon be shown, only a rare moth any season emerges before the blossoms fall, and almost no eggs are laid until after the calyces have closed.

The Earliest Moths. In the spring of 1909 the first moth we reared in out-door cages emerged on June 12th and the last on July 25th. In 1910, as Table No. 1 above shows, the first moth emerged on May 29th, the second June 6th, and the last on July 22nd. In order to check our rearing records by a study of the conditions in the orchard we searched carefully for eggs on the leaves. The earliest found in 1910 was one at Guelph on June 15th. This one, as shown by the absence of the red ring, had not been laid more than three days, and the moth that laid it had probably emerged about June 9th or 10th. At Stoney Creek, in the Niagara district, several hours were spent on June 18th searching for eggs in two orchards notorious for the number of wormy apples each year. Only 12 eggs were found in all, and most of these on one tree. Out of the 12 only 4 had been laid more than three days, the rest not having the red ring. These four hatched by June 23rd, and had probably been laid about June 13th. The moths would therefore have emerged a few days earlier, probably about June 9th or 10th. In 1909 the first eggs found were June 21st, but as three or four freshly hatched larvæ were found on June 25th, it is clear that the eggs must have been laid by June 15th, or possibly a day or two earlier, and the moths have emerged by June 10th at latest. Thus our rearing experiments and orchard observations both indicate that it is a rare moth indeed that emerges before the end of the first week in June. By this time the blossoms in an average year in most parts of the Province are all off and the first spraying is well under way or in some districts completed.

The State of New Hampshire corresponds pretty closely in climatic conditions with Ontario, so that it is interesting to find that Sanderson gives June 9th, 13th and 6th as the respective dates for the emergence of the first moths in the years 1906, 1907, and 1908. These dates correspond very closely with those given above. Hammar gives June 17th for the earliest moth in Northern Pennsylvania in 1907, May 25th in 1908, and June 12th in 1909. (The spring of 1908 in Pennsylvania was unusually early, and the apple trees were out in bloom as early as May 15th.)

The Latest Moths. As mentioned above the latest moth reared in the spring of 1909 emerged July 25, and in 1910 on July 22. When these dates are compared with the earliest dates they show that the moths continue to emerge in spring during a period of about a month and a half. This means the eggs from this brood will continue to be laid, hatch out and the larvæ to enter the fruit for about the same length of time—a very different state of affairs from what is ordinarily supposed to exist.

When the Majority of Moths Emerge. Out of a total of 63 moths of which the date of emergence was kept during the spring of 1910, 35—more than half—emerged between June 20 and 25. This was three weeks or more after the blossoms had fallen. Sanderson gives the date for the majority in New Hampshire in 1906 as about June 14; in 1907, July 2; in 1908, June 20. Hammar gives for Northern Pennsylvania in 1907 about June 24; in 1908, June 10; in 1909, June 25. The average of all these dates is about June 21.

What the Moth Looks Like.

Very few fruit growers have ever seen the moths themselves. Those who wish to rear them can very easily do so if they will put a band of burlap around the trunk of an unsprayed apple tree that is laden with fruit. The band should be put on any time early in July and examined about the end of the first week in August, when both larvæ and pupæ will be found underneath it. If the pupæ are taken out without injuring them, put into a glass tumbler in some dry, shady place, and kept covered with cheesecloth to prevent escape, the moths will appear in a few days.

The average adult (as shown in Fig. 1) has an expanse of wing of about three-quarters of an inch. The general color of the front wings is dark gray and of the hind wings light brown. Out near the tip of each front wing, as the photograph shows, there is a well marked brown patch which shows golden when the light falls on it. The presence of this patch is the easiest way to distinguish this moth from many others about the same size and color. The male moths are usually somewhat smaller than the females, and can be distinguished from them by a number of long black hairs situated close together on the upper surface of the hind wing, and by an elongated patch of black scales near the middle of the under side of the front wings. The tip of the abdomen of the two sexes also differs. The majority of moths seem to be males.

Habits of the Moths.

During the day the moths are very seldom seen as they are resting quietly on the leaves, fruit or bark, resembling the latter so much in color that it takes well trained eyes to detect them. Towards evening they begin to fly around and lay their eggs. Many have claimed that they could be trapped by lights and destroyed. We have asked such persons to send us specimens of the moths thus captured, and in every case they have turned out not to be Codling Moths at all, but other small species of about the same size. Professor Slingerland and others have proven that the moths are seldom attracted to lights. The writer has only twice seen a Codling Moth come into a lighted room.

It has been proven that the moths will drink water and are fond of sweet liquid substances. How much they feed in this or any other way does not seem to have been well studied.

How Long the Moths Live.

It is difficult to determine the average length of life of the moths. In our experiments several moths, both of the spring and later brood, lived for 10 days, but most of them died in 3 or 4 days. As only a very few could be got to lay eggs in cages, while most of the free females in an orchard may be expected to do so, it seems clear that the moths did not find their surroundings congenial. A few experimenters have had individual moths live as long as 20 or 25 days. It would seem probable, therefore, that the average length might be 9 or 10 days. Jenne gives the average for the spring brood as about 10 days, and Hammar as 11 days, with about 9¾ days for the males of the later brood and nearly 11½ days for the females.

The Egg.

Its Appearance. The egg, as shown in Fig 2, is nearly circular and small, being less in diameter than the head of a pin. It is almost flat, is transparent, pearly white or yellowish white in color, and looks like a tiny drop of tallow or of milk. Often it is spoken of as resembling a fish scale glued to the surface on which it is laid. It is always much easier seen when the light is shining on it.

Where Laid. The eggs are laid both on the upper and lower surfaces of the leaves, on the fruit and on the twigs. Usually only one is found on each leaf or fruit, though it is not at all uncommon to find two or more. We have made careful estimate for two seasons of the percentage of the first brood eggs laid on the leaves, fruit and twigs respectively, and find it to be approximately 80 per cent on the leaves, only a small proportion of these being on the under surface, and the rest on the upper surface; 18 per cent. on the fruit and 2 per cent. on the twigs. Most entomologists give a higher percentage on the leaves and lower on the fruit. To the second brood eggs we have not given sufficient attention to be able to state what difference there would be from the above proportions. Simpson states that where there are plenty of apples on the tree, 50 per cent. of the second brood eggs are laid on the fruit.

When eggs are laid on the leaves these are usually situated within a few inches of the fruit, though many eggs are laid at some distance from it. We have sometimes found them 6 or more feet away from the nearest apple.

There is some doubt about how many eggs are laid on trees that have no fruit when these are situated near trees with fruit. We have frequently examined such trees and have so far found only two eggs. We, therefore, believe that very few eggs are laid on fruitless trees in Ontario. On the contrary Sanderson seems to imply that the moths readily lay upon them in New Hampshire.

Duration of the Egg Laying Period of the Spring Brood of Moths. From what has been said about the length of time during which the first brood of moths continues to emerge we can easily see that freshly laid eggs will be found in the orchard from about June 12 to the end of July. Moreover, just as we have seen that most of the moths of this brood emerge about the end of the third week in June, so we should expect that most of the eggs would be laid a few days later or by July 1st, for the moths begin to lay from 2 to 4 days after they emerge.

Average Number of Eggs Laid by a Female. No definite information can be given on this point. In our cages no moth laid more than 36 eggs, whereas Sanderson in larger cages obtained as high as 136 eggs from one moth, though this was almost twice the number he obtained from any other. He thinks the average should be placed at least as high as 60.

Length of Time Required for Incubation. This depends very largely upon the temperature, as the warmer the weather the shorter the time required, as a rule. In the early, and again in the later part of the season, the average length of time seems to be about 10 days, and in the warmest weeks about 7. We have had eggs hatch early in August in 5 days.

CHANGES THAT TAKE PLACE DURING INCUBATION. In two or three days after the eggs have been laid a little red ring appears in them. This can be seen by the naked eye, and is caused by the developing embryo inside. Eggs with this ring are unquestionably fertile. A few days before the eggs hatch this red ring has disappeared, and by examining carefully one can see the young larva within, a black spot indicating the head. After the larva has broken through and escaped the empty shell will often remain for weeks on the leaf or fruit, and is usually easier to see than a freshly laid egg.

THE LARVA.

APPEARANCE. When newly hatched the larva is a tiny whitish caterpillar not more than one-sixteenth of an inch in length, with a black shiny head, and a dark area on the collar (cervical shield) and another just above the tip of the abdomen (anal shield). Scattered over the body are a number of little tubercles that in some specimens are much darker in color than in others, and therefore more conspicuous. By the time the larva is full grown it is about three-quarters of an inch in length and most of them are pinkish or flesh color, while the rest are whitish or cream-colored. Some time before this the head has changed to a glossy brown and the dark area over the collar and above the tip of the abdomen has also become brown. The tubercles are now much less distinct, being of a light brownish color.

It is important that this difference in appearance between the earlier and later stages of the larvæ should be known by fruit growers; because some of them, having become familiar with the brown head and brown cervical and anal shields of the later stage, and then having noticed that many of the side-entering worms in late summer and in autumn had these parts colored black instead of brown are wont to come to the conclusion that these are the larvæ of some new pest equally as destructive as the Codling Moth and not controlled by the ordinary sprayings.

HABITS OF THE YOUNG LARVA. Soon after it has hatched, the young larva, if the egg is laid on the fruit, seeks for an easy place to enter. If it finds any wound or scar it will readily enter by it. Not infrequently it enters where two apples touch or where a leaf is in contact with the fruit. We also find a number entering through the uninjured surface of the side and very occasionally of the stem end. The great majority, however, enter by the blossom end of calyx, as we shall henceforth call it. The little leaflets here give an excellent footing and make entrance easy. After it has worked its way in it feeds for a few days inside the calyx cavity (Fig. 8), and then proceeds to eat a passage to the core, where it seems to delight in the seeds. For some time after its entering at the calyx it is not possible to tell whether the larva is in the fruit or not unless we cut through this part, for no castings are visible. After a few days, however, it proceeds to enlarge the entrance hole and throw out the castings, thus clearly revealing its presence in the apple. (Fig. 7.)

When the eggs are laid on leaves near the apples, the larvæ, evidently by instinct, make for the fruit, in some cases feeding a little upon the leaves before they reach it. If the eggs are situated at a considerable distance from any fruit it seems evident that most of the larvæ that hatch must perish, for, though we have reared larvæ for three

Fig. 7. Castings at calyx end, showing clearly where larva entered the apple.

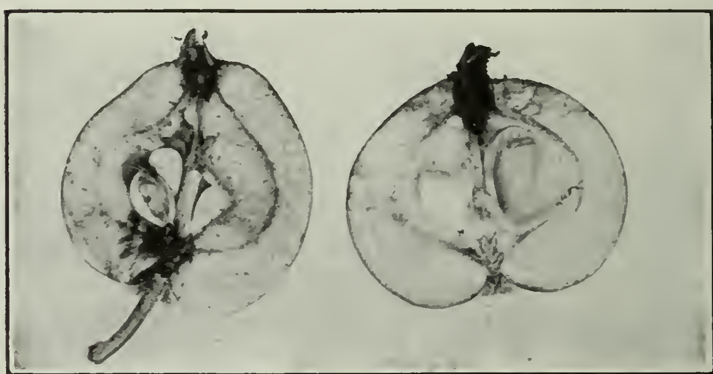

Fig. 8. Apple cut through the calyx, the dark area showing where the larva usually feeds for a few days before proceeding to the core.

weeks on leaves and twigs in cages, and believe that with extra care we could have brought them through to maturity, we have searched in vain for proof that they feed for any appreciable length of time in this way on the trees.

PERCENTAGE OF LARVÆ OF THE FIRST BROOD THAT ENTER BY THE CALYX. It is necessary in determining this point accurately to cut doubtful apples through the calyx and examine with a hand lens to see whether there are any traces of the larvæ within. This should be done towards the end of July, when nearly all the larvæ will have entered the fruit. We have made many counts in this way and found that the average was a little more than 75 per cent. Slingerland places it at about the same figure, Simpson at 81, Petit at 70, Ball at 60, Sanderson at 66, and Quaintance from about 76 to over 80. Pears in our observations were found to have an even higher percentage of calyx entrance than apples, our counts for both 1909 and 1910 showing 90 per cent. entering at this part.

Quite frequently in badly infested orchards one finds apples that have been attacked by several larvæ. We should naturally expect a high percentage of calyces under such circumstances to have been entered. Not nearly sufficient observations have been made to determine what the facts are, but at Stoney Creek on August 17th 100 wormy apples were picked at random from the ground. Most of these apples had been entered by two or more worms. On close examination it was found that 98 out of the 100 had been entered by the calyx.

Length of Time Passed by the Larva in the Fruit. Our average for July and August would indicate that the usual time thus spent is about 26 days. Later in the season in September and October, unless the weather is warm, larvæ will sometimes spend 50 days or more in the fruit. Unfortunately we failed to observe a sufficient number of larvæ from the time of hatching to the time of leaving the fruit to make sure that our average of 26 days was correct. It is interesting, therefore, to compare it with those of other writers. Jenne gives about 24 days for the first brood larvæ in Missouri, and about 24½ days for second brood. Hammar gives 26 days for the first brood in Northern Pennsylvania and 40 days for second brood. Sanderson gives from about 25 to 30 days for the first brood in New Hampshire.

Manner of Leaving the Fruit. When a larva is almost ready to leave the fruit it makes a passage to the outside of the apple, but does not at once emerge; instead, it continues to feed for a short time and then when it has reached the proper stage comes out and at once seeks for a suitable place to make its cocoon. In many cases the exit hole is situated in a different part of the fruit from the entrance. Therefore, the presence of two worm holes in an apple does not necessarily indicate that two larvæ have entered it, but may merely mean that one is the entrance and the other the exit. Not unfrequently, however, the larva does leave by the same hole as it entered by. In such cases it usually makes its way to it by a new passage and avoids working back by the old one.

Proportion of the Larvæ Leaving the Fruit Before and After it Falls.

The greater number of the larvæ remains in the fruit until it falls to the ground, but they do not all do so; a few, but only a few, come out while the apples or pears are still on the trees and let themselves down to the ground by a silken thread; nearly all, however, of those that emerge before the fruit drops work their way down the twigs and branches towards the trunk in search of good hiding places in which to make their cocoons. To find out what proportion emerged before the fruit fell two trees on clean ground that afforded no hiding places were scraped and banded with two bands of burlap about 20 inches apart and with a band of tanglefoot between. As the larvæ could not work their way over the tanglefoot all those under the upper band must have left the fruit before it fell, while those under the lower must have all left it after it had fallen with the exception of the few that lowered themselves to the ground by a silken thread. From July 26th to September 11th, a total of 621 larvæ were collected from the bands. Of these 566 were under the lower bands and 55 under the upper. This shows that in the case of these two trees ten times as many larvæ had come up from the ground as had come down the tree. Next year, 1910, we repeated the test on a large Snow apple tree, but as the ground was not so clean and the bark was so rough that scraping did not remove all the hiding places, the test was not so good as the previous year. The total number obtained from August 4th to September 1st was 155, and of these 121 were under the lower band and 34 under the upper, showing that probably four times as many larvæ on this tree had left the fruit after it fell as before. Apparently this high proportion of larvæ leaving the fruit after it falls does not always hold true, because we have seen the reports of tests by other persons in which the percentage of those leaving before and after was given as almost equal. It seems clear, however, that at least 50 per cent., and often a very much higher percentage, are still in the fruit when it drops. This matter is of considerable importance, as we shall see later when we come to consider means of controlling the Codling Moth.

When the Earliest Larvæ Leave the Fruit. Bands were put on three trees at Guelph on July 9th in 1910, and by July 11th 4 larvæ were found beneath them. From this time on fresh larvæ were obtained under these bands daily, a total of 47 being collected by the end of July. In the Niagara district Mr. Peart of Burlington found one larva under a band on July 10, and on July 12th the writer found 20 larvæ and 3 pupæ under two bands at Stoney Creek. (The pupæ were all under the one band.)

In 1909, on July 15th, there was an average of 2 larvæ under bands in the Niagara district, and among them 2 pupæ. At Guelph that year the bands were not put on the trees until July 24th, but up to July 30th only 3 larvæ were found beneath them, the first being July 26th.

The above statements show that at Guelph the earliest larva leaves the fruit somewhere between July 10th and 26th. In Niagara district the date is somewhat earlier, and probably ranges from July 4th to July 10th. If we compare these dates with the date of the emergence of the last of the spring brood moths we find that the larvæ coming from the first eggs laid by the first of the spring brood of moths are full grown, and in a few cases have left the fruit before the last of this same brood of moths from the over-wintering larvæ have emerged and laid their eggs; for as shown by Table I. the last moth did not emerge until about July 22nd.

WHAT BECOMES OF THE FIRST BROOD LARVÆ.

By the first brood larvæ we mean all the larvæ that at any time during the season hatch from eggs laid by moths that come from the pupæ of overwintering larvæ. Such moths for convenience may be called the spring brood of moths. These larvæ, as we have already said, begin to emerge at Guelph in some years as early as about July 10th and in other more backward seasons not until about July 26th, whereas in the warmer parts of the Province, like Niagara district, they begin to emerge from about July 4th to July 10th. As we should expect from a study of the dates of emergence of the moths themselves, as shown in Table I., the larvæ will continue to emerge up to September 1st or even later. Our band rcords for 1909 and 1910 at Guelph show that the largest number of larvæ emerge between August 21st and 31st, twice as many having left the fruit in this period as in any other period of equal length.

All the larvæ, on emerging, at once seek for a convenient place to make their cocoon. Once this is made the great majority of them, at least at Guelph, remain here quietly without any further feeding or change until next spring; the earliest ones, however, act very differently, for after remaining a week or so as larvæ in the cocoon they change into pupæ and then in about two weeks more transform into moths and lay eggs for a second brood of larvæ.

WHEN THE EARLIEST OF THE NEW BROOD OF MOTHS EMERGE.

In 1909 the first moths reared from first brood larvæ and pupæ brought from Niagara district on July 15th emerged on August 2nd. In 1910 from three pupæ and several larvæ brought from the same district on July 12th the first moth emerged July 29th and the second August 1st. The first empty pupal case found under bands on trees at the Experimental Farm, Jordan Harbor, was July 30th. We thus see that August 1st is approximately the date of the earliest emergence of the new brood of moths in the Niagara district.

For Guelph we have not obtained the earliest date for 1909, but in 1910, as the following table will show, the earliest moth appeared August 5th and the second on August 6th. This is just one week later than the earliest from Niagara.

A search for eggs of the second brood at Stoney Creek on August 4th, 1910, resulted in finding only 3, all of which had been recently laid and had not yet got the red ring. This would, therefore, show that our rearing dates agreed with conditions in the orchard.

It is interesting to note that at this date, August 4th, all the first brood eggs had apparently hatched and the last larvæ had entered the fruit. About a week later eggs of the second brood would begin to hatch.

TABLE II.—SHOWING THE DATES AT GUELPH OF EMERGENCE OF THE FIRST BROOD LARVÆ FROM THE FRUIT, OF PUPATION, AND OF EMERGENCE OF MOTHS; ALSO THE NUMBER OF DAYS PASSED IN THE COCOON, FIRST AS LARVÆ AND THEN AS PUPÆ, AND THE TOTAL TIME IN THE COCOON.

Larva left apple.	Pupated	Moth emerged	Days as larva in cocoon	Days as pupa	Total number days in cocoon
July 12......	July 22......	Aug. 5 ..	10	14	24
" 12......	" 20......	" 6 ..	8	17	25
" 13......	" 21......	" 6 ..	8	16	24
" 13......	" 21....	" 10 ..	8	20	28
" 14......	" 22......	" 10 ..	8	19	27
" 15......	" 24......	" 10 ..	9	17	26
" 17......	" 22.... .	" 10 ..	5	19	24
" 17... ..	" 24......	" 12 ..	7	19	26
" 21......	" 27......	" 16 ..	6	20	26
" 23......	" 28......	" 18 ..	5	21	26
" 23......	" 29......	" 19 ..	6	21	27
Aug. 2......	Aug. 13.	" 30 ..	11	17	28
" 3......	" 11......	" 28 ..	8	17	25
" 3......	" 13......	" 29 ..	10	16	26
" 5......	" 16......	" 30 ..	11	14	25

From this table we see that the maximum time as a larva in the cocoon was 11 days, the minimum 5, and the average 8; the maximum time as pupa 21 days, the minimum 14, and the average nearly 18; and the maximum total time in the cocoon 28 days, the minimum 24, and the average 25 4-5.

Hammar gives for Northern Pennsylvania an average of about one week as larva in the cocoon and of 12 days as pupa. This average would probably be about what we should find in the Niagara district.

WHEN THE LAST LARVÆ OF THE FIRST BROOD CHANGE TO PUPÆ.

At Guelph, as Table II. shows, the last larva pupated on August 5th and emerged August 30th. In the Niagara district, or other warmer parts, the transformations would naturally be expected to continue to take place for some time longer. We have not been able to make sufficient observations to determine exactly how much longer. In 1909, on September 13th, a number of bands that had not been removed for several weeks were examined but no live pupæ were found under them. Supposing that the last moth had emerged on this date, September 13th, and that we take Hammar's average of about 19 or 20 days for the time spent in the cocoon before the moth appears, it is clear that the last larva to pupate must have emerged as early as August 24th or 25th. That the date is earlier than this would appear very probable from the following facts. In 1910 two bands were placed on two trees at Stoney Creek on August 20th, and on September 8th, after an interval of 19 days, these were examined for pupæ but none were found, though as shown above it only requires an average of 8 days even at Guelph for the larva to pupate after entering the cocoon. This, therefore, throws the latest date for 1910 back to at least August 20th. That it is still earlier than this is not improbable, because in Northern Pennsylvania Hammar found that the last larva to transform in his rearing cages had left the fruit on August 14th. If the date in Niagara were August 15th, this would still be 10 days later than at Guelph, so far as one can judge from a single year's test.

Total Time Required for all Stages from Egg to Egg.

If we take the minimum periods given above we get the following: Egg stage 5 days, larva in fruit 20, larva in cocoon 5, pupa 14, moth before laying egg 2, total 46 days. The average time is as follows: Egg stage 10 days, larva in fruit 26, larva in cocoon 8, pupa 18, moth before laying egg 3, total 65 days.

If the stages are counted not from egg to egg but from egg to death of moth we must add about 5 or 6 days to the average, making the total about 70 days.

Percentage of Larvæ of the First Brood that Transform to Moths and Produce a Second Brood of Larvæ.

Between July 11th and September 1st, at Guelph, 438 larvæ were collected from under bands on three trees. This probably does not represent all of the first brood larvæ from these three trees. From these 438 a total of 35 moths emerged, which would mean that almost 8 per cent. of the larvæ had transformed. From the probability that a number of larvæ of the first brood had not left the fruit by September 1st, and from partial records in previous years, we are inclined to think that 8 per cent. is too high a figure for Guelph and other districts of about similar climatic condition. Probably 5 or 6 per cent. would be nearer the average. In the colder apple sections the percentage would be still lower, so that in districts like Ottawa we should expect to find very few larvæ transforming in an average year; in fact Dr. Fletcher stated that there was only one brood at Ottawa. On the other hand in the Niagara and other warmer parts of the Province there is no doubt that a very much higher percentage transforms. This we should naturally expect from the fact that the new brood of moths began to appear there in 1910, as shown above, a week earlier than at Guelph and, owing to the longer period of high temperatures, would continue to emerge a week or more after they had ceased to do so at Guelph.

We have not had an opportunity to determine the percentage for these districts, but should not expect it to be much, if any, higher than in Northern Pennsylvania where Hammar found that in 1908 67.7 per cent. of the first brood larvæ transformed and in 1909 23.46 per cent.

Fig. 9. Downy Woodpecker. (Photograph from a poorly mounted specimen.)

Where the Second Brood Larvæ Enter the Fruit.

In well-sprayed orchards nearly all the second brood larvæ enter the fruit from the side. This is because the poison from the spraying is still in the calyx end and kills any larvæ that may attempt to enter there. On unsprayed orchards it is found that a fairly large percentage of this brood enters by the calyx, the average being probably 50 per cent. Quaintance and his assistants in their experiments in Virginia, Arkansas, and Michigan in 1909 found that the proportion of larvæ of the first and second broods combined entering apples by the calyx end was 68.17 per cent.

Remarks on the Number and Destructiveness of the Second Brood Larvæ.

Many fruit growers, especially in the Niagara district, having suffered great loss from the second brood larvæ, think that to produce such a large number, all of the first brood larvæ must transform to moths. A little consideration of this matter will show that if even 25 per cent. of the first brood were to transform this would be sufficient to produce 5 times as many second brood larvæ as first. In proof of this let us start with a single fertile female moth in the spring. According to Sanderson, this moth will probably lay about 60 eggs. Not all of the larvæ from these will reach maturity and leave the apples, but we shall suppose that 40 will do so. If 25 per cent. of these, which would be 10, transform to moths and 5 of these are females we should expect these to lay 5 x 60 = 300 eggs.

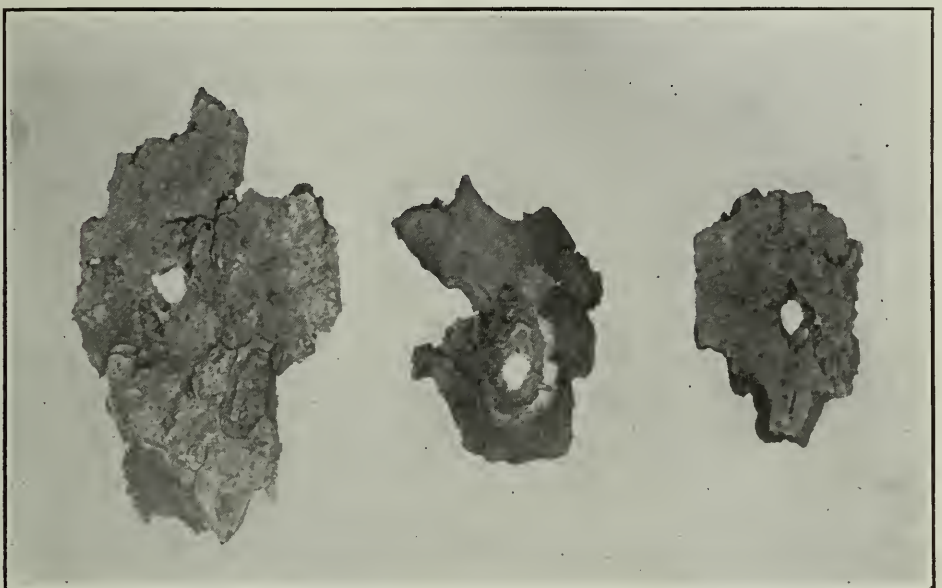

Fig. 10. Holes made by Downy Woodpecker through rough bark to get at the larvæ beneath. (Cotton wool has been inserted in the holes to make the areas more distinct.)

The moth we started with in the spring only laid 60 eggs; therefore even when only 25 per cent. of the larvæ transform we get 5 times as many eggs and consequently 5 times as many second brood larvæ hatching from them as we had first brood. If 50 per cent. of the first brood transformed we should get 10 times as many second brood larvæ as first, and if only 5 per cent. transformed the two broods would be about equal in number of larvæ. We thus see that to get great numbers of second brood larvæ it is not necessary that all or even a very large percentage of the first brood should transform. But even where the number of the two broods is the same we shall find the second doing more damage than the first in well-sprayed orchards because a much larger percentage of the second brood enters by the side than by the calyx. Almost all that enter by the calyx at any time in the season will be killed by the poison placed there by the spraying just after the blossoms fall, whereas special sprayings for the side-entering larvæ of the second brood have little effect.

Wherever a second brood occurs we shall find the larvæ in various stages right up to the end of the season.

Having now discussed the life-history of the Codling Moth as fully as seems desirable, we shall pass on to a consideration of how it may be held in check and as leading up to this shall first take up its natural enemies.

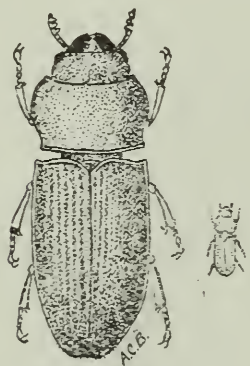

Fig. 11. Black Beetle, Tenebroides sp. The drawing on the right is life size; that on the left is enlarged four times.

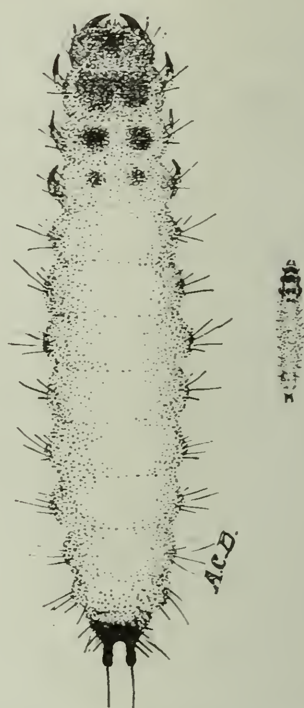

Fig. 12. Larva of the beetle shown in Fig. 11. The drawing on the right is natural size; that on left much enlarged.

Natural Enemies of the Codling Moth.

We have not yet made a thorough study of all the enemies of the Codling Moth in Ontario but, when searching under bands and loose bark for larvæ in the spring, we have been surprised at the very large percentage that had perished during the winter. Sometimes as high as 90 per cent. or more seem to have been destroyed by various causes. The chief of these, so far as we could see, were birds, the grub of a small black beetle (*Tenebroides sp.*) and diseases.

Many birds at one time or another during the year feed upon either the adults or larvæ of the Codling Moth, but during the winter the most useful birds in this respect are the woodpeckers, especially the Downy

Woodpecker (Fig. 9) and the Chickadee. If these two birds are encouraged during winter by hanging bones or pieces of meat on the trees they will often stay in the orchard all year and search every trunk and large branch carefully for larvæ. Fig. 10 shows holes made through the loose bark by the Downy Woodpecker in getting the larvæ of the Codling Moth. It is interesting to see how invariably these birds will find the right place to make the holes and pierce the larvæ and draw them out by means of their barbed tongues.

The grub of the small black beetle mentioned above (Figs. 11 and 12) is whitish and flattened with reddish black to black head, two black spots on the top of each of the first three segments of the body and a pair of stout horn-like projections on the last segment. We have found these grubs under most of the bands. Usually there are two or more to a band. We have observed them attacking both the larvæ and the pupæ, and believe that the total number they destroy in a year is large. The adult beetles are also found under the bands along with the grubs but, while we have frequently suspected them of feeding on the pupæ and larvæ, we have not been able hitherto to prove it, nor have we been able to determine whether this is the same species of beetle referred to by Slingerland as *Trogosita corticalis,* which he found very useful against Codling larvæ in New York State. Prof. Wickham identified it for us as a species of *Tenebroides* (*Trogosita*), stating that it was very difficult to be sure of the species.

In the spring a small proportion, apparently not more than 5 per cent., of the Codling Moth larvæ are found to be dead from disease; a number of them are also destroyed by disease inside the fruit during the growing season.

In addition to the above enemies we have found a small red mite about the size of the head of a pin or smaller feeding upon the eggs of the Codling Moth. All the contents of the egg were eaten and the empty shell left.

In August of 1909 a pupa was found that had been attacked by some species of 4-winged parasite, apparently a Chalcid Fly. The pupa broke when we were removing it and showed the immature parasites inside. We tried to rear them but failed. Efforts have been made to find whether this parasite was at all common but, as none emerged in the glass vials in which we reared the pupæ, it seems probable that it is of rare occurrence.

Slingerland found that the eggs of the Codling Moth were not infrequently parasitized in New York State by a very tiny, almost invisible, 4-winged fly. We have not yet devoted much attention to discovering whether this parasite is in Ontario, but it is natural to suppose that it is.

These are some of the natural foes of the Codling Moth. If it were not for them and for unfavorable weather conditions such as a sudden drop of the thermometer or driving rainstorms that must destroy many eggs and newly-hatched larvæ, the pest would be even more abundant than it is. But the successful fruit-grower cannot depend on these enemies to keep the insect under control and therefore must use devices of his own for combating it.

How the Codling Moth can be Successfully Combated.

Though spraying with a poison will, as we shall show later, thoroughly hold the Codling Moth in check, there are several other means which can in many instances be used to supplement this.

(1) *The destruction of fallen fruit throughout the season.* When speaking of the life-history of the insect we showed that more than half of the larvæ did not leave the fruit until after it fell to the ground. It stands to reason therefore that, whenever it is practicable, it will be very helpful to destroy this fruit the same day as it falls and before the larvæ will have escaped. The easiest way to do this in many districts is to allow hogs, calves, or sheep to run in the orchard in sufficient numbers to keep it clean of fallen fruit. In a number of cases it will pay to gather the fruit after the first of August and either feed it to the stock or sell it to the evaporators. Such a course is especially desirable after this date in districts where the Apple Maggot or Railroad Worm is prevalent, as the rapid destruction of fallen fruit is the best known remedy for this pest.

Fig. 13. Band on tree to catch larvæ.

(2) *When thinning apples or pears watch for the wormy ones and put them into a bag or basket by themselves and destroy them* by feeding to stock or in other ways. Some good fruit-growers think that if they

throw these small wormy apples on the ground the larvæ will not be able to mature but will die. We have tested this and find that it is a mistaken idea for the larvæ mature just as well as if they were in a large apple. Thinning apples is beginning to be practised in Ontario to a considerable extend. It offers, therefore, to the thoughtful man an excellent way in which to make sure that most of the larvæ of the first brood that the spray has not killed may be destroyed.

(3) *Banding Trees.* For many years the device of trapping larvæ by bands of thick cloth or burlap placed on the trunk of the tree has been used (Fig. 13). These bands should be put on by about the first week in July to make sure of catching the first larvæ that leave the fruit. They ought to be examined about every twelfth day and the larvæ and pupæ destroyed by cutting them through with a knife. The bands need not be

Fig. 14. Blossoms off, calyces open and ready to spray.

wider than 6 or 8 inches and may be held in place by a cord as shown in the photograph or by a small nail or any other simple and handy device. It must not be overlooked that to get the best results from them it is absolutely necessary to scrape all the loose rough bark off the trees before putting the bands on so that these may be the only good hiding-places that the larvæ can find on the trees. As no larvæ transform after about August 20th in any part of the Province, it is not necessary to examine the bands from this date until the end of the season, but when the severe frosts have come and no more larvæ are left to enter beneath them it is very important to make the final round and destroy all that can be found.

(4) *Prevent moths that hatch in fruit-houses from escaping.* The best way to do this is probably to fumigate such places with sulphur, or to cover the windows with cheesecloth and keep the doors fastened.

Spraying.

With the improved methods of spraying of the last few years all doubts about the possibility of controlling the Codling Moth even in the worst infested districts, such as Niagara, have been removed. It is true there are still many growers in these districts who, because they have failed to get good results, think that this is impossible. The explanation in these cases usually is that the work was not done thoroughly. Those who read what follows will understand how easily this can be the case.

When to Spray. We have shown above that as a rule 75 per cent. or more of the first brood larvæ enter the apples by the calyx end. Therefore if we can place poison in this part before the larvæ enter we can kill

Fig. 15. Calyces nearly closed, rather too late to spray.

these before they do any injury. In observing the growth of the young apple we find, as shown in Fig. 14, that for about a week or sometimes ten days the little leaflets that form the calyx remain open, but at the end of this time, as seen in Fig. 16, they close up.

From these facts we see that if we are going to get the poison into the calyx we must begin our spraying at once after the blossoms drop and have it all finished inside of a week or ten days. Then when the calyces do close the poison will be inside and will remain there all through the season, so that any larvæ either of the first or second brood which attempt to enter at any time will be killed.

If the orchard is large and contains many trees which blossom a few days ahead of the others, it will be well to spray these first, but usually one may wait until all the blossoms have fallen from the early varieties and most but not quite all from the others. By this time it will be found that the bees have finished their work so that there will be no danger of the poison doing any harm to these valuable friends.

How Often Must We Spray. In some way not yet fully understood the spray immediately after the blossoms drop and before the calyx closes will, if thoroughly done, kill not only the 75 per cent. that enters by the calyx but also nearly all the remaining 25 per cent. which ordinarily enters by the side or stem end. Therefore, this one application is all that is necessary for the control of the Codling Moth in any district except where there is a large proportion of second brood. In the latter we recommend that a second application be made about three weeks after the blossoms drop because, as the life-history of the insect shows, it is not until about this time that the eggs begin to hatch and the larvæ to enter the fruit. Therefore by covering the apples and leaves thoroughly with poison at this time we shall help to make more certain that almost all the first brood is destroyed.

We are often asked when to spray for the second brood. The answer is: Do the first two sprayings so thoroughly that there will not be sufficient

Fig. 16. Calyces closed; cannot get the poison inside now.

first brood left to produce a second brood that can injure more than a very small percentage of the fruit. Efforts to control the second brood by spraying for it about the end of the first week in August give very poor results and do not pay. In most parts of the United States and in our own Province the most successful apple growers are finding out that the secret of preventing injury from the second brood is just what has been said above: such thorough spraying for the first brood that it is practically annihilated.

Can a Man Control the Codling Moth in His Orchard if His Neighbor's Orchard is Not Sprayed? Our answer to this is YES, The writer has done it himself, and has seen it done even more successfully by others in the worst infested districts in the Province. It is true that a few trees nearest the unsprayed orchard are likely to be wormier than they would otherwise be but the moths do not fly far as a rule and lay their eggs on the trees near where they emerged.

What Poison Should Be Used.

Almost all over Canada and the United States arsenate of lead is the most popular poison for the Codling Moth. It is not so cheap as arsenite of lime or Paris green, nor does it kill quite so rapidly, but it stays in suspension in the spray tank much better, is much less likely to injure the foliage, and remains on the trees in wet weather much longer. It should be used at the strength of 2 lbs. to 40 gals. of Bordeaux mixture or diluted lime-sulphur. Many claim that 1 lb. is sufficient, but so far as our tests go we prefer 2 lbs., though more than this is unnecessary. If Paris green is used it should be at the rate of ¼ lb. to 40 gals. of Bordeaux. For the method of making arsenite of lime, see Bulletin No. 177, page 43. The strength there indicated is sufficient. When Bulletin 177 was published it was believed that arsenite of lime could be safely used with diluted lime-sulphur, but experiments in 1910 in several orchards showed that in some seasons the mixture causes serious injury to the foliage and occasionally to the young fruit. Therefore *with lime-sulphur the only arsenical that can safely be used is arsenate of lead.* With Bordeaux mixture we may use arsenate of lead, Paris green, or arsenite of lime.

In spraying for the Codling Moth a fungicide, either Bordeaux mixture or lime-sulphur, should be used with the arsenical poison instead of using water alone. This is because the most important time to spray for the Apple and Pear Scab is just after the blossoms drop, and therefore by combining the fungicide with the insecticide we secure a two-fold result. The Bordeaux mixture for this application need not be stronger than 3.3.40, nor the commercial lime-sulphur than 1 gal. diluted to 40 gals. This is because to control the Codling Moth the spray at this time must be applied so thoroughly that a weaker fungicide will suffice.

That the combination of arsenate of lead with lime-sulphur, or of arsenate of lead or arsenite of lime or Paris green with Bordeaux mixture does not lessen the value either of the insecticide or fungicide has now been clearly proven. Arsenate of lead itself is believed to possess considerable fungicidal properties.

Spray Outfits.

Spray Machines. Without a fairly good spray outfit we cannot do good work against the Codling Moth. For orchards of from 2 to 5 acres of trees 25 years old and upwards a good barrel pump will serve the purpose. For 5 to 10 acres we should have a good double-acting pump with a tank holding at least 80 gals. For orchards of more than 10 acres a strong pump driven by a gasoline engine is very desirable. A good engine soon pays for itself by dispensing with the services of at least one man, and by giving so much more pressure that the work can be done much more thoroughly and quickly.

Machines of any of the above kinds can be purchased from the following companies:

The Spramotor Co., London, Ontario;

The Friend Manufacturing Co., Gasport, N.Y.;

The Bean Spray Pump Co., Cleveland, Ohio; Canadian agent, M. C. Smith, Burlington, Ont.;

The Goulds Manufacturing Co., Seneca Falls, N.Y.; Canadian agent, Robert Thompson, St. Catharines, Ont.

These are at present the best known firms, but doubtless others equally good will soon make their appearance in Ontario.

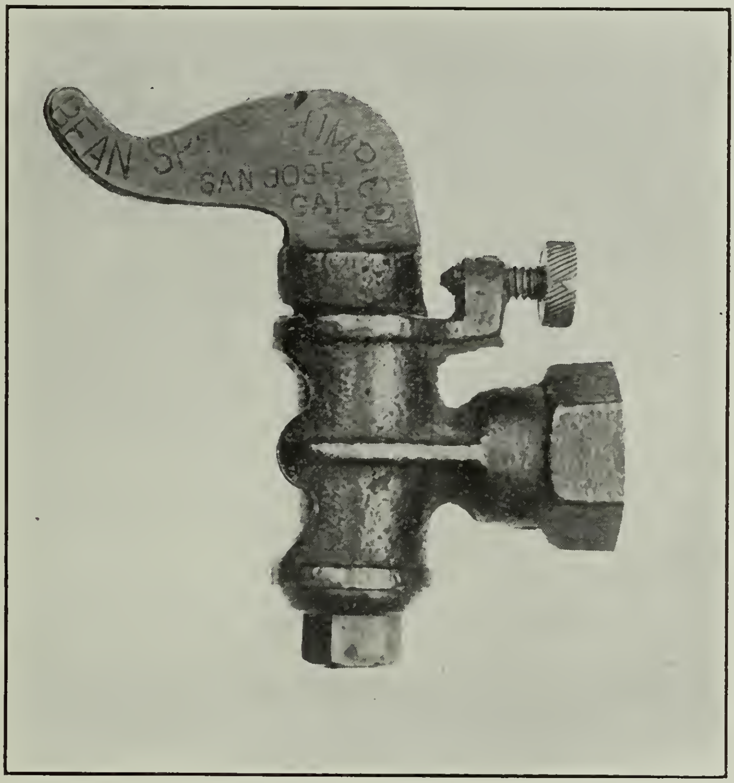

Fig. 17. New type of Bordeaux nozzle.

Hose. It will pay to purchase a good brand of hose, one guaranteed to stand about 300 lbs. pressure, though this much will never be used.

For a barrel pump one line of hose of about 20 feet long is all that will be required. For double-acting pumps, whether driven by hand or by gasoline engines, two lines of hose are necessary, one about 12 or 15 feet long for use on the tower, and the other at least 25 feet long for use on the ground. In order to save the man on the ground from being drenched by the man on the tower when both are spraying the same tree some use 40 feet of hose for the lower line, and thus the man using this can be spraying the last part of the tree behind when the man on the tower is spraying the nearer side of the next tree.

Extension Rods and Nozzles. The rod for the man on the tower should be about 9 ft. long, and as light as possible, while the one for the man on the ground should not be more than 6 or 7 ft.

The nozzle preferred by many in the West is the new Bordeaux nozzle (Fig. 17). This is a much better nozzle than the ordinary Bordeaux type, but the writer, after testing many different kinds of nozzle, advises the use of a disc nozzle of the Friend type (Fig. 18). For the spray immediately after the blossoms fall he chooses nozzles of this kind that have been used sufficiently to wear the holes a little so that a some-

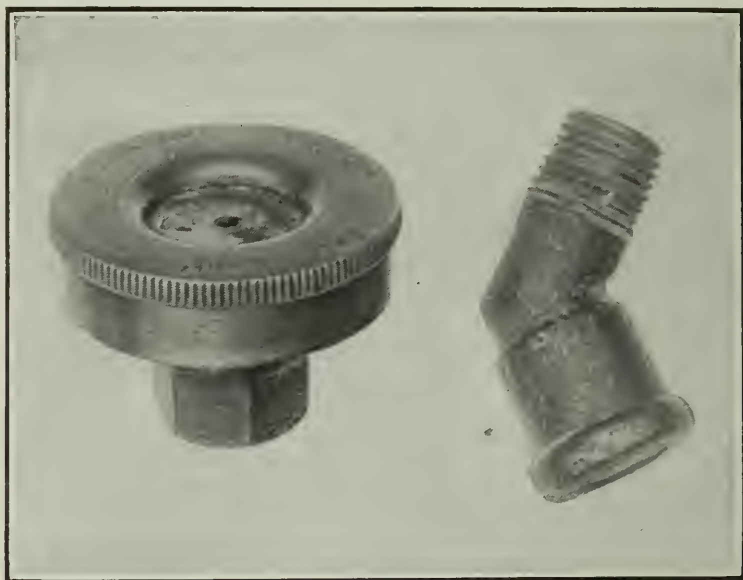

Fig. 18. Friend type of nozzle, and a small brass elbow found very desirable in spraying. Both natural size.

what coarser spray may come out. Each spray rod is equipped with two of these nozzles on a V, each nozzle having an elbow of the type shown in Fig. 18 behind it so that the two may be adjusted in such a way that the cone-shaped spray from the one will extend half-way into that of the other and by this overlapping make much more thorough work. *The elbow device sets the nozzles at an angle of 45 degrees to the spray rod. This is very important,* for with a nozzle in the same straight line with the spray rod it is not possible to control the direction of the spray and send it straight down into the calyx. Some set the nozzles at an angle of 75 degrees or more but this is not so satisfactory as 45.

Tower. For trees 20 years old and upwards a tower on the spray waggon is a necessity (Fig. 19), otherwise the poison cannot be sent into the highest blossoms sufficiently well.

How to Spray.

In spraying for the Codling Moth our object must be to see that every calyx end of the forming fruit is thoroughly covered with the poison before the calyx closes. The deeper the poison is driven into the cavity at this part the more certain will be the destruction of the larvæ trying to enter here. Therefore to accomplish this it is necessary to do very thorough work and to have as high pressure as can be conveniently obtained, never less than 100 lbs. and if possible as high as 150 or even 200 lbs. Endeavor to hold the nozzles about 20 inches or 2 feet away from the blossoms and to send the spray directly into each. Anyone who tries to do this on a tree that has been well covered with bloom will soon see that it requires great care, and before it is accomplished the tree will have been drenched. It is easy to see therefore that the old rule to stop spray-

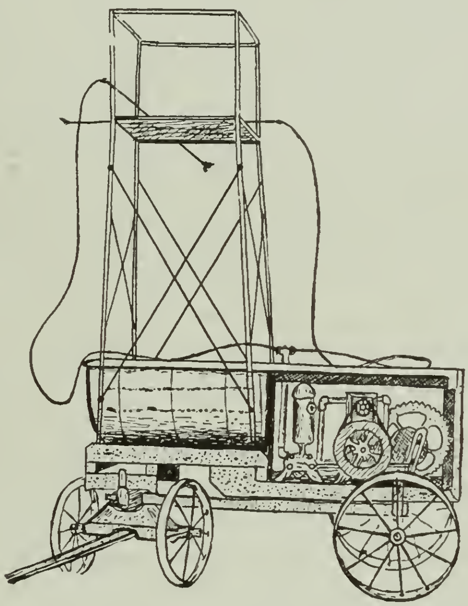

Fig. 19. Tower for spraying tall trees, and spray tank with gasoline engine.

ing when the mixture begins to drip is quite wrong. The rule should be: *Stay at the tree till you have put the poison thoroughly into every calyx but waste no more material than you can help.* From time to time examine the calyces to see if any are being missed. Do the spraying yourself or trust only your best man to do it. A careless man cannot spray well.

Large trees may sometimes, if there have been many blossoms, require as high as from 8 to even 15 gallons, and trees of 25 or 30 years of age from 4 to 8 gallons. If the tree has only a very few blossoms, look after these carefully and give the foliage a light coat to keep it healthy. If time is pressing the trees that have had no bloom may be left until all the others are done and then touched up.

Of course the spraying should be done with the wind and the stronger the wind the better as it carries the spray more forcibly through the tree. As we can never be sure that the wind will completely change its direction in time to get the other side done before the calyces close it is necessary to spray two-thirds of the tree from the first side. To accomplish this stop the waggon just before it comes to the tree and spray as far in as you can on this side. Then drive directly opposite the tree and spray this part, then drive slightly past and finish as much of this side as can be reached conveniently. If this is done it is very seldom that the wind will not veer sufficiently to enable one to finish the remainder of the tree, though it cannot be so thoroughly done as if the wind were to change directly around.

Where a person has to use a barrel pump and a single line of hose, the sprayer should stand on the tower and with a little extra care he can do the whole tree very thoroughly from this position.

The second spraying for the Codling Moth, which, as we have said above, is only required in very badly infested districts and should be given about three weeks after the blossoms fall, does not require to be so heavy as the first. Nozzles with fresh plates with unworn holes should be used and the mixture should be applied in as fine a mist as possible, the aim being merely to coat every fruit and leaf thoroughly with a very fine covering of poison. If the orchard is free from signs of Apple Scab, and if the weather is dry, the Bordeaux or lime-sulphur may be omitted in this application; otherwise it should be used.

Results Obtained from a Single Thorough Spray for the Codling Moth Immediately After the Blossoms Fell.

Careful experiments have been made in the control of Codling Moth in 1910 by the writer at Guelph, by I. F. Metcalf, Agricultural Representative, assisted by W. F. Kydd, in Simcoe County, and by J. H. Hare, Agricultural Representative in Ontario County. None of the orchards so far as known had been sprayed before, and all except one were composed chiefly of trees varying from 25 to 60 years of age. Two of the outfits were barrel pumps and the third a double-acting pump. The pressure used ranged from 100 to 140 lbs., averaging a little over 100 lbs. The mixture consisted of 2 lbs. arsenate of lead to 40 gals. of commercial lime-sulphur of the strength of 1 gal. to 40 gals. of water. In a few cases the lime-sulphur was used stronger, namely at 1 to 30.

In ten orchards thoroughly sprayed at the right time in these three districts the proportion of worm-free fruit ranged from 80 per cent. to 98 per cent., with an average of 90 per cent. In unsprayed orchards in the same districts nearly all the fruit was unsaleable because of worms and Scab and a large percentage of it dropped off the trees early; whereas in the well-sprayed orchards there was very little dropping until the heavy winds came towards the end of the season, and even then only a small percentage fell.

Scarcely any wormy apples that had been entered by the calyx end could be found in any of these orchards. This should always be the case in well-sprayed orchards.

We believe that another season's thorough spraying of these orchards would give 95 per cent. of clean fruit.

Results in Niagara District from One Thorough Application Immediately After the Blossoms Fell and a Second Three Weeks Later.

In 1909 the writer sprayed 25 acres of apple orchard for Mr. Joseph Tweddle, of Stoney Creek. Two double-acting spray pumps were used, giving an average pressure of about 140 lbs. each. The work was not so thoroughly done, however, as it could have been with a gasoline engine; especially was this the case in one-half of the orchard where the trees were very old and high, making it very difficult to spray them thoroughly. The other half consisted of trees from 30 to 35 years of age and was better done. Very few apples dropped until shortly before picking time. The better sprayed half gave an average of 94 per cent. worm-free apples on the packing tables and the other half 84 per cent. Taking into account wormy apples on the ground the percentages of worm-free apples would be 90 and 75, respectively. Neighboring orchards had from 20 per cent. to 50 per cent. of worm-free apples.

In 1910 the writer sprayed the Jordan Experimental Station orchard in the same way, using Bordeaux (3.3.40) mixture and 2 lbs. arsenate of lead on part of it and commercial lime-sulphur and 2 lbs. arsenate of lead on most of the rest. One mixture gave just about as good results as the other. From the director's report 85 per cent. of the fruit was free from all kinds of insect injury. This orchard in 1909 had less than 50 per cent of worm-free apples.

At an orchard demonstration meeting held on the 7th of September, in 1910, at the orchard of M. C. Smith, Burlington, 100 fruit-growers from almost every apple district in the Province saw the results that could be obtained from careful spraying repeated each year for 4 years on an old orchard very hard to spray. At that date there were not more than 2 per cent. of wormy apples and probably not more than 1 per cent. in this orchard, while neighboring orchards had from 50 per cent. to 80 per cent. of wormy apples. Mr. Smith gives two thorough applications each year, following exactly the directions given above. The secret of his success is THOROUGHNESS and good pressure.

Results on Apple Scab.

Almost all of the orchards mentioned above received two sprayings previous to the first spraying for the Codling Moth, and in every case where this was done the Apple Scab was completely controlled even on

Snow apples. There was an average of 99 per cent. of scab-free apples in the orchards sprayed by the writer in 1910, and about as high in those sprayed by Messrs. Metcalf and Kydd, Hare, and Smith, though this was the worst season for Apple Scab that there has been for a long time.

OTHER INSECTS WHOSE WORK IS LIKELY TO BE MISTAKEN FOR THAT OF THE CODLING MOTH.

Lesser Apple Worm. Fig. 20 shows the work of the Lesser Apple Worm. The larva of this insect looks almost exactly like a half-grown

Fig. 20. Work of Lesser Apple Worm. (After Simpson.)

larva of the Codling Moth, except that it is rather a deeper flesh color and tapers a little more towards each end. It has about the same life-history as the Codling Moth. Its native food seems to be haws. There are 2 broods in a year and the last is much the worst. When it attacks the apple, instead of boring into the core, it continues to feed near the surface causing an ugly blotch. It seldom goes deeper than quarter of an inch. As a rule the injury is done at the calyx end but not infrequently it is found at the side or stem end. Occasionally the Codling Moth works somewhat in the same way but seldom makes so large a blotch.

It is difficult without further observations in various parts of the Province to say just how much loss is caused by this insect but it probably does not exceed from 2 to 5 per cent. of all the wormy apples. Around Guelph in neglected orchards the percentage runs higher, in one case over 40 per cent. of the wormy apples on a well-laden tree had been caused by this pest. The same spraying as controls the Codling Moth keeps it fairly well in check.

Plum Curculio. Fig. 21 shows the appearance of the injuries caused to apples after about the middle of August by the Plum Curculio. (These are feeding punctures made by the adults, which are little, grayish-black,

Fig. 21. Work of Plum Curculio on apples in late summer and in autumn.

hard-shelled, rough-backed beetles, about quarter of an inch long. They do the injury by cutting a small hole through the skin and then eating out the pulp beneath as far as their rather long beak will reach. Sometimes there will be 20 or more of these holes in a single fruit. Smooth-skinned varieties, like Spys, are generally exempt, while the rougher varieties are often badly attacked. In neglected orchards the Curculio sometimes does as much damage as the Codling Moth.

The best methods of control are: (1) Remove all rubbish, brush and thickets in or around the orchard, because the insects winter in such places.

(2) Cultivate the orchard carefully from as early in spring as the ground is in shape to go on up to as late as is safe. The latter date will be from about June 10th to July 10th, according to the coldness of the district. Do not let weeds grow up until cultivation ceases.

(3) Spray as for the Codling Moth.

BRIEF SUMMARY OF RULES FOR SPRAYING ORCHARDS FOR INSECTS AND DISEASES.

Every pear and apple orchard should be sprayed 3 times each year and in some years 4 times as follows:—

(1) Shortly before, or as the leaf buds are bursting. Use lime-sulphur, either commercial or home-made, corresponding to the strength of the commercial diluted 1 gal. to 10 gals. with water. No poison as a rule is necessary. This application kills San José Scale, Oyster-shell Scale and Blister Mite, and helps ward off Cankers, and Apple and Pear Scab.

(2) Just before the blosoms burst. Use commercial lime-sulphur diluted 1 to 30 or 35, or Bordeaux mixture (4.4.40), and 2 lbs. arsenate of lead to each 40 gals. This application is to destroy all early feeding caterpillars, such as Tent-caterpillars, Case-bearers, Canker Worms and Bud Moths, and to help against Apple and Pear Scab and Cankers.

(3) Immediately after the blossoms fall. Use the same mixtures as for No. 2, but the lime-sulphur need not be stronger than 1 to 40 nor the Bordeaux than 3.3.40. This application is chiefly to control Codling Moth and Apple and Pear Scab, but also helps greatly against Lesser Apple Worm and Plum Curculio.

(4) If a fourth application is given it should be about 3 weeks after the blossoms fall and with the same mixtures as in No. 3, except that if the season is dry the fungicide may sometimes be omitted. This application assists in holding the Codling Moth in check in the warmer parts of the Province and in moist climates is often necessary for the thorough control of the Apple Scab.

N.B.—*Thoroughness is the great secret of success.*

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BULLETIN 188.] [APRIL, 1911.

Ontario Department of Agriculture

ONTARIO AGRICULTURAL COLLEGE

The Weeds of Ontario

BY J. EATON HOWITT, M.S.A., Lecturer in Botany

FOREWORD.

A review of the history of the Weed Bulletins issued from the Ontario Agricultural College reflects the growth of the seriousness of the weed problem throughout the Province during the past twenty years, the consequent gradual increase of an interest in the practical study of weed plants, and the never-ending necessity for education in the matter.

The first bulletins sent out were prepared by the late J. Hoyes Panton, M.A., F.G.S., Professor of Natural History and Geology. No. X., which appeared in 1887, was a small three-paged circular. It called attention to the rapid increase of weeds in Ontario, and warned farmers particularly against the inroads of the *Perennial Sow Thistle,* which had made its appearance in the neighborhood of Stratford, and *Pennycress,* which had been reported in the vicinity of Almonte. Bulletin LXXXV., appearing in 1892, dealt with methods of destroying eleven of the worst common weeds of the time, viz., *Canada Thistle, Sow Thistle, Wild Flax, Pigeonweed, Ragweed, Couch Grass, Ox-eye Daisy, Burdock, Blueweed, Mustard* and *Wild Oat.* Bulletin XCI., "Weeds of Ontario," issued in 1893, besides listing 92 common weeds known in Ontario, drew special attention to *Pennycress, Tumbling Weed, Wild Carrot, Clot Bur* and *Dodder.* This was a small seven-page circular. In 1900, Bulletin 128, "The Weeds of Ontario," by F. C. Harrison, B.S.A., was issued. In 1903 a second edition, revised by Mr. Harrison and Wm. Lochhead, M.A., M.S., Professor of Botany, was issued, and in 1906 a large third edition, revised again by Mr. Lochhead, was published. From the small three pages of the first bulletin prepared by Prof. Panton, this had grown to a full-sized ninety-six-page bulletin.

Owing to the rapid increase in the spread of *Perennial Sow Thistle* and other newly-introduced weeds, Bulletin 168, "The Perennial Sow Thistle and Some Other Weed Pests," by J. E. Howitt, M.S.Agr., of the Department of Botany, was issued in 1908.

With the exhaustion of the supply of these two former bulletins, it has been deemed advisable to incorporate them now into one publication. This work has been carried out by Mr. Howitt, who has given special attention to this branch of botanical study during the past four years. With the exhaustive revision and many additions made this bulletin is practically a new work. The drawings for the new cuts used in this edition were made by A. C. Baker, a fourth year student in biology.

It is hoped that its distribution amongst those who are actively engaged in farming, the teachers and pupils in the schools, and others who are interested in our weed problems, may have beneficial results.

S. B. McCready.

ACKNOWLEDGMENTS.

The writer wishes to state that in the revision of this bulletin much of the information about the weeds recently introduced into Ontario has been obtained from "Farm Weeds of Canada," by G. H. Clark, B.S.A., and Dr. James Fletcher, of the Dominion Department of Agriculture.

WHAT IS A WEED?

There are several definitions of a weed, viz.: "A plant out of place"; "Any injurious, troublesome or unsightly plant that is at the same time useless, or comparatively so"; "A plant which interferes with the growth of the crop to which the field is temporarily devoted."

INJURIOUS EFFECTS OF WEEDS.

1. They absorb soil moisture and thus lessen the supply of water available to the crop plants. "An average Mustard plant pumps from the soil about fourteen ounces, or seven-tenths of a pint, per day."

2. They use up the plant food in the soil, and thus rob the crop plants. Furthermore, they often mature their seeds before the crop plants, and during the time they are ripening their seeds draw heavily upon the plant food in the soil, and thus leave little available for the crop plants when they require it to mature their seeds.

3. They shade, crowd and choke out useful plants. Weeds frequently grow more vigorously than the crop plants, and thus often stand above them, preventing the light and air required for healthy growth from reaching them.

4. Weeds are a constant source of expense. They increase the cost of every operation, in the preparing of the land, and in the seeding, cultivating, harvesting and marketing of the crop.

5. They may interfere with the regular rotation of crops. It is sometimes necessary, on account of some particular weed, to drop some crop from the rotation entirely.

6. Some weeds, as Water Hemlock and Horsetail, are poisonous to stock. Quite frequently reports are received of stock being poisoned by eating such weeds.

7. Milk is often tainted by the cows eating such weeds as Wild Garlic and Stinkweed.

8. The market value of seed grain, clover and grass seeds is much decreased by the presence of weed seeds in any quantity.

9. Weeds often harbor or favor the development of injurious insects and fungus diseases.

10. Weeds are unsightly, and their presence detracts very materially from the value of a farm. No man cares to buy a weedy place if he can secure a clean one.

INTRODUCTION AND SPREAD OF WEEDS.

Most of the injurious weeds found in this Province have come directly or indirectly from other countries. They are brought in and conveyed from field to field and farm to farm in various ways:

1. *By the wind.* Seeds which are carried by the wind usually have tufts of fine, silky hair attached to them. Such are the seeds of the Dandelion, Canada Thistle, Sow Thistle (annual and perennial), Willow Herb, and Cotton Grass. These and similar seeds are wafted to and fro, till they become attached to the soil and commence to grow. In some cases, as in the Dock and Wild Parsnip, the seeds are winged; in others the pod containing the seed has flat and extended edges, exposing much surface to the wind. The Pennycress is an example of the latter.

Some weeds are rolled along the ground by the wind. To this class belong the Russian Thistle and the Tumbling weed of the North-West. When these weeds ripen, they break off close to the ground; and, being light, they are easily carried by the wind, especially on an open prairie, and the seeds drop out as the weed rolls from place to place.

An examination of snow drifts in Dakota, a few years ago, showed the presence of many weed seeds. Thirty-two seeds of nine species were found in two square feet of a drift. In the same place it was observed that a twenty-five mile wind carried wheat seed a distance of thirty rods in a minute.

Seeds which become sticky when wet often adhere to leaves, and go wherever the leaves are carried by the wind. This is true of the Plantain.

2. *By water.* Some seeds, especially those of aquatic plants, are distributed by water. Darwin maintained that many seeds, dropping into the sea, or being washed in from the shore, might be carried nearly a thousand miles by the movements of the water without injuring their vitality. Seeds which float on the surface of water are carried to and fro by the wind till they find a lodgment and begin to grow; and many, of various kinds, are carried from high to low ground and distributed far and near by the rills and streams which flow from mountain, hill, and upland after heavy rains and spring thaws. The common Speedwell and Ragweed are often distributed in this way.

3. *By birds and other animals.* Seeds are distributed by animals in a variety of ways. "It is estimated that about 10 per cent. of all flowering plants possess seeds which are dispersed by means of barbed or cleaved processes." By these barbs or processes the seeds cling to the feathers of birds and the hairy coats of animals, and in this way are carried from place to place. To this class belong the Bur, Burdock, Hound's Tongue, Bedstraw, Cockle, and such like. And the seeds of some plants, such as Mistletoe and the Meadow Saffron, exude sticky substances which cause them to adhere to birds and other animals.

In the hardened earth taken from the feet of birds Darwin found a large number of seeds, many of which germinated; and it is, undoubtedly, true that seeds are often conveyed from one place to another in the dirt that clings to the feet of animals.

Seeds often pass through the stomachs of animals without being digested; and, during their passage, they are conveyed hither and thither by the animal, and finally deposited, to grow and reproduce their kind, whether of weeds or useful plants. Every farmer knows the truth of this statement as regards cattle, horses and swine; and it may be mentioned that Darwin picked from the excrement of small birds twelve kinds of seeds which were perfect in form and germinated in nearly every instance.

Ants, locusts, and other insects also do something in the way of distributing the seeds of certain plants, including noxious weeds.

4. *By man.* Man himself, however, has most to do with the spread of troublesome weeds, chiefly through the agency of railroads, implements, farm yard manure, feed-stuffs, and impure seed.

Many weeds are carried from one province or country to another in the fodder and litter used by animals in transit on railways and in grain carried by rail. More or less of the grain, litter and fodder are scattered at places along the track, and at stations where grain and animals are unloaded and cars cleaned out. Weeds thus get a start and spread to neighboring farms. The Russian Thistle was introduced in this way.

When implements are transferred from one field to another pieces of dry earth or sod are frequently dislodged, and new weed seeds are introduced. This is a common method of spreading weed seeds all over farms and throughout whole neighborhoods. Threshing machines from dirty farms are well known sources of trouble under this head.

Fresh barnyard manure from city stables is very often full of weed seeds, and should be rotted or piled and allowed to heat thoroughly before it is applied to clean land. Wild lettuce, for example, was brought from Toronto to the neighborhood of Burlington in manure; and in this way many other pests have been distributed from towns and cities to the farms of the Province.

COLLECTION AND IDENTIFICATION.

Not only every seedsman, but every farmer, and every teacher in a rural school, should have a collection of weed seeds for reference and comparison, in order that he may be able to detect and identify such seeds when they are in grass seed, clover seed, rape seed, or any other kind of seed which is sold or offered for sale. A good collection can be easily made in the summer months. All that is necessary is a number of small bottles and a little attention at the right time. The so-called homeopathic vials of one drachm capacity are suitable for the purpose, but they should be carefully and plainly labelled. If they are not so labelled, the collection will be valueless.

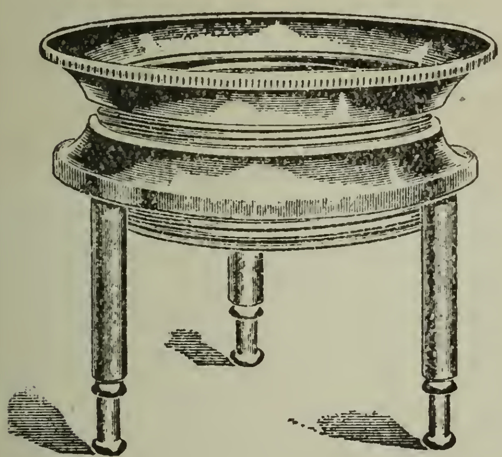

Fig. A. Tripod magnifier.

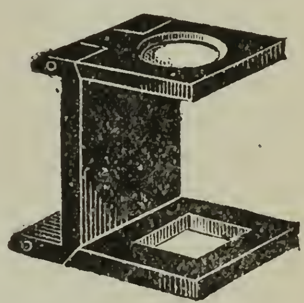

Fig. B. Linen tester.

A small magnifying glass is very useful in identifying seeds. Perhaps the most convenient glass for the purpose is the *tripod magnifier* (Fig. A), costing about fifty cents. The *linen-tester* (Fig. B), is cheaper, but yet quite serviceable.

CLASSIFICATION OF WEEDS.

Weeds may be classified according to the length of time they live, as follows:

Annuals, or weeds which germinate, bloom, fruit, and die in one year or season. Corn Cockle is an example.

Winter Annuals, which germinate late in summer or autumn, pass the winter as seedlings or immature plants, and complete the cycle of their existence by blooming, fruiting, and dying during the following summer. Such are Chess and Shepherd's Purse.

Biennials, which produce leaves and roots the first year, and flowers and seeds the second year, after which they die. The Wild Carrot and Evening Primrose are familiar examples.

Perennials, which last from year to year, blooming and seeding annually. These are divided into two classes:

(1) Those with underground creeping stems, such as the Canada Thistle.

(2) Those with roots which do not spread underground, such as Chicory, Plantain, and Dock.

It is important to know the class to which a weed belongs, as the method of eradicating an annual is often very different from that required to destroy a perennial.

GENERAL PRINCIPLES IN THE CONTROL OF WEEDS.

1. Never allow weeds to mature seeds. Cut those on the roadsides, headlands, in waste places and in the fence corners, as well as those in the fields.

2. Be constantly on the watch for the appearance of new weeds. Do not wait until a weed has become established before finding out what it is. It is a comparatively easy task to get rid of a few plants of Perennial Sow Thistle, but a long, tedious and costly operation to clean a field which has become overrun by it.

3. Sow only pure seed. Impure seed is dear at any price. Pure seed is the purchaser's right by law, and he should insist on having it.

4. In dealing with perennial weeds with creeping underground roots, be careful not to harrow or cultivate through patches and drag the "roots" all over the field.

5. See that the separator is cleaned before being brought upon the farm. Burn the refuse from the separator, and do not throw it on the manure heap.

6. Avoid feeding stock upon chop containing weed seeds in any quantity. Such food should be boiled before being fed.

GENERAL METHODS FOR THE ERADICATION OF WEEDS.

1. Crop Rotation.

Crop rotation is of utmost importance in dealing with weeds. Some sharp, short rotation of crops should be adopted which will allow of the frequent use of the cultivator, the cutting of the flowers before seeding, and the introduction of a smother or hoed crop. One cannot recommend a system of cropping which will be suitable to all kinds of farming. Each farmer must select the rotation most suitable to his conditions, keeping in mind those features of rotation which will best enable him to fight the particular weed or weeds with which he has to contend.

The following short rotation is recommended for the eastern provinces by J. H. Grisdale, Agriculturist of the Central Experimental Farm:

"To destroy weeds, probably the best rotation possible is one of three years' duration, including clover and mixed hay, followed by roots or corn, the land shallow-plowed in fall and sown to grain the next spring with ten pounds of red clover and twelve pounds of timothy per acre. (When the land is heavy or clayey, the ten pounds of red clover may be replaced by six pounds of red clover and two of alsike.) If a portion of the arable land must be used for pasture, then the land might be allowed to remain under grass or hay for two years instead of one year, the second being used for pasture, thus extending the three-year into a four-year rotation. The pasture land in the four-year rotation, or the hay land in the three-year rotation, should be broken up early in August and cultivated at intervals to destroy the successive growths of weeds as they appear. The land should be again plowed, or preferably ridged, in the fall."

2. Hoed Crops.

The growing of such crops as potatoes, corn and roots provides a means by which many weeds may be effectively fought. Hoed crops alone do not give entire satisfaction in fighting creeping perennial weeds. This is due to the fact that in cultivating and hoeing the rootstocks are cut but not all destroyed and in a short time some begin to grow again. Hoed crops, therefore, should not be depended upon alone to eradicate creeping perennials but should be used in connection with other methods as outlined further on.

3. Summer Fallowing.

This method is extremely efficacious with all sorts of weeds, including the Perennial Sow Thistle. By fallowing for weeds a bare fallow is understood, or at least one which is given sufficient cultivation to prevent weeds from reproducing themselves by seeds or "roots." A neglected fallow is nothing more or less than a weed bed, and is useless and a source of contamination for every field on the farm. The chief objection to fallowing is the lying idle of the field for a season, but this is probably offset by the effectiveness of the method in dealing with such weeds as the Perennial Sow Thistle as compared with other methods which require a great deal more labor, time and attention.

4. Early After-harvest Cultivation.

This is one of the best ways to destroy annual and winter annual weeds, such as False Flax, Corn Cockle and Wormseed Mustard. Plow shallow immediately after harvest and harrow and cultivate frequently. By the shallow plowing the weed seeds are kept near the surface, and by the frequent stirring of the soil they are made to sprout, and having sprouted they are easily destroyed by further cultivation.

5. Seeding Down.

Fields overrun with some kinds of weeds, particularly annuals, may be cleaned by seeding to grass for hay or pasture. This method has the advantage of requiring little labor, which is expensive at the present time. Cutting the hay crop early will prevent most weeds from maturing any quantity of seed. Close pasturing, especially with sheep, will in time destroy most weeds, even perennials.

6. Sheep Destroy Weeds.

A flock of sheep will do much to keep a farm free from weeds, and it is to be deplored that sheep are not more generally kept upon Ontario farms. *" When an abundance of succulent pasture of the finer grasses is provided, weeds can scarcely be said to be favored by sheep as a staple part of their diet. Sheep will, however, even when good pasture is provided them, vary their diet by nipping off seedling plants or the fresh growing parts, and the bloom with its contents of sweets from older plants of many of our common weeds. When their pasture is depleted, sheep feed readily on Wild Mustard, Ox-eye Daisy, Yarrow, Plantain, Perennial and Annual Sow Thistle, Wild Vetch or Tare, Docks, Sorrel, Lamb's Quarters, Milkweed, Ragwort, Burdock and Shepherd's Purse. In fact, there are few weeds that sheep will not eat, to the extent of preventing them from seeding, if there is not enough of their favorite grasses to satisfy them. It is only when the supply of food is unusually short that sheep will feed on plants having leaves and stems covered with bristly hairs or spines, or with a flavor that is obnoxious to them. When the plants are young and tender, however, sheep have been observed to eat such weeds as Ragweed, Blue-weed, Cockle, Orange Hawkweed, Hound's Tongue, Stickseed, Mullein, Canada Thistle, Stinkweed, Toadflax, and

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* Farm Weeds of Canada.

others that are bristly or have a pungent flavor. Thorough cultivation with a systematic rotation of crops, combined with the maintenance of as many sheep as can be kept to advantage, is a certain and profitable means of keeping weeds under control."

7. Smothering.

The aim of this method is to kill the weeds by depriving them of light and air. This is accomplished by getting some quick growing crop, such as rape or buckwheat, established on the land while the weeds are in a weakened condition. The result is that the smother crop soon occupies every available foot of the land and forms a dense shade in which the weeds in their weakened state cannot continue to grow.

8. Hand Pulling.

Hand pulling and the total removal of weeds is the most effective means of destruction, but of course is only practicable with shallow-rooted weeds not very abundant in a field. Small patches of perennial weeds can be destroyed by digging out the plants with a fork, roots and all, and burning them. Great care must be taken to get every bit of the "root," and the patch should be watched, and if new shoots appear, they should be taken out at once. In an ordinary season several diggings will be required in order to completely exterminate a creeping perennial.

A FEW FACTS REGARDING WEED SEEDS IN CLOVER AND GRASS SEEDS.

Alfalfa Seed.

Out of 147 samples of alfalfa seed submitted for test by farmers and seedsmen, 15 were found to be absolutely free from weed seeds of any kind, 98 to be free from the weeds covered by the Seed Control Act, though containing other weed seeds in various amounts; 34 were found to contain sufficient weed seeds to disqualify them from being offered for sale in Ontario. Out of the 147 samples tested 7 were noticeably dark and discolored, indicating lack of germinative capacity, and 4 were found to contain very large quantities of grit and other inert matter.

The following weed seeds were found to be the most common impurities in alfalfa seed: Green Foxtail (*Setaria viridis*), present in 56 samples; Lamb's Quarters (*Chenopodium album*), present in 42 samples; Russian Thistle (*Salsoli kali*, var. *tenuifolia*), present in 35 samples; Buckhorn or Ribgrass (*Plantago lanceolata*), present in 32 samples; Curled Dock

(*Rumex crispus*), present in 21 samples; Pigweed (*Amaranthus retroflexus*), present in 20 samples; Ragweed (*Ambrosia artemisaefolia*), present in 11 samples; Yellow Foxtail (*Setaria glauca*), present in 10 samples; Chicory (*Cichorium intylbus*), Wild Carrot (*Daucus carota*), Bull Thistle (*Cirsium lanceolatum*) and *Centaurea picris* present in 9 samples.

Other weed seeds found in alfalfa were Black Medick (*Medicago lupulina*), Sweet Clover (*Melilotus alba*), Lady's Thumb (*Polygonum persecaria*), Knob Grass (*Polygonum aviculare*), Sheep Sorrel (*Rumex acetosella*), Dodder (*Cuscuta* sp.), Old Witch Grass (*Panicum capillare*), Mayweed (*Anthemis cotula*), Yellow Cress (*Radicula paulstris*), Field Mustard (*Brassica arvensis*), Night-flowering Catchfly (*Silene noctiflora*), Scotch Thistle (*Onopordum acanthium*), Corn Flower (*Centaurea nigra*), Black Bindweed (*Polygonum convolvulus*), Mint (*Mentha* sp.), Water Hemlock (*Cicuta maculata*), Musk Thistle (*Carduus nutans*), Stick Seed (*Lappula exhinata*), White Cockle (*Lycnhis alba*), Bedstraw (*Galium aperine*), Canada Thistle (*Circium arvense*), Barnyard Grass (*Echinochloa crus-galli*), Cow Cress (*Lepidium campestre*), Corn Gromwell (*Lithospernum arvense*), Mallow (*Malva rotundifolia*).

Alsike Seed.

Out of 45 samples of alsike seed tested none were found to be absolutely free from weed seeds; 4 only were free from the weed seeds covered by the Seed Control Act; 41 contained weed seeds covered by the Act.

The following were found to be the most common impurities in alsike seed: Night-flowering Catchfly present in 37 samples, Curled Dock present in 17 samples, Sheep Sorrel present in 16 samples, Lamb's Quarters present in 11 samples, Green Foxtail present in 7 samples.

Other weed seeds found in alsike were: Bladder Campion, Bugle Weed (*Lycoups virginicus*), Rib-grass or Buckhorn, Rough Cinquefoil (*Potentilla monspeliensis*), Wormseed Mustard, False Flax, Chickweed (*Stellaria media*), Canada Thistle, Black Bindweed, Lady's Thumb, Black Medick, Common Plantain, Old Witch Grass, Pigweed, Ragweed, Yellow Cress, Yellow Foxtail, Evening Primrose, Pepper Grass (*Lepidium* sp.), Mayweed, Mouse-ear Chickweed (*Cerastium vulgatum*), Shepherd's Purse (*Capsella bursa-pastoris.*)

Red Clover Seed.

Out of 78 samples tested 1 was absolutely free from weed seeds; 21 were free from the weed seeds covered by the Seed Control Act; 56 contained weed seeds covered by the Seed Control Act; 5 samples contained large amounts of grit and other inert matter.

The following were found to be the most common impurities in red clover seed: Green Foxtail present in 50 samples, Buckhorn or Ribgrass present in 35 samples, Curled Dock present in 26 samples, Lady's Thumb present in 21, Ragweed in 20, Lamb's Quarters present in 17 samples, Pale Plantain (*Plantago rugelii*), Night-flowering Catchfly, and Sheep Sorrel present in 12 samples.

Other weed seeds found in red clover were Mayweed, Wild Oats (*Avena fatua*), Black Medick, Canada Thistle, Yellow Foxtail, Common Plantain (*Plantago Major*), Bladder Campion (*Silene latifolia*), Heal-all (*Prunella vulgaris*), Pigweed, False Flax (*Camelina sativa*), Bracted Plantain (*Plantago aristata*), Catnip (*Nepeta cataria*),Wormseed Mustard (*Erysimum cheiranthoides*), Stickseed, Evening Primrose (*Onagra biennis*), Old Witch Grass, Barnyard Grass, Cow Cress, Knot Grass, Black Bindweed, Wild Carrot, Wild Vetch (*Vicia cracca*), Dodder.

Timothy Seed.

Out of 33 samples tested 3 were entirely free from weed seeds, 17 contained no weed seeds covered by the Seed Control Act, 13 contained weed seeds covered by the Act.

The following were the commonest impurities found in timothy seed: Pale Plantain present in 16 samples, Lamb's Quarters present in 11 samples, Evening Primrose present in 8 samples, Ribgrass or Buckhorn present in 7 samples, Pepper Grass and Cone Flower (*Rudbeckia hirta*) present in 6 samples.

Other weed seeds found in timothy were: Mint, Ergot (*Claviceps purpurea*), Blue Vervain (*Verbena hastata*), Night-flowering Catchfly, Spiny Annual Sow Thistle, Old Witch Grass, Finger Grass (*Digitaria sanguinale*), Wormseed Mustard, Common Plantain, Rough Cinquefoil, Green Foxtail, Bugle Weed, Curled Dock, Mayweed, False Flax, Lady's Thumb, Sheep Sorrel, Catnip and Mouse-ear Chickweed.

SECTIONS OF THE SEED CONTROL ACT.

[Reprinted from The Revised Statutes of Canada, 1906, Vol. III Chap. 128, embodying the amendments passed January 28, 1910.]

Prohibitory Clauses.

Section 6.—No person shall sell, or offer, expose or have in his possession for sale, for the purpose of seeding, any seeds of cereals, grasses, clovers or forage plants, unless they are free from any seeds of the following weeds: Wild Mustard or Charlock (*Brassica sinapistrum*, Boiss.);

Wild Radish (*Raphanus raphanistrum*, L.) ; Tumbling Mustard (*Sisymbrium sinaspistrum*, Crantz.) ; Hare's Ear Mustard (*Coringia orientalis* (L.) Dumort) ; Ball Mustard (*Neslia paniculata*, Desv.) ; Field Pennycress or Stinkweed (*Thlaspi arvense*, L.) ; Wild Oats (*Avena fatua*, L., and *Avena strigosa*, Schreb.) ; Bindweed (*Convolvulus arvensis*, L.) ; Perennial Sow Thistle (*Sonchus arvensis*, L.) ; Ragweed (*Ambrosia artemisiaefolia*, L.) ; Great Ragweed (*Ambrosia trifida*, L.) ; Purple Cockle (*Lychnis Githago*, Lam.) ; Cow Cockle (*Vaccaria vaccaria* (L.), Britton) ; Orange Hawkweed or Paint Brush (*Hieracium aurantiacum*, L.) ; and *Hieracium praealtum*, Vill.) ; and from the Sclerotia known as Ergot of Rye (*Claviceps purpurea*, Tul.) ; unless each and every receptacle, package, sack or bag containing such seeds, or a label securely attached thereto, is marked in a plain and indelible manner,—

(a) With the full name and address of the seller;

(b) With the name of the kind or kinds of seed;

(c) With the common name or names of the weeds hereinbefore named, the seeds of which are present in the seed sold or offered, exposed or had in possession for sale. 4-5 E. VII., c. 41, s. 3.

Section 7.—No person shall sell, or offer, expose or have in his possession for sale, any seeds of timothy, red clover, alsike, alfalfa, or any mixture containing the said seeds, in or from any receptacle, package, sack or bag upon which is marked "No. 1," or any other designation which represents such seeds as of first quality, unless they are free from the seeds of weeds named in the last preceding section, and are also free from the seeds of White Cockle (*Lychnis vespertina*, Sibth.) ; Night-flowering Catchfly (*Silene noctiflora*, L.) ; Bladder Campion (*Silene latifolia*, Mill.) ; False Flax (*Camelina sativa*, Crantz., and *microcarpa*, Andrz.) ; Canada Thistle (*Cnicus arvensis*, Hoffm.) ; Ox-eye Daisy (*Chrysanthemum Leucanthemum*, L.) ; Curled Dock (*Rumex crispus*, L.) ; Blue Weed (*Echium vulgare*, L.) ; Ribgrass (*Plantago lanceolata*, L.) ; Chicory (*Cichorium Intybus*, L.) ; Alfalfa Dodder (*Cuscuta* species) ; and contain out of every one hundred seeds not less than ninety-nine seeds of the kind or kinds represented, or seeds of other useful and harmless grasses and clovers, of which ninety-nine seeds, ninety seeds must be germinable. 4-5 E. VII., c. 41, s. 4.

Section 8.—No person shall sell, or offer, expose or have in his possession for sale, for the purpose of seeding in Canada, any seeds of timothy, alsike, red clover or alfalfa, or any mixture containing the said seeds, if the seeds of the weeds named in this Act are present in a greater proportion than five to one thousand of the seed sold, or offered, exposed or held in possession for sale. 4-5 E. VII., c. 41, s. 6.

Section 8a.—No person shall sell, or offer, expose or have in his possession for sale, for seeding, any seeds of cereals, grasses, clovers, forage plants, field roots or garden vegetable crops which are not capable of germinating in the proportion of two-thirds of the percentage standard of vitality for good seed of the kind, unless every receptacle, package, sack, or bag containing such seed, or a label securely attached thereto, is marked in a plain and indelible manner with the name of the kind of seed and the percentage of the seeds that are capable of germination.

Regulations of the Governor in Council.

Sections 6, 7 and 8a are modified by subsections 2 (a) and 2 (aa). The regulations made by the Governor in Council, under section 2 of the Act, are subject to change. On April 18, 1910, an order in council was passed ordering that the regulations that were approved on August 26, 1905, be rescinded from and after the first day of July, 1910, and the following regulations made in lieu thereof:—

The number of seeds of the weeds named in sections 6 and 7 of the Seed Control Act that may be tolerated in any seeds, without affecting their character as being within the meaning of the said sections free from the seeds of the said weeds, shall be as follows:—

(a) For seed of oats, barley, wheat or other seeds that are similar in size to these grains, one weed seed in one pound avoirdupois.

(b) For seed of timothy, red clover and alfalfa, five weed seeds in one ounce avoirdupois.

(c) For seed of alsike, ten weed seeds in one ounce avoirdupois.

Standards of Purity for Timothy, Alsike, Red Clover and Alfalfa Seed.

The following table combines the standards of purity for timothy, alsike, red clover and alfalfa seed defined by the Act and fixed by order

Kind of seed.	Section 6. Weeds named in sec. 6 allowed without labelling.	No. 1 Quality, Section 7. Weed seeds named in Sec.'s 6 and 7 allowed.	No. 1 Quality, Section 7. Other weed seeds allowed. (1-100).	Section 8. (5 weed seeds per 1,000 of the good seeds).
	Maximum number per ounce.	Maximum number per ounce.	Maximum number per ounce.	Maximum number per ounce.
Timothy	5	5	822	410
Alsike	10	10	425	212
Red Clover ...	5	5	184	92
Alfalfa	5	5	145	72

EXPLANATION OF REPORT ON PURITY TEST.

*Timothy, alsike, red clover and alfalfa seed to be first quality or No. 1 must not contain weed seeds named in Sections 6 and 7 of the Seed Control Act in greater numbers than 5 per ounce of timothy, 10 per ounce of alsike, and 5 per ounce of red clover and alfalfa. The total number of all kinds of weed seeds, including those named in the Seed Control Act, must not exceed 13,142 per pound of timothy, 6,800 per pound of alsike, 2,944 per pound of red clover, or 2,320 per pound of alsike. Any seed containing weed seeds named in the Seed Control Act in greater numbers than 410 per ounce of timothy, 212 per ounce of alsike, 92 per ounce of red clover, or 72 per ounce alfalfa, is prohibited from sale for seeding purposes, under Section 8 of the Seed Control Act. Grades of the above mentioned seeds coming between these two standards fixed by the Act may be sold for seeding in Canada, under the conditions defined by Section 6 of the Seed Control Act; but they may not be graded No. 1 or given any designation or brand implying that the seed is of first quality.

The quantities of seed generally used for purity test are half an ounce of timothy, half an ounce of alsike, one ounce of red clover and of alfalfa. The report states the fraction of an ounce that was used in making the test and the number of the weed seeds named in the Seed Control Act that were found in the amount used. From this the number per ounce of the weed seeds named in the Act can be readily determined; and, as the total number of all kinds of weed seeds per pound is given in the report, the rating or grade of the seed can be arrived at. Thus, if a sample of red clover contains not more than 5 per ounce of the weed seeds named in the Seed Control Act, and does not contain a total of more than 2,944 per pound of all kinds of weed seeds, it will grade No. 1. If it contains more than 92 per ounce of the weed seeds named in the Act, it is prohibited from sale for seeding purposes. If it contains over 5 per ounce of the weed seeds named in the Seed Control Act but not more than 92, it can be legally sold, but it cannot be rated as first-class seed.

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*Seed Testing, Revised 1910, by Geo. H. Clark, Seed Commissioner.

A NUMBER OF COMMON WEEDS, WITH POPULAR DESCRIPTIONS AND NOTES ON ERADICATION

Descriptions of the Weed-seeds Illustrated on Opposite Page.

1. *Green Fox-Tail.* About one-twelfth of an inch long; oval with blunt ends; unequally bi-convex; brown and often mottled; surface granular and striate. Yellow Fox-Tail seed is about one-eighth of an inch long, plano-convex, with fine, distinct cross ridges.

2. *Chess.* About one-third of an inch long; back rounded; glume 7-nerved; middle nerve projecting as an awn; the palet bears a row of spine-like hairs along each nerve.

3. *Wild Oat.* About three-fourths of an inch long; spindle-shaped; glume 9-nerved, middle nerve forming a twisted and bent awn; a tuft of brownish hairs arise from scar at base.

4. *Couch Grass.* Seeds about one-half inch in length; rather slender; oval; and tipped with a short awn.

5. *Curl Dock.* One-eighth to one-twelfth of an inch long; pointed elliptical, with three faces; surface smooth; reddish brown.

6. *Sheep Sorrel.* Seeds about one-twentieth of an inch in length; usually greyish or reddish brown, and finely roughened; provided with three equal faces, egg-shaped, each face of the cover of the seed bears central ridges with branches.

7. *Lamb's Quarters.* Circular, lens-shaped, and black; grooved on one face; often partially covered with the seed covering.

8. *Purslane.* One-twenty-fourth to one-twenty-fifth of an inch in diameter; jet black; flattened egg-shaped; notches at smaller end; surface finely roughened.

9. *Corn Cockle.* Seeds from one-twelfth to one-eighth of an inch long; angular in outline; color jet black, occasionally dark brown; each surface is crowded with ridges or spines arranged in circular rows leading from the scar.

The small drawings beside the enlarged drawings represent the natural size of the seeds.

Descriptions of the Weed-seeds Illustrated on Opposite Page.

10. *Bladder Campion.* About one-sixteenth of an inch in length; kidney-shaped; surface roughened by many little projections arranged more or less in concentric rows; light brown in color.

11. *White Cockle.* Resembling Bladder Campion, but lighter in color; roundish and not so angular; depression about scar not so well marked.

12. *Night-Flowering Catchfly.* Resembles white cockle, but darker.

13. *Pepper-Grass.* About one-sixteenth of an inch in length; egg-shaped but much flattened; the groove is curved and quite evident; the scar is white; reddish yellow to reddish brown.

14. *Penny Cress.* Seeds one-twelfth of an inch long; somewhat egg-shaped and flattened; surfaces have 12-14 curved ridges, which start and end at the pointed end of the seed; color dark reddish brown.

15. *Wild Mustard.* One-sixteenth of an inch in diameter; dark brown to reddish brown in color; almost spherical in outline.

16. *Worm Seed Mustard.* About one-twenty-fourth of an inch in length; most are pointed at the end opposite the scar; the groove is quite evident; surfaces smooth and dull; reddish yellow in color.

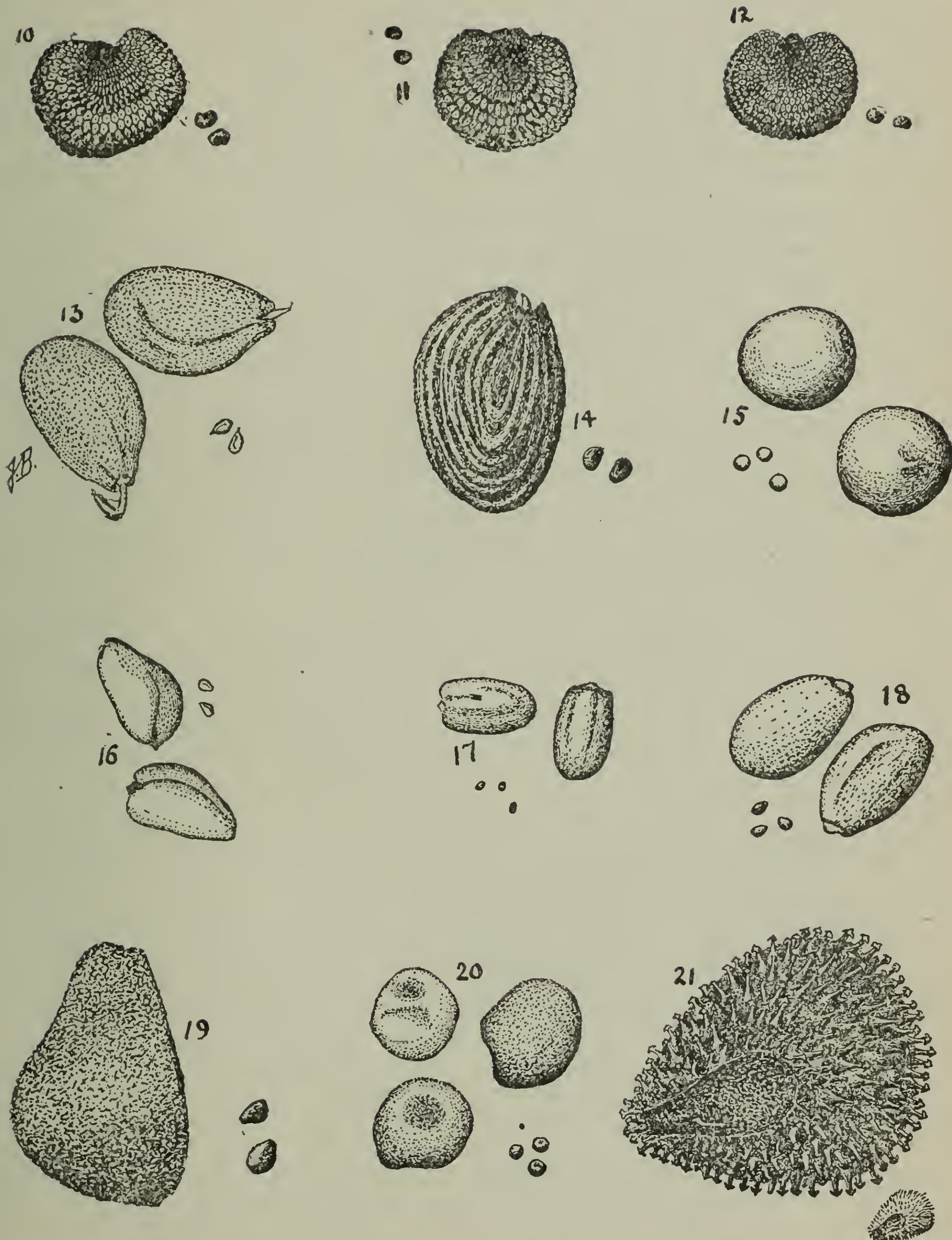
17. *Shepherd's Purse.* About one-twentieth of an inch in length; somewhat flattened; oval; each face has two grooves; color reddish yellow.

18. *Small Seeded False Flax.* Reddish brown; more or less oval and slightly flattened; about one-twentieth of an inch long; the groove more evident on one face than on the other; a whitish scar at one end.

19. *Field Bindweed.* About one-sixth of an inch long; oval; color dark brown; surface is somewhat roughened; outer face convex; inner face divided by a ridge into two plane faces.

20. *Dodder.* Ranging from one-sixteenth to one-twenty-fourth of an inch in length; slightly egg-shaped and flattened; notch near one end; resembles red clover seed, but is smaller, with a dull, roughened surface; color is yellow to brown and reddish, or often yellowish green.

21. *Hound's Tongue.* Seeds are spiny nutlets, one-eighth of an inch long; upper side flat, oblique and roughened with hooked prickles.



The small drawings beside the large drawings represent the natural size of the seed.

DESCRIPTIONS OF THE WEED-SEEDS ILLUSTRATED ON OPPOSITE PAGE.

22. *Blue Weed.* Stone-like in hardness; about one-tenth of an inch in length; surface roughened and of a gray color; the scar is large and triangular at flat end; the ridge along the outer face is convex.

23. *Mullein.* About one-twenty-fifth of an inch in length; thimble-shaped; base flat with scar at centre; thimble slightly six-sided, each side deeply pitted; pits of adjacent rows alternate; light to dark brown. The seeds of Moth Mullein and Common Mullein are much alike.

24. *Rib-Grass.* From one-eighth to one-twelfth of an inch in length; oval in shape with one face rounded, the other deeply grooved bearing a central scar; dark brown or amber colored.

25. *Ragweed.* Ranging from one-fifth to one-twelfth of an inch in length; top-shaped; apex-pointed, and bearing a crown of four to eight spines; light to brown in color.

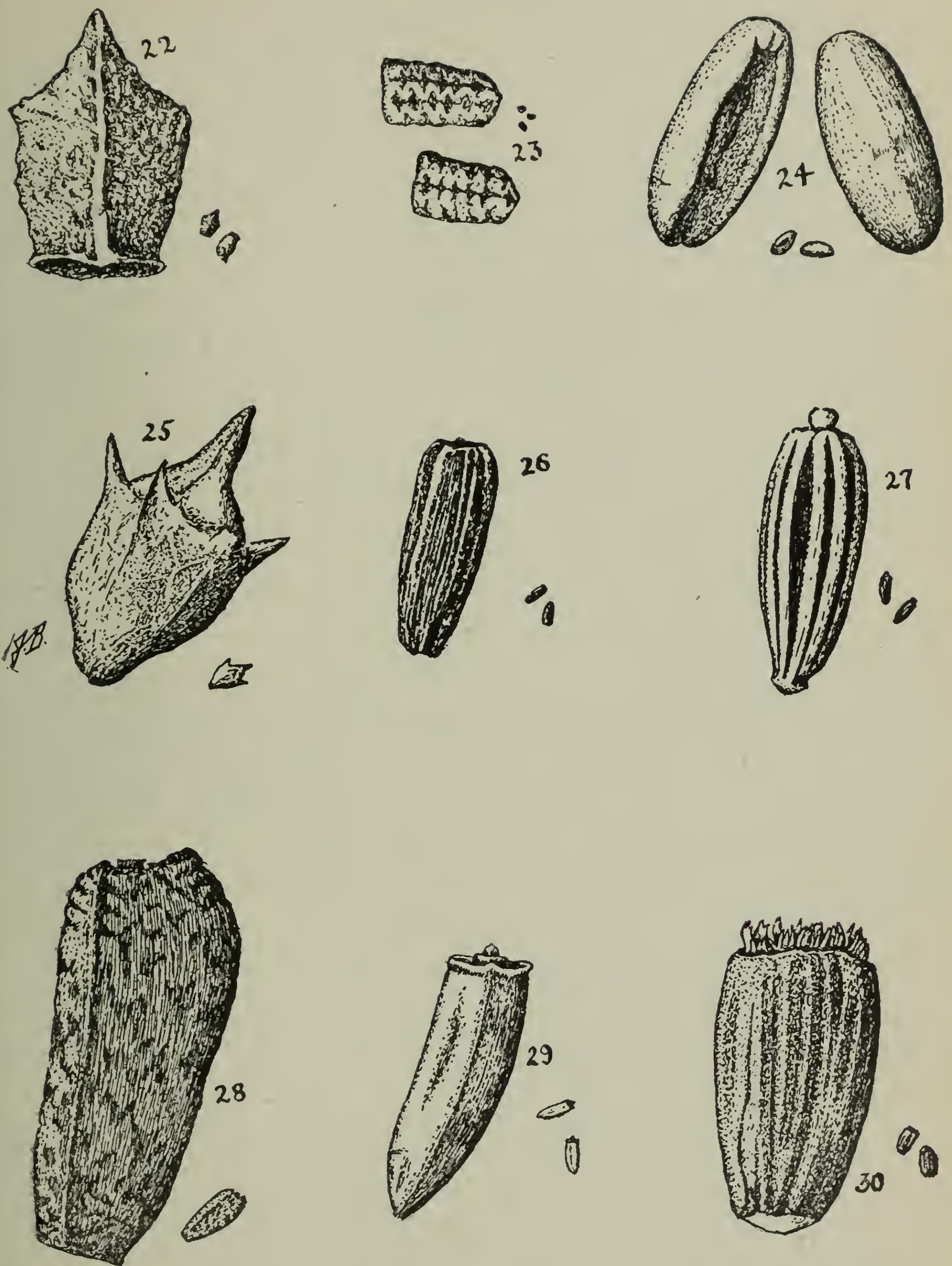
26. *Yarrow.* Seeds about one-twelfth of an inch long; small and thin; slightly egg-shaped; color varying from yellowish-white to gray.

27. *Ox-Eye Daisy.* About one-twelfth of an inch long; ten slender, white ribs running from end to end; a knob at the broad end; and slightly club-shaped.

28. *Burdock.* One-fifth to one-fourth of an inch in length; prismatic and mottled; four or five faces; apex broader than base; apex star in centre of a distinct brown ring.

29. *Canada Thistle.* From one-eighth to one-twelfth of an inch in length; brown in color; somewhat spindle-shaped, but often flattened; top end cup-shaped with a rim and a small central knob.

30. *Chicory.* From one-eighth to one-twelfth of an inch in length; usually light brown; usually cylindrical; top flat and crowned with scales.



The small drawings beside the enlarged drawings represent the natural size of the seeds.

Descriptions of the Weed-seeds Illustrated on Opposite Page.

31. *Prickly Lettuce.* Seeds one-eighth to one-sixth of an inch in length; broadly lance-shaped; each face has 5-7 ribs; color dark brown, somewhat mottled with black; apex is tipped with a beak which is almost as long as the seed.

32. *Spiny Sow Thistle.* One-eighth of an inch in length; varying from oval to lance-shaped; flat; each face bearing three narrow ridges which meet at the ends; surfaces smooth; color straw-colored to reddish brown.

33. *Perennial Sow Thistle.* Slightly spindle-shaped with blunt ends and often much flattened; five coarse, finely wrinkled ridges running lengthwise on each face; dark reddish-brown; about one-eighth of an inch long.

34. *Fleabane.* Seeds one-twentieth of an inch long; oval; remnants of pappus bristles remaining often at the apex.

35. *Dandelion.* Seeds one-eighth of an inch long; exclusive of short beak; lance-shaped in outline; ten ridges running lengthwise; provided with barb-like teeth towards the apex; color varies from light to dark brown.

36. *Wild Carrot.* Seeds each one-eighth of an inch in length; and flattened on the back; primary ribs slender, bristly, and five in number; secondary ribs, 4 in number, each bearing a row of barbed prickles.

37. *Pigeon Weed.* Nutlets one-twelfth of an inch long; egg-shaped and curved; scar is conspicuous; surface roughened; gray in color.

38. *Broad-Leafed Plantain.* Seeds about one-twentieth inch long; flattened; outline variable from oval to rhomboidal; wavy lines on surface; color, brown.

39. *Pig-Weed.* About one-twenty-fourth of an inch in length; flattened, egg-shaped, or lens-shaped; polished and jet black; a slight notch on sharp edge is the scar; near the scar-notch is a small projecting point.

The small drawings beside the enlarged drawings represent the natural size of the seeds.

Descriptions of the Weed-seeds Illustrated on Opposite Page.

40. *Barnyard Grass.* One-tenth of an inch long, plano-convex or mandolin-shaped. It is a smooth, glossy seed, and the color is usually greenish or grayish yellow.

41. *Witch Grass.* A small, shiny gray seed, about one-sixteenth of an inch long, oval and somewhat flattened bi-convex.

42. *Black Medick.* Often found in the black, ribbed pod or legume which is somewhat coiled up. The seed is egg-shaped, but otherwise resembles Alfalfa seed.

43. *Common Chickweed.* Very small seed, one-twenty-fourth of an inch in diameter, somewhat wedge-shaped, with a notch at the point. The surface is finely tubercled, in four or five looped rows on each of the parallel faces, and the color varies from reddish to gray.

44. *Cinquefoil.* Minute, yellowish-gray seeds, somewhat kidney-shaped, and covered with curved ridges.

45. *Orange Hawkweed.* Small torpedo-shaped seeds, about one-twelfth of an inch long, and grooved. Ripe seeds are dull jet black, immature seeds reddish.

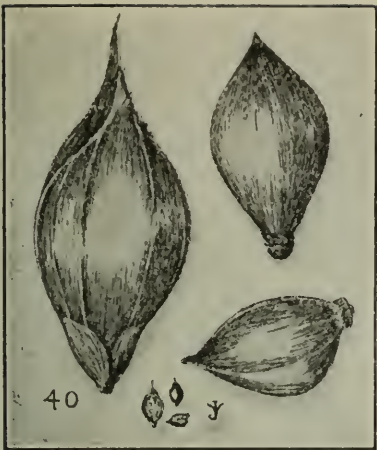
46. *Cone Flower, Yellow Daisy, Black-Eyed Susan.* A small dull-black seed, curved and somewhat angular, with fine longtiudinal striations on the four faces.

47. *Wild Lettuce.* A thin, flat, oval seed, with a slender beak or tip. It has a dull black color and faint cross-ridges, and is about one-sixth of an inch in length.

48. *Wild Buckwheat, Black Bindweed.* A jet black, shiny three sided seed, about one-eighth of an inch long. It is broadest near the abruptly pointed apex, and the sides are slightly concave, but the angles are rounded.

49. *Heal All, Self-Heal.* A brownish seed, about one-twelfth of an inch long, oblong-oval, tapering to a small white triangular scar-appendage at the base. Dark lines follow the margins and centres of the faces. These pretty double lines are characteristic.

50. *Evening Primrose.* An angular, reddish-brown seed, usually with a narrow wing along the edges. The four faces are finely roughened, and faintly ridged. Some seeds are pyramidal, some prismatic, others wedge-shaped, but commonly four-sided with one face rounded.



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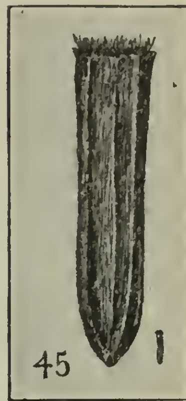

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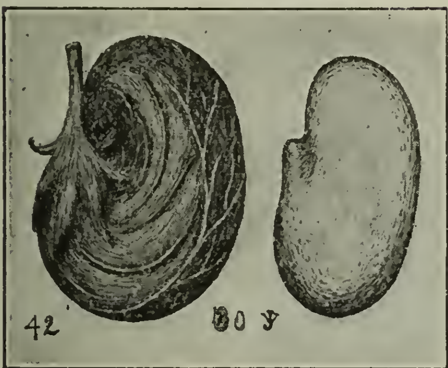

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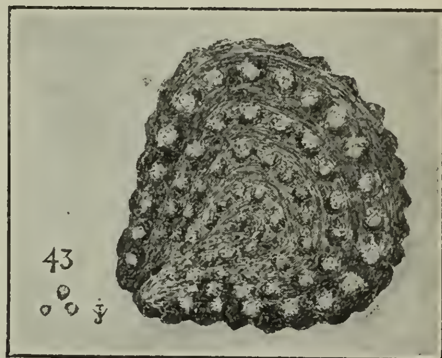

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HORSETAIL FAMILY (*EQUISETACEAE*).

Horsetail or Scouring Rush.

Equisetum arvense (L).

This plant is found in damp grass lands, in low places in cultivated fields, and on apparently dry sandy land which has a poorly drained subsoil. If fed in quantity in hay it is poisonous to horses.

The Horsetails appear in early spring as small pale stalks with yellowish or brownish heads. Later in the season feathery, tail-like leafy green shoots appear. These are frequently described by correspondents as being like little pine trees. It is this form of the plant which is usually noticed in cultivated fields.

Eradication. The appearance of this weed in any quantity always indicates lack of proper underdrainage. This lack supplied, the weed soon disappears from cultivated fields.

THE GRASS FAMILY (*GRAMINEAE.*)

Fig 1.

Fox-tail, Yellow Fox-tail or Pigeon Grass.

Setaria glauca (L).

A common weed in stubble, fallow or root fields. It has an annual root, with stems about two feet high, of erect habit of growth. At the summit of that part of the leaf which sheaths the stem (the ligule) there is a fringe of hairs. The leaves are flat, rough above, and smooth beneath. The dense, close spike, which resembles millet, is bristly and tawny yellow in color.

The seeds are 1/8 in. long, of various shades of brown in color, and with transverse wrinkles. They frequently retain their green color, and are quite commonly found as an impurity in clover and grass seed. (See Fig. 1, a.) An average plant produces about 15,000 seeds.

Time of flowering, July-September.

Time of seeding, August-October.

Eradication. Gangplow stubble ground about three inches deep early in the fall; as soon as the seeds have had time to sprout, cultivate thoroughly; repeat cultivation and rib the land with a double mould board plow the last thing before the frost. Put in a hoed crop (potatoes, roots or corn) next spring, and cultivate thoroughly throughout the growing season. Follow with a grain crop seeded with clover, without plowing after the roots, for if the land is plowed it is liable to bring more seed to the surface. When the sod is broken up, plow shallow in the latter part of harvest, cultivate with harrow and cultivator throughout the fall, and rib up as above.

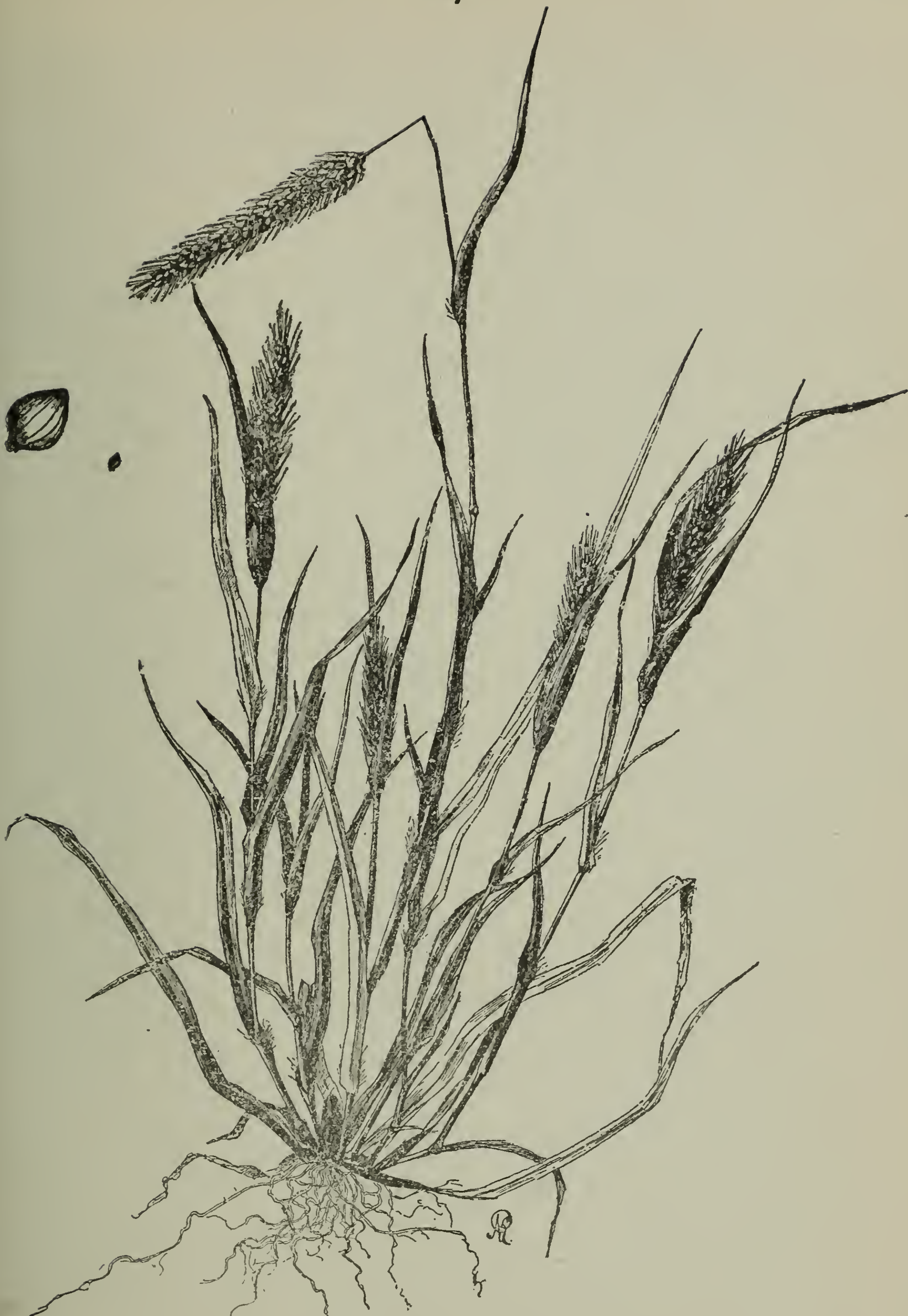

FIG I.

YELLOW FOX-TAIL.

(*Setaria glauca.*)

In the early after-harvest cultivation of stubble ground, some harrow the stubble as the first step; and when the weed seeds have sprouted under their light covering, then gang-plow and harrow, and stir afterwards with the cultivator as time permits throughout the fall.

Green Fox-tail.

Seteria viridis (L.).

A grass very similar to Yellow Fox-tail and found in similar situations. It can, however, be distinguished from Yellow Fox-tail by the denser spike with green or golden bristles, and by the seeds which are smaller and with the cross ridges less distinct. The seeds are very frequently found in clover and grass seed. The method of eradication is the same as for Yellow Fox-tail.

Fig. 2.

Chess, Cheat or Wheat Thief.

Bromus secalinus (*L*).

A weed naturalized from Europe. It is a winter annual, with fibrous roots and rough, coarse leaves. It has large spikelets, dark green in color, of characteristic shape, and grows from three to four feet high.

Many look upon Chess as degenerated wheat, because it appears among fall wheat that has been winter-killed. This idea is erroneous and without foundation. The fact is that Chess will mature seed under adverse conditions, even though the plant be only a few inches high. The seed possesses great vitality, and is often found in wheat and rye.

Chess is most commonly found among wheat and rye.

The flour made from it is dark-colored, and has narcotic principles. Care in the selection of seed grain and careful cultivation, tending to prevent the maturing of the seeds, are the chief remedies. The planting of a crop that can be harvested before the Chess matures is a good plan in badly infested localities. An average plant produces about 1,000 seeds.

Time of flowering, June. Time of seeding, July.

" Chess is a typical plant belonging to the genus *Bromus*. Wheat belongs to the genus *Triticum*. Chess will produce Chess and only Chess, and a seed of wheat cannot be sown to produce Chess, and Chess cannot produce wheat under the most favorable conditions of growth.

" In instances where parts of a plant, apparently a combination of Chess and wheat, were so united as to seem but one plant, close examination proved them to be parts of separate plants, and that the apparent union was not real."

Eradication. Avoid sowing Chess in seed grain. The seed is comparatively short-lived and a four-years' rotation exclusive of winter grain will clean it out of the soil. Patches in grain fields should be cut before

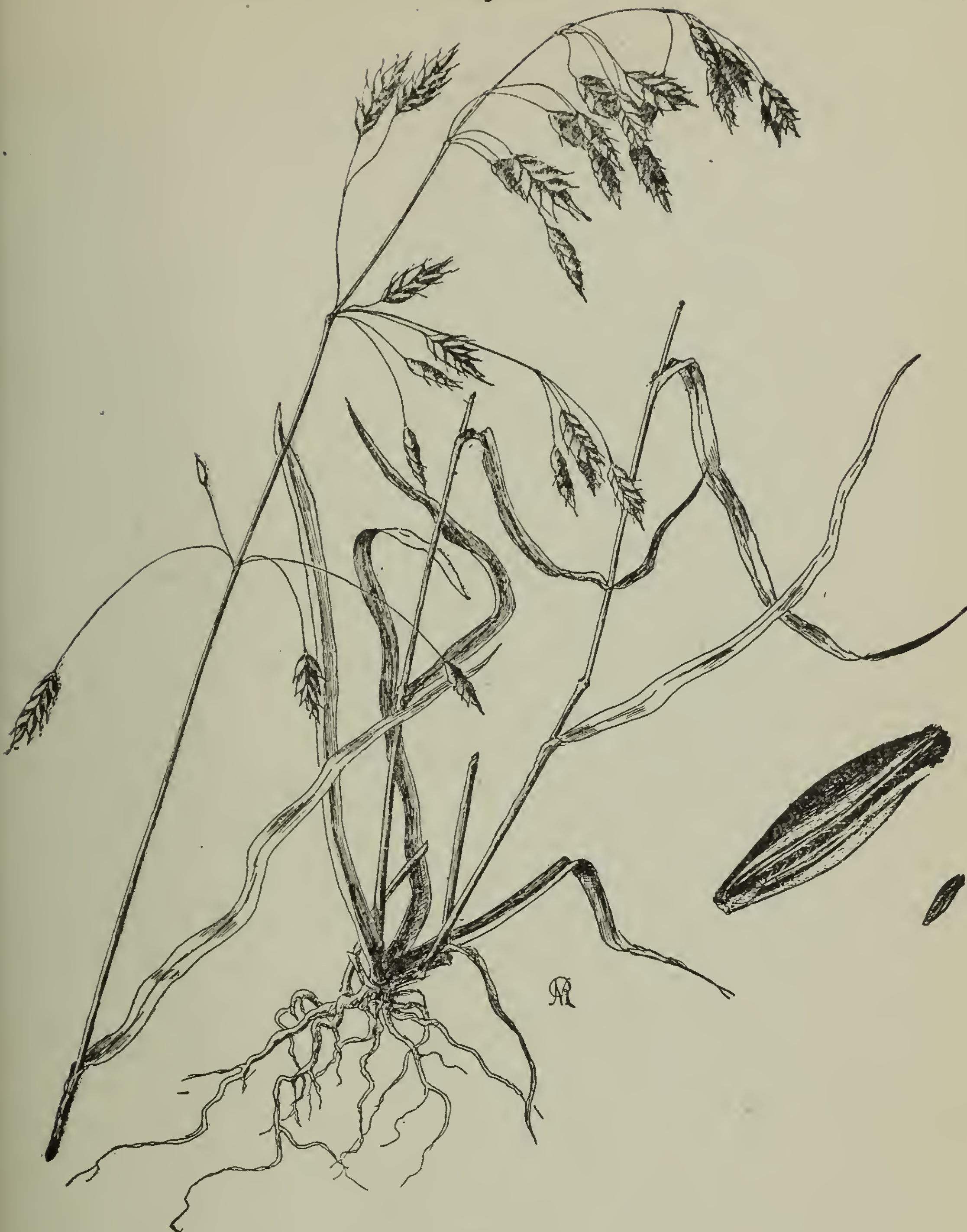

FIG. 2.

CHESS.

(*Bromus secalinus.*)

the plants mature their seeds. Thick seeding with early red clover is recommended for badly infested fields. The first crop of hay should be cut before the Chess has had an opportunity to produce seeds. Shallow, after-harvest cultivation will do much to keep this pest in check.

Fig. 3.

Wild Oat.

Avena fatua (L.).

An annual weed with erect and smooth stems. The leaves and stems are covered with white bloom, which give a peculiar white-green color to the whole plant. The head forms a loose panicle, with nodding and spreading branchlets. The awn is long and bent, and covered with brown hairs. It is bent most when dry; but if moistened, it uncoils and wriggles around, thus causing the seed to move appreciable distances.

The principal points of difference between the wild and cultivated oats are (1) In the former the chaff is thick and hairy, while in the latter it is thin and hairless; and (2) The wild oat has a long, stiff awn which is bent and twisted when dry, while the cultivated oat either has a much smaller and less stiff awn or none at all. An average plant produces about 800 seeds.

Time of flowering, July. Time of seeding, July-August.

Dispersal—Conveyed from place to place by threshing machines, and as an impurity in seed-grain.

Wild oats are at home in any soil that will grow cereals, and they ripen their seeds among almost any cereal crop. The seeds possess wonderful vitality, some of them remaining buried in the soil for years and germinating as soon as they are brought under favorable conditions.

Eradication. On a field infested with wild oats, cereal crops should be dropped out of the rotation as far as possible; and hoed crops, soiling crops, hay, and pasture should take their place. To get the land under grass, it should be fallowed during part of the season, the cultivation being frequent and shallow, to destroy all seeds that may have germinated in the upper layer of the soil. The land can then be sown with winter wheat and seeded, or with an early variety of barley, which should be cut on the green side. The treatment mentioned is suitable for pasture land, or land which has produced a hay or soiling crop during the forepart of the season. Two hoed crops in succession will do much to exterminate this pest.

Fig. 3.

Wild Oat.

(*Avena fatua.*)

FIG 4.

COUCH-GRASS, TWITCH-GRASS, QUACK-GRASS, QUITCH-GRASS, OR QUICK-GRASS; ALSO WHEAT-GRASS.

Agropyron repens (L.).

Couch-grass is a creeping perennial which grows from 1 to 3 feet high. It has a jointed root-stock which penetrates deeply into the ground and possesses great vitality. The plant produces spikes from 3 to 8 inches long. The small spikelets alternate at each notch of the flower stalk, with the side of the spikelet turned towards the stalk.

The seeds are about ½ in. long, and rather slender (Fig. 4). An average plant produces 400 seeds.

Time of flowering, June-July.

Time of seeding, July-August.

Dispersal—The root-stocks are carried around by implements, and the seeds are occasionally found in seed-grain.

Whatever value Couch-grass may have for pasture, its habit of taking and keeping possession of the soil renders it extremely objectionable. It flourishes best in loamy or humus soils, from which it is especially difficult to eradicate.

Eradication. As soon as the crop is harvested plow lightly, then harrow with the ordinary harrow, and, if necessary, cultivate with the spring-tooth cultivator. This shakes the roots free from the soil and makes it possible to gather them up with the horse rake. Burn as soon as they have dried sufficiently. Repeat this process two or three times. If the weather at this time should happen to be dry and hot, so much the better. Late in the fall rib up the land into drills, and allow to stand over winter. The frost, in all probability, will render material assistance in the eradication. The following spring plow about the end of May, cultivate well, and put in some hoed crop, or summer fallow, sowing buckwheat, the crop to be plowed in. A carefully cultivated crop of rape is recommended as being particularly effective in destroying this pest.

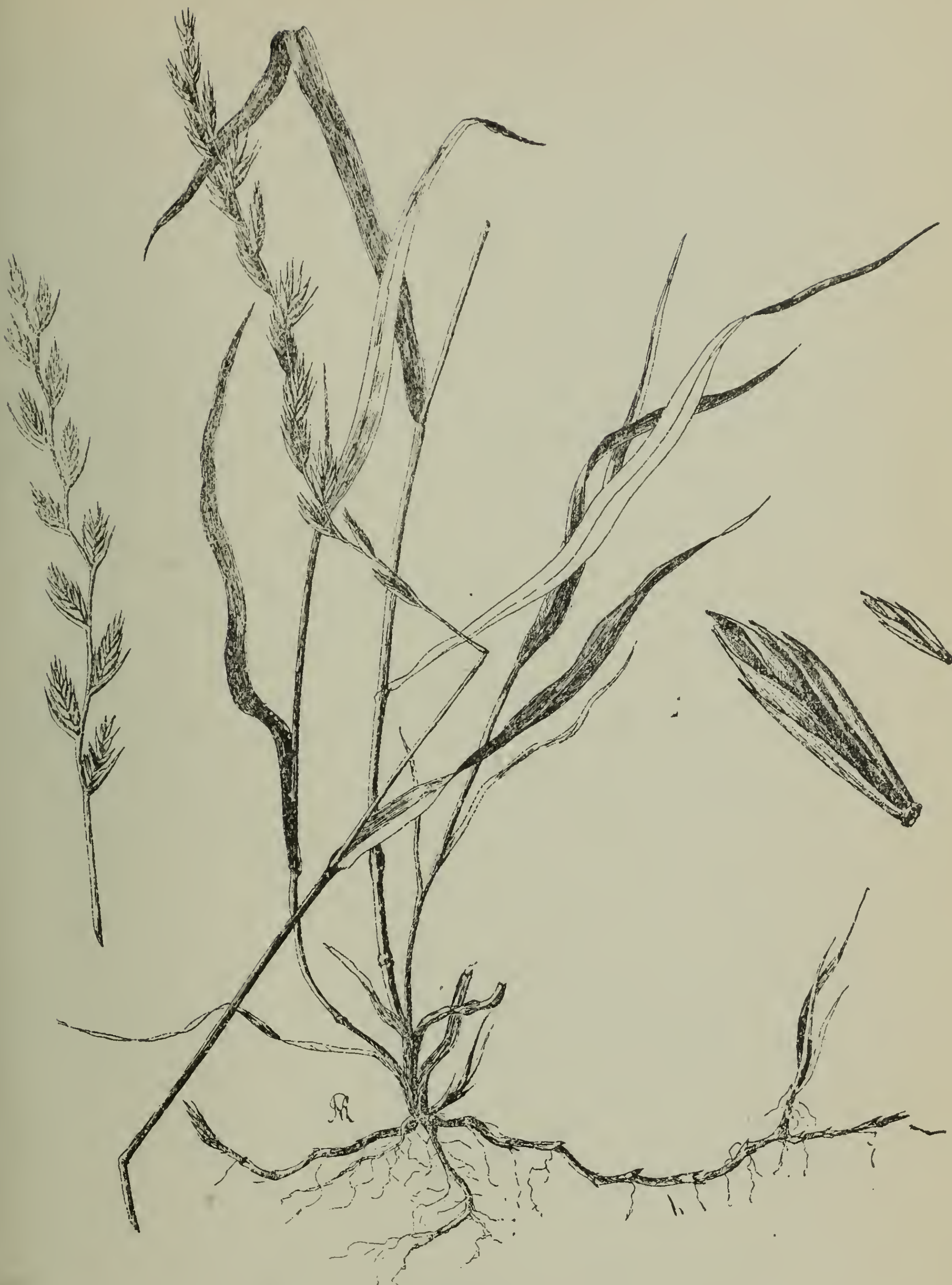

FIG. 4.

Couch Grass on right of figure and part of a stalk of perennial *rye-grass* (*Lolium perenne*) on left. Note the arrangement of spikelets in rye-grass.

FIG. 5.

SKUNK-TAIL GRASS, WILD BARLEY, OR SQUIRREL-TAIL GRASS.

Hordeum jubatum (L.).

This grass is very troublesome in the West, and is now quite frequently found in many parts of Ontario, especially along railways.

A native perennial grass forming tufts from 8 to 12 inches high. Leaves are pale green in color, from 3 to 4 inches long with rough margins. Flowers are in a silky, bristly spike, from 3 to 4 inches long, pale yellowish green in color. The seed is slender, sharp-pointed, somewhat resembling a small barley seed, and has a long upwardly barbed awn.

Eradication. Cut the plants whenever they appear in waste places, and thus prevent them from going to seed and spreading. This weed is not troublesome in cultivated crops. If it becomes abundant in pastures, mow as soon as the heads come out. This will not injure the other grasses in the meadow.

OLD WITCH GRASS OR TUMBLE GRASS.

Panicum capillare (L.).

An annual grass, very common in neglected hoed crops, gardens and waste places. Plants stout, with hairy leaves and large, finely branching, loosely spreading tops (panicles) which are often seen rolling over the ground on windy days in the fall of the year.

BARNYARD GRASS OR COCKSPUR GRASS.

Echinochloa crusgalli (L.).

This grass is often abundant in hoe crops, headlands and waste places. The seed occurs occasionally in commercial seeds. A coarse annual grass from one to three feet high with broad leaves. Inflorescence 1 to 3 inches long, consisting of several one-sided branches crowded together and bearing numerous short awned spikelets. Seeds dark green to brown, flat on one side, rounded on the other, 1/8 inch long, very smooth and shining.

Eradication. Proper cultivation of hoe crops and taking care to cut in waste places before it seeds will cause it to disappear.

FINGER GRASS OR CRAB GRASS.

Digitaria sanguinalis (L.) (Scop.).

A troublesome grass in lawns and sometimes in low fields. A much branched, leafy annual, from ten inches to two feet high, spreading on the

Fig. 5.
Skunk-tail Grass.
(*Hordeum jubatum.*)

ground and frequently rooting at the lower joints of the stem. The leaves are from two to four inches long with rough margins. Flowers are produced in spikes which come off from the stem like the fingers on the hand, hence the common name, Finger Grass.

Eradication. A much harder grass to eradicate than the Fox-tails because it roots so readily at the joints. Repeated cultivation after harvest will do much to destroy it. Spud out patches in lawns and stir the soil with a rake and sow heavily with lawn grass seed when the ground is moist.

THE BUCKWHEAT FAMILY (*POLYGONACEAE*).

Fig. 6.

Dock, Curled Dock, Sour Dock, or Yellow Dock.

Rumex crispus (L.).

A deep-rooted perennial weed introduced from Europe.

It occurs around buildings, in neglected lanes, along waysides and in pastures. The stem is quite slender, and the leaves are from six to twelve inches long, with wavy margins; hence the common name, "curled dock." The flowers are in racemes, green in color.

The seed is winged, and is carried considerable distances by the wind. The manner of attachment of the seed to the wing is shown in illustration (Fig. 6). The seeds are light brown in color, triangular, with sharp edges and tapering point. They are smooth and shiny.

The wind acts as an agency in scattering the seed, and it is a very common impurity in clover and other seeds used on the farm.

An average plant produces about 17,000 seeds.

Time of flowering and seeding, July-August.

Eradication. In most cases this weed can be kept in check by the frequent introduction of well-cared-for hoed crops into the rotation. The shorter the rotation, the better. The later sown hoed crops, especially rape, are more effective than those sown earlier in the season. Before the hoed crop is sown, this weed may be kept from breathing above ground by going frequently over the field with a broad-shared cultivator, which will cut the plants an inch or two below the surface; but, as the roots are tough and strong, it may sometimes be necessary to use the gang-plow, or even the single plow. About the 1st of July, the land may be sown with rape in drills, say 26 inches apart, and kept clean, or nearly so, by the horse-hoe and more or less hand-hoeing. The rape can be pastured off in the usual way during the fall; and, occasionally, it may be necessary to put another hoed crop on the same ground the following spring, say a crop of corn; but much depends upon the timeliness, regularity, and thoroughness with which the hoeing is done.

Fig. 6.
Curled Dock.
(*Rumex crispus.*)

Fig. 7.

Sorrel, or Sheep Sorrel.

Rumex acetosella (L.).

A perennial with running root-stocks. The stem is slender and erect with branches. The leaves are spear-shaped and quite characteristic. The flowers occur in racemes, and are green in color. The foliage has a pronounced acid taste.

The seed is 1-16 in. long, triangular, smooth, and shining when naked, but dull brown when invested by its covering. An average plant produces about 10,000 seeds.

Time of flowering, June-September.

Time of seeding, July-October.

Propagation—By its running root-stocks, and as an impurity in clover seed, especially Alsike.

Eradication. Sorrel is usually an indication of a poor, sandy, or gravelly soil. It prefers acid soils, hence liming and manuring are effective remedies when the land is well tilled. The remedies given for the Dock (Fig. 5) are applicable to Sorrel, only it requires more frequent use of the broad-shared cultivator, which should be used so as to cut the roots just below the surface of the soil, without bringing up any of the creeping root-stocks.

Lady's Thumb, or Smartweed (*Polygonum Persicaria*). This plant grows to a height of 12 to 18 inches. Its leaves are lance-shaped, usually with a blotch near the centre. It is an annual and is often abundant.

Treatment. Prevent from seeding, and sow clean seeds.

Fig. 7.

Sheep Sorrel.

(*Rumex acetosella.*)

Fig. 8.

Wild Buckwheat or Black Bindweed.

Polygonum convolvulus (L.).

An introduced annual found commonly in cereal crops throughout Ontario. It is a twining herb with branching stems and thin, smooth, arrow-shaped leaves. Flowers small, greenish, in clusters in the axils of the leaves and at the end of the stems. Seed, black, buckwheat-shaped, ⅛ of an inch long, but when found in grain the outer black coat is often missing and the seed is then white and waxy in appearance.

Time of flowering, from June to September; seeds ripe about the middle of July.

Dispersal—By seeds.

Eradication. Sow pure seed grain. Cultivate lightly after harvest and cause the seeds to germinate, then harrow out the young plants.

FIG. 8.
WILD BUCKWHEAT.
(*Polygonum convolvulus.*)

THE SPINACH OR GOOSEFOOT FAMILY (*CHENOPODIACEAE*).

FIG. 9.

LAMB'S QUARTERS, OR GOOSEFOOT.

Chenopodium album (L.).

An annual weed widely distributed in cultivated land. It grows to a height of from 2 to 6 feet. The stem is grooved and much branched. The leaves are whitish green below and dark green above. The flowers are inconspicuous and greenish in color.

The seed (Fig. 9) is black and shining, lens-shaped and round, about 1-16 in. in diameter.

Time of flowering, June-October.

Time of seeding, August-October.

Distribution—By seeds, especially as an impurity in clover and grass seeds.

Eradication. Late cultivation is especially necessary in combating this weed, as it flowers and seeds till very late in the season. The land should be gang-plowed shallow and harrowed immediately after harvest, and cultivated at intervals until late in the fall, when it may be plowed or ribbed up for a hoed crop the following spring. Subsequent treatment the same as for Foxtail (Fig. 1).

Oak-leaved Goosefoot. Usually spreads on the ground. Its leaves are like minute white oak leaves.

Maple-leaved Goosefoot. Grows erect, with large, thin, triangular leaves.

Strawberry Blite. Resembles the last, but has red seed clusters.

Spreading Orache. Somewhat resembles Lamb's Quarters, but has larger and thicker leaves, goosefoot shape. It is much branched or spreading and the seed covers are warty.

Fig. 9.

Lamb's Quarters.

(*Chenopodium album.*)

FIG. 10.

RUSSIAN THISTLE.

Salsola Kali, var. *tenuifolia* (G. F. W. Mey).

This is a new weed which has appeared on many farms in Ontario during the past season. It has been introduced as an impurity in Alfalfa seed. A large percentage of the samples of Alfalfa seed examined at the Department of Botany this spring, 1907, contained the seeds of this weed, and already this fall several specimens of the weed, found in Alfalfa fields, have been sent in for identification. The Russian Thistle is a very serious pest in several of the Western States, and is found in the Prairie Provinces, but has not yet been reported as being very troublesome there. The plants, when ripe, break off at the surface of the ground and are rolled long distances by the wind, scattering their numerous seeds on their journey. It is this tumbling habit that makes this weed particularly adapted to the prairie lands of the West, and it probably will never be a serious pest in Ontario where fences, trees and other obstructions will prevent its being spread far and wide by the wind.

Description. The Russian Thistle is a native of Europe and Western Asia. It is a nearly smooth, bushy branched annual, from 1 to 3 feet high. Mature plants are more or less spherical in form. The stems and branches are red in color. The leaves are awl-shaped, 1 to 2 inches long, soft and fleshy when young, very prickly pointed when mature. The flowers are inconspicuous, being small, without petals, and solitary in the axils of the leaves. The seeds are about 1-12 of an inch long, obconical in general outline, with a cup-shaped depression at the upper end in the centre of which is a pointed projection; color dull grey or green, embryo spirally coiled.

Eradication. The Russian Thistle being an annual weed is not hard to exterminate. If once cut off at the surface of the ground it never grows again, and hence in well cultivated fields it is not likely to prove a pest. The chief danger lies in neglect. A single plant produces an enormous number of seeds, and if a few specimens are allowed to mature they will seed down a whole field and cause serious trouble the following year, especially in a crop which does not allow of the frequent use of the cultivator. Farmers in Ontario should, therefore, be on the lookout for this weed and destroy any specimens they may find in their fields, fence corners, or along the road sides. If a field is neglected until it becomes seeded, repeated plowing will be required in order to clean it. *" When

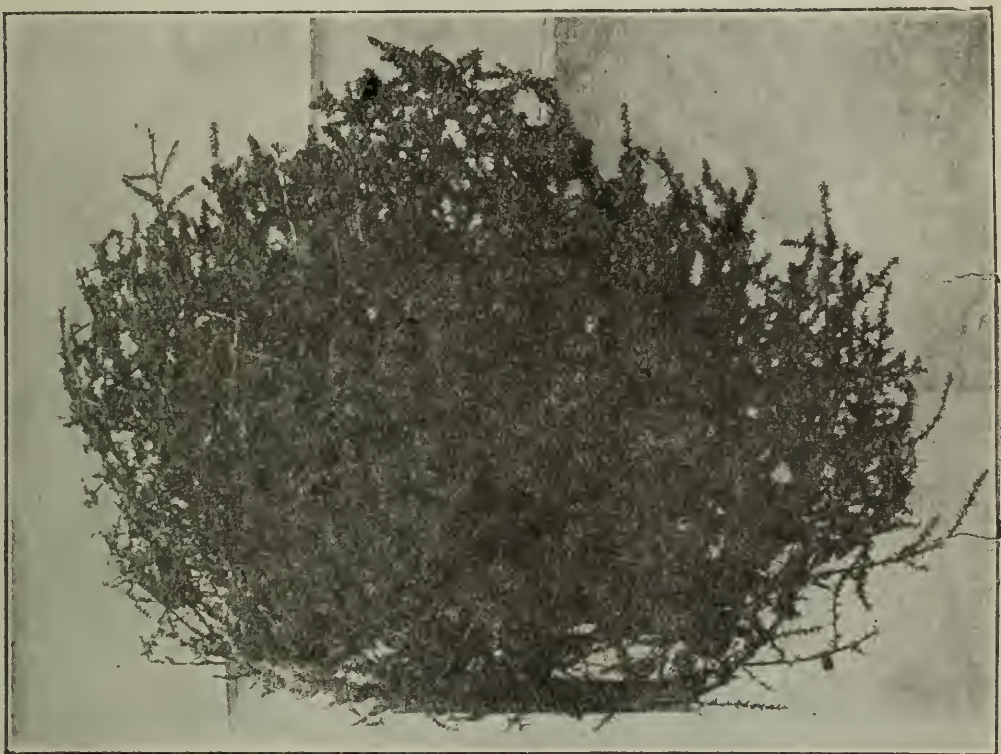

FIG. 10.

RUSSIAN THISTLE.

the plant is not more than six inches high careful plowing with a drag chain from the end of the doubletrees to the plow beam, dragging back so as to have every plant dragged under the furrow, with harrowing to fill every crevice between the furrows, will destroy every plant that cannot get its leaves to the surface."

*" Farm Weeds of Canada," by George H. Clark and Dr. James Fletcher.

THE PIGWEED FAMILY (*AMARANTHACEAE*).

FIG. 11.

PIGWEED, OR REDROOT.

Amaranthus retroflexus (L.).

An annual, with pink root, stout, erect stem, and many branches. it grows from 1 to 6 feet high. The leaves are light green in color, and ovate in shape. The flowers are in spikes, which terminate branches, or are from the axils of the leaves, and are green in color.

The seeds (Fig. 11) are round and lens-shaped, smooth, and shiny black in color, resembling the seed of Lamb's Quarters, but slightly smaller and thinner. An average plant produces 15,000 seeds.

Time of flowering, July-September.

Time of seeding, August-October.

Dispersal—The seed is distributed by the wind and as an impurity in grass seed.

Eradication. Special attention must be given to fall cultivation of the soil, so as to prevent plants from ripening, and to sprout and destroy the seeds which have fallen upon the ground. The land should be gang-plowed shallow and harrowed immediately after harvest, and cultivated at intervals until late in the fall, when it may be plowed or ribbed up for a hoed crop the following spring. Subsequent treatment the same as for Foxtail (Fig. 1).

Tumble Weed, or White Pigweed (*Amaranthus graecizans*). This plant resembles Russian Thistle quite closely, but can be distinguished from it by its round, shiny, jet-black seeds, and by its leaves, which, although small, have a definite blade. It is a low branched annual when growing in sandy, open fields and roadsides.

Treatment. Prevent the maturing of the seeds which ripen in August. The plants, as a rule, are conspicuous, and may be readily collected and *burned*. The seeds are often found in grass-seed mixtures.

Spreading Amaranth (*Amaranthus blitoides*), forms large mats on waste ground, along roadsides and walks.

FIG. 11.

PIG-WEED.

(*Amaranthus retroflexus.*)

THE PINK FAMILY (*CARYOPHYLLACEAE*).

FIG. 12.

CORN SPURREY.

Spergula arvensis.

This is an annual weed introduced from Europe. It is found chiefly on sandy soil. It grows from 18 to 15 inches high. The flowers are small, white and in loose, terminal clusters. The leaves are needle-like in whorls at the joints of the stem. The seeds are dull black mottled with brown, round and flattened with the margin extended into a narrow rim.

Time of flowering, July; seeds ripe July to August.

Dispersal.—By seeds.

Eradication. Frequent stirring of the soil to make the seeds sprout and frequent harrowing to destroy the seedlings.

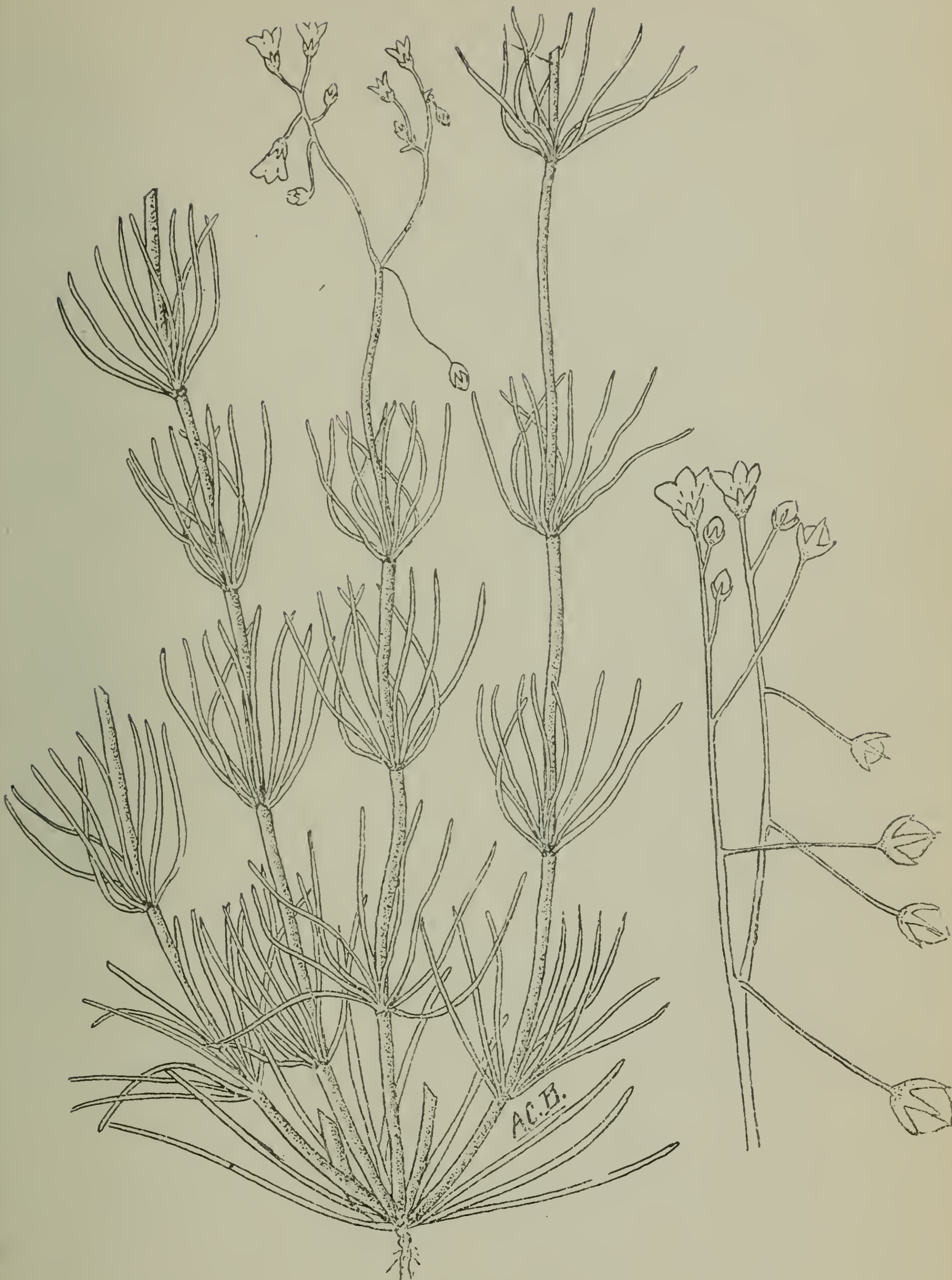

Fig. 12.

Corn Spurrey.

(*Spergula arvensis.*)

FIG. 13.

CORN COCKLE, OR CORN CAMPION.

Agrostemma githago (L.).

An annual adventive from Europe, about 1 to 3 feet high, with erect habit of growth. It has but few branches, and the stems are all very hairy, with whitish-green hairs. The leaves are rather long and narrow, with pointed ends. The flowers are red to purple, and the flower cup (calyx) has long lobes, three or four times the length of the petals.

The seed capsules are generally well filled with seed which is black in color and kidney-shaped, with tubercles (small conical projections) arranged in rows around the sides of the seed. (See Fig. 13.) The seed is about 1-8 in. across. An average plant produces about 500 seeds.

Time of flowering, July.

Time of seeding, August.

Dispersal—By birds, in manure, and as an impurity in seed.

It may be noted, in passing, that the seed is injurious to young chickens, and the husks of the seed often elude the miller and appear as black specks in flour, which is seriously damaged thereby. An old writer, Gerarde, says:

"What hurt it doth among corn (wheat) the spoyle unto bread, as well in colour, taste, and unwholesomeness, is better known than desired."

Eradication. Sow clean seed; and when the weed is not very thick pull it by hand. Otherwise use the same treatment as for mustard.

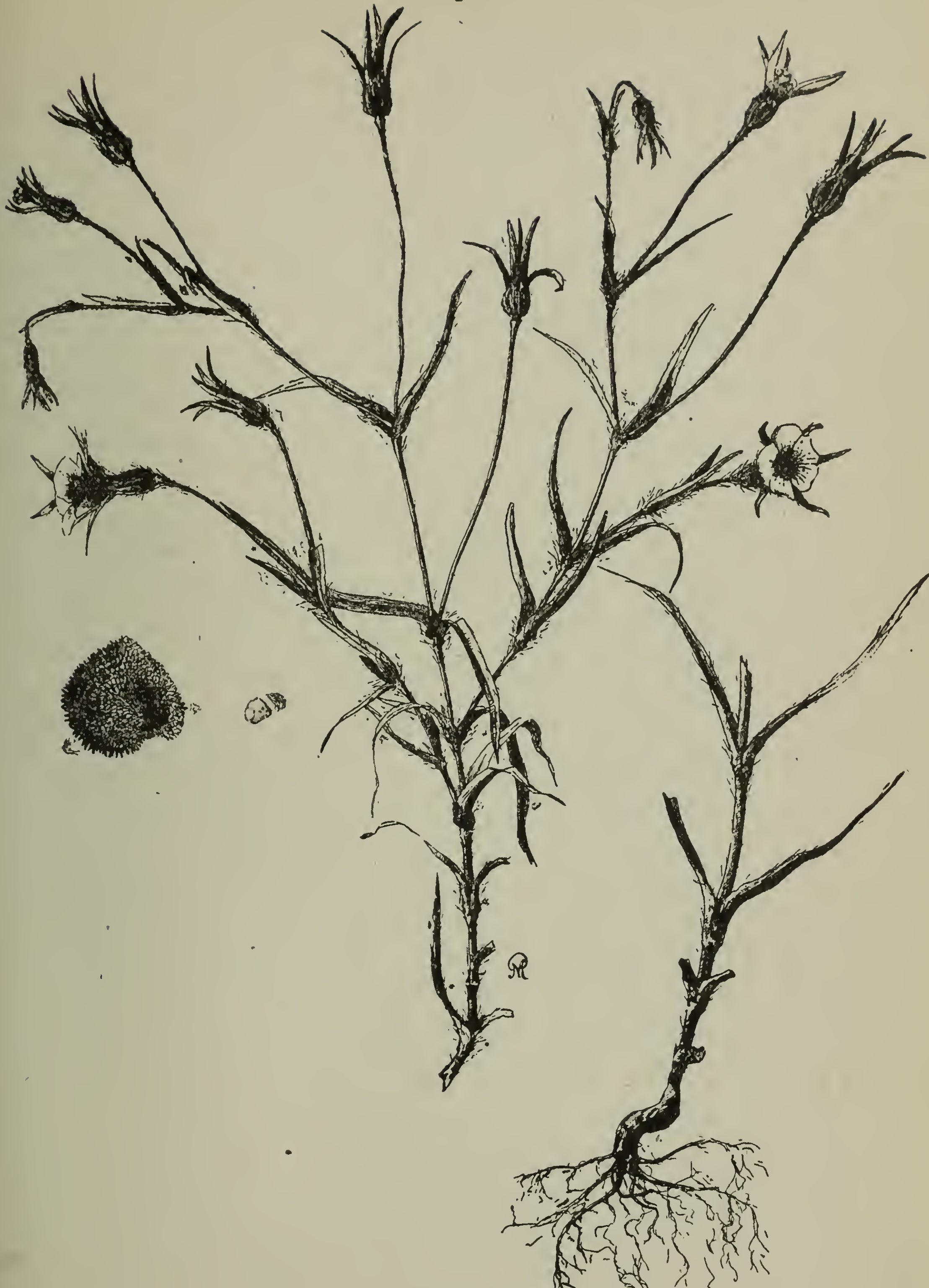

FIG. 13.
CORN COCKLE.
(*Agrostemma githoga.*)

FIG. 14.

BLADDER CAMPION, COW BELL OR BLADDER WEED.

Silene latifolia (Mill).

This is another bad weed which is becoming a serious pest on many farms in Ontario and about which a great many enquiries have been made during the past two years. It is spread chiefly as an impurity in clover seed. A large number of the samples of clover seed, especially those of red and alsike clover, sent to the Department of Botany this past season for examination as to purity, have been found to contain the seeds of this weed. As it is a free seeder, and very difficult to exterminate once it becomes established, too much care cannot be taken to secure clover seed free from this impurity, and to dig up by the roots and burn any stray specimens that by any means may find their way on to the farm.

Description. The Bladder Campion is a naturalized, deep rooted, freely branching, perennial weed belonging to the Pink Family (*Caryophyllaceae*). It grows from six inches to two feet high. The leaves are ovate lanceolate, smooth, in pairs with their bases meeting around the stem. The flowers are white, nearly an inch in diameter and borne in loose clusters which are often drooping. The petals are two-cleft and the calyx much inflated and bell-shaped, with distinct purplish veins. It is from the inflated calyx that the plant derives its common names, Bladder Campion, Bladder Weed and Cow Bell. The capsule or "seed pod" is enclosed by the inflated calyx and opens at the top by 5 short recurved teeth. This weed flowers from June to August and matures seed from July to September. Large quantities of seed are produced. They are about 1-16 of an inch in length, irregularly kidney-shaped, light brown to dark grey in color, the surface covered with regularly arranged rows of tubercles. Typical seeds show a marked depression at the scar. This character, and the more conical shape of the tubercles, make it possible for a careful observer to distinguish them form the seeds of the Night-flowering Catchfly and White Cockle, which they resemble very closely.

Eradication. The roots of this pest are very long, thick, and much branched. A good-sized plant will have a root over two feet long with numerous deep rootstocks. A weed with such an underground root system is necessarily hard to combat. Some means must be taken by which the deep roots and rootstocks can be destroyed. Small patches should be carefully dug out early enough in the season to prevent seeding, taking pains to get every piece of the root and rootstocks. Badly infested fields should be plowed deeply immediately after harvest; and then thoroughly cultivated and cross-cultivated with the broad-shared cultivator in order to cut up and weaken the underground root system. The following spring continue this deep cultivation at intervals of about two weeks until it is time to put in a hoed crop, which must be kept thoroughly clean in order to be effective.

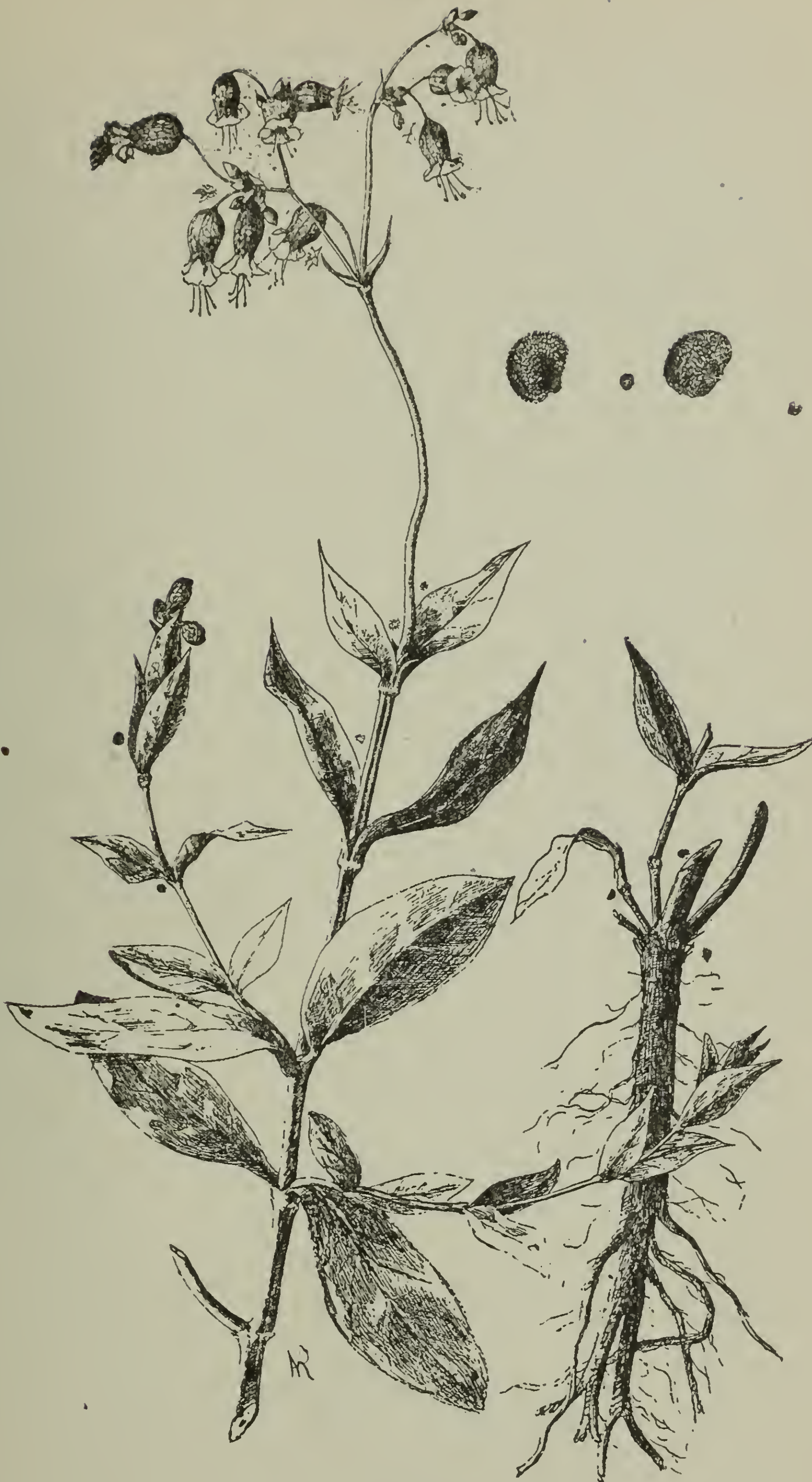

FIG. 14.

BLADDER CAMPION.

(*Silene latifolia.*)

Fig 15.

White Campion, or White Cockle.

Lychnis alba (L.).

A biennial weed introduced from Europe, with hairy and branching stems from 1 to 3 feet high. Like the Night-flowering Catchfly, it has a viscid secretion, which attracts many insects. The leaves are oblong, with acute tips. The flowers are in loose panicles, white or pink in color, and nearly ¾ in. broad. As a rule, they open at night, and remain so until the morning of the following day. The pod has short teeth around the top, which curl back when dry, and the seeds are distributed by the winds swaying the stem, when the seeds drop out. In wet weather these teeth straighten out and completely close the opening at the top.

The seed (Fig. 15) is grey in color and kidney-shaped, with tubercles regularly disposed over the surface. An average pistillate plant produces 10,000 seeds.

Time of flowering, June-August.

Time of seeding, July-August.

Dispersal—By wind and as an impurity in seeds.

Eradication. Exercise great care in cleaning seed grain, and examine all purchased grain with a sharp lookout for this seed. If the weed be on the farm, follow the method outlined for Fox-tail (Fig. 1).

Cow Cockle or Cow Herb.

Saponaria Vaccaria (L.).

A weed common in grain fields in the West. The seed is often found in grain from the West. During the past few years it has been found in many parts of Ontario, but has not yet become a serious pest in this Province. It is a smooth, glaucous, annual plant, from 1 to 2 feet high. The leaves are oval lance-shaped, opposite and clasp the stem at the base. Flowers are bright pink, about ½ inch in diameter. Seed pod is enclosed in the inflated, 5-angled calyx and contains about 20 black, spherical seeds about 1-12 inch in diameter, with the surface minutely pitted.

Time of flowering, July; seeds ripe in August.

Dispersal—by seeds only.

Eradication. The plant being conspicuous is easily hand pulled. Fall and spring cultivation will do much to clean badly infested fields.

The Night-flowering Catchfly (*Silene noctiflora,* L.), resembles the Bladder Campion; but it is an annual, tall and very leafy, with a viscid secretion all over its stem, often so profuse that the stems and leaves are covered with small insects entangled in it. It opens at night and possesses a fragrant smell. It is not so bad a weed as its relative, the Bladder Campion. In Fig. 14 are shown the seeds of these two plants, natural size and enlarged. That on the left is Bladder Campion, that on the right is the Night-flowering Catchfly.

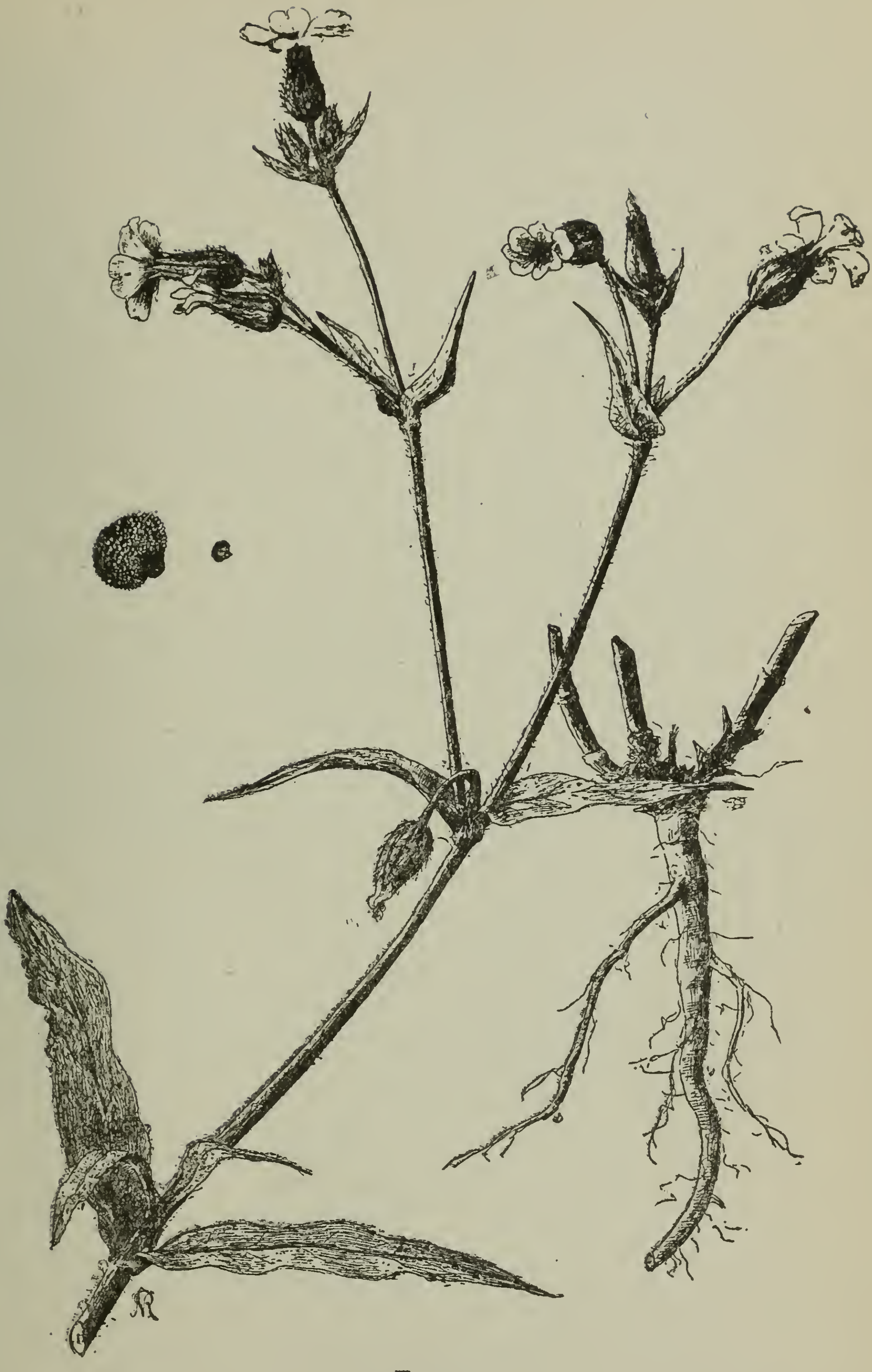

Fig. 15.
White Cockle.
(*Lychnis alba.*)

PURSLANE FAMILY (*PORTULACACEAE*).

FIG. 16.

PURSLANE, OR PURSLEY.

Portulaca oleracea (L.).

Purslane is pre-eminently a garden weed and is readily recognized by its fleshy leaves and stem, which lie prostrate on the ground. It is an annual.

The stems are red, and the leaves wedge-shaped and clustered at the ends of branches. The flowers are bright yellow, about ¼ in. across and open only during full sunlight for a few hours in the morning. The seeds (Fig. 16), in small capsules, are black, kidney-shaped, and extremely small. An average plant produces 60,000 seeds.

Time of flowering, July, until frost.

Time of seeding, August, until frost.

Dispersal—By seeds.

Purslane has been used as hog feed in very dry seasons, but the cost of gathering it is too great.

Eradication. Careful hoeing and constant cultivation. The latter should be as early as possible. The same treatment should be followed as that outlined for Foxtail (Fig. 1).

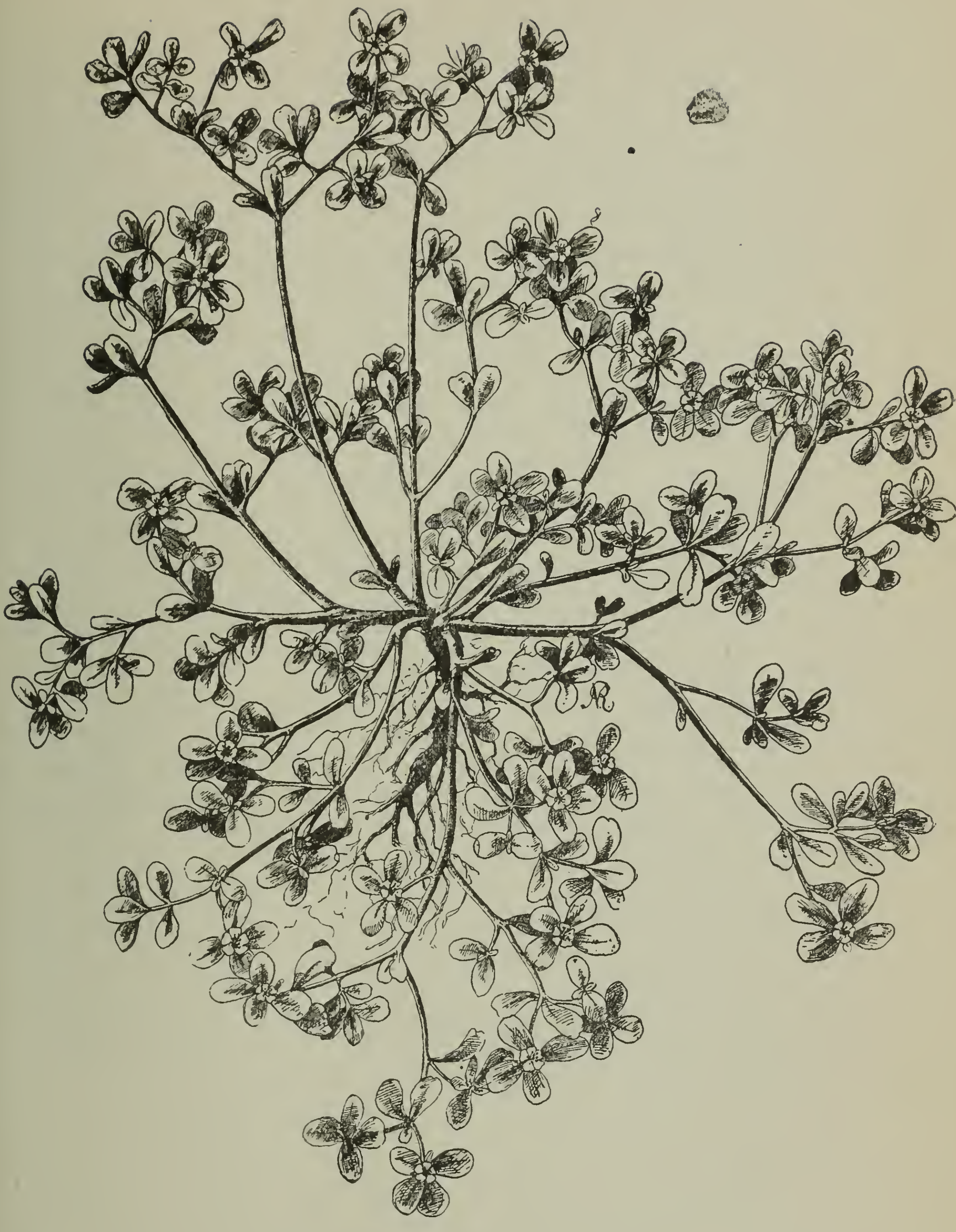

Fig. 16.

Purslane.

(*Portulaca oleracea.*)

THE BUTTERCUP FAMILY (*Ranunculaceae*).

FIG. 17.

TALL BUTTERCUP, TALL CROWFOOT, MEADOW BUTTERCUP.

Ranunculus acris (L.).

A noxious weed in low meadows and pasture lands. It crowds out the grass and cattle will not eat it on account of its hot tasting, blistering juice. It is seldom troublesome on well drained land under a short rotation of crops.

An introduced perennial weed with fibrous roots and an erect, somewhat hairy stem. The leaves are three-parted with the divisions again three-cleft with deeply lobed segments. Flowers are produced from early in June until frost. They are bright yellow in color and conspicuous. The dry seed-like fruits are in globose heads.

Time of flowering, June to September; seed ripe by July.

Dispersal—By seeds.

Eradication. When possible the land should be well drained and brought under cultivation, and not seeded down again until the weed has disappeared. On pasture lands which cannot be cultivated the weed should be cut closely two or three times each year; once early in June and again in July or August. This treatment to be successful must be repeated for two or three years.

FIG. 17.
TALL BUTTERCUP.
(*Ranunculus acris.*)

THE MUSTARD FAMILY (*CRUCIFERAE*).

FIG. 18.

PENNY-CRESS, BASTARD-CRESS, FRENCH WEED, WILD GARLIC, OR STINK-WEED.

Thlaspi arvense (L.).

A winter annual, introduced from Europe, and a very bad weed. It is very abundant in Manitoba, and is becoming rather common in Ontario. It grows as an erect plant, with a number of branches from the upper part. The leaves are numerous during the first of the season, and clasp the stem by ear-line lobes. The flowers are white and small, with spreading flower stalks. The pods which succeed the flower are very characteristic. They are nearly orbicular, about half an inch broad, quite flat, with a broad wing all around, and notched at the top. Fig. 18 shows this peculiarity. Each pod produces about twelve seeds, which are dark brown to black and oval in shape, with curved lines. An average plant produces about 20,000 seeds.

The plant has a peculiar odor, resembling that of garlic, hence some of the common names. The seed also has a very pungent taste. When eaten by milch cows, it imparts a disagreeable flavor to the milk.

Time of flowering, May-September.

Time of seeding, June-September.

Dispersal—Chiefly by the wind.

Eradication. Continuous growing of hoed crops with thorough cultivation thereof, followed by heavy seeding with rye. In places where the weed is very thick, mowing and burning is a good remedy. The method outlined for eradicating Mustard is applicable to this weed.

Fig. 18.
Penny-cress.
(*Thlaspi arvense.*)

FIG. 19.

PEPPER GRASS, OR TONGUE GRASS.

Lepidium apetalum (Willd.).

A native annual which grows from six inches to a foot and a half high. The stem usually has many branches, and the lower leaves terminate in a large lobe (with small lateral ones), with edges slightly cut in along the margin. The upper leaves are tapering. The flowers are small and white, with slender spreading flower stalks. The seed pods are round, with a very small wing at the top and a notch at the extremity. The end of a branch with seed pods is shown nearly natural size in Fig. 19.

The seeds are reddish brown, flat and oval in shape, and 1-16 in. long. The average plant produces about 18,000 seeds.

Time of flowering, June-August.

Time of seeding, July-September.

Dispersal—By birds and as an impurity in clover seed.

Eradication. Be careful to prevent the plants from seeding, and do not plow them under when half ripe, as many of the seeds will germinate even though partially matured. Pull and burn where only a few plants exist, and when they are numerous use the method employed for the eradication of Mustard.

FIG. 19.

PEPPER GRASS.

(*Lepidium apetelum.*)

Fig. 20.

Field Pepper Grass or Cow Cress.

Lepidium campestre (Br.).

This is a comparatively new weed in Ontario, about which many enquiries have been received during the past few years. From information gathered from correspondents it seems certain that it has been spread as an impurity in clover seed.

Field Pepper Grass or Cow Cress is an introduced annual or biennial weed belonging to the Mustard family (*Cruciferae*). It grows from 1 to 2 feet high and branches freely above. The basal leaves are petioled, oblong and entire; stem leaves spear-shaped, entire or slightly toothed and clasping the stem by their arrow-shaped bases. Flowers are small, white or yellowish in color. The seed pods are broadly ovate, boat-shaped, being rounded below and hollowed out above. They stand out stiffly from the stem on pedicels of about their own length. The seeds are reddish brown in color, about 1-12 of an inch long, sharply egg-shaped, rounded or somewhat flattened, and the surface is granular and slightly scurfy.

Eradication. Hand pull small patches. Cut clover early enough to prevent seeding. Plow up badly infested fields, and put in a hoed crop for one season.

FIG. 20.
FIELD PEPPER GRASS OR COW CRESS.
(*Lepidium campestre.*)

Fig. 21.

Shepherd's Purse.

Capsella bursa-pastoris (L.).

A winter annual, naturalized from Europe, with a long, deep, tap root. The root leaves are lobed and form a large rosette which lies close to the ground, and in this state it passes the winter. The following spring a more or less branched stem arises, with arrow-shaped leaves thereon. The flowers are very small and white in color, and are much less conspicuous than the seed vessels, which are triangular in shape, and are attached to the stalk or pedicel at the lower apex of the triangle. From the character of these pods, the plant obtains its scientific and common name. The triangular pod is divided down the centre by a partition, forming two cells, each of which contains from 10 to 12 seeds (Fig. 21). In size the plant varies greatly from a few inches to two feet, depending on the soil and locality. But even a very diminutive plant produces many seeds. The seed is very small, light brown in color, and oblong in shape (Fig. 21). An average plant produces over 50,000 seeds. Fig. 21 shows shape of seed, also the arrangement of seeds in the pod.

Time of flowering, early spring till the beginning of winter.

Time of seeding, early spring till the beginning of winter.

Dispersal—As an impurity in grass seed; also by birds, as the pods when ripe open and drop the seeds, which are eaten by birds, and often evacuated without digestion or injury.

Eradication. It easily succumbs to cultivation; and as the plant spreads only by seed, persistent effort should be made to prevent seeding.

Fig. 21.

Shepherd's Purse.

(*Capsella bursa-pastoris.*)

FIG. 22.

FALSE FLAX, OR GOLD OF PLEASURE.

Camelina sativa (L.).

This weed probably came to this country in imported flax seed. In Europe it is cultivated for the fine oil extracted from the seed, which is used in feeding cattle. Its common name arose from its supposed resemblance to flax.

An annual and winter annual, with simple or branching stems; the lower leaves are long, with a stem, or petiole; and the upper ones clasp the stem with arrow-shaped bases. The flowers are numerous, yellow, and somewhat inconspicuous. The seed vessel, or pod, is pear-shaped or globular, with a small projection from the upper end. The little stalks holding the pods are slender and spreading or ascending. The seed is brown and larger than that of Shepherd's Purse. (Fig. 22.) An average plant produces about 40,000 seeds.

Time of flowering, June-August.

Time of seeding, July-August.

Dispersal—As an impurity in flax and clover seed, and occasionally in grain.

Eradication. Plow lightly as soon as the crop is harvested. Harrow and then cultivate frequently throughout the autumn, to destroy the young seedlings. It is important that this autumn cultivation should be thorough. Grow a hoed crop the following year. The rotation of crops should be modified in the infested fields by dropping winter wheat out for a time. Grass seed should be sown along with the spring wheat or barley.

Fig. 22.

False Flax.

(*Camelina sativa.*)

Fig. 23.

Ball Mustard.

Neslia paniculata (Desv.).

A weed of European origin, common in grain fields in the western provinces and now becoming frequent along railway lines and in waste places in Ontario.

A slender annual or winter annual from 2 to 3 feet high. Leaves oblong, pointed and clasping the stem at the base. Flowers small, orange yellow in color, in long, slender terminal clusters (racemes). Pods round, veiny, ridged and containing a single yellow seed. They do not split open and are commonly taken for the seeds. They are frequently found in seed grain and screenings from the West.

Eradication. Avoid sowing seed grain containing the "seeds" of this weed. Hand pull and burn when in small quantities. Badly infested fields should be given thorough early after-harvest cultivation, followed by spring cultivation and a hoed crop next season.

FIG. 23.
BALL MUSTARD.
(*Neslia paniculata.*)

FIG. 24.

WILD RADISH.

Raphanus raphanistrum (L.).

This is a weed of European origin which is a serious pest in the Maritime Provinces and which has recently been introduced into Ontario. It is an annual and winter annual from 1 to 2 feet high. In general appearance it is like the Wild Mustard, but its yellow flowers have purplish veins on the petals and the pods are much more jointed in appearance. The seeds are 1-10 of an inch long, light reddish brown, oval in outline, and with the surface finely roughened.

Time of flowering, June to September; seeds ripe by August.

Dispersal—By seeds.

Eradication. Hand pull when it first appears to prevent it from spreading. If it becomes very plentiful, follow the method of cropping outlined for Wild Mustard.

FIG. 24.
WILD RADISH.
(*Raphanus raphanistrum.*)

FIG. 25.

WILD MUSTARD, CHARLOCK, OR HERRICK.

Brassica arvensis (L. Ktze.).

Among the worst weeds in Ontario is the Wild Mustard, an annual, naturalized from Europe, with fibrous roots and erect habit of growth. The stem is rough, with stiff hairs somewhat scattered over the surface. The branches arise from the upper part of the stem and bear oblong leaves and the lower leaves have one terminal large lobe and several smaller lateral ones (lyre shaped). The flowers are yellow, showy, and about ⅔ in. broad, with stout flower stalks, which are more noticeable when the plant is in fruit. The pods, which appear on the lower part of the stem whilst the top is still in flower, are from 1 to 2 inches long, and are either spreading or ascending.

The shape of the pod is characteristic; it is constricted between the seeds, thus giving the appearance of a rounded enlargement where each seed is borne. This appearance is termed "knotted." The pod terminates in a two-edged beak, and the two valves of the pod are strongly veined or ribbed.

The seed (see Fig. 25) is black, 1-10 in. in diameter, perfectly spherical, and very much like rape or turnip seed, and it retains its vitality for a long time when buried in the soil. An average plant produces 15,000 seeds.

Time of flowering, June-September.

Time of seeding, July-September.

Dispersal—By birds and implements, but chiefly as an impurity in seed.

Eradication. Owing to the great vitality of the seed, Mustard is a very hard weed to eradicate. The seeds, once in the ground, live for years, and continue to germinate as they are brought near the surface. Hence it takes patience, a great deal of labor, and a long time to get rid of the weed, when it once gets possession of the land. When present only in small amounts, hand-pulling is the best method, provided the pulling is done before seeds have formed; and as persons pulling in a hurry cannot wait to examine for seed, it is best to put the weeds, as they are pulled, in bundles where they can be burned when dry.

When fields are overrun with the weed, it is best to proceed as follows: Harrow stubble-ground early after harvest, or gang-plow and harrow. As soon as the seeds have had time to sprout, cultivate thoroughly; repeat cultivation at intervals; and rib up with a double mouldboard plow the last thing in the fall. Put in a hoed crop, either roots or corn, the following spring, and cultivate it thoroughly throughout the growing season. Cultivate and harrow well two or three times after roots or corn, having first run the plow along each row of corn roots to cut the roots and turn them up; and rib up before the frost. (If the

Fig. 25.
Mustard.
(*Brassica arvensis.*)

plow is used after roots or corn, it is likely to bring more seed to the surface.) Sow a crop of grain the following spring and seed with clover. Pull weeds by hand out of the grain crop; take a crop or two of hay, or pasture; and break up the clover sod, treating it as outlined in the note to Mr. Rennie's method of cleaning land. (See page 138.) When necessary at any stage in this method, use a grubber or subsoil plow to stir the soil to a greater depth than is reached by the surface cultivation.

Spraying with Chemicals.

Repeated tests have proved that solutions of blue stone (blue vitriol, or copper sulphate) or of green stone (copperas or iron sulphate) can be used successfully to destroy Mustard in cereal crops without injury to the standing grain.

The experiments conducted by the Botanical Department would indicate that iron sulphate is on the whole more satisfactory for this purpose than copper sulphate. A 20 per cent. solution of iron sulphate should be used (80 lbs. to 40 gallons of water) and the field should be sprayed on a bright, sunny day when the young Mustard plants are well up and just about to come into bloom. If the solution is applied too late some of the older plants will not be destroyed and may produce seeds, and the results, therefore, will not be entirely satisfactory. If copper sulphate is used a 2 per cent. solution (1 lb. in 5 gals. of water) is sufficiently strong. Stronger solutions would be apt to injure the crop.

An ordinary barrel sprayer with a hand pump or a potato sprayer with a broad-cast attachment can be used to apply these solutions. Further information on spraying to kill Mustard may be had by applying to the Botanical Department, O. A. C.

Fig. 26.

Hare's-ear Mustard.

Conringia orientalis (L.) (Dumort).

A weed which is quite general throughout the West, in grain fields, on stubble and by roadsides; spreading rapidly. It has been found in one or two places in Ontario. An annual and winter annual with a straight, slightly branched stem from 1 to 3 feet high. Whole plant smooth and when young covered with a bloom like that of a cabbage. Leaves somewhat fleshy, oblong oval, entire and clasping the stem by two rounded lobes. They resemble in shape a hare's or rabbit's ear, hence the common name, Hare's ear Mustard. Flowers are creamy white, about ¼ inch across. Pods are four-sided and 3 to 4 inches long. Seeds are dark reddish brown, 1-12 of an inch long, somewhat wheat-shaped, with the surface granular roughened.

Fig. 26.
Hare's-ear Mustard.
(*Conringia orientalis.*)

Time of flowering, July; seeds ripe in August and September.

Dispersal—By seeds.

Eradication. Hand pull small patches when the weed first makes its appearance. If a field becomes badly infested, try thorough, early, after-harvest cultivation.

Tumbling Mustard.

Sisymbrium altissimum (L.).

This Mustard, which is troublesome in the West, is now found in many parts of Ontario, though it has not yet become a pest in cultivated fields in this Province. The fact, however, that it produces great quantities of seed indicates that if neglected it may become a serious nuisance. It is therefore advisable that a watch be kept for it in order that any plants which appear in cultivated fields may be destroyed before they mature their seeds.

Tumbling Mustard is a bushy-branched annual or winter annual, from 2 to 5 feet high. The lower leaves are pinnatifid with the segments pointing backward (runcinate); the upper leaves are very variable in size and outline but are all deeply pinnatifid with narrow segments. The flowers are numerous at the end of the branches, pale yellow, and about ⅓ of an inch in diameter. They are succeeded by long, slender pods, each of which contains numerous seeds. The plants, when mature, break off near the surface of the ground and are rolled about by the wind, scattering their seeds as they go. It is from this tumbling habit that the plant gets its name, Tumbling Mustard. The seeds are very small, less than 1-24 of an inch in length. They are greenish yellow to olive brown in color and somewhat U-shaped. Being so very small they are not readily crushed by grinding and thus frequently find their way unharmed into chop. It has been estimated that a single plant may produce a million and a half seeds, but fortunately they do not appear to have the vitality of the seeds of Field Mustard.

Time of flowering, June to September; seed ripe in August.

Dispersal—By seeds.

Eradication. Pull stray plants along the roadsides and in waste places before they mature. Hand pull in fields unless very abundant. Badly infested fields may be cleaned by fall cultivation and harrowing over spring grain to destroy the seedlings.

Fig. 27.

Green Tansy Mustard.

(*Sisymbrium incisum* (Engelm.), var. *filipes* (Gray).

A common weed in grain fields in the West. In Ontario it is found chiefly along railways and in waste places. During the past year (1910) it was reported as growing as a weed in cultivated fields from one county

FIG. 27.

GREEN TANSY MUSTARD.

(*Sisybrium incisum.*)

in Ontario. It is a biennial weed and produces the first season a rosette of finely divided leaves which lie on the ground; the second season it produces a much branched stem from 2 to 4 feet high. Leaves bright green, much divided into fine segments. Flowers bright yellow, ⅛ of an inch across, borne in elongated clusters (racemes) and succeeded by narrow, smooth, slightly curved pods from ½ to ¾ inch long, on slender, spreading stems. Seed is brownish red, about 1-25 of an inch long, somewhat oblong in shape.

Time of flowering, July; seeds ripe in August.

Dispersal—By seeds.

Eradication. Hand pull. Thorough fall and spring cultivation will clean badly infested fields.

FIG. 28.

WORMSEED MUSTARD, OR TREACLE MUSTARD.

Erysimum cheiranthoides (L.).

A native weed, which seems to be spreading rapidly through the Province. Many specimens have been sent here for examination during the past year.

An annual or winter annual with erect and branching stems from 8 in to 2 ft. high. The foliage is bright green and abundant. The leaves are long, tapering at the base into a short petiole, and they are covered with T-shaped hairs. The flowers are yellow and about ¼ in. across. The little stalks (pedicels) holding the pods, come out from the stem obliquely, but the pod stands erect on the pedicel, parallel with the stem. The pod is about an inch long and four-angled, with one row of seeds in each cell. The seeds are 1-16 in. long and light brown in color, with a furrow on one side. An average plant produces 25,000 seeds.

Seeds give a bitter taste to feed containing them.

Time of flowering, June-July.

Time of seeding, July-August.

Dispersal—Frequently as an impurity in clover seed.

Eradication. Hand pulling and burning is the best remedy when the weed occurs in small quantities; but where there is much of it, the following procedure is advised: Harrow stubble-ground early after harvest, or gang-plow and harrow. As soon as the seeds have had time to sprout, cultivate; repeat the cultivation, and rib up the land with a double mould-board plow the last thing in the fall. Put in a hoed crop, either roots or corn, the following spring, and cultivate thoroughly throughout the growing season. Cultivate after the roots or corn, sow a crop of grain, and seed with clover. If not too much, pull weeds by hand out of the growing crop.

FIG. 28.
WORMSEED MUSTARD.
(*Erysimum chieranthoides.*)

Rocket, or Salad Rocket.

Eruca sativa (Lam.).

This is a weed recently introduced into Ontario. It is a native of Europe, and has been recently brought here in alfalfa seed. At a little distance it would easily be mistaken for Wild Mustard or Charlock, which it resembles closely in size, habit of growth, foliage and flowers. It requires, however, only a glance to distinguish it. The leaves are more or less deeply pinnately lobed. The flowers are light yellow and the petals are distinctly veined with purple. When the pods are present the plant can be known with certainty, for the upper third of these is a flat empty beak. As the plant has been introduced so recently we have little indication as to whether it is likely to prove a bad weed or not. It is not considered a bad weed in its native country, but that is not very safe ground for us to go upon, since some of our worst weeds are of little importance in the country of their origin. So far we have no information as to the persistence of the weed after the breaking up of the alfalfa and the putting in of a hoed crop. We should be glad if those whose attention is called to the matter would make observations to this end and so extend our exact knowledge of the habits of the plant.

Since it is a close relation to the Wild Mustard and is evidently a free seeder we think it advisable that farmers should take due precautions against it. We would recommend hand pulling before it goes to seed if it is present only in small quantity in grain. When in the hay crop and more numerous we would recommend cutting the alfalfa before the seeds of the Rocket can mature. The plant is an annual and if kept from seeding must rapidly die out. Too great care cannot be exercised in selecting seed free from the seeds of the weed.

THE ROSE FAMILY (*ROSACEAE*).

Fig. 29.

Rough Cinquefoil.

(*Potentilla monspeliensis* (L.).

A native annual weed found frequently in meadows and hay fields in some parts of Ontario. Stem erect, branching, rough-hairy. Leaves compound, with 3 somewhat oblong, oval, toothed leaflets. Flowers bright yellow, in terminal clusters (cymes). The seeds are light brown, about 1-30 of an inch long, blunt and slightly curved, with branching longitudinal veins on the surface.

Time of flowering, June to July; seeds ripe July to September.

Dispersal—By seeds, which are frequently found in timothy seed.

Eradication. This weed will not persist in cultivated crops. Repeated close cutting in hay fields, meadows and waste places will destroy it.

Fig. 29.

Rough Cinquefoil.

Rough-fruited Cinquefoil.

Potentilla recta (L.).

A perennial weed with larger, paler, yellow flowers than the last, and 5 to 7 leaflets in each leaf. It is reported as being troublesome in meadows and hayfields in some parts of Ontario. Breaking up the field and putting it under a cultivated crop should clean out this weed.

THE PEA FAMILY (*LEGUMINOSAE*).

White Sweet Clover.

Melilotus alba (Desr.).

This and the yellow species (*Melilotus officinalis*) are found commonly in vacant grounds and neglected fields about cities and along roadsides. They are tall, rank growing plants, and thrive best on heavy clay soils. They are biennials and produce the second year tall, tough, much branched stems which bear the sweet scented flowers so attractive to honey bees. These plants have the redeeming features of being nitrogen gatherers and good soil formers.

Eradication. Keep closely cut for two years in succession. Plants which are cut off early in the season may grow again and produce seeds before frost comes. Two or three cuttings are therefore often required in a single season.

Wild Tares or Perennial Vetch.

Vicia cracca (L.).

This is a perennial plant with a deep system of root-stocks. It is often reported difficult of eradication. The flowers are blue, and there are 10 to 12 pairs of leaflets to each compound leaf. This plant appears to persist most tenaciously in damp soil. The same cultivation which is used in controlling the Canada and Perennial Sow Thistles will subdue the Perennial Vetch.

THE EVENING PRIMROSE FAMILY (*ONAGRACEAE*).

Fig. 30.

Common Evening Primrose.

Oenothera biennis (L.).

A tall, stout, native biennial weed found frequently in Ontario in hay fields and on the edges of cultivated fields. The leaves are from 1 to 6 inches long, oblong to lance-shaped with wavy, slightly toothed margins.

FIG. 30.
COMMON EVENING PRIMROSE.
(*Oenothera biennis.*)

Flowers open in the evening and are large and bright yellow in color. Seed pods lie close to the stem and are about an inch in length. Seeds are reddish brown and irregular in outline, 4 to 5 sided.

Time of flowering, June to September; seeds ripe by August.

Dispersal—By seeds.

Eradication. Spud out plants on the headlands and in the fence corners. Never troublesome when a field is brought under cultivation.

THE PARSLEY FAMILY (*UMBELLIFERAE*).

FIG. 31.

SPOTTED COWBANE, OR WATER HEMLOCK.

Cicuta maculata (L.).

A weed of wet, marshy places. Cattle are frequently poisoned by eating the roots of this plant, especially early in the spring when pasture is scarce.

A smooth perennial from 2 to 5 feet high. Leaves compound, of 2 or 3 divisions, the stalks with expanding bases which clasp the stem, the leaflets lance-shaped and sharp-toothed. The flowers are small, white, and in flat topped clusters (umbels). The root consists of a number of spindle-shaped "tubers."

Eradication. Watch marshes and low places for this weed and hand pull any plants that are found. This is easily done if the roots are first loosened with a spud or other implement. Be sure to destroy the plants after pulling them.

FIG. 31.

SPOTTED COWBANE OR WATER HEMLOCK.

(*Cicuta maculata.*)

FIG. 32.

WILD CARROT, BIRD'S NEST, OR DEVIL'S PLAGUE.

Daucus carota (L.).

This is a biennial, naturalized from Europe, with a deep, strong tap root, a bristly stem, and much divided leaves like the cultivated carrot. The clusters of flowers are in compound umbels which resemble bird-nest cavities.

Time of flowering, July-September.

Time of seeding, August-December.

Dispersal—By seeds carried by wind and animals.

Eradication. Spudding is quite effective when the roots are cut before blossoming the first season. When the field becomes badly infested it should be plowed and cultivated and treated to a hoed crop, as described for the treatment of Blue-weed (page 94).

MILKWEED FAMILY (*ASCLEPIADACEAE*).

MILKWEED, OR SILKWEED.

Asclepias syriaca (L.).

This plant quite frequently appears in cultivated crops in Ontario, and once it becomes established its extermination is a difficult task.

It is a deep-rooted perennial weed, with a stout stalk from 2 to 5 feet high covered with soft hairs. Leaves large, lance-oblong to broadly oval with fine down on the under surface. Flowers dull purple to white in color and borne in compact clusters (umbels). Fruit, a large pod which opens down one side (follicle) to allow the white plumed seeds to escape.

Eradication. Cut early to prevent from seeding. Spud out scattered plants in meadows and grain fields. If a field is very badly infested break it up and follow one of the methods suggested for Perennial Sow Thistle.

Fig. 32.

Wild Carrot.

(*Daucus Carota L.*)

THE MORNING GLORY FAMILY (*CONVOLVULACEAE*).

Fig. 33.

Bindweed.

Convolvulus arvensis (L.).

A very troublesome weed which winds its tough and curling stems around the stalks of various plants, partially chokes them, and thereby hinders their growth. It is a perennial with a very extensive creeping root which penetrates far into the soil, and any piece of the root possessing one or more buds is capable of starting new plants; hence it is necessary to clean implements very thoroughly after they have been used in a field containing this weed. The stems are branched and either trail on the ground or climb by twisting around some other plant. The leaves are rather small, with 2 to 4 lobes at the base, giving them an arrow-headed shape. The flowers are white or rose-colored and 1 inch across. The seeds, three in number, are large, black, and angular, and are held in a spherical capsule (Fig. 33). An average plant produces about 160 seeds.

Time of flowering, June-September.

Time of seeding, August-October. Often no seed is produced.

Dispersal—Chiefly by means of its creeping roots; sometimes as an impurity in seed grain.

Eradication. This is a very difficult weed to eradicate, and careless cultivation only increases the trouble by carrying the roots from place to place. Salting is recommended by some practical farmers who have succeded in eradicating this very troublesome pest; but we cannot speak from experience as to the value of this method of treatment.

The weed may be kept in check by the frequent introduction of well-cared-for hoed crops into the rotation, and the shorter the rotation the better. The later sown hoed crops, especially rape, are more effectual than those sown earlier in the season. Before the hoed crop is sown, the weed may be kept in check by going frequently over the field with a broad-share cultivator, so as to cut all the plants an inch or two below the surface without bringing up any of the creeping rootstocks. About the 1st July the land may be sown with rape in drills, say 26 inches apart, and during the early growth of the crop the weeds may be kept in check by means of the horse-hoe, with more or less hand-hoeing. If the land has been well manured or is naturally rich in vegetable matter, the rape will make a rank growth and smother some of the weeds. The rape may be pastured in the fall, and in extreme cases may be followed by another hoed crop, such as corn. If the corn is well cultivated and hoed, most, perhaps all, of the plants will be destroyed.

Fig. 33.

Bindweed.

(*Convolvulus arvensis.*)

In some cases it may be advisable to summer-fallow, and in such cases it is best not to plow more than is absolutely necessary, but to depend mainly on the broad-share cultivator. Buckwheat sown on summer-fallow and plowed under when coming into blossom, followed by surface cultivation with broad-share cultivator, will assist very much in killing the weed. If necessary, the summer-fallow may be followed by a hoed crop.

FIG 34.

DODDER, DEVIL'S GUT, OR STRANGLE WEED.

Cuscuta epithymum (Murr.).

This weed is spreading very rapidly as an impurity in alfalfa and clover seed. It is by no means a new weed in Ontario, but during the past year has been especially abundant. Judging by the numerous samples sent in for identification, and by the host of questions asked concerning it, more information is required as to its appearance, habit of growth and method of control. It is therefore discussed rather fully here.

Dodder differs from ordinary weeds in possessing no leaves. The yellow thread-like stems of the plant twine around the clover plants and send into their tissues small short rootlets, which are called suckers or haustoria. By means of these suckers the Dodder draws from the clover the food necessary for its growth and reproduction. It thus kills the clover by robbing the plant of its food and causing it to starve. The yellow thread-like stems of the Dodder first appear quite early in the season. They soon spread from plant to plant until a tangled mass of yellow threads covers a whole patch of clover. Badly infested fields may become entirely covered with this pest in a short time. On these yellow threads are produced dense clusters of small white flowers, which are succeeded by rounded, brown seed pods. Each plant produces a large number of seeds. The seeds vary in size from 1-24 to 1-15 of an inch; are grey or yellowish brown in color, vary greatly in shape, but are generally somewhat oval in outline, and the surface is dull and roughened.

Great care should be taken to secure clover seed free from Dodder seed. Alfalfa seed containing this impurity is dear at any price. Small patches should be mowed, raked and burnt early enough to prevent seeding. If by any chance some of the seeds are scattered before the patches are mowed, several thorough hoeings should be given in order to prevent any young plants from getting established. Badly infested fields should be plowed and put under a hoed crop for a season. Clover or alfalfa should not be sown in the field again for two or three years.

FIG. 34.
FIELD DODDER ON RED CLOVER.
a Flowering Cluster; *b* Cluster of Dry Seed Vessels. From a photograph. Natural size.
(Reproduced by the courtesy of the U. S. Dept. of Agriculture, from Farmers' Bulletin 306 "Dodder in Relation to Farm Seeds," by F. H. Hillman.)

THE BORAGE FAMILY (*BORAGINACEAE*).

Blue Bur, Stickseed, or Sheep Bur.

Lappula echinata (Gilbert).

A disagreeable weed on roadsides, in waste places and in pastures. The burs become matted in the wool of sheep.

An introduced annual and winter annual. Erect and branching, covered with rough hairs. Leaves linear oblong, stem-leaves without stalks. Flowers small, ⅛ inch across, pale blue in long, slender one-sided clusters. Seeds greyish brown in color, pear-shaped, about ⅛ inch long, with hooked spines around the margin.

Time of flowering, from June; seeds ripe in July.

Dispersal—By seeds.

Eradication. In pastures and waste places continued close cutting for a number of years will prevent its seeding and finally cause it to disappear. If a field becomes very badly infested, break it up and put it under a cultivated crop for a year or two. Hand pull stray specimens.

Fig. 35.

Blue Weed, Viper's Bugloss, Blue Thistle, or Blue Devil.

Echium vulgare (L.).

A biennial weed naturalized from Europe, with deep tap root, which penetrates to a great depth. During the first year, the portion above ground is a rosette of leaves; and from the centre of this, next season, bristly, hairy, and erect stems arise 1 to 2½ feet high. The leaves are oblong, 2 to 6 inches in length, with both upper and lower surface hairy. The flowers are numerous, arranged in a rich spire, and are azure blue in color. The seeds are hard and brown in color, with a broad base and angular body 1 to 8 inches long (Fig. 35). An average plant produces 3,500 seeds. The seeds are probably dispersed in winter by the wind, as they remain for a long time on the plant.

Its names, both Latin and English, are significant of the notion that it was an effectual remedy against the bite of a viper.

The weed prefers gravelly and lime soils.

Time of flowering, July-October.

Time of seeding, August-October.

Dispersal—By seeds, especially in winter, when they are blown over the snow.

Eradication. This weed gives very little trouble in arable land, if the cultivation is at all thorough. In fence corners, on roadsides, and in waste places, cutting below the crown with a spud is practically the only effective method of destroying the weed. Sometimes, however, this is impracticable, because of the number; and in such cases some special treatment, similar to that recommended for the Dock may be resorted to.

FIG. 35.

BLUE WEED.

(*Echium Vulgare.*)

Fig. 36.

Hound's Tongue, Dog Bur, or Burs.

Cynoglossum officinale (L.).

A biennial weed, with erect hairy stem, of rank growth, and much branched, 1 to 3 feet high. The lower leaves have petioles; the upper ones clasp the stem. They are 6 to 12 inches long and coverd with downy hair, and have a disagreeable odour resembling that of mice. The flowers are small and lurid purple-red in color. The fruit consists of a broad, rounded bur, ¼ inch long, with one flat side and covered with short spines which enable it to adhere to clothing or to animals (Fig. 36). An average plant produces about 600 seeds.

Time of flowering, June-August.

Time of seeding, July-September.

Dispersal—Chiefly by animals carrying the burs.

Eradication. Spud or cut deep in fall and early spring; the former to destroy the plant in its first year, and the latter to complete the destruction by removing those that escape the first cutting.

Pigeon Weed, Wheat Thief, Red Root, or Corn Gromwell (*Lithospermum arvense,* L.). A winter annual naturalized from Europe, with reddish roots. It is usually branched, and grows to a height of 12 inches. The leaves are sessile, narrow, and harsh to feel. The flowers are small and white; at maturity, four small smooth seeds are produced, which have considerable vitality.

Time of flowering, from April to July.

Time of seeding, from June to August.

Dispersal—Mainly through seed grain, such as wheat, rye, timothy, and alsike clover; often spread by birds and distributed in the manure.

Eradication. Drop fall wheat from the rotation. Cultivate lightly after harvest and cause the seeds to germinate. When three or four inches high, harrow or plow them under. If this treatment is repeated each fall, wheat can again be grown.

FIG. 36.

HOUND'S TONGUE.

(*Cynoglossum officinale.*)

THE FIGWORT FAMILY (*SCROPHULARIACEAE*).

FIG. 37.

MULLEIN, OR VELVET DOCK.

Verbascum thapsus (L.).

The mullein is a weed introduced from Europe; very common in waste places, roadsides, and gravelly or sandy pastures. It is a biennial, with large, long roots, from which spring a tall and unusually unbranched stem, 2 to 6 feet high. Both stem and leaves are densely woolly all over, with branched hairs. The leaves are whitish, thick, and velvety to the touch. The flowers are yellow and arranged on densely crowded elongated spikes. The capsule containing the seeds is about 3/8 in. long, and the seeds are small, about 1-20 in. long, six-sided, with irregular ridges running lengthwise between the sides. The color of the seed is dark brown. An average plant produces 6,000 seeds.

Time of flowering, July-September.

Time of seeding, August-November.

Dispersal—As an impurity in clover and grass seed.

Eradication. Spud or cut below the crown; or dig up the roots when young; or break up the soil and grow hoed crops. It easily succumbs to cultivation.

The Moth Mullein (*Verbascum blattaria*) is a worse weed than common mullein, as it infests meadows and bears far more seed. The seed is often found as an impurity in clover and timothy. The plant itself is smooth and tender, from 2 to 6 feet high, with dentate leaves. The flower is yellow, with brown marks on the back of the petals; and the stamens have violet filaments. The seed is brown, very small, and six-sided. Treat it the same as common mullein.

In Fig. 37 are shown the seeds of the mulleins—the upper seed is the common mullein, the lower is the moth mullein.

Fig. 37.
Mullein.
(*Verbascum Thapsus.*)

FIG. 38.

TOAD FLAX, OR BUTTER AND EGGS.

Linaria vulgaris (Hill).

This weed has become very plentiful in Ontario, and is now found in many pastures, on roadsides and in waste places.

It is a deep-rooted, persistent, perennial weed. The stem is slender and erect, somewhat wiry, and from 12 to 18 in. high. The leaves are narrow, stalkless and scattered along the stem at very short intervals. The flowers are showy, distinctly two-lipped, about 1 in. long, bright yellow in color with orange lips and borne in a long terminal cluster (raceme). The seeds are dark brown or black in color, about 1-10 in. in diameter, flat and disc-like, with a distinct wing around a thicker central portion which is roughened with little projections.

Time of flowering, June to September; seeds ripe by August.

Dispersal—By seeds and rootstocks.

Eradication. Adopt a short rotation of crops and give thorough deep cultivation in spring and fall. Hand pull when the soil is wet in pasture lands which cannot be broken up. Break up badly infested pastures in July, keep under clean summer fallow until fall and put on a hoed crop the following season.

Fig. 38.
Toad Flax, or Butter and Eggs.
(*Linaria vulgaris.*)

THE PLANTAIN FAMILY (*PLANTAGINACEAE*).

Fig 39.

Common Plantain.

Plantago major (L.).

A weed of meadows and lawns, the seeds of which are too often found in grass and clover seed.

A perennial with a short, thick rootstock bearing numerous large, dark green, oval, long-stalked leaves close to the ground. Flowers inconspicuous, borne in long dense spikes. Seed pods oval, dividing about the middle and containing from 8 to 16 small, flat, irregularly-shaped brown seeds.

Eradication. A short rotation including a hoed crop will keep this weed in check. *" Plantain in lawns may be weeded out when the soil is firm by forcing a small implement like a chisel, with a half-rounded blade having a point like the tip of a spoon, between the soil and the fleshy crown of the weed to a depth sufficient to break the plant away from its fibrous roots without disfiguring the turf."

Pale Plantain, or Rugel's Plantain.

Plantago rugelii (Dene).

This Plantain is found as frequently as Common Plantain, from which it can be distinguished by the paler green leaves with the stalks dark purple at the base, the longer and more tapering spikes with the flowers less crowded, and the seed pods, which open below the middle and contain from 4 to 9 flat, irregularly-shaped black seeds, which are larger than the seeds of the Common Plantain.

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*" Farm Weeds of Canada," by G. H. Clark, B.S.A.

Fig. 39.
Common Plantain.
(*Plantago major.*)

Fig 40.

Plantain, Black Plantain, Rib-grass, or Rib-wort.

Plantago lanceolata (L.).

This plant was once very generally believed to be a favorite food of cattle, yet the opinion of most agriculturists is against it. It is considered a bad weed, especially when it appears in lawns. Numerous inquirers ask what it is, and how to get rid of it. It is a perennial or biennial, with a short thick root-stock, of erect growth, or more generally lying on the ground as a rosette of leaves. At the base of the leaves there are tufts of brown hair; and the leaves themselves are long, narrow and tapering, with prominent veins, or ribs running lengthwise; hence some of the popular names. The flower-stock is slender and channelled, is without leaves and terminates in a dense spike. The stamens project from the inconspicuous flowers, giving a whitish appearance to the whole head. The seeds are enclosed in small pods, each containing two seeds. The seeds are about 1-12 of an inch long, brown and shiny, with a groove on one side, in the centre of which there is a black spot. The opposite side is rounded, as are also the ends. An average plant produces 1,200 seeds.

Time of flowering, June-September.

Time of seeding, July-September.

Eradication. If the plants are not numerous, cut below the crown with a spud. If they are, break up the field and put in a hoed crop.

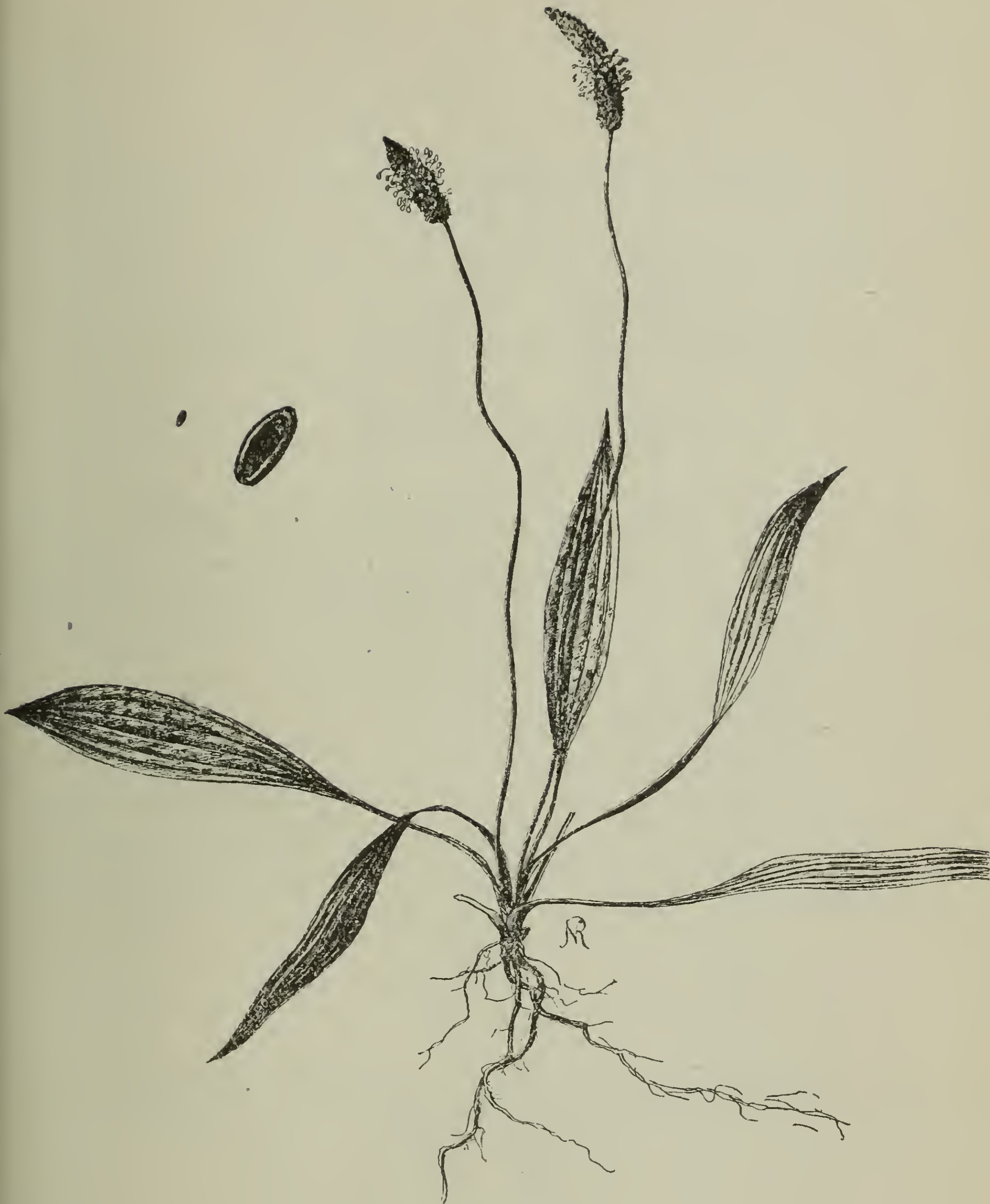

Fig. 40.

Plantain.

(*Plantago lanceolata.*)

THE SUNFLOWER FAMILY (*COMPOSITAE*).

Fig 41.

Canada Fleabane, Horse Weed, or Butter Weed.

Erigeron canadensis (L.).

A tall, hairy plant, very common in meadows. It is a winter annual. The stem is much branched, hairy, and may vary from 3 inches to 10 feet in height. The leaves are downy, from 1 to 4 inches long. The flower heads are numerous, about ¼ in. broad, with white flower rays. The seeds are small, light in color, and 1-16 in. long, with a pappus of short tufty hairs. An average plant produces 120,000 seeds (Kerner).

Time of flowering, June-September.

Time of seeding, June-September.

Dispersal—Chiefly by the wind.

Eradication. Having a small root, this weed can be easily pulled. Hence, where there is not very much of it, hand-pulling is a satisfactory means of eradication. As a rule, the weed is troublesome only in meadows, and the frequent breaking up of meadow land tends to keep it under control.

Daisy Fleabane (*Erigeron annuus,* L.) has larger and fewer flowers, ½ inch across. It is common in meadows and along roadsides from May to November.

FIG. 41.

FLEABANE.

(*Erigeron canadensis.*)

Fig. 42.

Great Ragweed, or Kingweed.

Ambrosia trifida (L.).

A weed in Western grain fields and in waste places in Ontario. A rough, coarse-growing annual weed from 3 to 6 feet high, with large opposite leaves which are mostly three-lobed. The flowers are of two kinds, the sterile borne on tapering spikes about 4 inches in length; the seed-producing flowers grow close to the stem in clusters in the axils of the leaves at the base of the spikes; sterile flowers ¼ inch across, cup-shaped, nodding; stamens yellow and conspicuous. Seed-producing flowers inconspicuous with slender purplish pistils.

Time of flowering, July; seeds ripe by August.

Dispersal—By seeds. Wheat from districts of the West often contains Great Ragweed seed.

Eradication. Hand pulling and mowing.

FIG. 42.

GREAT RAGWEED.

(*Ambrosia trifida.*)

FIG. 43.

RAGWEED, HOGWEED, BITTERWEED, OR ROMAN WORMWEED.

Ambrosia artemisiifolia (L.).

Ragweed is an annual. The stem is much branched and slightly hairy, from 1 to 3 feet high. The leaves are very finely divided, the lower surface being of a lighter color than the upper. The flower heads are very numerous, from 1 to 6 inches long, green and inconspicuous. The flowers are yellow, 1-6 inch across, infertile in the terminal spikes, and fertile only at the base of the spikes. The seed is dark brown, with a sharp tip, around which are arranged 4 to 6 spines, 3-16 inches long. They have great vitality and remain in the soil a long time without injury. An average plant produces about 5,000 seeds. The seed has a bad taste and gives a peculiar odor to the milk of cows which eat it.

Time of flowering, July-September.

Time of seeding, August-November.

Dispersal—As an impurity in seed grain; and by wind and water, being borne long distances by freshets.

Eradication. For the eradication of this weed, special attention must be given to the fall cultivation of the soil, to prevent seeds from ripening. Gang-plow or cultivate, and harrow stubble ground immediately after harvest, and repeat cultivation at intervals until late in the fall; then plow or rib up, and follow with a hoed crop. Care should be taken with the hoed crops that no specimens of Ragweed go to seed. When in grass, go over with a mower in September or October, if any plants are likely to mature seed. Do not sow late maturing crops. Ragweed when eaten by cows causes bitterness in milk.

FIG. 43.
RAG WEED.
(*Ambrosia artemisiifolia.*)

FIG. 44.

YELLOW DAISY, CONE-FLOWER, BLACK-EYED SUSAN, OR NIGGERHEAD.

Rudbeckia hirta (L.).

A biennial and sometimes annual weed found in pastures and meadows. It grows about 1 to 3 feet high. The stems are sparingly branched and very bristly. The leaves are thick, hairy, oblong and tapering towards the point. The flower is about 1 in. across, with orange yellow rays or petals (10 to 20 in number) and dark purple brown discs almost spherical or cone-shaped. The seeds are dark brown, almost black, four angled, and about 1/8 in. long, with no pappus, or tuft of hair. (Fig. 44). An average plant produces about 2,000 seeds.

Time of flowering, June-August.

Time of seeding, July-September.

Dispersal—As an impurity in seed grain.

Eradication. It can generally be killed by mowing, but it is sometimes necessary to break up meadow or pasture land, as suggested in note to Mr. Rennie's method of cleaning land, and follow with a hoed crop. If this is well cared for, it will destroy all Cone-flowers.

Fig. 44.
Cone Flower.
(*Rudbekia hirta.*)

FIG. 45.

OXEYE DAISY, WHITE DAISY, WHITE WEED, OR POVERTY WEED.

Chrysanthemum Leucanthemum (L.).

The Oxeye Daisy is a weed naturalized from Europe, and is very closely related to the Chrysanthemum or national flower of Japan.

It is a perennial with short, thick root-stocks, possessed of much vitality. Very many stems spring from one root. It grows from 6 inches to 3 feet high. The leaves slightly clasp the stem, the lower ones, narrow, long, and toothed along the edges, the upper ones, small and without teeth. They are slightly aromatic, more perceptibly so if bruised. The flowers are 1 to 2 inches broad, on long stalks, with from 20 to 30 white rays and bright yellow disc. The seed is about 1-12 in. long and angled, with alternate white and black longitudinal ribs. It has a short point but no pappus (Fig. 45). An average plant produces 7,500 seeds.

Time of flowering, June-August.

Time of seeding, June-September.

Dispersal—Chiefly in grass seeds and by birds.

Eradication. The Daisy is most troublesome in pastures, and can be got rid of only by breaking up the sod. It can be eradicated by the method outlined for Canada Thistle, or by seeding down to clover and plow up after one crop has been cut and taken off. The clover should always be cut before the Oxeye Daisy has had a chance to mature seed.

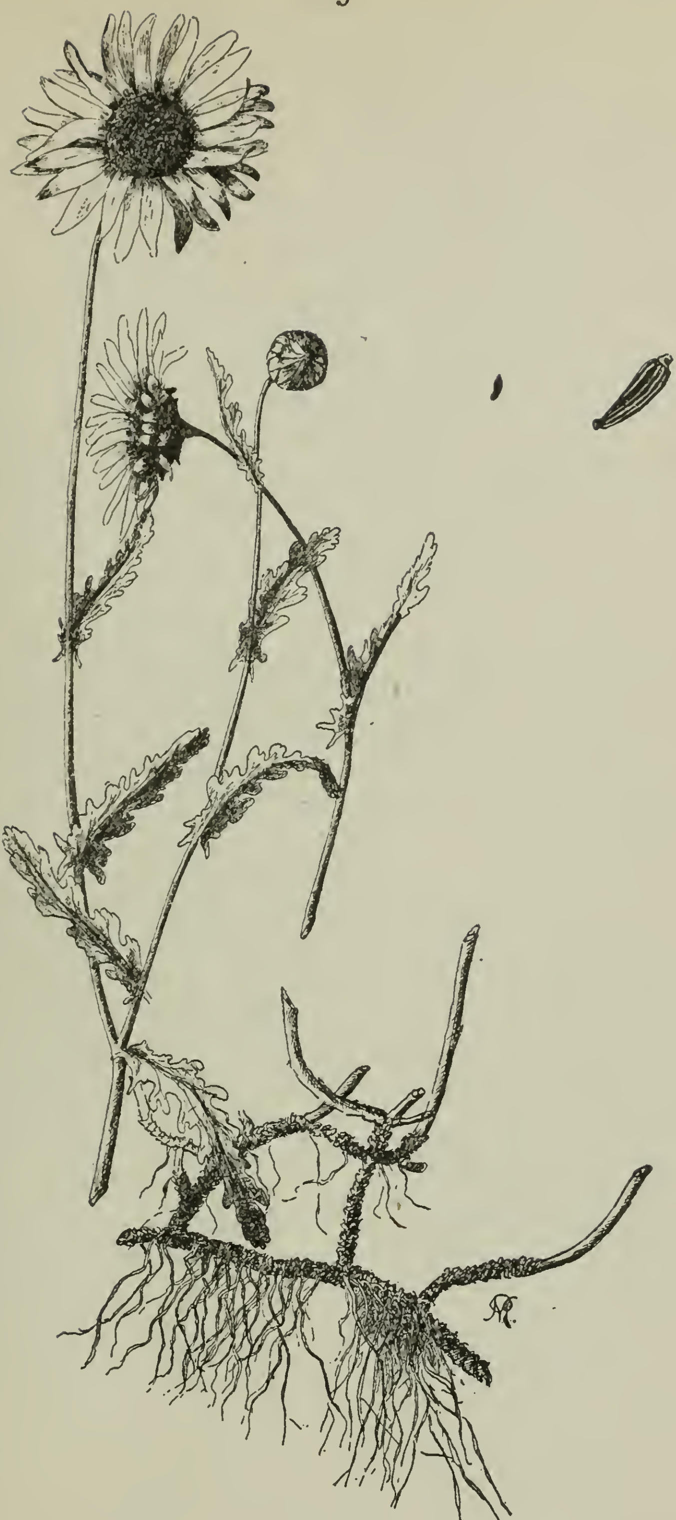

Fig. 45.

Oxeye Daisy.

(*Chrysanthemum Leucanthemum.*)

Fig. 46.

Common Ragwort, Tansy Ragwort, or Staggerwort.

Senecio Jacobaea (L.).

This plant has been sent to the Department on one or two occasions from the neighborhood of Guelph. It has probably been reported before as occurring in Ontario, since it is mentioned in the official list of the Toronto Educational Department Herbarium, but as it is not recorded, to our knowledge, in any other list, it is for all practical purposes a plant new to the Province.

This is the weed which has caused so much trouble in the Eastern Provinces. It is a very dangerous weed because, when eaten by cattle, it causes a curious and fatal disease of the liver (Hepatica cirrhosa). For this reason farmers should keep a sharp lookout for it, and destroy it whenever it appears. It is easily recognized, being a large, conspicuous, strong growing plant, about 2 to 3 feet high. The flowers are in numerous heads in corymbose clusters, bright yellow in color and very showy. The root leaves are 6 to 8 inches long, petioled. Stem leaves sessile and clasping, all leaves dark green, deeply twice pinnatified, the segments crowded and overlapping, crisped and waved. This being a short-lived, shallow-rooted perennial it is not difficult to eradicate, all that is necessary being to cut it in time to prevent it from seeding for several successive years.

Fig. 46.

Ragwort, Tansy Ragwort or Staggerwort.

(*Senecio Jacobaea* L.)

FIG. 47.

LESSER BURDOCK, BUR, CLOT-BUR, OR BEGGAR'S BUTTON.

Arctium minus (Bernh.).

A biennial weed with tremendous roots, probably the largest of all weed roots. This root is uniform in size for a foot below the surface; further down it is much branched and has a great hold on the ground. The stem is much branched (from 4 to 6 feet high) and rough, with broad rounded leaves, the lower surface of a lighter green than the upper. The flower heads occur in clusters and are purple in color. The flower receptacle, or involucre, as it is called, is composed of hooked spines, which are very adhesive and do much injury to the wool of sheep. The seeds are brown, ⅜ in. long and spotted with darker brown (Fig. 47).

Time of flowering, July-September.

Time of seeding, August-October.

Dispersal—Chiefly by animals carrying the seed from place to place.

The plant when burned yields a good quality of alkaline ash, equal to the best potash; and a decoction from the roots is said to be equal to the juice of Sarsaparilla as a blood purifier, etc.

Eradication. Cut below the crown with a spud and burn the tops.

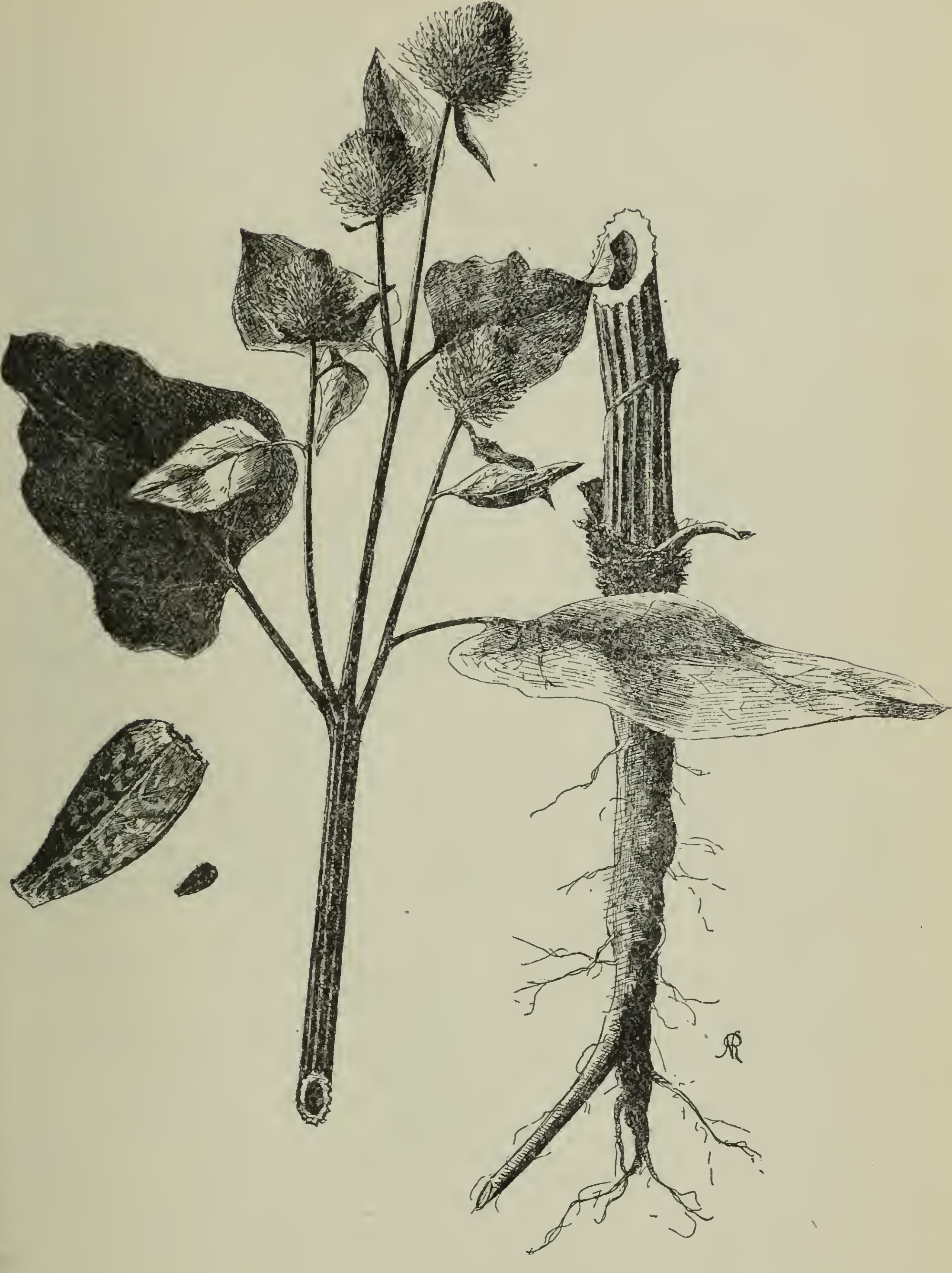

FIG. 47.

BURDOCK.

(*Arctium minus.*)

FIG. 48.

CANADA THISTLE, OR CREEPING THISTLE.

Cirsium arvense (L.) (Scop.).

This weed was originally introduced from Europe, and hence incorrectly named Canada Thistle. It is a hardy perennial, with numerous underground stems which bear a large number of shoots. (See Fig. 48, illustrating two of these shoots.) It grows to a height of 1 to 3 feet. The leaves are narrow and long, deeply indented into very prickly, lobed segments. The leaf has a crimped appearance, and at the base slightly clasps the stem. The under surface of the leaf is woolly, the upper surface less so. It produces numreous heads containing flowers, which are ½ to ¾ inches across and of a lilac-purple color. The flower is smaller than that of other thistles. The seed is grey, oblong, and about ⅛ in. long, with slight longitudinal markings. Attached to the top is a conspicuous tuft of long hairs (the pappus) (Fig. 48). The seed is carried long distances by the wind. An average plant produces 3,500 seeds.

Time of flowering, June-August.

Time of seeding, July-September. Many plants produce no seed.

Dispersal—Chiefly by the wind.

Great care should be taken to prevent Canada Thistle from seeding.

Eradication. The Canada Thistle can be eradicated in several ways, if thorough work is done at the right time:

1st. By careful and persistent spudding, done in such a way as to prevent the plant from developing top above the ground.

2nd. By early after-harvest cultivation of stubble ground.

3rd. By the frequent introduction of hoed crops into the rotation.

4th. By the seeding much with clover, taking one or two crops of hay, plowing the clover sod shallow early after harvest, and cultivating frequently throughout the fall.

5th. By summer-fallowing.

Assuming that all land should be plowed in the fall, we may outline briefly one or two methods of destroying thistles:

(1) *In stubble ground for spring crop.* Gang-plow shallow and harrow early after harvest (immediately after the crop is off); and as soon as seeds have had time to sprout or thistles begin to appear, cultivate thoroughly with a broad-share cultivator, the points or shares overlapping far enough to cut all plants; and harrow again, to pull up and expose the plants that have been cut. Repeat the cultivation at intervals throughout the fall, and plow in the usual way, or, if possible, rib up with a double mould-board plow just before the frost. This systematic cultivation from harvest till winter will check thistles and other weeds very much, and when followed by a hoed crop (mangels, corn, turnips, carrots, beans or rape), properly cultivated, it will not only clean the land, but put it into good shape for a crop of grain (oats, barley, etc.), the next spring, which crop should be seeded with red clover.

Fig. 48.
Canada Thistle.
(*Cirsium arvense.*)

(2) *In sod* (*meadow or pasture*) *for spring crop.* After one or two, but not more than two, crops of hay or pasture, plow shallow (not more than four inches) early after harvest, say the 1st to the 15th of August, and harrow at once. Let it stand a couple of weeks, and then cultivate the same way it was plowed, two or three inches deep, with a spring-tooth cultivator. After a while cross-cultivate a little deeper. If possible, cultivate a third, or even a fourth time, going a little deeper each time. Then, if you can manage to do so, rib it up with a double mould-board plow the last thing in the fall. This will make a good foundation for any crop the following spring—grain, roots, corn or rape—and if the portion in hoed crop is thoroughly cultivated with horse and hand hoes, very few, if any, thistles will be left. The portion intended for rape must be kept clean by surface cultivation till the time for putting in the crop, say the last half of June or the 1st of July, after which it should be treated like other hoed crops.

Some recommend a crop of fall rye on land which is intended for rape the following summer, but the rye takes so much moisture from the soil in the spring that the rape after it is apt to be a poor crop, unless in favorable seasons.

If summer-fallowing is resorted to, it will be well not to plow any more than is necessary, but to rely on surface cultivation with the broad-share cultivator and the harrow, done in such a way as to cut the plants two or three inches below the surface, without bringing up any of the numerous rootstocks which run along a little lower down. It will also be well to keep the fallow covered part of the summer by growing some kind of green crop, say a crop of buckwheat, sowed rather thick and plowed under when coming into bloom. This will help to prevent the loss of nitrates which bare land suffers from washing, and will improve the soil by increasing the supply of vegetable matter in it.

When necessary at any stage in the above method of cultivating either stubble-ground or sod, say for mangels, use a grubber or subsoil plow to stir the soil to a greater depth than is reached by the surface cultivation.

FIG 49.

CHICORY, OR WILD SUCCORY.

Cichorium intybus (L.).

A perennial weed introduced from Europe, with long, deep tap-root, which when dried and ground up is used in adulterating coffee and as a substitute for it. The stems are almost leafless, from 1 to 3 feet high, much branched, slightly hairy and whitish in color. The leaves, spread out on the ground, are long, with irregular edges. The flower heads are numerous, occurring in clusters, without flower stalks, on the naked branches. The flowers are about 1½ inches across, bright blue in color,

FIG. 49.

CHICORY.

(*Chicorium intybus.*)

and are usually closed by noon. The seed is about ⅛ inch long, tapering to a blunt point, the opposite end having a fringe of minute hairs around the crown. The body of the seed is corrugated. An average plant produces about 3,000 seeds.

Time of flowering, July to October.

Time of seeding, August to October.

Dispersal—Frequently as an impurity in clover and grass seed.

Eradication. Seldom troublesome in well cultivated fields. A short rotation of crops will soon cause it to disappear. Badly infested fields may be cleaned by deep, thorough, fall cultivation, followed by a hoed crop the next season.

Barnaby's Thistle.

Centaurea solstitialis (L.).

This plant is comparatively new to Ontario. Its home is in the Mediterranean region, but it has been introduced into most temperate climates with alfalfa, clover and other seeds. It has become scattered pretty well over Ontario as an impurity in alfalfa. It is a bushy-branched, annual weed from 1 to 2 feet high. The flowers are yellow and surrounded by conspicuous, stout, yellow spines about three-fourths of an inch long. The lower leaves are divided, the upper linear entire and run along the stem at the base (decurrent). This plant being an annual and very conspicuous is not likely to become a bad weed.

Fig. 50.

Fall Dandelion.

Leontodon autumnalis (L.).

An introduced perennial weed reported recently from several places in Ontario as occurring in hayfields. Leaves mostly basal, springing from a short, thick rootstock and resembling somewhat the leaves of the Common Dandelion. Stems branched, scaly and few flowered. "Flowers" about 1 inch across, bright yellow. Seed is ¼ inch long, brown, linear, ribbed lengthwise and bears a row of feathery bristles about its own length.

Time of flowering, July till frost; seeds ripe by August.

Dispersal—By seeds and by division of the crown.

Eradication. *"Badly infested fields should be brought under cultivation. Pasture lands that cannot be cultivated may be improved by severely raking the surface with a spring-tooth harrow and sowing the most vigorous grasses."

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*"Farm Weeds," by G. H. Clark.

FIG. 50.

FALL DANDELION.

(*Leontodon autumnalis.*)

FIG. 51.

THE PERENNIAL SOW THISTLE.

Sonchus arvensis (L.).

This is by all means the worst weed in the Province of Ontario at the present time. It is found in almost every county, and upon almost every farm. So rapidly and so persistently is it spreading that in some parts of the Province it threatens to entirely over-run the fields and drive out the farmer. In spite, however, of its wide dispersal there are many who are not able to recognize this pest and who mistake it for its two comparatively harmless cousins, the Common Annual Sow Thistle and the Spiny Annual Sow Thistle. This should not be the case, as it is a very conspicuous weed, and differs markedly from the other two species. The Perennial Sow Thistle grows freely on a great variety of soils, but is especially troublesome on rich, low, damp land. It appears the first year in a field in scattered patches consisting of young plants, each plant made up of a rosette of leaves lying close to the ground, and thus, when numerous, they completely cover it. These young plants have but short underground root stocks, and are comparatively easy to destroy. The second year a large stem bearing numerous leaves and flowers is produced and the rootstocks grow long and send up quantities of new shoots. Once established in this manner, it is no easy task to destroy this pest.

Description—The Perennial Sow Thistle (*Sonchus arvensis*) is a tall, coarse growing perennial weed with deep roots and numerous thick, underground stems or rootstocks, commonly spoken of as "roots." Upon these at intervals of a few inches are borne buds which develop into new plants. The stem is smooth and hollow and the whole plant is filled with a bitter milky juice. The leaves are pointed, 4 to 12 inches long, deeply cut with the segments pointed backwards (runcinate), slightly prickly. The flowers, or more correctly speaking, the heads of flowers, are about 1 to 1½ inches across, and bright orange in color. The involucre, or, as it is commonly called, the flower cup, and the peduncles or flower stems are covered with distinct, yellow glandular bristles. The seeds are dark reddish-brown in color, about ⅛ of an inch long, somewhat spindle shaped with blunt ends, and each surface bears a number of very deeply wrinkled, longitudinal ribs. Each seed bears at the top a tuft of white silky hairs (pappus) which, when dry, acts as a parachute and enables the seed to be borne long distances by the wind.

POINTS OF DISTINCTION BETWEEN THE PERENNIAL SOW THISTLE AND THE ANNUAL SOW THISTLES.

1. The Perennial Sow Thistle is a taller, coarser growing plant than either of the other two Sow Thistles.

2. The Perennial Sow Thistle has numerous underground rootstocks while the annual species have only fibrous roots. (See illustrations.)

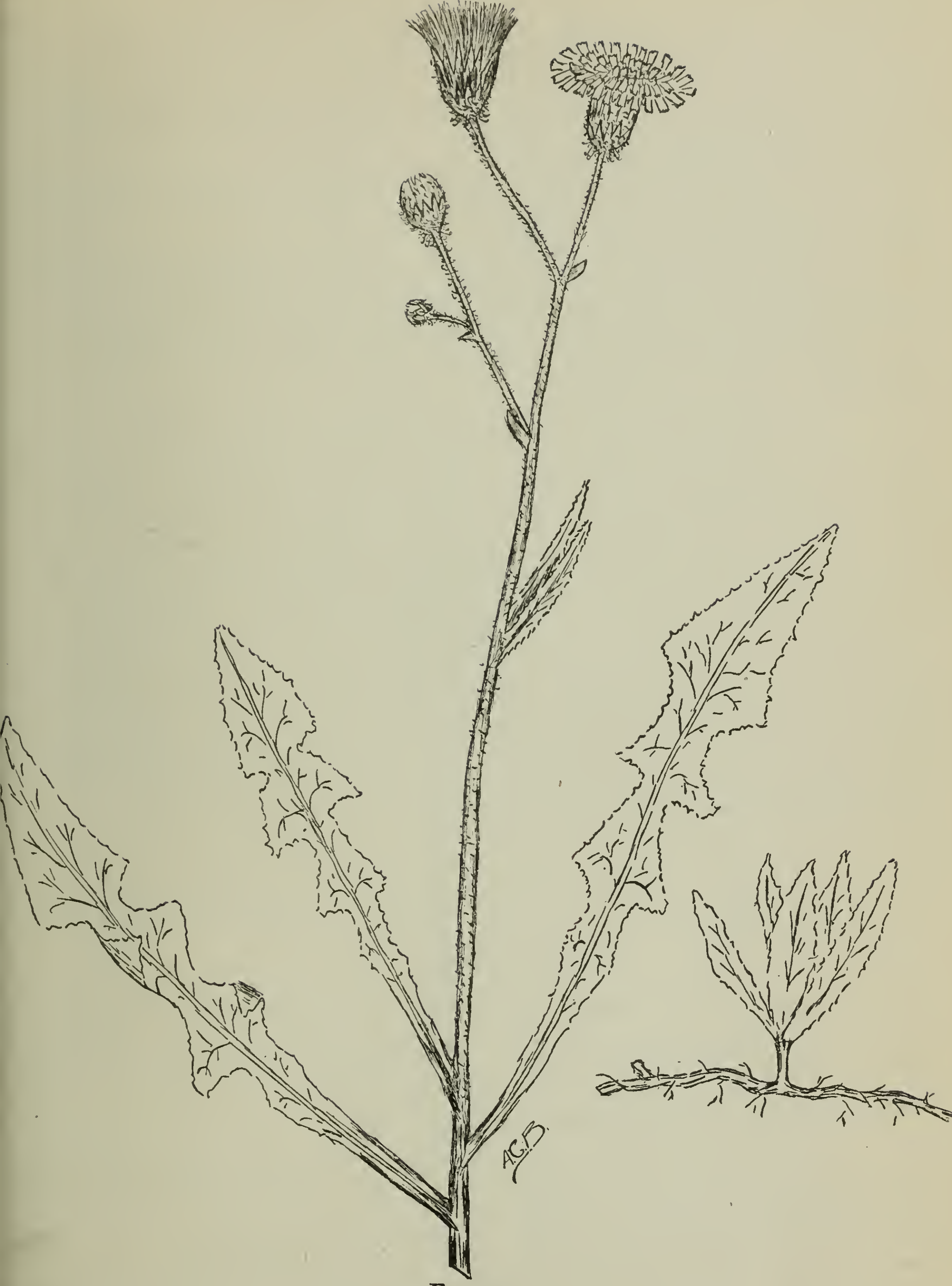

Fig. 51.
Perennial Sow Thistle.
(*Sonchus arvensis.*)

3. The leaves of the Common Annual Sow Thistle are deeply cut and lobed and scarcely spiny. The leaves of the Spiny Annual Sow Thistle are almost entire, very prickly and often decidedly waxy. The leaves of the Perennial Sow Thistle are deeply cut, but not lobed, and slightly prickly. (See illustrations.)

4. The "flowers" of the Perennial are bright orange in color and about 1½ inches across, while the flowers of the Annuals are pale yellow and less than ½ inch in diameter.

5. The "flower-cups" (involucres) and "flower stems" (peduncles) of the Perennial Sow Thistle are conspicuously covered with yellow glandular bristles, while those of the annual species are nearly smooth.

6. The seeds of the three species also differ as to shape and markings.

How the Perennial Sow Thistle is Spread.

The Perennial Sow Thistle is being rapidly and widely spread by means of its numerous seeds, which are blown far and wide by the wind, and to some extent by its abundant underground rootstocks which with remarkable rapidity spread through a field, sending up new shoots which soon entirely cover the ground and choke out all other vegetation. The rootstocks when broken up are often carried from field to field by harrow or cultivator. It has been estimated that an average plant produces 2,000 seeds. There are thousands of these plants going to seed on neglected farms, on road sides and in fence corners. Many more mature plants are harvested with the grain and their millions of seeds scattered at threshing times. Is it to be wondered that the Perennial Sow Thistle is becoming such a serious pest in Ontario?

Methods of Eradication.

These are discussed under the headings of General Suggestions and Detailed Methods.

General Suggestions.

1. Bear in mind that a few patches of Perennial Sow Thistle, if allowed to mature, may seed down a whole neighborhood. Therefore, take every precaution to prevent the seeding of patches in meadows, grain fields, fence corners, and on the road side.

2. Watch for the first two or three patches in the field and destroy them before the pest becomes established.

3. Be careful not to harrow or cultivate through patches and drag the underground rootstocks all over the field.

4. The Perennial Sow Thistle thrives most luxuriantly on rather low, damp land. Underdraining therefore will help to control it.

5. Sheep are fond of this weed, and, if turned on a field after harvest, will prevent its seeding and by their close cropping weaken the underground rootstocks.

Fig. 52.
Spiny Annual Sow Thistle.
(*Sonchus asper.*)

Detailed Methods.

Several methods of exterminating the Perennial Sow Thistle are here outlined in detail. They have all been suggested by practical farmers. It is hoped that those who are looking for information on this subjcte will find among them a method suited to their own conditions.

Method No. 1. This method is suggested by Professor Zavitz, who found it effective in the eradication of Quack Grass. Cultivate the field until about the middle of June, running over it frequently with the cultivator so as to keep the tops down and thus weaken the "roots." Then apply manure at the rate of about 20 tons per acre (12 good loads). Cultivate the manure in thoroughly and with a double mould board plow slightly ridge up the land, making the ridges about 26 inches apart. On the ridges sow pasture rape at the rate of 1½ lbs. per acre. It is important that the right amount of rape should be sown, for if too little is sown the stand will not be thick enough to smother the weeds, and if on the other hand too much is sown the plants will be too crowded and not grow vigorously enough to keep ahead of the thistle. Sow the rape when the land is sufficiently moist to insure quick germination of the seed. If the rape is slow in starting the Sow Thistle may get a start in the rows and thus necessitate hand cultivation there. Cultivate the rape every week or ten days until it occupies all the ground and makes further cultivation impossible. If, when the rape is cut or pastured, any Sow Thistles remain, the field should be ridged up the last thing in the fall and put in with a hoed crop the following year. This should not be necessary if a good stand of rape is secured.

Method No. 2. This is a system of intensive cropping suggested by Professor Zavitz. As soon as a cereal crop is harvested, plow the land and give frequent cultivation to the first or middle of September. Then sow winter rye at the rate of about two bushels per acre. This can be pastured the following spring, or cut for hay or grain. As soon as the crop is off the land, put in rape, turnips or buckwheat. The advantage of this system is that three crops are harvested in two years and the Sow Thistle fought at the same time.

Method No. 3. This method is recommended by Professor Day. Immediately after harvest gang-plow shallow and run over the field several times with the broad shared cultivator. Later in the fall plow a little deeper, and continue cultivating every week or ten days as long as the season permits. Last thing before the ground freezes rib up the land with a double mould board plow. The following spring give frequent cultivation up to the first of July, then sow pasture rape.

Method No. 4. This is a short rotation which has been recommended by several Farmers' Institute workers. Clover is followed by a crop of grain, then clover again. The clover is cut in June, and the land plowed about four inches deep and given frequent and thorough cultivation during the rest of the summer. The following spring a grain crop is sown, seeding down with clover. For best results the grain crop should be one which can be cut early enough to prevent the thistle from seeding.

FIG 53.

ANNUAL SOW THISTLE.

(*Sonchus oleraceus.*)

Method No. 5. Directly after harvest plow the land lightly, and then give frequent cultivation as long as the season permits. The following spring gang-plow, and leave in summer fallow until it is time to sow fall wheat. The summer fallow to be effective must be a *bare fallow.* The field must be cultivated thoroughly and frequently, with the object of keeping the tops down and breaking up and bringing to the surface of the ground as many of the "roots" as possible. The gang-plow should occasionally be run over the field in order to insure the cutting of the roots. Bare summer fallow has given excellent results on the College farm in seasons when other methods were at best only partially effective.

FIG 53.

ANNUAL SOW THISTLE, COMMON SOW THISTLE, OR MILK THISTLE.

Sonchus oleraceus (L.).

An annual weed introduced from Europe. It grows 2 to 3 feet high, has fibrous roots and leafy stem, and is not quite so large or coarse as the Perennial Sow Thistle. The leaves are much lobed, and have short, soft spines. Each head is many-flowered; but the flowers are small, about 1½ in. across, and of a pale yellow color. The seeds are brown, dull or roughened, and about ⅛ in. long, with 5 longitudinal ridges finely wrinkled crosswise, and attached to the top is a large tuft of fine hairs united at the base.

Time of flowering, June-August.
Time of seeding, July-August.
Dispersal—Chiefly by the wind.

Eradication. Cultivate stubble-ground and sod early after harvest and throughout the fall as for Canada Thistle (see Fig. 53). Follow with hoed crop, preferably corn or roots, and cultivate thoroughly throughout the growing season. Use the cultivator, instead of the plow, after roots or corn; sow a crop of grain and seed with clover; if practicable, pull the weeds by hand out of the grain crop; take one or two crops of hay or pasuure, and again break up the sod, plowing, harrowing and cultivating as for Thistle.

FIG. 54.

PRICKLY LETTUCE.

Lactuca Scariola (L.).

Prickly Lettuce is a native of the old world, and has invaded this Province both from New York and Michigan. It is a winter annual; it springs from seeds in the fall, and survives the winter. The plant grows to a height of 3½ feet; the stem is leafy and usually smooth; the leaves

FIG. 54.
PRICKLY LETTUCE.
(*Lactuca scariola.*)

are oblong and slightly pointed, often clasping at the base; the under surface of the midrib of the leaf is spiny: Heads are numerous and yellow.

Time of flowering, July-September.

Time of seeding, August-October.

Dispersal—By means of its seeds, which are provided with a pappus or tuft. An ordinary plant may produce 8,000 seeds.

Eradication. The best methods of destroying the weeds are: 1. To mow repeatedly as it comes into bloom, or earlier. 2. To cultivate thoroughly with a hoed crop. By this method the weeds in the soil will be induced to germinate. They should not be covered deeply in plowing. Mature plants should be cut down and burned lest the seeds be blown about and scattered by the wind.

Farmers should be careful to buy only clean clover, millet and grass seeds, and the weed inspector should insist on the fulfilment of the law, and have all fence-corners, roadsides, and waste lands cleared of the pest.

Fig. 55.

Wild Lettuce, Southern Thistle, or Trumpet-milkweed.
(Erroneously called Prickly Lettuce.)

Lactuca Canadensis (L.).

An annual or biennial plant with a leafy stem, which may attain a height of seven feet. The leaves are deeply lobed, terminating in an acute point, and have stalks or petioles, the lower ones being smaller than those near the top of the stem. The stem branches at its summit into a compound flower-cluster. The flowers are small, yellow in color, and open only a few at a time. The seed is dark brown in color, flat and oval, with longitudinal ribs and a threadlike beak at the apex, and possesses a small white tuft of hair.

Time of flowering, June-October.

Time of seeding, July-October.

Dispersal—Chiefly by the wind.

Eradication. Where there is not much of it, pull and burn before ripening. Where this cannot be done, use the same method as for Mustard.

Fig. 55.
Wild Lettuce.
(*Lactua Canadensis.*)

FIG. 56.

PAINT BRUSH, DEVIL'S PAINT BRUSH, OR ORANGE HAWK WEED.

Hieracium aurantiacum (L.).

This is another weed which is gaining ground in Ontario. It has been common for some time in the eastern part of the Province, but is now reported as being found as far west as Oxford County. It has been found in the vicinity of Guelph for many years. It is being dispersed as an impurity in clover seed, and by means of its tufted seeds, which are blown about by the wind. It is a serious pest when it gets into meadows and pastures, as it spreads rapidly by runners and soon crowds out the grass. Careful watch should therefore be kept to prevent its establishment upon the farms of Ontario.

It is a perennial weed of European origin, and produces slender runners, which lie near the surface of the soil. The leaves are all basal, and lie close to the ground, forming a rosette. They are broadly lance-shaped, from 2 to 6 inches in length, the "flower" is orange red in color, about ⅔ of an inch in diameter, and borne in clusters on the top of a simple, nearly leafless stem from 12 to 18 inches high. The seeds are provided with tufts of down. When found in clover seed, however, the down is usually absent. They are torpedo shaped, about 1-12 of an inch long, and ribbed lengthwise. Ripe seeds are dull jet black in color, unripe seeds deep red.

Eradication. Paint Brush is but a shallow-rooted perennial, and readily succumbs to cultivation. Infested meadows and pastures should be broken up and put under a short rotation of crops. Salt at the rate of 1½ tons per acre is recommended for the destruction of this weed. It should be scattered over the patches so as to fall on the leaves. It is claimed that it destroys the Paint Brush and improves the grass.

Fig. 56.
Paint Brush.
(*Hieracium aurantiacum*, L.).

KNOW THE WEEDS.

It is very important that those engaged in farming should get to know the worst weeds and the weed seeds most frequently found in commercial seeds. This they can do with a little trouble. Strange weeds should be sent to the Botanical Department here for identification, and a collection of the most common weed seeds should be secured for reference and comparison.

WEED IDENTIFICATION AND SEED TESTING.

The Department of Botany is at the service of farmers, gardeners, seed merchants and others in the identification of weeds, weed seeds, plant diseases, grasses and economic plants. Clover and other farm seeds are tested and reported upon as to purity absolutely free of charge. Plant specimens and samples of seeds should be carefully packed and addressed with postage prepaid to the Botanical Department, Ontario Agricultural College, Guelph, Ontario.

ERADICATION OF WEEDS.

The most important points under this head are:

First, a determination to get rid of weeds and to keep the land clean.

Second, the method or methods of tillage and cropping.

As regards the latter point, the writer feels that he cannot do better than submit the method outlined by the late Wm. Rennie, whose experience of over thirty years warranted him in speaking with some confidence on the subject. Mr. Rennie's method not only cleans the land, but increases its fertility, and those who wish fuller information should consult the college reports for 1895, 1896 and 1897.

For various reasons very few farms in the older sections of the Province of Ontario are free from weeds, and the question how to clean our lands without incurring too much expense is one of the most important which can engage the attention of Canadian farmers.

In the first place, I would say that all obstructions to cultivation, such as piles of stone, must be removed—hauled away to the woods or an out-of-the-way corner in the winter or some other slack time. Secondly, places for harboring weeds, such, for example, as snake fences, should be got rid of as soon as possible. On the Ontario Experimental Farm nearly all field fences have been removed. The outside and lane fences are almost the only ones left. Portable fences are used when required for pasturing live stock.

Annuals and Biennials. Wild oats, wild mustard seed, and some other seeds belonging to these classes, have great vitality. If down pretty well beyond the reach of the air, they will live for twenty years, and will germinate as soon as they are brought near the surface.

The best way to destroy annuals and biennials is by thorough and frequent shallow cultivation early after harvest in stubble ground and in sod plowed for the following year, and at the proper season (spring and summer) among what are called "hoed crops," that is, potatoes, carrots, turnips, mangels, Indian corn, etc. By shallow cultivation the seeds are kept near the surface, and by frequent stirring of the soil they are made to sprout; and, having sprouted, they can be killed by further cultivation. Those which sprout late in the fall are destroyed by the winter frost. It is impossible to get rid of such weeds by plowing the ordinary depth, say seven or eight inches, once in the fall or at any other time. Plow shallow (not more than four inches in sod and three inches in stubble ground), and harrow and cultivate frequently, as by each stirring of the soil fresh seed is made to sprout, and what has already sprouted is destroyed. When necessary to loosen the soil to a greater depth, use a grubber or a subsoil plow.

Perennials. It is necessary to study the habits of perennial weeds to see how they grow and propagate themselves from year to year, in order to keep them in check; and a close examination of almost any of them will show that the buds from which the young plants start are near the surface of the soil. Hence shallow cultivation, similar to that mentioned above, is the effective method of destroying them. Disc harrows cut the shallow, creeping roots into fragments, which bud and greatly increase the difficulty of eradication. Deep plowing only transplants the buds to a greater depth, and increases the trouble. Plow shallow (see preceding paragraph), and harrow and cultivate frequently, using a grubber or subsoil plow when it is necessary to stir the soil to a greater depth. As above, the cultivation must be early after harvest and throughout the fall in stubble ground and sod, and in spring and summer among corn, potatoes and root crops. Ill-timed, irregular or partial cultivation only makes all weeds grow more vigorously.

Canada thistle, perennial sow thistle, couch-grass, bindweed, etc., can be destroyed by the following method: Middle of May gang plow the land about three inches deep and harrow thoroughly. In two weeks, when the weeds are nicely up, cultivate with a common or spring-tooth cultivator provided with wide points that overlap so as to cut off every plant two or three inches below the surface. Then harrow to pull up the plants and leave them to die. In the middle of June there will be another crop, and possibly a greater number of plants, but not so vigorous as the first crop. Repeat the operations with the wide point cultivator and the harrow. In July a few delicate plants will make their appearance and will have to be destroyed in the same way. This will be sufficient for most weeds; but bindweed may need one or two extra cuttings with the wide points, and a corresponding number of harrowings.

The preceding method will clean the land, but it involves the loss of a year's crop; so it is well to add that land may be kept comparatively free from weeds without the loss of a crop, by after-harvest cultivation of all fields not in grass, begun with each field *just as soon as the crop is off* and continued throughout the fall, first by shallow gang-plowing and harrowing, and afterwards at intervals, as above, by the wide-point cultivator and the harrow. This treatment followed by a hoed crop *properly attended to* will destroy most perennial weeds and all annual and biennial seeds that are near the surface.

Note. To Mr. Rennie's method, or methods, as above given, we would venture to add one which we have seen carried out with the most satisfactory results by Mr. Rennie on the College farm, and with marked success by farmers in other parts of the Province. It may be put in the imperative form, as follows: Sow much with red clover, in order to have a rich clover sod to plow down for all or nearly all spring crops, taking as far as possible only one crop of hay or pasture before plowing, occasionally two, but not more than two. Plow the clover sod shallow, not more than four inches, early after harvest, say the 1st to the 15th of August, and harrow at once. Let it stand a couple of weeks; then cultivate, the same way as it was plowed, two or three inches deep, with a spring-tooth cultivator. After a while, cross cultivate a little deeper. If possible, cultivate a third, or even a fourth time, going a little deeper each time. Then, if you manage to do so, rib it up with a double mouldboard plow, as you would for a crop of turnips. When this is done the available plant food (clover roots, etc.) is preserved in the centre of the drills, the water runs off early in the spring, and the drills can be levelled with the cultivator and harrow, either for spring grain or for hoed crops.

This method will not only clean land, but will greatly enrich it.

AN ACT TO PREVENT THE SPREAD OF NOXIOUS WEEDS.

Province of Ontario

1. Where used in this Act the term "non-resident land" shall apply to all lands which are unoccupied, and the owner of which is not resident within the municipality, and the term "resident lands" shall apply to all lands which are occupied or which are owned by persons resident within the municipality.

2. It shall be the duty of every occupant of land, or, if the land be unoccupied, it shall be the duty of the owner, to cut down and destroy all Canada thistles, ox-eye daisy, wild oats, ragweed and burdock growing on his land, and all other noxious weeds growing on his land to which this Act may be extended by by-law of the municipality, so often each and every year as is sufficient to prevent the ripening of their seed, provided that such cutting or destruction does not involve the destruction of the growing grain.

3.—(1) The council of any city, town, township or incorporated village may, by by-law, extend the operation of this Act to any other weed or weeds, or to any other disease of grain or fruit trees or fruit (other than the diseases known as "yellows" and "black knot" in fruit trees), which they declare to be noxious to husbandry or gardening in the municipality; and all the provisions of this Act shall apply to such noxious weeds and diseases as if the same were herein enumerated.

(2) Such council may and, upon a petition of fifty or more ratepayers, shall appoint at least one inspector to enforce the provisions of this Act in the Municipality, and fix the amount of remuneration, fees or charges he is to receive for the performance of his duties and in case a vacancy occurs in the office of inspector, it shall be the duty of the council to fill the same forthwith.

(3) The council of any township in which there are any large tracts or blocks of waste or unoccupied land, may, upon the petition of not less than thirty ratepayers, by by-law, suspend the operation of this Act, in respect of such waste or unoccupied lands; such by-law shall define with sufficient clearness the tracts or blocks of land so exempted, and shall remain in force until repealed by such council; and until repealed the lands therein described shall be exempt from the operation of this Act.

(4) The council may pass a by-law dividing the municipality into such sections or divisions as may be necessary for the carrying out of this Act, and may appoint inspectors for such divisions whose duties and powers shall in all respects be the same as that of the township inspector.

4.—(1) It shall be the duty of the inspector to give or cause to be given notice in writing to the owner or occupant of any land within the municipality whereon the said noxious weeds are growing and in danger of going to seed (and in the case of property of a railway company, the notice shall be given to any station master of the company resident in or nearest to the municipality) requiring him to cause the same to be cut down or destroyed within ten days from the service of the notice; and it shall be the duty of the inspector to give or cause to be given such notice for the first time not later than such date or dates in each year as may be fixed by by-law of the municipality.

(2) In case such owner or occupant of land (or, if it be railway property, then the station master upon whom notice has been served) refuses or neglects to cut down or destroy all or any of the said noxious weeds within the period aforesaid, the inspector shall enter upon the land and cause such weeds to be cut down or destroyed with as little damage to growing crops as may be, and he shall not be liable to be sued therefor; or the inspector, instead of entering upon the land and causing such weeds to be cut down or destroyed, may lay information before any justice of the peace as to such refusal or neglect, and such owner or occupant shall, upon conviction, be liable to the penalties imposed by section 9 of this Act; but no inspector shall have the power to cut down or destroy noxious weeds on any land sown with grain.

(3) Where such noxious weeds are grown upon non-resident lands it shall not be necessary to give notice before proceeding to cut down or destroy the same.

5.—(1) The inspector shall keep an accurate account of the expense incurred by him in carrying out the provisions of the preceding sections of this Act with respect to each parcel of land entered upon, and shall deliver a statement of such expenses, describing the land entered upon, and verified by oath, to the owner or occupant of resident lands, requiring him to pay the amount.

(2) If any owner or occupant of land liable under the provisions of this Act deems such expense excessive, an appeal may be had to the said council (if made within thirty days after the delivery of such statement) and the said council shall determine the matter in dispute.

(3) In case the owner or occupant of resident lands refuses or neglects to pay the same within thirty days after such request for payment, the said claim shall be presented to the council of the municipality in which such expense was incurred, and the said council is hereby authorized and required to audit and allow such claim, and order the same to be paid from the fund for general purposes of the said municipality.

6. The inspector shall also present to the said council a similar statement, verified by oath, of the expenses incurred by him in carrying out the provisions of this Act upon any non-resident lands; and the council is hereby authorized and required to audit and allow the same, or so much thereof as to the council may seem just, and to pay so much thereof as has been so allowed.

7. The council of the municipality shall cause all such sums as have been so allowed and paid by the council under the provisions of this Act, to be by the clerk severally placed on the collector's roll of the municipality against the lands described in the statement of the inspector, and to be collected in the same manner as other taxes imposd by by-laws of the municipality.

8.—(1) It shall be the duty of the overseers of highways in any municipality to see that the provisions of this Act relating to noxious weeds are carried out within their respective highway divisions, by cutting down or destroying, or causing to be cut down or destroyed at the proper time to prevent the ripening of their seed, all the noxious weeds growing on the highways or road allowances within their respective divisions; such work to be performed as part of the ordinary statute labor, or to be paid for at a reasonable rate by the treasurer of the municipality, as the council of the municipality may direct.

(2) In unorganized townships where road commissioners have been appointed under the provisions of the Assessment Act, or under any Act relating to statute labor in unorganized townships, it shall be the duty of every owner or occupant to cut down and destroy or cause to be cut down and destroyed, at the proper time to prevent the ripening of their seed, all the noxious weeds growing in any highway adjoining such land, not being a toll road, from the boundary of such land to the centre line of such road, and in case of default, after notice from the road commissioners requiring such work to be done on or before a day named in the notice, such owner or occupant shall incur a penalty of $5 for each lot or parcel in respect of which default is made, and upon conviction thereof before a Justice of the Peace having jurisdiction in the township such Justice shall order the penalty, together with the costs of prosecution and distress, to be levied by distress of the offender's goods and chattels, and every penalty so recovered shall be paid the road commissioners, and be expended in improving the roads in such township.

(3) In case of such default as mentioned in the preceding sub-section the road commissioners may perform the work in place of such owner or occupant, and the cost thereof to the extent of $1.25 for each day's labor involved shall be recoverable as a debt due by such owner or occupant to the road commissioners in any court of competent jurisdiction.

9.—(1) Any owner or occupant of land who refuses or neglects to cut down or destroy any of the said noxious weeds, after notice given by the inspector, as provided by section 4, or who knowingly suffers any of the said noxious weeds to grow thereon, and the seed to ripen so as to cause or endanger the spread thereof, shall upon conviction, be liable to a fine of not less than $5 nor more than $20 for every such offence.

(2) Any person who knowingly sells or offers to sell any grass, clover or other seed, or any seed grain among which there is seed of Canada thistles,

ox-eye daisy, wild oats, ragweed, burdock, or wild mustard, shall, for every such offence, upon conviction, be liable to a fine of not less than $5 nor more than $20.

(3) Every inspector, overseer of highways or other officer who refuses or neglects to discharge the duties imposed on him by this Act shall, upon conviction, be liable to a fine of not less than $10 nor more than $20.

(4) Any person who sows any wheat or other grain knowing it to be infected by the disease known as smut, without first using some proper and available remedy to destroy the germs of such disease, shall, upon conviction, be liable to a fine of not more than $20.

10. Every offence against the provisions of this Act shall be punished, and the penalty imposed for each offence shall be recovered and levied, on summary conviction before any justice of the peace; and all fines imposed shall be paid to the treasurer of the municipality in which the offence is committed, for the use of the municipality.

11. The council of every municipality in Ontario shall require its inspector, overseer of highways and other officers to faithfully discharge all their duties under this Act.

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BULLETIN 189.] [MAY, 1911.

Ontario Department of Agriculture

ONTARIO AGRICULTURAL COLLEGE.

Farm Poultry with the Results of Some Experiments in Poultry Houses and Fattening Chickens

By W. R. Graham, Professor of Poultry Husbandry.

This bulletin is intended to give information to farmers and others on general matters pertaining to the keeping of poultry.

It also contains the results of a few experiments which have been conducted at this institution on various matters pertaining to poultry.

CONSTRUCTION OF POULTRY HOUSES

We find poultry thriving and yielding good returns in so many different styles of houses, that it is very difficult to lay down any hard and fast rules. The tendency at the present time is towards cheaper houses, with better ventilation. The hot-house style of housing poultry during the winter has not been satisfactory, many houses being damp, and the air in them anything but agreeable. Disease has been quite common; and results in many cases have been disappointing.

Every poultry house should be light; at least one-third of the south side should be of glass, or otherwise opened to the sun. It should face the south-east or south. The sun's rays are very beneficial to fowls, especially during the winter months.

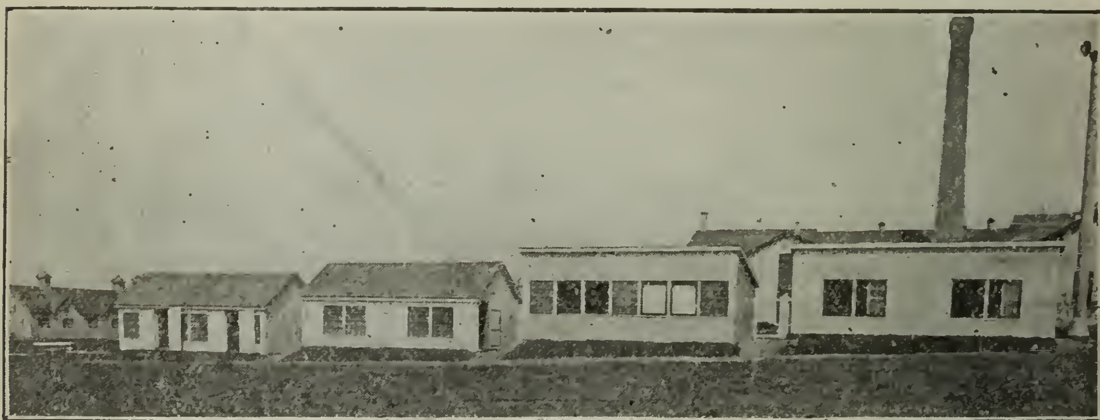
College Poultry Houses.

For a number of years we have been trying various styles of house. The first houses constructed were well built, tight and warm. They were fitted with stoves or hot water pipes, so that the fowls could be kept at a comfortable temperature. This plan was not satisfactory;

mainly for the reasons that it was difficult to keep the fowls in good health, and furthermore the eggs were low in hatching power. The cost of heating was also considerable, in fact the entire equipment was too expensive to be successful as a business.

It was noticed yearly that the surplus stock held in the cheap houses was much healthier than those fowls kept in the warm houses. During the past eight years we have been trying to evolve a house that could be cheaply constructed, that would keep the fowls in good health, and at the same time get a fair egg yield from the fowls so housed.

Seven years ago, four houses, representing different styles of popular poultry houses, were constructed. These houses were stocked with birds representing, as nearly as possible, the same strains of the breed.



No. 4. No. 3. No. 2. No. 1.

Fig. 1. Different Styles of Poultry Houses Suitable for an Ordinary Farm.

The breeds used were White Wyandottes and Buff Orpingtons, the one a rose combed breed, the other a single combed breed.

The houses are of equal size as regards floor space. Each house is 24 feet long and 12 feet wide. The house is divided by a wire and board partition, making two pens each 12 feet square. The pens will accommodate from 20 to 25 birds each, or about 50 to the houses. Fig 1 shows fairly well the appearance as regards windows, etc., of the house. The roosting quarters of each house are very similar in construction. A dropping-board is used which is constructed of matched dressed lumber. The board is placed at the back of the building, and is about three feet above the floor level. The dropping-board is three feet wide. The roosts are made of dressed 3 x 3 scantling, and are placed six inches above the dropping-board. A curtain is arranged to be let down during cold nights, as in No. 1 and No. 2 houses. There is no curtain used in No. 3 or No. 4 houses.

House No. 1 is made of matched boards which are dressed on one side. The front and ends of the house are single-ply. The back is sheeted

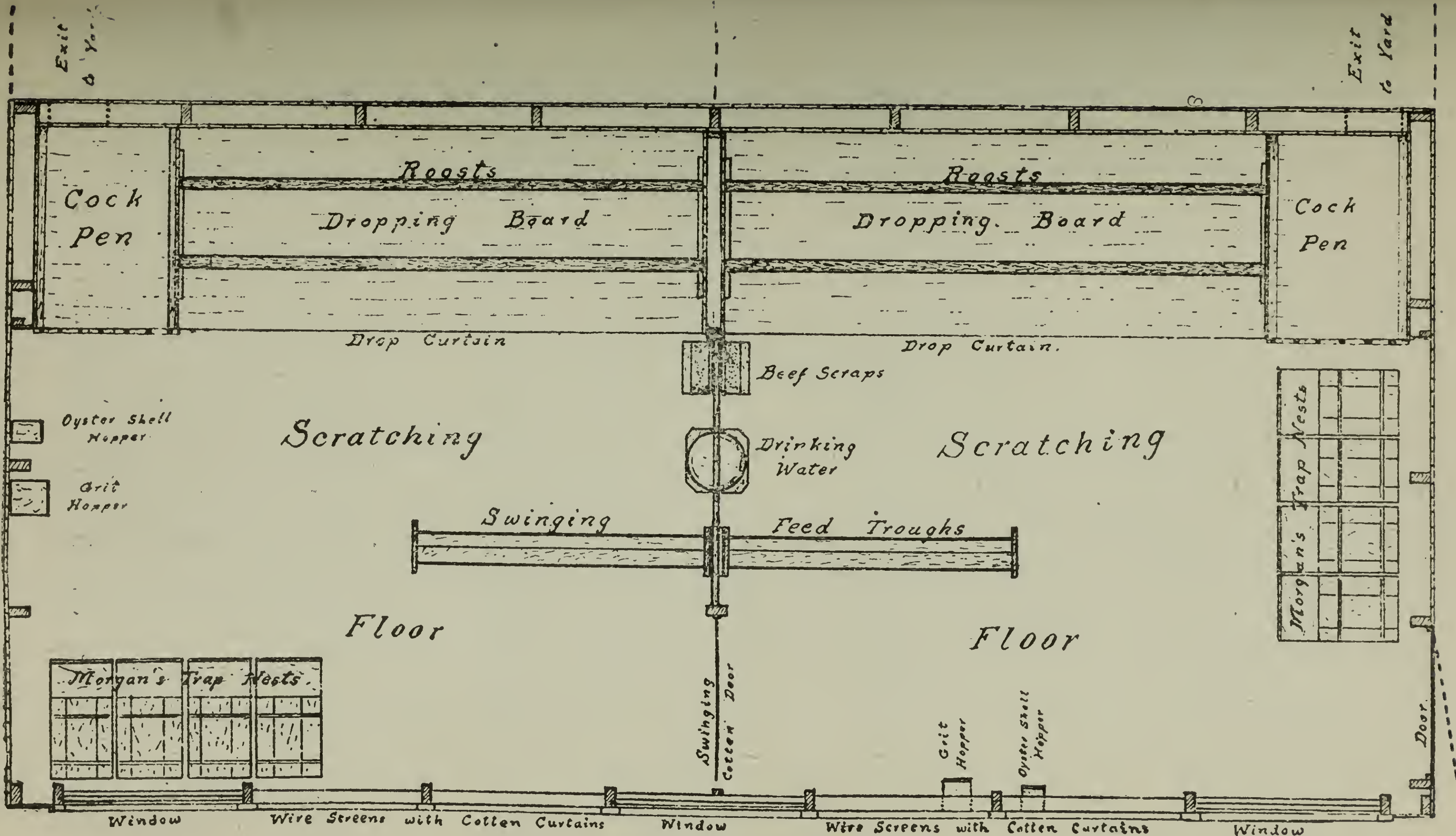


Fig. 2. Ground Plan of House No. 2.

The general arrangement in the other Houses is much the same on the inside, building paper being used under the boards so as to make the wall tight or free from draughts. The windows in this house slide back and forth, so that the ventilation can be adjusted to the weather conditions. The roosting quarters in this house have curtains which can be dropped on very cold nights.

Trap-nests are used in all the houses, and are on the ground level. These take up some floor space that might be used for exercising the fowls were we using other styles of nests.

The second house is what is known as the "Maine State" house. This house is practically open to the weather on the front or south side. There are canvas curtains which can be dropped as a protection against

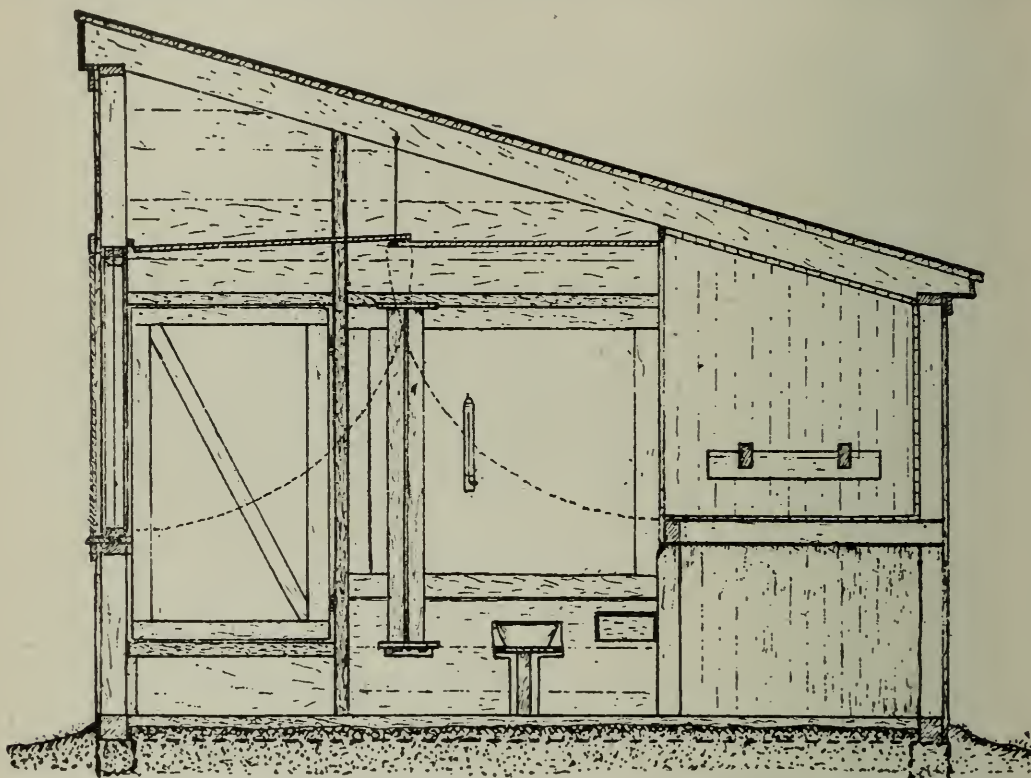


Fig. 3. Cross section of House No. 2, showing the curtains in position for the day, etc.

wind and snow on stormy days. On other days these canvas curtains are to be rolled up, and the fowls allowed to exercise in the fresh air. The ends of the house are single-ply matched lumber; the back wall of the house is matched lumber lined with paper, and is sheeted again on the inside. This is done in order to make a warm roosting coop, which is protected at night in front by canvas curtains.

The third house is the warmest house of the four and is built of matched lumber and lined with paper. There is a dead air space between the inside and outside walls. The building is made as tight as possible, the windows, doors, etc., all being made to fit tightly.

Many houses built on this plan are moist inside. To do away with the moisture we have a straw loft. The straw is placed on boards, which are from four to six inches apart. These boards are placed on a level with the roof or ceiling. The straw absorbs the moisture and keeps the house dry.

The fourth house is one of the extremely airy ones, being made of boards that are dressed on one side and the cracks battened; about half of the front is open to the weather, but may be closed on stormy days by large doors. There is not any special protection for the roost, the chickens roosting in this house in exactly the same temperature as they worked in during the day. This house, needless to mention, is much cheaper than the other styles.

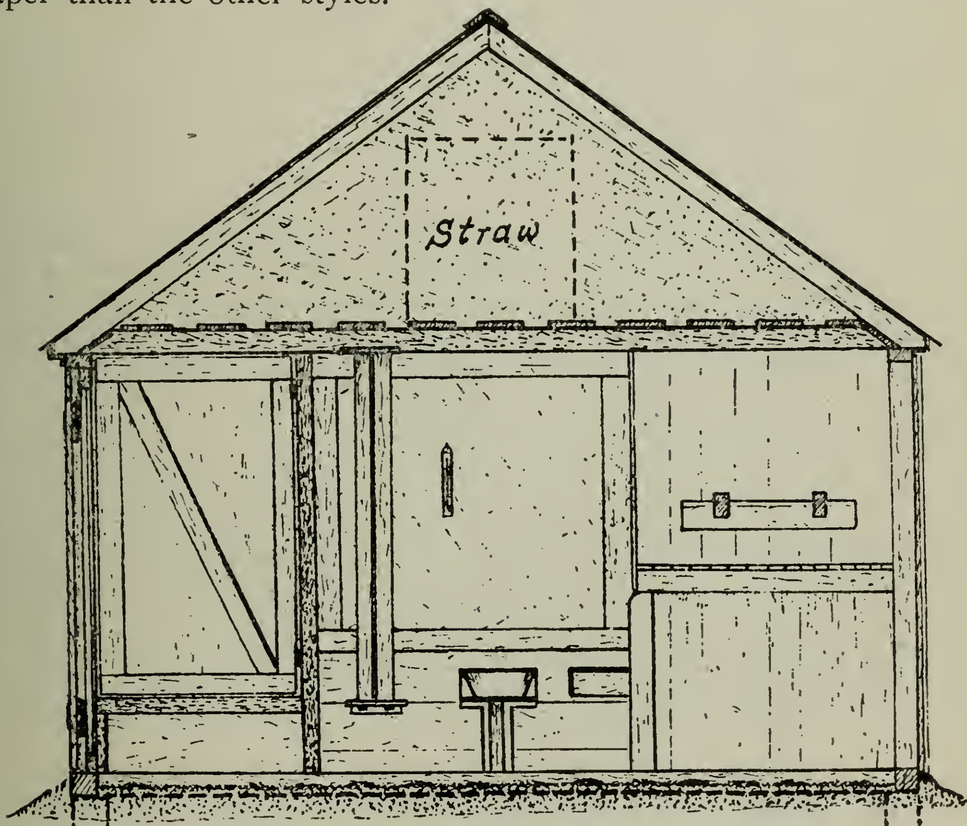


Fig. 4. Cross section of House No. 4.

The following record shows in a concise form the difference in the percentage of egg production in favor of the cold or fresh air house during the five years for the months of December, January, February and March, the first year beginning December, 1904-05, 76 per cent.; 1906, 8 per cent.; 1907, 11.8 per cent.; 1908, 15.6 per cent; 1909, 12.4 per cent.

The house with the cloth front and the one with the movable windows compare favorably with the cold house. There is probably not enough difference in the actual egg production to warrant a statement that either of these houses is very much inferior to the cold house. They are about three degrees warmer than the coldest house and about 15 degrees colder than the warm house.

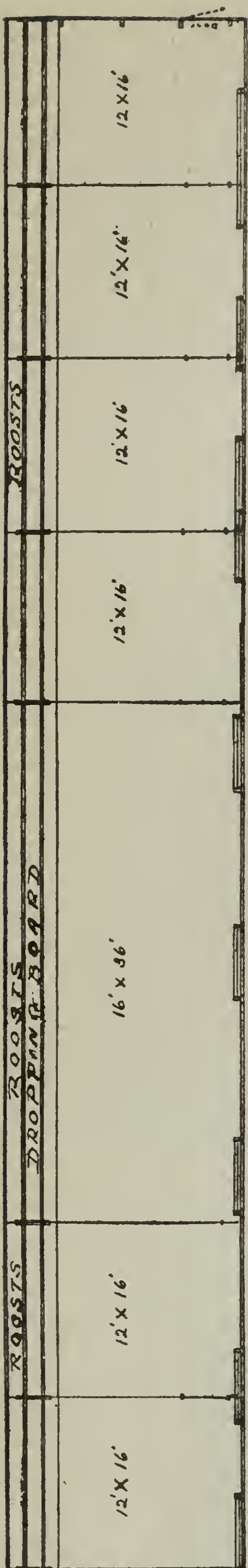


Fig. 5.

These figures must not be taken to mean that hens will lay better in a cold house than in a warm one, but that fresh air is essential to health, and health is a factor in egg production. When one tries to retain the animal heat of the body to maintain the heat of the house, one necessarily allows but little air circulation, hence the air becomes foul or stagnant, which is not healthful.

The above results indicate that the free admission of fresh air is a very essential factor in house construction.

House No. 3 in Fig. 1, which gave the poorest results for each of the five consecutive winters, was operated quite successfully the sixth and seventh winters by introducing more fresh air; that is to say, one-half of the windows were removed until about December 1st, and when these were put in, the openings (about one foot square), where the fowls go out into the yard at the north side were left entirely open. These except during mild days appear to supply sufficient air to keep the birds doing nicely. This statement is made as a means of helping any person who may have a similar house, and who wishes to continue using the same.

Our experience is that all four houses, while fairly satisfactory, especially No. 4, are not all that may be desired, for the reason that they must be adjusted according to weather conditions—that is to say, on bright, sunshiny days, the doors, movable windows, or cloth screens should be opened for nearly all the day, or, again, for but an hour, depending upon the sunshine and temperature.

The slope or shanty roofs on houses Nos. 1 and 2 have not been as satisfactory as the pitched roofs on houses Nos. 3 and 4. The roofs on the latter houses are more durable and the houses themselves much cooler in summer, and furthermore, the straw lofts in these houses are very effectual in preventing dampness in the houses; no frost collects upon the walls or ceilings.

We have tried several houses with curtain fronts, and we are pleased to say they work fairly well, when used in a house as in Figures 5 and 6, which is practically the same style of house as No. 4 in Figure 1, but these require adjusting according to the weather, and if they are not kept brushed, the dust and dirt will gather to such an extent as to prevent free ventilation, so that they will not ventilate very well. Our experience has been that such cloth screens should be of the cheapest of cotton; heavy cotton or duck scarcely ventilates at all. There is yet another objection to these cloth screens, in that the hens, especially the lighter breeds, become notionate about trying to lay or roost upon the screens.

To the person who is breeding the tender varieties or those with large combs, some means must be taken to keep them fairly warm at night or their combs will become badly frosted. The females of such breeds as Leghorns or Minorcas will stand a temperature considerably below zero without frosting their combs.

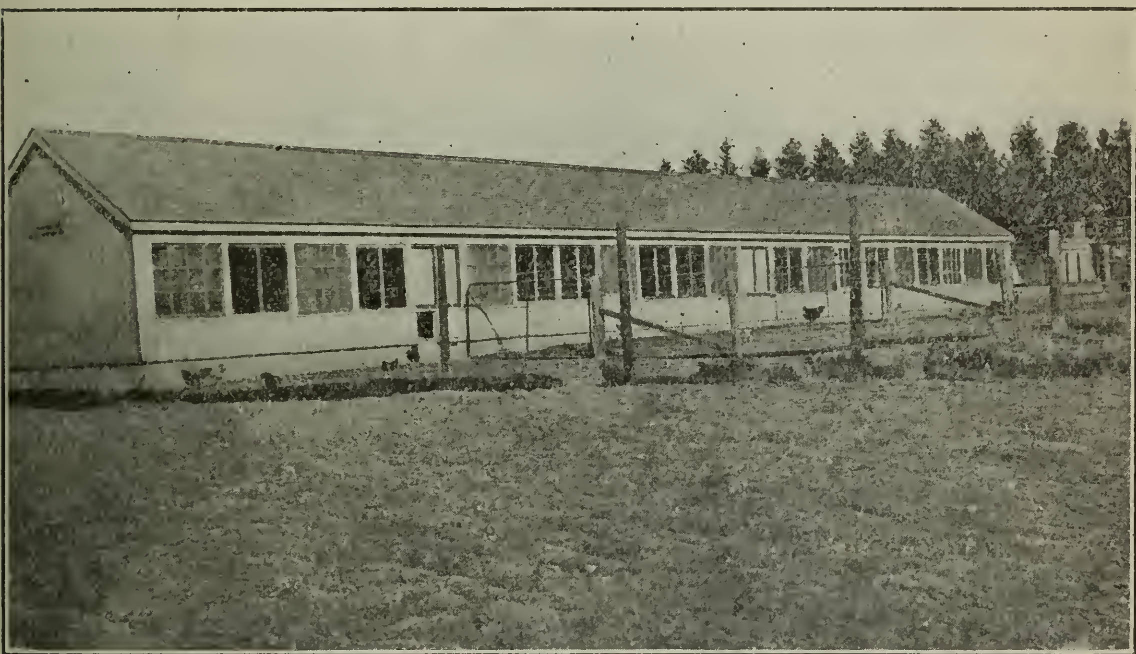


Fig. 6.

The question naturally arises: can a house be constructed which is nearly self-operating, that will keep the birds in health, and at the same time ensure a fair egg yield.

Open Front House.

Our experience has been that the fowls thrive best in low-down houses, especially during the winter. We have four houses with the fronts entirely removed, except a two-foot wire netting, which keeps the fowls in, and the sparrows, etc., out. These houses for this climate must be low down, especially in front, to keep out the snow and a portion of the wind. It is the writer's opinion that Fig. 7 will meet the needs of the average farmer, where he wishes to keep seventy-five to one hundred

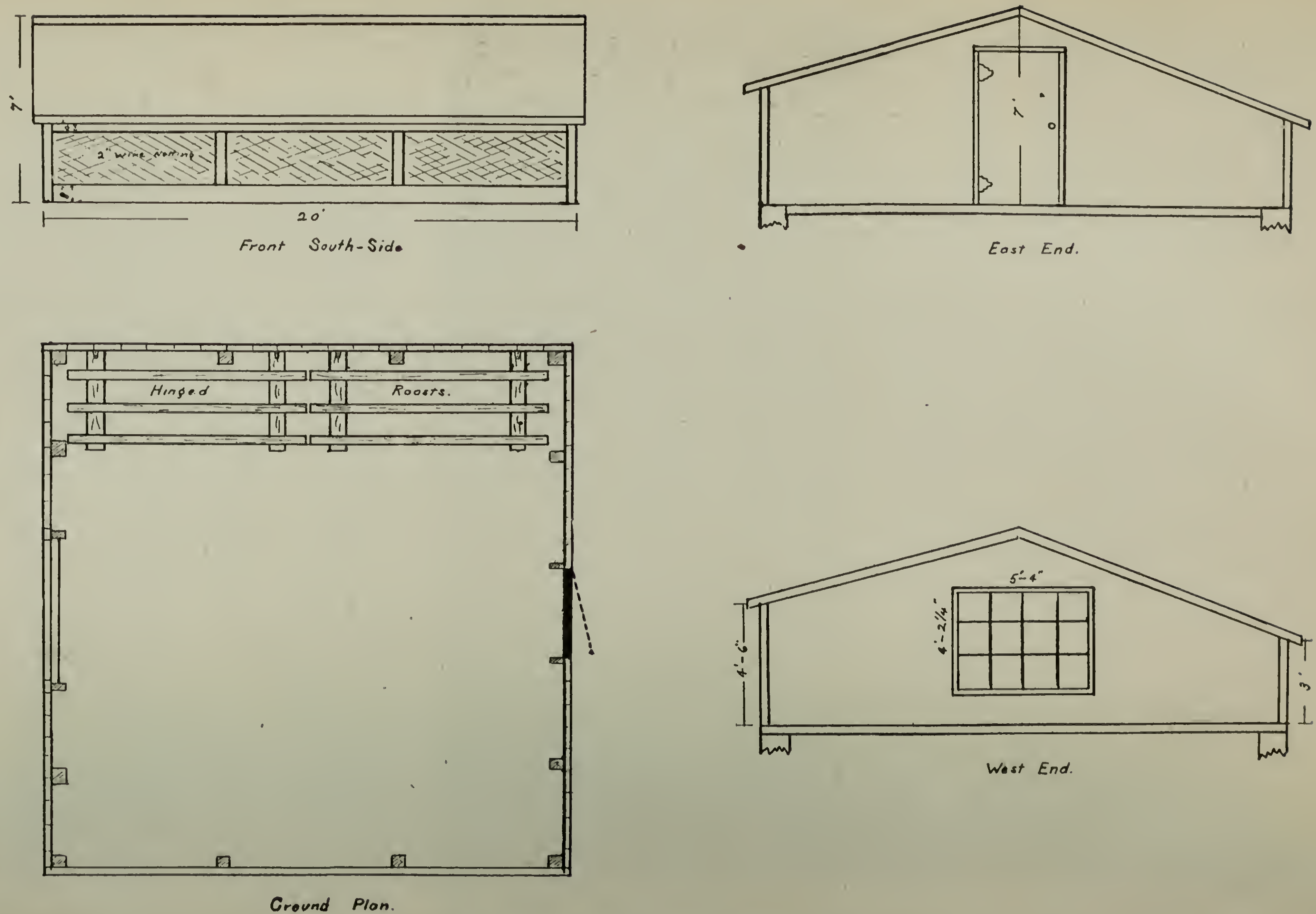
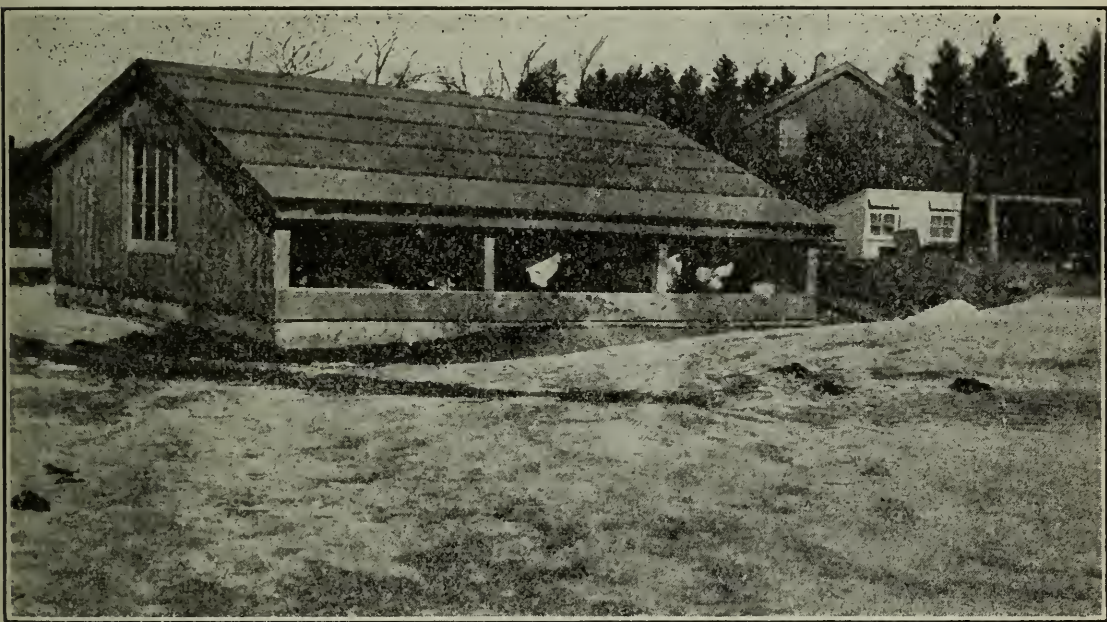


Fig. 7. Open Front Poultry House.

hens. The house looks too cold, but the birds do well. They possibly could be made to lay more eggs during the months of January and February with cotton screens properly adjusted to meet the weather conditions; but few farmers would be there at the exact time to do the adjusting, hence we use it entirely open.

The large window in the west, essential for light, should be hinged at the top, so that it may be opened during the summer months, otherwise the house will become too warm in summer.

It will be noticed that no dropping-boards are used in this building. During the winter the manure freezes almost as soon as it is made, hence no odor or bad results, and if cleaned, say, every two months, it will answer very well. We would rather have this condition than dropping-boards, covered one foot deep with manure as we so frequently see them.



Open front poultry house in Fig. 7.

In conclusion we are free to admit that the open-front houses apparently keep the stock in better health, brighter in plumage, and they require less labor than any house we have yet used. It is not perfect, and no doubt could be improved upon for special, painstaking poultrymen, but this class is very limited, and as now used comes most near to meeting the average man's position.

Long, Continuous House.

No doubt some readers will wish for a plan of a long, continuous house, in which a large number of fowls may be housed under one roof, or where a number of different breeds can be kept in the same building.

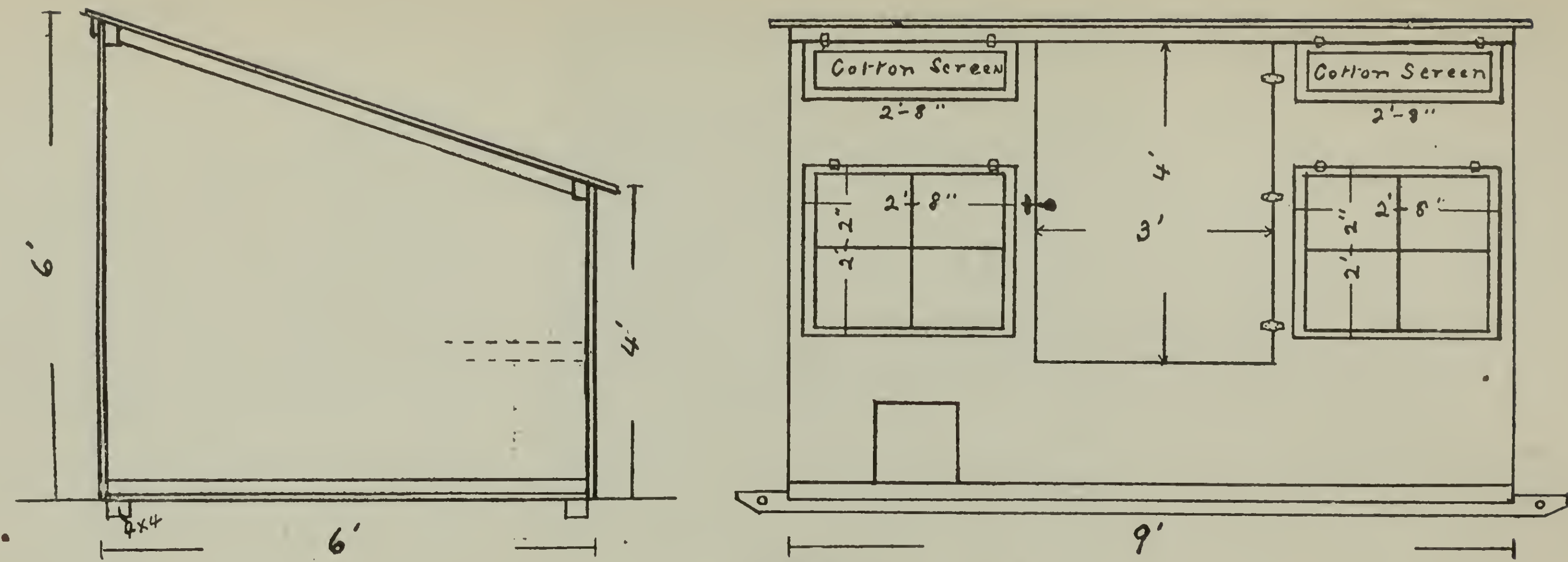

6'
4'
4x4
6'
Cotton Screen
2'-8"
Cotton Screen
2'-8"
2'-8"
2'-2"
4'
3'
2'-8"
2'-2"
9'

Fig. 8.

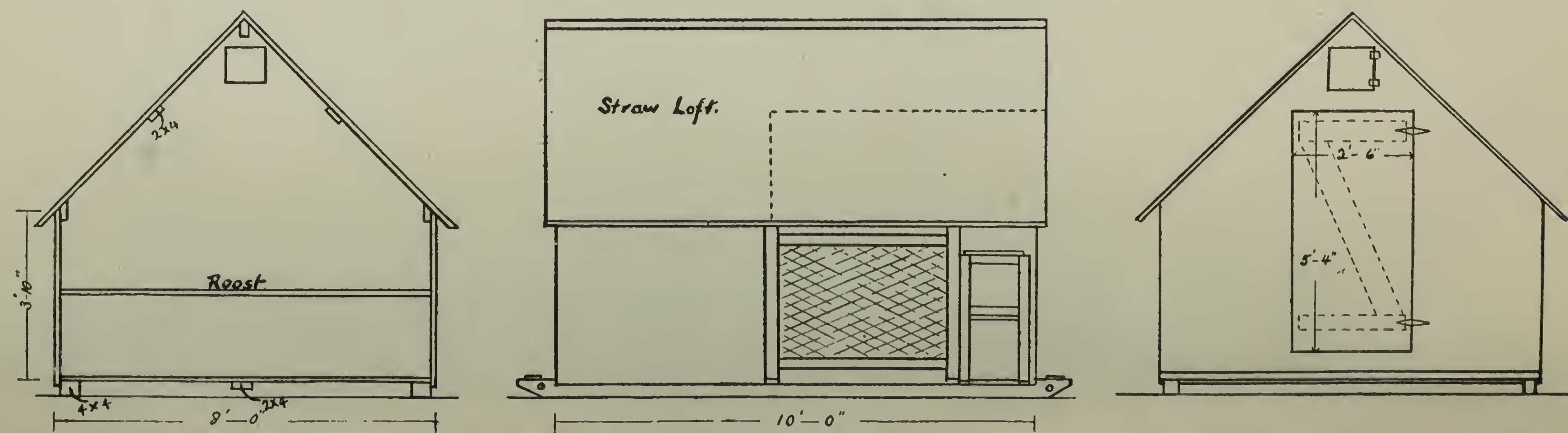

2x4
Roost
3'-10"
4x4
8'-0"
2x4
Straw Loft.
10'-0"
2'-6"
5'-4"

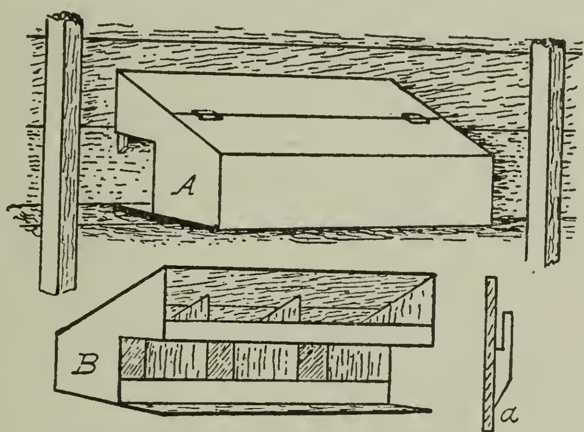
Fig. 9.

Fig. 5 gives the ground plan of this building as now used. The partitions are temporary, made of cloth tacked to wooden frames, and can be moved or adjusted to suit almost any sized flock. This house was originally used for flocks of 50, 75 and 100 laying hens, with the idea of testing large and small flocks. The house was used in this manner for three seasons with slightly better results from the flock of 50.

The plan as now given accommodates 25 fowls in each flock, with the exception of the large pen, in which can be kept 75 fowls of such breeds as Rocks or Orpingtons, or 90 of such as Leghorns. The large pen could, of course, be divided into the smaller pens.

General Rules for Building.

Every hen should be allowed at least four to six square feet of floor space. Each bird of the Plymouth Rock, Wyandotte, and such breeds,



Figs. 12 and 13. Front and Back Views of Nests. (*Poultry Craft.*)

requires about nine inches of perch room; Leghorns, etc., about eight inches; and Brahmas ten inches.

Roosts should be made low, or near the ground. There are several reasons for this. Fowls of the heavier breed cannot fly high, and those of the lighter breeds frequently injure the soles of their feet in jumping from high perches.

When dropping-boards are used, they should be moderately low down, to admit of easy cleaning. Dropping-boards should be made of matched lumber, and should be 20 inches wide for one roost, and three feet for two perches, the first being placed eight to ten inches from the wall.

Most poultrymen prefer roosts two inches by two inches, with edges slightly rounded.

Nests.—Many use only old boxes; but such nests, if near the

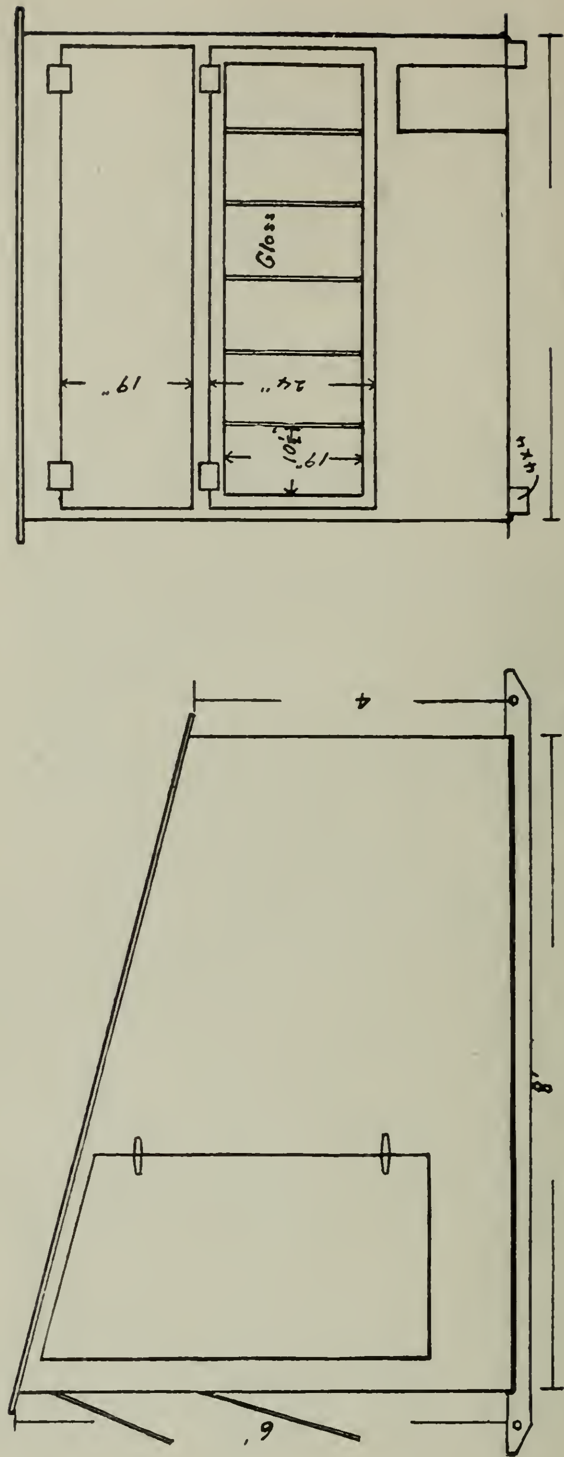


Fig. 10.

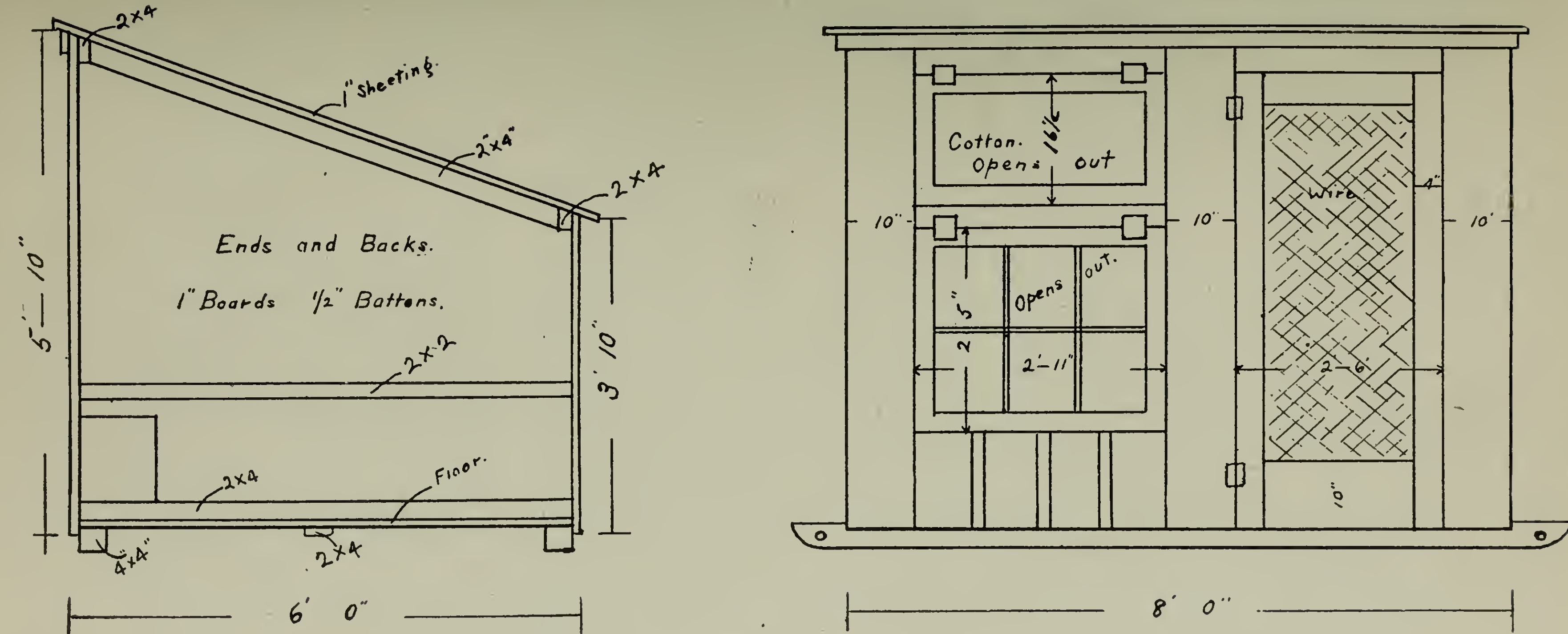


Fig. 11. Bill of Material for Colony House.

2 **Pieces** 4 in. x 4 in. x 10 ft. Runners.
3 " 2 in. x 4 in. x 7 ft. 10 in., Plates and Cen. Runner.
2 " 2 in. x 4 in. x 5 ft. 10 in., End Sills.
2 " 2 in. x 2 in. x 5 ft. 10 in., Roost Supports.
50 **Feet** 1 in. Matched Flooring.
50 " 1 in. Roof Boards.

140 Feet 1 in. x 10 in. Outside Boarding: Door, etc
½ Square Shingles.
1 Sash, 6 lbs., 10 x 12 Glass.
1 Cotton Screen, 2 ft. 11 in. x 16½ in.
1 Door, 2 ft. 6 in. x 5 ft. 6 in.
1 Cotton Screen, fits on doors.

100 Feet Run, ½ in. x 2 in. Battens for ends and sides.

ground, are apt to induce egg-eating. Dark nests prevent this. (Figs. 12 and 13.)

Nests are usually made from 12 to 15 inches square.

Cement floors are the cleanest and the results are very good. Their cost is a serious objection. Ground floors are more in favor than board floors, and cost much less.

In my own experience, the best results are obtained from keeping 20 to 25 birds in a flock. Some succeed with 60 to 75 in a flock; but these are the minority. We have received fair returns from a flock of 100 hens.

Colony Houses.

Many people living in towns and cities wish for plans of houses suitable for housing a dozen fowls each. In some instances they wish these houses so constructed that they can be moved from place to place.

There is also a demand among farmers for a small house for rearing chickens, or for small special breeding pens. The plans given below are all adaptable to these conditions, and have been used here for the purposes mentioned above. The houses are of sufficient size to accommodate 100 chicks to a two-pound weight, or fifty chickens to a four or five-pound weight; but for winter use I would not advise putting in more than a dozen laying hens. See Figs. 8, 9, 10 and 11.

EGG PRODUCTION.

In considering this subject there are several factors worthy of notice—the housing and the range, the breed and the strain, the kind of feed and the method of feeding, the attendant, the cleanliness of the buildings, their surroundings and the weather.

In the foregoing pages we have discussed houses, and no further mention is needed here.

The question of which is the best breed is rather a delicate one, and moreover, my experience is that there is as much in strain as there is in breed. However, it can be safely stated that the heavier breeds such as Plymouth Rocks, Wyandottes, Rhode Island Reds, Orpingtons, etc., usually lay better during the winter—if hatched early—than do Leghorns, Hamburgs, etc., or the lighter breeds. The lighter or smaller breeds, with us, are more easily affected by sudden climatic changes during the winter. Usually their egg production declines considerably during a cold snap. Where one has no particular desire to get eggs in winter and does not care for roasting chickens, they would find the lighter breeds most profitable. Where one wants a general purpose chicken, that is a fair layer during both winter and summer, and at the same time a chicken that will make a fair broiler or roaster, such breeds as Plymouth Rocks, Wyandottes, etc., will prove the most satisfactory. The light breeds can not be depended upon to hatch and rear their own young, whereas the heavier breeds may be relied upon for this purpose.

We have our best egg production yearly, from April and early May hatched pullets. These will commence laying if well reared between September and December, depending upon the strain or family as to whether or not they are late or early in maturing. March hatched pullets usually lay during August and then go into moult some time in November. These, of course, lay but little before March after moulting. They are, however, useful where one must have a constant supply of eggs, as the old hens decline rapidly during September and October, and the April pullets are then just getting started.

We find that Leghorn pullets or pullets of similar breeds hatched before April 15th, are apt to moult, so that we usually try and hatch these varieties after the middle of April.

Yearling hens lay fairly well, but older than this they are usually unprofitable, except as breeders when they have shown exceptional merit.

EGG PRODUCTION AND COST OF FEEDING.

COLLECTIVE RESULTS FOR 138 PULLETS FROM OCTOBER 1ST, 1909, TO MARCH 1ST, 1910.

Males.	Females.	House No.	Eggs laid.	Cost.	Average Eggs per Hen.	Amount Grain consumed.
2	23 R.I. Reds	6	1131	$15.21	49.1	851 lbs.
2	23 B. Rocks	6	1098	14.81	41.7	826 "
2	23 R.I. Reds......	5	821	14.74	35.6	820 "
2	23 B. Rocks......	5	1469	15.70	63.8	880 "
2	23 B. Rocks(weak).	3	694	14.09	30,1	748 "
2	23 B.Rocks(strong)	3	622	16.04	27.0	867 "
12	138		5835	$90.59		4992 "

COLLECTIVE RESULTS, 138 PULLETS, MARCH 1ST, 1910, TO SEPTEMBER 1ST, 1910.

Males.	Females.	House No.	Eggs laid.	Cost.	Average Eggs per Hen.	Amount Grain consumed.
2	23 R.I. Reds	6	2,187	$15.52	95.0	811 lbs.
2	23 B. Rocks.......	6	2,243	14.70	97.5	759 "
2	23 R.I. Reds	5	1,778	12.53	77.3	631 "
2	23 B. Rocks.......	5	2,185	14.41	95.0	746 "
2	23 B. Rocks (weak)	3	1,488	12.47	64.6	626 "
2	23 B. Rocks(strong)	3	2,120	15.24	92.1	788 "
12	138		12,001	$84.87		4361 "

It will be noticed in the above table, that the three pens lowest in egg production during the winter months, were also lowest during the summer months.

COLLECTIVE RESULTS, 138 PULLETS, OCTOBER 1ST, 1909, TO SEPTEMBER 1ST, 1910.

Males.	Females.	House No.	Eggs laid.	Cost.	Average Eggs per Hen.	Amount Grain consumed.
2	23 R.I. Reds	6	3,318	$30.73	144.2	1662 lbs.
2	23 B. Rocks.......	6	3,341	29.51	145.2	1585 "
2	23 R.I. Reds	5	2,599	27.27	113.0	1451 "
2	23 B. Rocks	5	3,654	30.11	154.4	1626 "
2	23 B. Rocks (weak)	3	2,182	26.56	94.8	1374 "
2	23 B. Rocks (strong)	3	2,742	31.28	119.2	1655 "
12	138		17,836	$175.46		9353 "

Average cost per dozen for winter months: 18.62c., or 19c.
" " " " " summer " 8.48c.
" " " " " eleven " 11.79c., or 12c.
Average cost of feeding each hen per month in winter: 13.12c.
" " " " " " " " " summer: 10.25c.
" " " " " " " " for eleven months: 11.55c., or 12c.
Average number of eggs per hen: 129.2.
Average amount of grain consumed per bird (males included): 62.35 lbs., or 5.66 lbs. per month.

FEEDS AND FEEDING.

A fowl requires grain food, vegetable food, meat food, and grit. These foods should be clean and wholesome, and furthermore a portion of them should be given in some form so as to induce the birds to take exercise, so that the fowls will be healthy. Fowls should be well supplied with water or milk to drink. Many make the serious mistake of not giving sufficient drink or not giving it regularly. The supply should be clean and constant. Dirty water, dirty or slimy drinking dishes, etc., will do more toward making a flock unhealthy and diseased than anything else. Most attendants are inclined to forget to clean the drinking vessels, and to keep them well filled at all times.

GRAINS.

Wheat with the Ontario people is the most popular feed and is one of the best. It is relished by all classes of poultry. The price of wheat, as compared with that of other grains during the past few years, makes it necessary to mix other grains with it. I doubt very much if it is advisable at any time to feed only one kind of grain constantly, as a variety is better; some birds like one grain while others relish another.

Wheat bran is fed dry in hoppers also in mashes. It has considerable feeding value. It helps materially in adding bulk to the ration, and prevents impaction in the stomach. In other words, it aids the digestive fluids in acting upon the food.

Middlings or shorts is of value in mashes, to all classes, and is one of the good foods to check looseness of the bowels, where an excess of vegetables is given.

Low-grade flour is often a cheap and economical food in mashes for stock birds or for fattening chickens. It also has a tendency to check looseness of the bowels.

Corn is not used so much in Ontario as in the New England States. There it appears to be used quite freely in both summer and winter feeding of fowls. It is used whole, ground, and cracked, the meal being used principally in the mash foods. Cracked corn is used largely for young chicks, and fowls when scattered in the litter. The whole corn is rather large and conspicuous; and when in the litter, does not usually give sufficient exercise. I am of the opinion that corn can be used in portions of Ontario, where it is grown extensively, much more freely than it has been heretofore. Corn is a heating and fattening food, and is, therefore, best adapted for winter use. It is considered by many, when fed in large quantities, to make the hens over fat; yet it is used extensively by many progressive poultrymen with little or no evil effects.

Oats should be a first-class poultry food, but owing to the large percentage of hull, they are not relished by chickens when fed whole, and for this reason are somewhat indigestible. When rolled hull and all they are an ideal food as a dry mash, and are relished by fowls better than any other dry mash we have yet used. Ground oats without the hull are used extensively for fattening chickens.

Barley, either whole or ground, is very good. It has rather too much hull, but otherwise is a satisfactory food. It is considered by many to be next to wheat in point of value.

Buckwheat is very popular as an egg producer in districts where it is extensively grown. Some difficulty is at times experienced when first feeding it to fowls in getting them to eat it, but this is usually overcome in a day or so, if other feeds are withheld. Boiling the buckwheat will sometimes start the birds to eat it. After they once get accustomed to its appearance, it is much relished by them. Ground buckwheat is an excellent food to use in a fattening ration. It is somewhat like corn in its fattening properties and, therefore, it is better for winter than for summer use.

Method of Feeding the Winter Laying Stock at the O. A. C.

We try to simplify our methods and use only the common foods, and at the present time are using as whole grains, wheat, corn and buckwheat. These grains are fed in equal parts both morning and evening. The morning feed is fed the previous evening after the hens have gone to roost, by sowing it on the litter, and then turning the litter over; the straw is now on top and the grain below, and when the hens get up in the morning, they start to dig out the grain, and are kept busy all forenoon. At noon we feed mangels, cabbage or clover hay. The night feed consists of the whole grain fed in troughs, and what the birds do not eat is taken up. Rolled oats are kept constantly before the hens in hoppers. Buttermilk only is given as drink.

Method of Feeding the Summer Laying Stock at the O. A. C.

At the present time our plan of feeding is to scatter whole grain in the litter both morning and evening. The grains used are wheat, barley, oats, and occasionally buckwheat and corn. Green food is supplied in the form of grass, etc., in the runs. Sour milk is given as drink.

Dry Feeding.

The tendency at the present time is to feed dry grain, and to use no wet mash foods. It has been claimed by some writers that mash foods, while tending to force growth, and possibly egg production, do not tend to produce good eggs for hatching purposes; that is to say, the mash is more or less of a forcing food. In the production of eggs, the number produced is probably as large if not larger where mashes are used, but the hatching power of the eggs in some instances is not as high. During the past two or three years we have not fed any wet mashes to our breeding birds, and have fed in place some sprouted grain, but mostly rolled oats in hoppers. As far as we can see at the present time the sprouting does not improve the feeding qualities of grain very much, with the one exception of oats. The palatability of oats is increased considerably. We have made the oats equally palatable by having them rolled or flattened, that is the hull and all.

Feeding When Wet Mashes are Used.

The general method of feeding is to give a mash of mixed ground grains moistened with water or milk, in the morning; a little whole grain scattered in the straw covering the floor, at noon; and all the whole grain they will eat at night. This latter meal is usually fed in the straw. Some poultry men adopt the plan of not feeding the mash until evening, we have been practising this plan for some time, and we like it very well. The objection to the former plan is that the hen is likely to become gorged with food early in the morning, and thus take to the roost for the rest of the day, which is usually followed by hens becoming too fat, and the egg record becoming small; but, notwithstanding, many successful poultrymen use this method to advantage. The objection to feeding the mash at night is that it becomes quickly digested, and the bird has not sufficient food to last it during the long winter night; but this objection can be overcome by giving a little whole grain after the mash at night.

Some poultrymen feed their fowls but twice a day, morning and evening, and get very good results; but I favor feeding three times a day. Our plan is somewhat as follows:—

Early in the morning the fowls are given half a handful each of whole grain. This is buried in the litter on the floor. Thus the fowls get exercise (a very necessary thing) in searching for it and at the same time keep themselves warm. At noon about two handsful of grain are given to a dozen hens in the litter; they are also given all the roots they will eat, either pulped or whole, as fowl relish mangels, sugar beets and turnips. Cabbage also—a very good green food—is sometimes given. About four o'clock in the afternoon they are fed a mash composed of equal parts of bran, shorts, oat-chop and corn meal (during cold weather); and to this is added about 10 per cent. of animal meal, if we have not cut green bone or cooked meat. These foods are thoroughly mixed together in the dry state, after which is added steeped clover, which has been prepared by getting a bucket of clover leaves, or cut clover hay, and scalding it with boiling water. This is done early in the morning, and the bucket is kept covered with a thick sack throughout the day. This will be quite warm at night, if it has been kept in a warm place. There is usually sufficient liquid to moisten the meal that has been mixed. Our aim is to have about one-third of the ration, in bulk, of clover. After the mash a small amount of whole grain is fed in the straw. There is—and should be—a plentiful supply of good, *pure water within easy reach at all times.*

To those who keep but a dozen or so fowls, or to those who wish to economize in the feed bills, by using table refuse such as bread, meat, vegetables, etc., the wet mash system is commendable, in that these cheap by-products, if clean, and cooked, make excellent mashes, when dried off with shorts and bran or other chop. This kind of mash usually gives excellent egg yields, and the labor entailed is not a serious consideration, under the above conditions, but it is, at times, where birds are kept in large numbers.

Animal Foods for Fowls.

The most expensive foods given to fowls are the animal foods. These are used as a substitute for the worms and insects that form a portion of the natural summer food of fowls upon free range. Flocks confined to small runs require to be fed more or less animal foods during the winter, and during very long dry spells in the summer; even where the range is unlimited it frequently pays to feed a little animal food.

Animal foods usually assist very materially in the production of eggs in winter. By some people these foods are considered as a forcing food, that is to say, they will induce heavy laying, which in some instances may be followed by serious sickness, or possibly the injury may be only very slight; in fact unnoticeable, except that the eggs from birds so fed may be of very low hatching power.

It is generally believed, and I think rightly so, that good egg yields cannot annually be secured without the use of such foods as green cut bone, beef scrap, or cooked refuse meat, etc. Many believe that the larger the amount of these foods fed the greater will be the egg production. There is good ground for doubting this statement, in that these foods are expensive, and the extra eggs may cost more than they are worth, moreover, herein is where serious injury may be done to the hen's digestive and reproductive organs.

Milk is available on many farms, and it is claimed that as an egg producer, this food is equal in value to any of the meat foods. Our experience has been that sour milk for fowls has a slightly greater value than sweet milk, and is certainly much more easily obtained.

Last year we planned an experiment with the idea of studying what effect various animal foods would have upon the egg production, and the hatching power of the eggs.

The plan of the experiment is for five years, with a different breed for each year. The males used in the different pens were brothers. Buff Orpingtons were used for this trial. The grain and green food were the same for each pen, and all were housed in the same building. There were twenty-five females and two males in each pen. The pen given green cut bone were fed about three quarters of a pound daily. Several trials were made to determine the hatching qualities of the eggs during January, March and April.

The following are the results for seven months, from October 1, 1909, to April 30, 1910:

Pen No.	Animal Food Used.	Whole Grain. Lbs.	Dry Mash. Lbs.	Animal Food. Lbs.	Total Cost.	Total Eggs Laid.	Cost per Dozen Eggs.	Percentage of Eggs hatched.
1	Buttermilk .	720	233	1453	$18.16	2040	10·68c	55.0
2	10% dry mash is B. Scrap	840	337	34	19.85	1670	14·28c	50.5
3	B. S. in hopper.......	900	216	141½	22.21	1664	15·84c	33.0
4	No animal food......	900	224	....	17.99	1496	12·69c	59.5
6	Green cut bone	900	196	127¾	21.37	1654	15·48c	40.5

(1) The above table must not be taken as a final conclusive result. It is simply what happened with one breed for one season. It is, of course, an indication of what may be the results in years to follow, and as such it is valuable.

(2) From the results in pens 3 and 6 it would appear that the feeding of very large quantities of meat foods is not to be commended.

(3) Sour milk, where it can be secured at 20 c. to 25c. per hundred pounds is an economical food.

(4) Where eggs for hatching purposes, only, are the object in view, all forcing foods are probably best left out of the ration.

Green Foods.

When fowls have free range, they eat a considerable amount of grass, or other green foods. It would appear, therefore, to be desirable that where birds are confined either in small runs during the summer, or in houses when the ground is covered with snow in winter, that some effort should be made to supply this food.

Many foods are available, such as waste cabbage, mangels, turnips, rape, clover hay, or clover leaves, and green food grown especially for the purpose.

Early in the fall we use cabbage or rape; or at times where the runs have been sown to fall rye or wheat, the fowls are allowed to feed upon these. Where rape is extensively fed it frequently will cause the whites of the eggs to have a greenish cast, which renders them unmarketable. This food is relished by the fowls, but must be fed carefully. Cabbage at times will flavor the eggs slightly, and if frozen may cause serious digestive troubles. Both rape and cabbage make good green foods, but good judgment must be exercised in their use.

Mangels are a very succulent food and are relished by the birds during the winter. They can be fed either pulped or whole. When they are fed whole, we usually stick them on a projecting nail, at a convenient height, upon the wall of the pen. When these are fed freely they frequently scour the fowls. For this reason during some seasons we are obliged to feed them not more than twice a week.

Turnips may flavor the eggs. They are not as palatable as mangels, in fact some birds will not eat them at all, but at the same time they have considerable food value.

Clover leaves, either steamed or dry, are relished very much, and upon the whole are the most reliable winter green food. One hundred hens will eat from a peck to a bushel of clover leaves daily. This food upon the farms is cheap and easily procured, and should be fed more than it is.

The growing of green food is becoming quite popular with many, but we have never received sufficient results to warrant our growing it extensively, except for little chicks.

The ordinary plan is to soak the grain—most people use oats—twenty-four hours previous to sowing. The ordinary greenhouse flat is useful for this purpose. Any box from 3 to 4 inches deep will answer. It is necessary that the bottom of the box should have sufficient holes to give good drainage. Place a little damp earth over the bottom of the box, and then put in about ½-inch of soaked grain, and cover this with about 1 inch of sand. Keep the box in a warm place, and keep the earth moist. In a few days the grain will begin to germinate. Most feeders allow the grain to grow two or three inches before feeding.

INCUBATION.

This is a very interesting topic. Here we are dealing with the renewal of the flock. This has been to the large grower a difficult problem, and to most farmers and small growers comparatively easy. (It is apparently easy for the farmer to hatch and rear 100 or more chicks, and very difficult to get hens to lay during the winter. The large grower can usually get a fair egg production during the winter, if he can get the chicks out and well grown.) There are so many factors that may influence the hatch and the vitality of the chicks, that it is at times an impossibility to say why one fails and another succeeds.

The first essential to successful incubation is good hatchable eggs. The hatching power of eggs is apparently influenced by the parent stock, not only in the present generation, but possibly for generations back. Granting this, we must then use only the strongest and best birds as breeders, and if a rigid culling is followed annually, it is our belief that gradually, but surely, the problem will become less difficult. Then, again, the methods of housing and feeding are factors. Birds kept in ill-ventilated, damp houses, or under any unsanitary conditions, are lowered in vitality or vigor, which of necessity must be more or less imparted to the germ of the egg. It has been shown under the discussion of foods that the hatch is influenced by the feeds.

The farmer's flock is usually strong and rugged; it has plenty of exercise in the fresh air, and, moreover, is seldom kept in such numbers that the ground about the buildings becomes seriously contaminated. There are, of course, some exceptions to the above statement. Fowls upon the farm are very seldom excessively fed upon meat, or what may be termed forcing foods. Then, again, the unlimited range and the great variety of foods available make the conditions upon the farm excellent for the production of good hatchable eggs. If more attention was paid to the selection of the males, the results would be improved. The selling of the largest, and earliest maturing males, and the breeding of the late hatched, immature, ill-nourished males is not conducive to progress, to say the least.

The difficulties of the large growers are mainly due to bad housing, yarding, and feeding. Many houses are poorly ventilated, and the yards are small, and the fowls are on them constantly, and are, therefore, in an unsanitary condition; and, furthermore, the lack of a variety of foods and exercise, and the use of animal foods, are also more or less injurious. All these conditions are largely under our control, and many of the failures in the past appear to be directly due to a too intensified condition. It has been many people's idea to see how many hundreds could be kept on the least acreage of land.

Natural and Artificial Incubation.

Whether it will pay to buy incubators and brooders depends largely on one's circumstances. Where chicks are wanted in considerable numbers earlier than April 15th, an incubator becomes practically a necessity, as it is seldom that hens become broody in numbers until after the 1st of April. Again, where one wishes to hatch more than 150 chicks, an incubator is in many cases cheaper and better than the natural methods. It is also a necessity where one is breeding from the non-setting varieties.

There are numerous illustrations of chicks being raised in large numbers by the natural method in the States of Rhode Island and Massachusetts, particularly in the former State. Where this method is followed, the chicks are hatched largely during the months of May and June; and where from 500 to 1,500 laying hens are kept, there is little difficulty in getting a sufficient number of broody hens. Those who are keeping large numbers of hens appear to be well satisfied with the natural method; but there can be no doubt that the number of incubators in use is increasing from year to year.

The average hatch is probably one chicken from every two eggs set. This, of course, varies with the different seasons, also with the percentage of fertile eggs, and the strength of the germ. We have found during the months of February and March, when the ground is covered with snow and the fowls are closely housed, that the percentage of fertile eggs is small, and that the germs are very weak. Under such conditions we have very poor hatches and chicks that are very hard to rear. Much better eggs are obtained in December and early January, or when the fowls get out into the fresh air and are able to pick some grass. Thus it will be seen that, as a general rule, as the percentage of fertile eggs increases, the vitality of the germ increases, the percentage hatched is larger and the mortality among the young chicks smaller. For example, we would expect to get a much larger percentage hatch of the fertile eggs from eggs that were 90 per cent. fertile than from those that were 60 per cent. fertile; and, moreover, we would figure on raising a much larger percentage of chicks from the former eggs than from the latter, owing to the chicks being stronger and having greater vitality.

Setting the Hen.—It is generally agreed that, in order to secure a good hatch, the hen must be placed where other hens are not likely to disturb her; for, as a rule, we seldom get good hatches where other hens lay in the nest with the sitter. Some farmers do not set a hen until one becomes broody on a nest where no others lay, which often necessitates late chicks. The difficulty can be overcome by making a new nest for the broody hen. Get a box about twelve inches square and six inches deep; put some earth, or an overturned sod, in the bottom, taking care to have the corners very full so that no eggs can roll out from the hen and get chilled; next put on about two inches of straw or chaff; and then put a few earthen eggs into the nest. Place the nest in some pen where nothing can disturb the hen, and put her on after dark. Feed and water must be within easy reach and a dust bath should also be convenient. If the hen is sitting quiet the next day, you will be safe in putting the eggs under her. In our experience we get 90 per cent. of the hens to sit by following this method.

It should be remembered that the hen will be in better condition if dusted with insect powder when set, and also a few days before the hatch comes off. This will usually keep the lice in check, especially if some tansy or mint leaves are used in making the nest.

Artificial Incubation.

During recent years many incubator experiments have been conducted here as well as at other colleges, and some progress has been made. It is our purpose at this time, not so much to go into the details of these, but to give, if possible, the best methods we know, that can be used by the average person.

Selecting an Incubator.—There are many makes of incubators on the market, that do fairly good work; they are not perfect, nor have they the hatching power of a normal hen, but then they are always ready to hatch eggs in any day of the year, and by their use eggs can be incubated in large numbers. They do not get balky, and cease hatching as some hens do—that is, unless the operator fails to do his part. Commercially they are a necessity. To the prospective buyer I would suggest the purchasing of a well built machine, one that is double cased, and that is easily cleaned, and whose fixtures, such as the lamps, etc., are convenient. I do not know which is the best incubator made.

Recent scientific investigations indicate that it is probable, in some instances, that disease organisms, found in dirty incubators, cause serious harm. Our plan—no matter what the type of machine—is to thoroughly wash the entire interior of every machine before putting in the eggs for hatching. We use a ten per cent. solution of a tarry compound, such as Creoline or Zenoleum. This helps to clean the machine, and if applied hot, so much the better. We have obtained best results by using water or moisture during the entire hatch. I have seen good hatches from incubators where no moisture was used. We use a pan beneath the egg-tray, nearly the full size of the machine, and keep this pan covered with water, or wet sand, not more than one inch in depth.

Many incubator thermometers are not reliable, and it is, therefore, advisable each season to have the thermometers tested; any druggist will have a registered thermometer, and can do the testing if the owner does not wish to do so.

The hatch is made or lost usually during the first week of incubation. Keep the temperature well up to 103 deg., with the thermometer lying on the eggs, and maintain as even a temperature as possible.

Do not set dirty, washed, small or extra large eggs. The shell is porous and disease germs that may be on dirty eggs might infect a number of eggs. Do not turn eggs when your hands are dirty, or immediately after handling lamps or kerosene.

The room in which the machine is operated should be clean and well ventilated. If possible select a room that varies but little in temperature; in such a room it is easier to keep the hatching chamber of the machine at an even temperature. Where there is a strong odor of lamp fumes, or where there are decaying vegetables, or where moulds grow upon bits of boards or upon the walls, an incubator will not usually do good work. The lamp burns brighter, the eggs hatch better, and the chicks have more vitality when the air in the incubator room is pure.

General Symptoms of What is Commonly Called White Diarrhoea in Young Chicks.

When chicks are about twenty-four to ninety-six hours old they resemble each other very much in appearance, with the exception that we have noticed that hen-hatched and chickens hatched in moist incubators were longer in the down, or looked larger and fluffier. The trouble generally begins about the fifth day. Some of the chicks will have a thin white discharge from the vent, the chick is not active, it has a sleepy look; also the head appears to settle back towards the body; one thinks the chick was cold or in great pain. Some of the chicks get in the warmest spot under the hover, others have intense thirst. The white discharge from the vent is not always present. The chicks may die in large numbers between the fifth and tenth days, or there may be a gradual dropping off each day until they are six weeks of age. The disease kills some quickly, others linger for a week or more. A few chicks appear to recover, but seldom, if ever, make good birds. They are small, unthrifty and are good subjects for roup or any other epidemic.

To the ordinary observer a post-mortem examination may reveal any or all of the following conditions: The lungs will usually show small white spots in them. These are generally quite hard and cheesy. These spots are not always present, but from our examinations I would judge they are in fifty per cent. of the cases. Some lungs have no white spots, but are red sometimes, fleshy. These in our experience are not very common unless the chickens are chilled. The yolk is often hard and cheesy. It varies greatly—some yolks are of a gelatinous nature or almost like the white of the eggs; others are hard and cheesy and very yellow in color, sometimes these are greatly inflamed; other yolks appear like a custard that has curdled, and they usually have a very offensive odor. The ceaca, or blind intestine, is frequently filled with a cheesy substance.

The white spots in the chicks' lungs are generally considered to be due to the growth of a common mould. This may be in the eggs, or more frequently comes from moldy feed or litter. It is much more troublesome in damp, dull weather, when the chicks are most inclined to stay under or near the hover.

REARING CHICKENS.

Experience and observation has led me to believe that chickens, in order to do their best, require to be grown on fairly good land, probably a clay loam or a sandy loam being the best. I have never been successful nor yet have I seen good flocks of chickens grown on very light sand. Chickens require dry ground at times, yet, at the same time, a rather moist location near by renders a good foraging ground.

Young chickens require plenty of ground to range over; some convenient shade, such as fruit trees, or growing corn or artichokes; tender green food and insects. Many growers of large numbers of chickens on limited areas crowd the birds far too much, the result being a large proportion of unthrifty chicks. These last mentioned chickens have been very much in evidence on nearly all the large, intensive poultry plants that I have visited. The chicks frequently outgrow these conditions to such an extent that they are very difficult to pick out when mature, but are readily seen when about one-half grown. Many growers appear to believe that as long as a chicken is alive it is a good one, but this is folly. I believe by breeding from such stock the vitality will gradually decrease until we shall reach a point where eggs are practically unhatchable.

Chickens when taken from the nest or incubator should be placed on ground upon which no other chickens have ranged that season. The range or run for a chick during the first four weeks of its life need not be large, but it should be fresh.

Many make the mistake of putting late hatched chickens on old tough sod, the green grass (if there is any) being so tough that the chicks cannot break it, and often the grass too thick to admit of a chick catching an insect before it is out of reach. I much prefer a cultivated piece of ground. A little tender lettuce, or rape, or even weeds for green food are preferable to summer sod, or grass. But after the middle of May the cultivated land gives better results than grass land.

A corn field well cultivated appears to be nearly an ideal place for raising late hatched chicks.

Chickens hatched in an incubator can be reared either with hens or

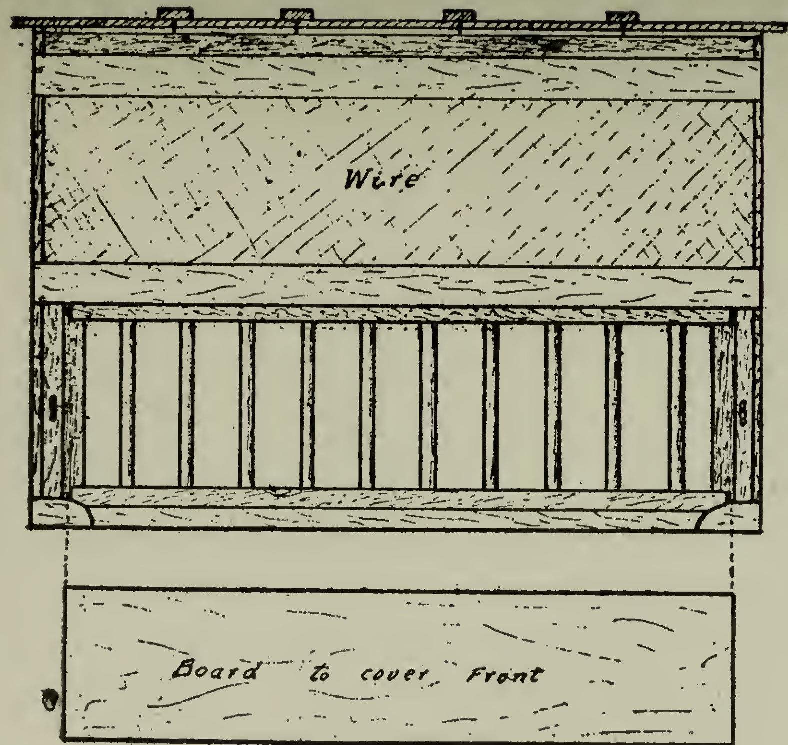


Fig. 14. Front of a convenient coop for hens and chicks.

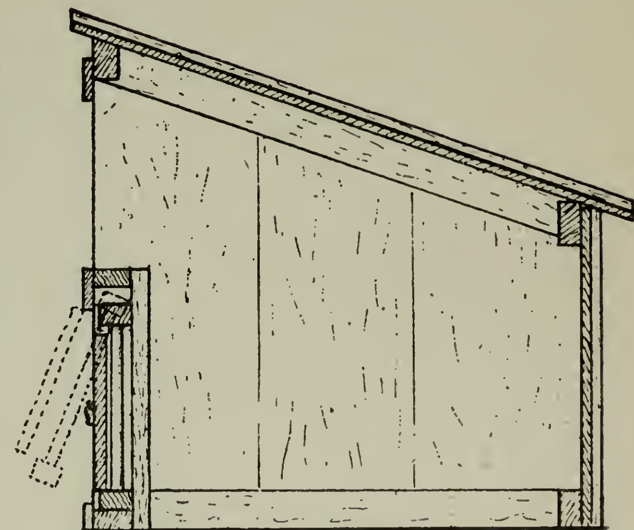


Fig. 15. Cross section.

This coop can be closed at night so as to keep out all animals that might destroy the chicks. The wire front is necessary to supply an abundance of air.

The movable front is a great convenience when the hen is running at large during the day.

The coop is two feet high in front, fifteen inches high at the back, and is two wide by three in length. The wire portion is one foot in width.

with a brooder. Some people are able to make good hatches with their incubators; but they are unable to rear the chickens in brooders. In this case I would advise the use of broody hens for mothers; and the same would apply to those who have an incubator, but do not care to invest in a brooder.

The best plan I know of to get the broody hens to take the chicks, is to give the hen two or three eggs out of the incubator on the 18th or 19th day and allow her to hatch them. When your incubator hatch is over take a dozen or fifteen chickens and put them under the hen after dark. Even if they happen to differ in color from those she has hatched, she will mother them all the same. If you give them to her in the day time she may not do so. Never neglect to give the hen a thorough dusting before giving her any eggs. If there is one thing more than another that requires careful attention in rearing young chickens, it is to keep

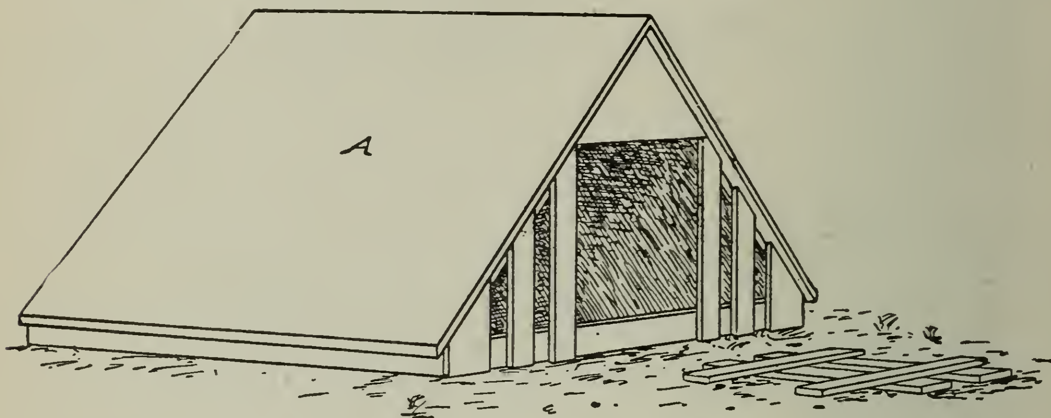


Fig. 16. Coop A.—Each side of roof 24 in. by 30 in.; bottom 2 ft. 4 in.

them free from lice. If lice get upon them, from the hen or elsewhere, a large proportion of them will be almost sure to die.

There are many good brooders upon the market which are well described in the manufacturers' catalogues; hence a description here is unnecessary. Personally, I am in favor of a three-compartment brooder, as it admits of keeping the chicks in near the heat when young, and on stormy days. The brooder lamp should always be arranged so as to give little chance of fire.

If the brooder can be placed in a small portable house, it is a good plan, as the brooder is thus protected from stormy cold winds in the early spring; also from the heat later on. The house protects the chicks from rain, and serves as a roosting coop after they become too large to stay in the brooder.

Chicks should not be fed until they are at least 36 hours old. It is a serious mistake to feed them earlier. Too early feeding is the cause of indigestion and bowel trouble in many cases. We try to keep the temperature of the brooder between 90 and 95 degrees at the chick level throughout the first week. After the first week the temperature is gradually lowered, generally speaking, about one degree a day. When the chicks are put into the brooder, it is well to remember that every 15 chicks will raise the temperature of the brooder one degree. Be careful not to get your brooder too hot, nor yet so cool as to chill the chicks. This is very important, especially during the first ten days.

The floor should be covered with clover chaff before the chicks are put into the brooder. Lukewarm water should also be put into the brooder for drink before the chickens are taken from the machine. I have had best success in starting young chicks on hard-boiled eggs, finely chopped, shell included, and bread-crumbs—about four parts by weight

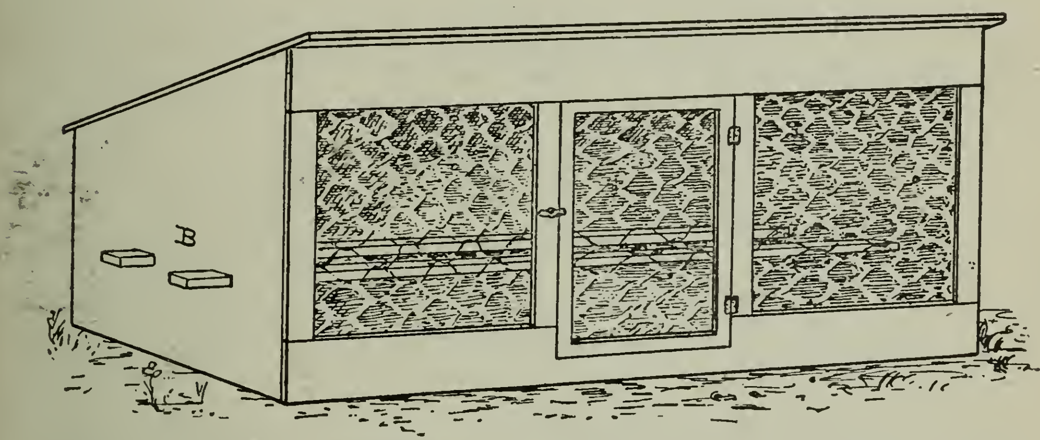


Fig. 17. Coop B.—Length, 6 ft.; width, 2 ft. 6 in.; height in front, 2 ft. 4 in.; height at back, 18 in.

of bread to one of eggs. This is fed dry. After the first two days we begin to give an occasional feed of seed chick-food, which is made as follows:—

Cracked wheat	30	parts.
Granulated oat meal	30	"
Small cracked corn	30	"
Grit (chicken size)	10	"

This can be used for the first feed and continued through the first eight to ten weeks with good results. We aim to feed the chicks five times a day. Generally after the first few days, there are three feeds a day of this chick-food, one of bread and milk (the bread being squeezed dry and crumbled), and one of whole wheat, or a mash made of equal parts of bran, shorts and corn meal, to which has been added ten per cent. of animal meal or blood meal. If we can secure fresh liver and get it boiled, this is generally given twice a week, and the animal meal is then omitted from the mash. If the chicks cannot get out to run about, the seed chick-food may be scattered in the chaff, and the little chicks will work away most of the day for it. This gives them exercise, which is a necessity in rearing chicks. If there is no *green food* to reach, it *must be supplied.* Lettuce is excellent. Sprouted grains are very good, as is also root sprout, cabbage, rape, etc.

When the chicks get to be about eight weeks of age, we usually feed three times a day—the mash food in the morning and whole wheat and cracked corn at noon and night. If we are anxious to force the chicks, we give two feeds of mash and increase the animal meal a little.

Chicks hatched at a season of the year when they can range out of doors need not be fed as often or as carefully as described above. Dur-

Fig. 18. Growing Chickens in the Cornfield.

ing the winter season where chicks are reared indoors too liberal feeding often causes leg weakness, etc.

We have used during the season of 1909 the hopper plan of feeding chicks during the spring and summer months with good success. We have tried placing a hopper or trough of chick feed, made of grains as previously described (seed chick-feed), in a coop along with the hen and chicks, and keeping the supply constant in or near the coop, from the day the chicks were put out until well grown, with most satisfactory results. Where chickens have a good range about the fields of the average farm I know of no better plan of feeding chicks. The hoppers may be made of any size or shape so long as the supply of grain is constant and the supply large enough to last for about one week. A hopper which slopes from both sides will feed better than one with a slope to but one side.

Where the hopper plan is adopted on the farm, the labor problem is very much reduced. This plan can be carried out with chicks in brooders, but for the first ten days or two weeks I prefer feeding the chicks about five times daily, after which time the hoppers are used. Water should be

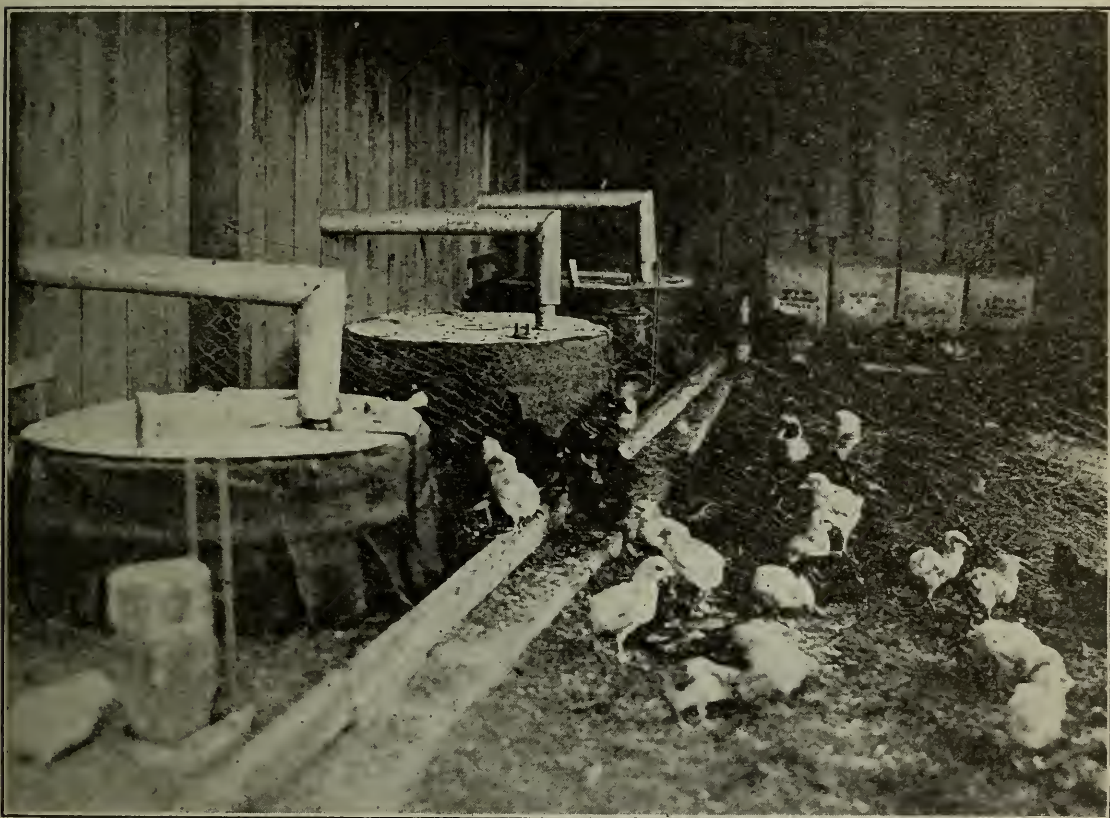
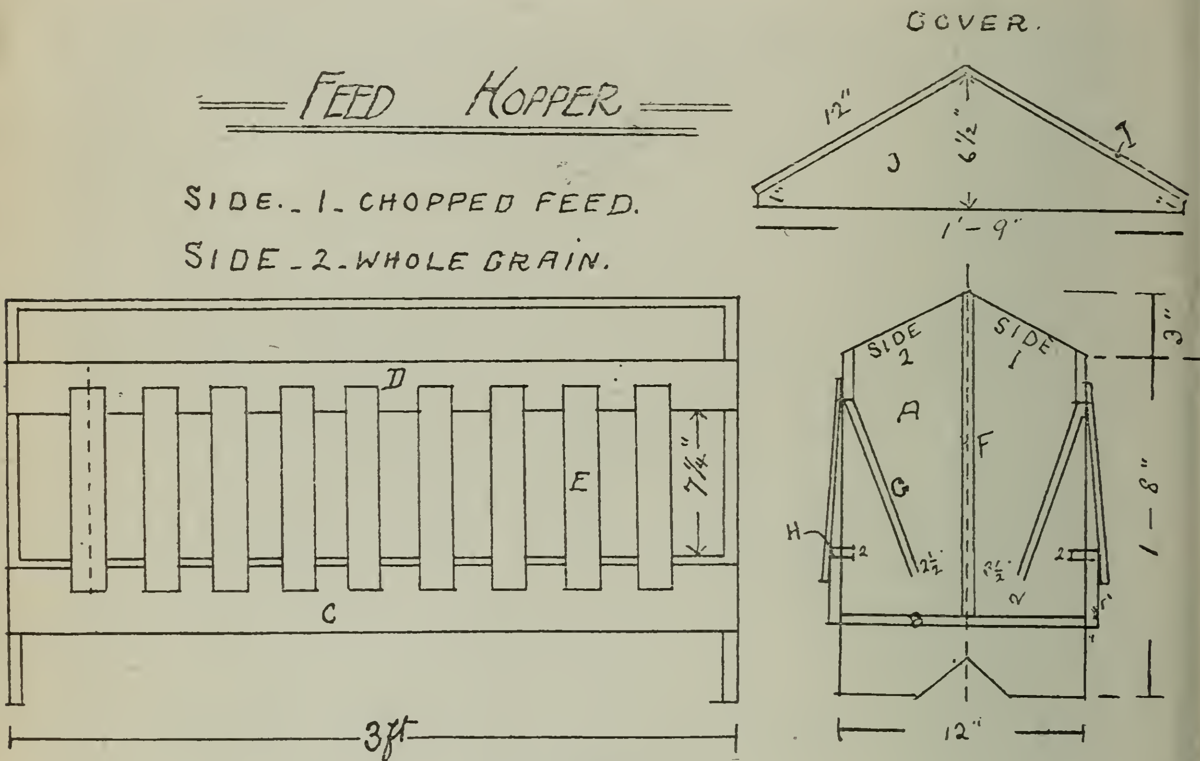


Fig. 19. This cut shows the method of Brooding, etc.

given daily in a clean dish. We have had chicks with hens do extra well when turned in a large corn field with a hopper of grain constantly near the coop, but no water. These birds were a long distance from a water supply, hence they were tried without water with no bad results. I would prefer giving water if the supply is clean and constant.

The chicks are taken from the out-door brooders at from six to eight weeks of age, according to the weather. A small coop (Fig. 16) is set in front of the brooder, so that the chickens cannot get to the brooder entrance, the result being that they get into the coop A. After a day or two take away your brooder, and the coop can then be moved daily to fresh ground. This will keep the coop clean. When the chicks get too large for the coop A, which will be in about ten weeks, they are put into coop B (Fig. 17). The same process is gone through with coop B. It is set in front of coop A, so as to obstruct the entrance, and the chicks then go into the coop B, and soon take to the roost. Coop B will roost 20 chicks until full grown. Try to keep your chickens roosting in the open air as long as possible. Never house them in close, stuffy houses. If you do they will be sure to go wrong, become weak, and be of little or no value, either as breeders or egg-producers. Where the indoor brooder is used in a colony house, the brooder is removed from *the house* and the chickens roost in colony house until they are ready to market.



BILL OF MATERIAL.

A. 2 ends ⅞ x 12″ x 1′—8″	*F.* 1 division ½ x 16″ x 2′—10¼″
B. 1 bottom ⅞ x 12″ x 2′—10¼″	*G.* 2 " ½ x 9½ x 2′—10¼″
C. 2 sides ⅞ x 3¾″ x 3′—0″	*H.* 2 pieces ¼ x 1″ x 3′—0″
D. 2 sides ⅞ x 2½″ x 3′—0″	*I.* 2 " ½ x 12″ x 3′—2″ } Cover.
E. 18 pieces ⅜ x 1⅝ x 10″	*J.* 2 ends ⅞ x 6½″ x 1′—9″ } Cover.

Side 1.—Chopped feed. *Side 2.*—Whole grain.

There are many advantages in using several small movable colony houses for rearing chickens.

(1) There is no loss of time in teaching the chicks to go from a small coop to a larger one. Movabie brooders are used inside the house, and when no more heat is required these are taken out. About this time low, flat perches are put in the house; the chicks soon commence perching, and thus prevent crowding. A hundred chicks can be put

in a house. This house will accommodate fifty chickens of about four or five pounds weight, or until large enough to be fattened or put into laying quarters. Usually some birds are sold as broilers, hence there is not much over-crowding.

(2) The chickens can be reared on a portion of the farm, where a full crop as well as a crop of chickens can be grown. This usually means new land each season for the chickens, which in turn means stronger and better birds reared with less grain. It also may mean the destruction of many injurious insects. We use the corn fields, pasture fields, and orchards, or any similar condition under which a crop of chickens, and an additional crop can be obtained from the land during the same season. Chickens grown on the same land year after year, do not thrive as well as those grown on new ground each year.

(3) Should the chickens at any time become destructive they can be moved. We have raised chickens in tomato fields, and if they develop the habit of destroying the ripe tomatoes, all that is necessary to avoid further trouble is to shut the chickens in at night, and next day draw the house to a new field and open the door. The chickens will come home to the colony house to roost.

(4) Where there has been considerable grain shelled on the field during harvest, the chickens can be easily moved to the field, and there they will gather the grain.

(5) Any vermin that might worry the chickens at night can be easily kept out by shutting the door.

(6) During rainy or bad weather, the chickens have a place for shelter. This is very important early in the spring and late in the fall.

Cost of Rearing.

We were able, during the season of 1909, to keep an exact record of the birds grown in the pasture field, and of those grown in the orchard. The chickens in the pasture field were hatched during the first two weeks in May. Three hundred and forty-five birds were grown to maturity or to a size suitable for fattening. We began to remove the cockerels from the field to the fattening pens on August the 25th. The pullets and cockerels held as breeders were all taken from the field by the 22nd of October. The breeds reared were Orpingtons, Wyandottes, Plymouth Rocks, Leghorns, etc. They consumed 4,304 lbs. of grain; of this about one-third would be dry mash, nearly 300 lbs. chick feed, and the balance wheat, corn and hulled oats in the proportion of two and a half, two and one. There was five per cent. of beef scrap added to the dry mash. The birds were weighed when taken from the field, weighing 3,341 lbs., or one pound of chicken representing 3.2 lbs. of grain. Some of the breeding cockerels weighed over seven pounds, and the Leghorn pullets did not average three pounds in weight. We removed most of the cockerels at about a three and one-half pound weight, or when they would fatten most economically.

The chickens reared in the orchard varied more in age. The first were hatched on the 25th April, and the last on July 6th. Most of the birds were hatched in May. We sold 218 as broilers from this lot during July. The later cockerels were removed to the fattening crates as was done with those grown in the pasture field. Most of the pullets were taken out about the 1st of October, and by the 1st November practically all had been removed with the exception of about 100, these were cockerels held as breeders, and the July chicks.

The above illustration shows how it is possible to produce two crops in one season, viz.: apples and chickens. This is one of the best places to grow strong, healthy chickens at a very low cost.

We raised in this field 733 chickens at a cost of 8,649 lbs. of grain. A pound of chicken equalled 3.34 lbs. of grain, or nearly the same as the pasture field chickens.

The figures mean that a farmer can in his fields raise a four-pound cockerel for thirteen or fourteen pounds of grain. This amount of grain at $30.00 per ton, would be worth twenty-one cents. The cockerel would sell in the market for at least forty cents, and if fattened, would be worth sixty cents. The data we have on hand would indicate that it costs about five to seven cents each to hatch the above birds, that is figuring eggs, oil and losses.

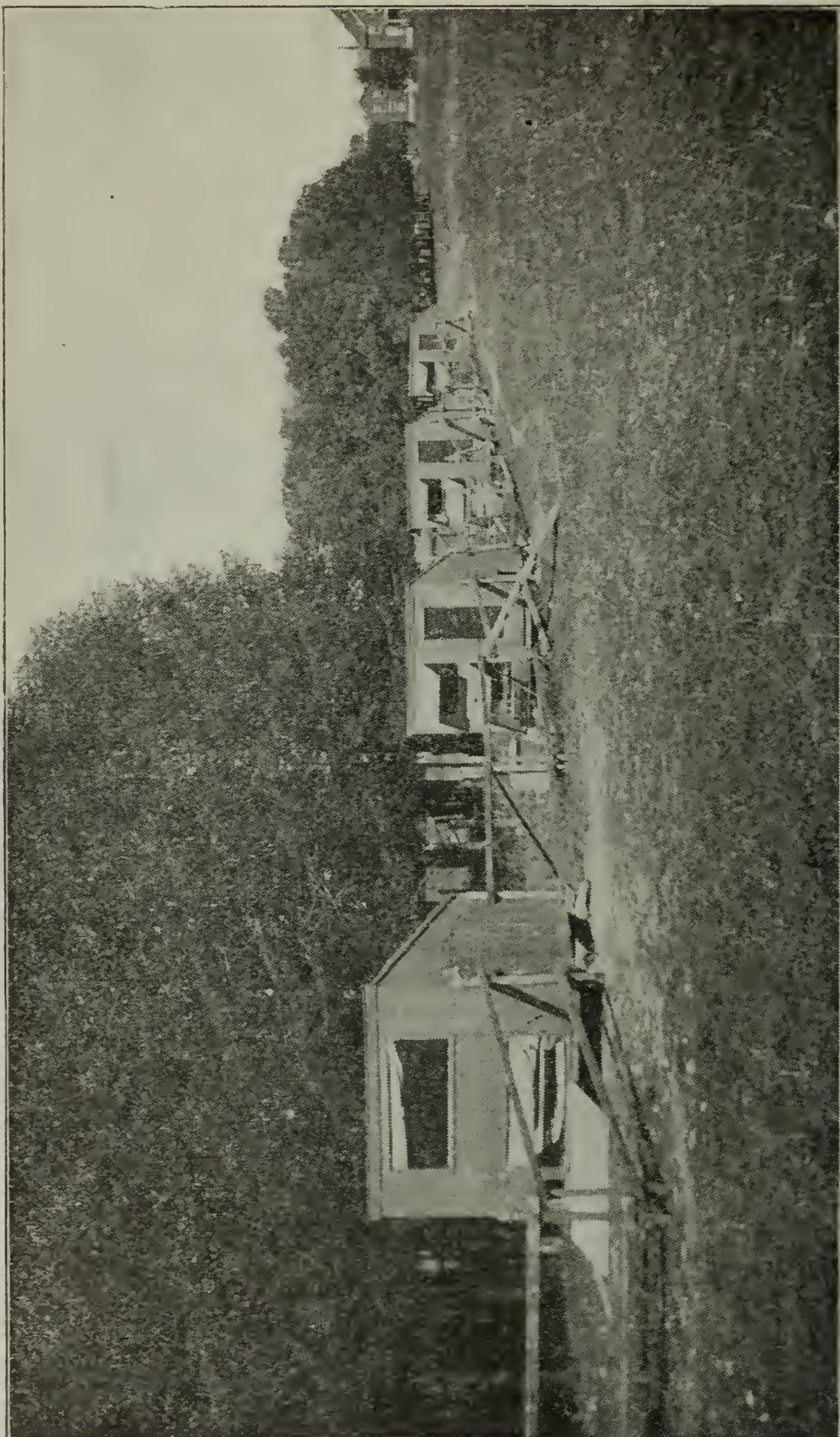
Breeding Market Fowls.

When looking over dressed poultry in some of the exporters' shops, I have often thought how easy it would be to improve the appearance of much of the ordinary poultry, and some of that which is specially fattened, if the birds are bred to a proper type. I have spent much time in examining different types of birds, alive and dressed, and in observing the feeding capacity of certain types; but it would take years to arrive at definite conclusions on these points. I am, however, of the opinion that one of the most important things to be sought after is *constitution.* This may have no actual market value, but it certainly has much to do with the bird's ability to grow and put on flesh. What we want is a good feeder, and an economical producer. Generally, a bird with a

Fig. 20. Colony houses used for rearing chicks. Artichokes growing as shade for the chickens.

short, stout, well-curved beak, a broad head (not too long), and a bright, clear eye, has a good constitution. And I have noticed that when a bird has a long, narrow beak, a thin, long comb and head, and an eye somewhat sunken in the head, it is usually lacking in constitution. Such a bird is likely to have a narrow, long body and long legs, upon which it seldom stands straight. There are some exceptions to this rule; yet generally speaking, if a bird has a good head the chances are favorable for a good body; and, if it has a poor head the chances are against it. I have frequently noticed in the rose-comb breeds, such as Wyandottes, that a good-shaped one is seldom found with a long, narrow comb.

The neck should be moderately short and stout, indicating vigor. The breast is the most important point in a market chicken. It should be



Portable colony houses on edge of pasture-field and woods.

broad, *moderately* deep; and, if broad, it will present a fine appearance and appear well-fleshed. It is quite possible that a broad, deep breast will carry more meat than a moderately deep breast of the same width; yet there is no doubt that the latter will present much the better appearance, and sell more quickly and at a higher price in the market. The breast bone should be well covered with flesh to the very tip.

When considering the length of breast, we must try to have it come well forward (see Figs. 21 and 22), and not be cut off at an angle, as in Fig. 23. The body, in general, should present the appearance of an oblong when the head, neck, and tail are removed.

We frequently see birds that are very fat in front, and cut up behind, as in Fig. 24. Chickens of this class have a very short breast; and, if the breast happens to be deep, as it is in this bird, the chicken will have a very poor appearance when dressed, as it will show a marked lack of width and length of breast, with excessive depth. (Notice that the head is narrow and long, the body is narrow, the eye is bright but slightly sunken, the legs are long and not straight under the body.)

In Fig. 23 observe the very flat breast, the length of back, the long neck and head, the narrow comb, the sunken eye, and the length of legs. The breast comes fairly well back, but not well forward.

In Figs 21 and 22, the bill is short and stout, but not so well curved as it should be. Note the breadth of head, the prominence and brightness of the eye, the short, stout neck, the great width of the breast, the fulness caused by the breast bone extending well forward, the short, stout legs (straight under the body), and the width between the legs. There is an expression about this chicken that indicates health and the essence of vigor.

The back should be broad, to give lung and heart capacity; and the width should extend well back to the tail-head. We do not want the wedge-shaped back, as seen in some fowls that have great width at the shoulders and taper rapidly toward the tail-head.

It is much easier to get good-shaped market pullets than good cockerels. The market demands a five-pound bird when dressed, and farmers have gone into raising big chickens. To that end they are asking for large, overgrown cockerels, of excessive depth, for breeders; and the result is that we get dressed chickens weighing four to five pounds each, that have immense, high breast-bones and very long legs. These are not attractive to the buyers, and they sell at less per pound than plumper birds. For example, if given two birds of the same width of breast, one is one and one-half inches deeper in the breast than the other. The result will be that one bird will look plump and sell readily, while the other will lack in plumpness and be slow in selling. This lack of plumpness can be bred out by using such males as that shown in Fig. 21.

We like to have birds as well built as we can get them, and Fig. 21 is as near the ideal market chicken as we have in the breed which he represents.

Fig. 21.

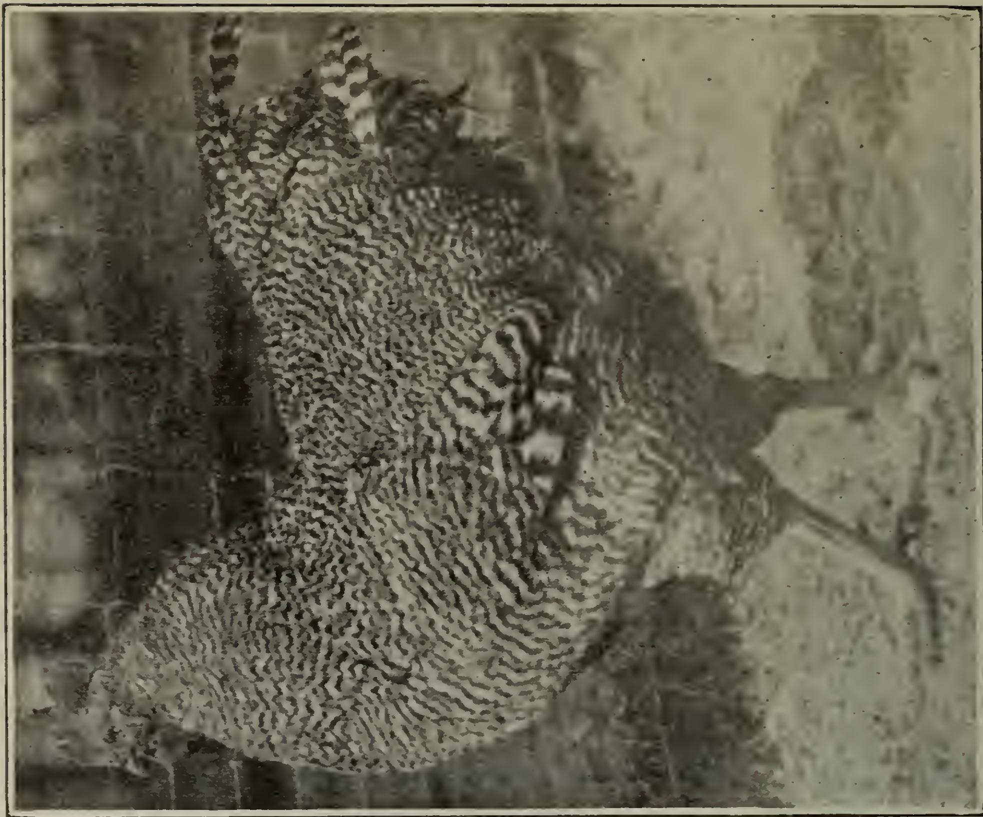


Fig. 22. Side view of Fig. 21.

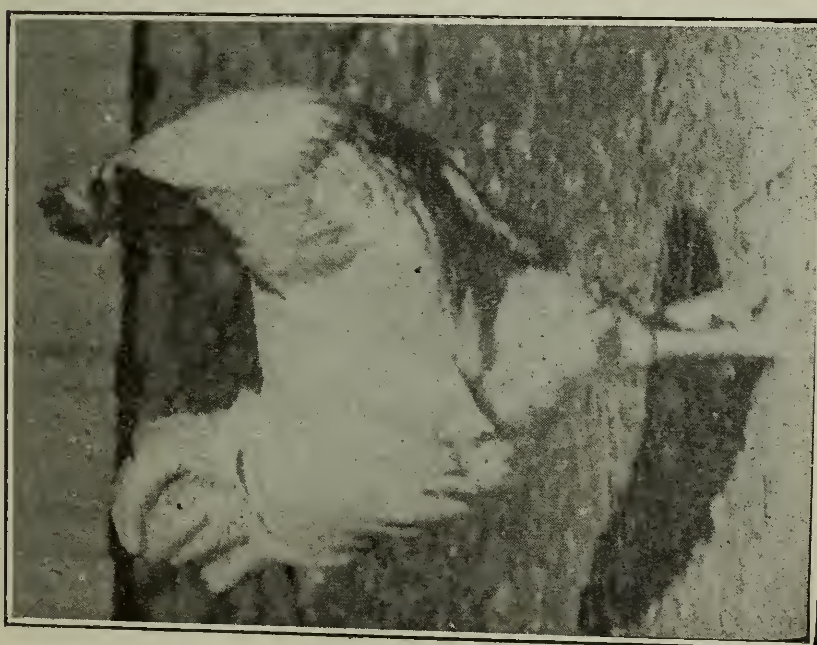


Fig. 23.

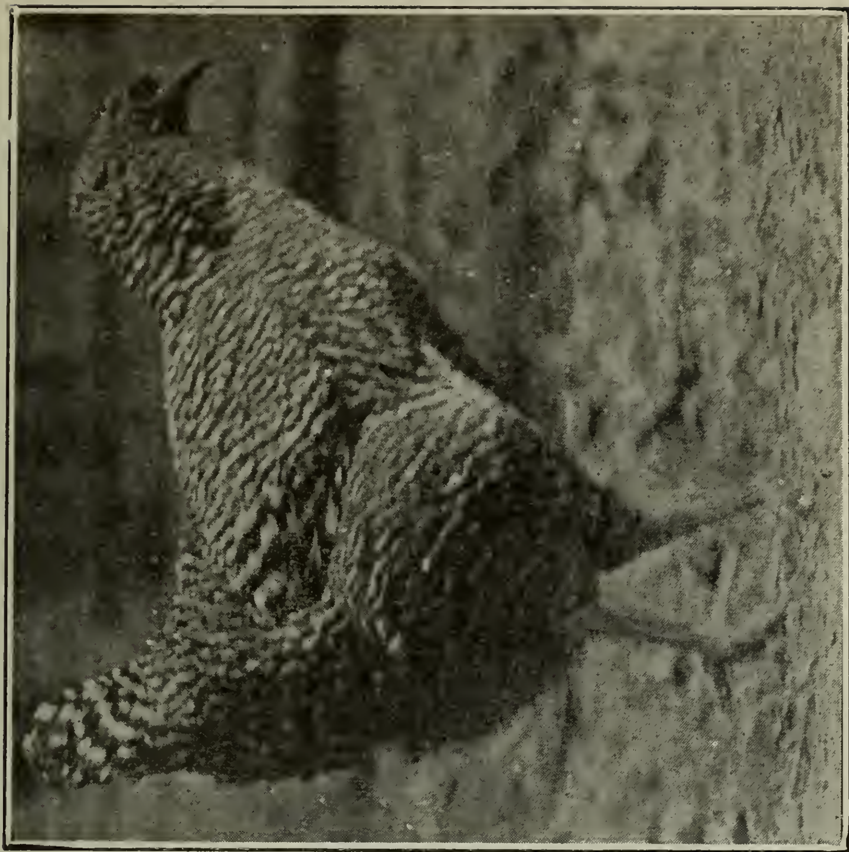


Fig. 24.

Fig. 25.

Fig. 26.

Fig. 27.

The hen as seen in Fig. 25 is of a good market type. (Note the width and fulness of breast.) As a breeder, she is a little fine in bone, and rather too small. She has, however, that blocky appearance which is desirable.

Fig 26 is a photo of a cross-bred chick (sire, Buff Orpington; dam, Houdan). Note the length and fulness of the breast; also good beak and eye

Fig 27 represents the long, narrow sort. (Note the long beak, the narrow head, the sunken eye, the long neck, and long, crooked legs.) When dressed his appearance will not be pleasing.

Fig. 28. Showing the difference in amount of flesh covering the breast bone, due to breeding.

Breeding for Meat Production.

Fig. 28 is a photograph of two fattened chickens, and shows very clearly the great difference in the amount of breast meat upon the two individuals. Many people believe that flesh upon the breast is a matter of feeding and not breeding. These two chickens are equally fat, and both have been equally well reared and fattened. The difference in the amount of breast meat is a matter of breeding and not so much of feeding.

Of course it is a well known fact that if birds are improperly nourished or are sick, their breasts will become bare of meat, but where judicious feeding is practised one will find a great difference in the amount of flesh or meat upon the breasts of various chickens due, of course, entirely to the individuality of the chicken.

Our experience has been that if we select males with long breast bones, that are well covered with flesh or muscle to the tip of the breast bone, we are able to produce chickens for market purposes that have, on an average, well covered breast bones.

Breeding for Egg Production.

Can the egg yield be increased by breeding from the best producers, or is one just as likely to get as many eggs from any strain, family or breed, provided the birds are strong and vigorous, and hatched at the proper season of the year?

The writer's experience is that there is a difference between families of the same breed or variety as far as egg production is concerned. Some families appear to lay much more readily than others, and a few families that have come under my observation require very careful attention and feeding in order to get a reasonable egg production.

The question naturally arises as to what number of eggs should be expected from a hen. The average over the Province is probably under 100 eggs per hen per year, and many of the good flocks do not average above 120 eggs per hen. Much, of course, depends upon the season of the year in which the eggs are laid. There is an over production of eggs during March, April and May, and an under production during October, November, December, January and February. The writer believes it is within the possibilities of most farmers to produce from 108 to 120 eggs per year from each hen kept, and it is also his opinion that large flocks may be expected to yield 150 eggs per year if well bred, and proper care and attention be given. Many small flocks will probably average much higher, but not in flocks of from 600 to 1,000. A dozen hens might be selected that would lay from 180 to 200 eggs each for one year, but with 500 or 600 similar hens or pullets it would be a very difficult task.

Good, strong, vigorous birds are essential for egg production. The simple fact that a hen has laid 200 or more eggs in her pullet year is not sufficient to warrant her being used as a breeder. The writer has seen a number of 200 egg hens with long narrow heads and sunken eyes, which indicate low vitality, and, moreover, has tested a number of them as breeders, and has yet to see one that was worth while breeding from, judging from the performance and living powers of her offspring.

A hen used for breeding, especially for the production of males to head the breeding pens the next season, should not only be expected to lay a large number of eggs per year, but these eggs should be high in hatching power, and the chicks should live, and, furthermore, they should develop into good sized birds quickly, and the pullets should lay well. Perhaps it might be well to give here the method that is used by us in breeding from selected layers.

The hen is required to be a good winter layer, and to lay at least 150 eggs in her pullet year. The next requirement is that her eggs hatch well—that is, it is expected that over 80 per cent. of the eggs will be fertile, and 90 per cent. of the fertile eggs will hatch. It is then required that 90 per cent. of the chicks will live to five months of age, and that the cockerels at this age be well developed and weigh—if from general purpose breeds—at least six pounds each, and, finally, that the pullets be good layers. If the pullets lay well during the fall, then I consider holding their brothers as breeders. We try as far as possible to test the males along similar lines, as to producers of plenty of strong vigorous chicks that also live, grow, and lay well. There is probably as much difference between males as there is between females.

The above method entails much work, so much so that it is only practicable to experiment stations, and to a few specialists. I would strongly urge the breeders of pure bred stock to exercise as much care as possible in trying to produce families or strains, that are high in the hatching power of their eggs, and that are equally as high in the living power and growth of the chicks.

There are many who cannot adopt the above method, but to the average grower the best advice we can give is to select a male that has been strong and vigorous from a chick up, one that has matured to normal size quickly, and that has never been unthrifty. Small, fine-boned, quick maturing males have been disastrous where they have been used, possibly not the first season, but shortly afterwards.

The hens bred should be the best you have. Select the hens that are active and look thrifty. Avoid the narrow headed ones, and those that are lazy and awkward.

The following table gives a comparison of two flocks of twenty-three Barred Rock pullets, that were in every way treated alike, except as to the method of breeding. They are the same age, were hatched and reared by the natural method, and have always lived in the same houses and enjoyed the same range.

The one flock, known as the heavier layers, has been bred for some years for early maturity and winter laying.

The other pullets are bred from birds that have been bred mainly with the idea of producing good specimens of the breed, as to shape, color and size.

The bred-to-lay pullets were larger by October 1st, but the others are larger at this writing, February 1st. In other words, the former matured earlier. Their brother's average weight at five months of age was nearly six and one half pounds.

Egg Production for Three Months of Pullets Hatched during the Last Week of April.

	October.	November.	December.	January.	Total.
23 Bred-to-lay pullets ..	101.	337.	296.	179.	913.
23 Common pullets	....	66.	190.	132.	388.

Fig. 29.

Fig. 30.

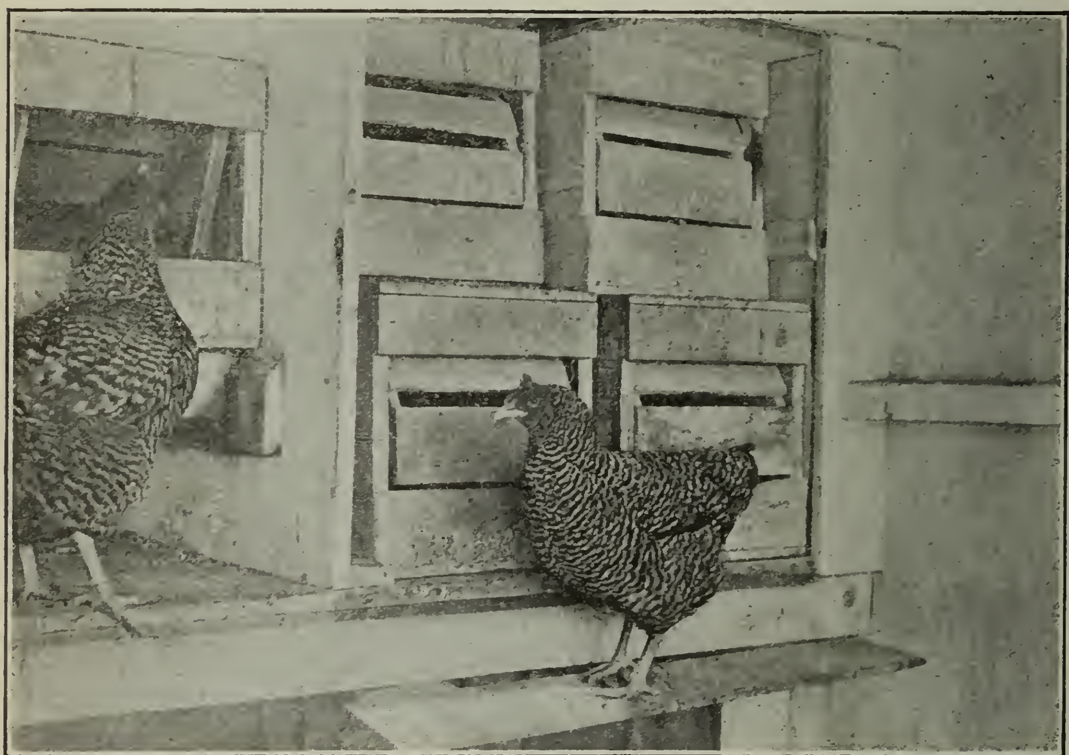


Fig. 31.

It would be more interesting if given for the entire year, but as we have not the exact comparison of these strains where the age and other matters of importance are exactly the same, we do not deem it wise to use the data; however, this much can be said, that the above record is similar to the others we have had.

Figs. 29 and 30. Type and color of Barred Plymouth Rock, males and females, which for several generations have been bred for heavy winter laying and early maturity.

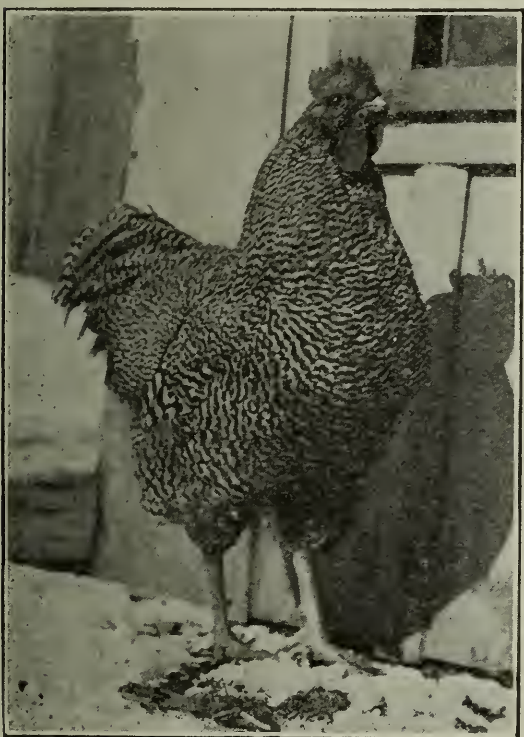


Fig. 32.

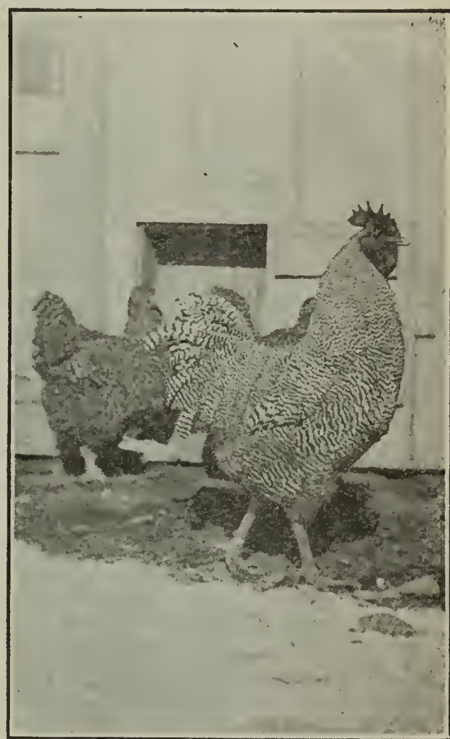


Fig. 33.

Fig. 31. Trap nests as arranged in the pen and two of the bred-to-lay Barred Plymouth Rock hens.

Figs. 32 and 33. Type and color of Barred Plymouth Rocks, which have been selected for generations for color and type. No particular attention was paid to egg production.

The writer believes that by careful breeding for a few years, a family can be secured that will mature early and lay well, which will have fair to good color and type.

FATTENING CHICKENS.

The selling of lean chickens is wasteful, to say the least. Much more interest is being taken in this branch of the industry year by year, and in districts where buyers discriminate in prices between the well finished and thin chickens, the progress has been very pleasing. There are many buyers who now pay a premium for good chickens. The demand for home consumption has increased to such an extent that the supply falls far short, and more than one wholesale dealer in our large cities is fattening the thin chickens sent to market. Some of the dealers have plans for buildings, which they purpose erecting this year, where they can fatten thousands of birds weekly. They know that the farmer or grower can do this work better and more cheaply, but if he will persist in sending lean chickens to market, and the consuming public demands fat chickens, some one must supply the demand. Some dealers have been trying the proposition in what might be termed a small way during the past two or three years. The business has, as I understand, been profitable, even where the milk was brought in by express, and a high rental paid for the building used. Surely if the dealer can buy all the raw materials from the farmer or grower, and make a profit, the producer should do as well or better.

There is ordinarily from three cents to seven cents per pound difference in the price paid for well fleshed or fattened birds, to that paid for birds just off the range or fields. This means a difference of from fifteen to thirty-five cents on a five pound chicken, depending upon the quality. Not only does the feeder make upon the gain made while the chicken is being fattened, but the original weight is increased in value by the improvement in quality. There is always a market for goods of prime quality, and the poor quality goes at begging prices, when the supply is great.

It is not difficult to produce good chickens. Like other lines of live stock, the scrub sort are not desirable. Good thrifty cockerels, either pure-bred, crosses or grades of such breeds as Rocks, Orpingtons, Wyandottes, Rhode Island Reds, Game, Dorking, etc., make economical gains. It is usually not very profitable to feed Leghorns, Minorcas, or birds of similar character. These breeds make medium broilers, but rather poor roasters. The birds usually make the greatest gain when about three to four months of age, or at a weight of three and one-half to four pounds. Should the market demand a chicken of more than five and one-half pounds in weight, then it will be required to allow the birds to range longer, and the gain (in our experience) will be hardly as profitable, unless the price paid is higher, at least one cent per pound.

The average birds make the most economical gains during the first two weeks of feeding. It seldom pays to feed much longer than three weeks or twenty-four days, after this period the added gain is not sufficient.

Chickens can be taught to eat by lamp-light, and where one's time during daylight is otherwise occupied, this feature is very convenient. After November 1st, or even earlier, we feed but few chickens during daylight. They are generally fed twice each day, and not more each time than they will consume quickly.

Construction of Fattening Crates.

Fattening crates are usually made 7 ft. 6 in. long, 18 to 20 in. high, and 18 in. wide. The crate is divided into three compartments, each holding from four to five birds, according to the size of the chicken. The crate is made of slats, except the ends and partitions between the compartments, which are solid wood—those on the top, bottom and back running lengthwise of the coop, while those on the front run up and

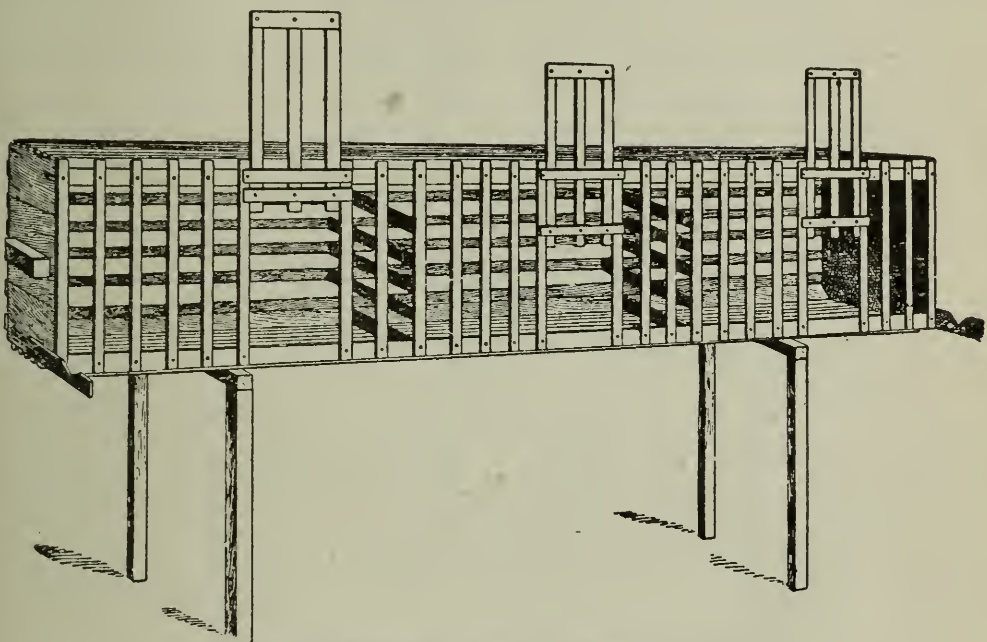


Fig. 34. Showing a single crate or coop.

down. The slats are usually 1½ inches wide and ⅝ inch thick. Those in front are placed 2 inches apart to allow the chickens to put their heads through for feeding. The slats on the bottom are placed about ¾ inch apart, so as to admit of the droppings passing through to the ground. Care should be taken not to have the first bottom slat at the back fit too closely against the back. An opening between the first slat and the back prevents the droppings from collecting and decomposing. The slats on the top and back are usually two inches apart.

There is a small V-shaped trough arranged in front of the coop for feeding and watering the chickens. This trough is from two to three inches deep and is generally made of ¾-inch lumber.

Very fair coops may be made from old packing boxes, by taking off the front and bottom, and substituting slats in their places (see Fig. 34).

During warm weather these crates may be placed out of doors. They need to be protected from the rain, which is easily accomplished by placing a few boards over them. In cold weather the crates should be placed in a house or shed where they are protected from raw, cold winds. When fattening chickens inside of a building, it is well to darken the building and keep the birds as quiet as possible.

After each lot of birds is killed, we paint the crates with some liquid lice-killer. Coal-oil and carbolic acid is very good. Use one gallon of coal-oil to one pint of crude acid. We have used some of the prepared mixtures with good results. If the birds (bought from different par-

Fig. 35. Cramming machine for the forced feeding of chickens, turkeys, etc.

ties) are very lousy when put up, they should be well dusted with sulphur. The birds should be watered at least twice every day in warm weather. Grit should be given them twice a week.

During the first week feed lightly—never quite all the birds will eat. I prefer feeding three times a day during the first week, and twice a day during the succeeding weeks. It seldom pays to feed the birds longer than three to four weeks. Chickens weighing from three to three and one-half pounds each, that are thrifty and of good breeding, appear to be the most profitable for feeding. Large chickens, weighing from five to six pounds, gain less and eat more than the smaller ones.

Should a bird become sick while in the crate, I find that if it is given a teaspoonful of salts and turned out on a grass run it will usually recover.

Cramming Machine.

The crammer consists of a food reservoir, to the bottom of which is attached a small force-pump moved by a lever and treadle which is worked by the foot of the operator.

Communicating with the pump is a nozzle, through which the food passes to the bird.

"A" is the food reservoir, "B" the pump, "E" the pump rod, "O" the lever, which on being depressed at the lettered end causes the pump rod "E," to which it is attached, to move downwards, and to eject the contents of the pump "B" out of the nozzle "K." On relieving the pressure at "O" the lever and the parts connected therewith are drawn up by the spring "C" until the motion is arrested by a stop "M," which serves to determine the quantity of food ejected at each depression of the treadle.

The charge may also be varied by arresting the pressure at any point in the downward thrust of the lever at "O."

The illustration (Fig. 35) shows one method of operation with this crammer, and this plan is now largely followed in some parts of Sussex, England.

Kind of Food Used in Cramming Machine.

Not all kinds of foods can be used in the machine. The food must be in a semi-liquid condition in order to pass through the machine. This necessitates the use of some kind of grain that will stay in suspension in the milk, beef broth, or whatever liquid is used in mixing the grain. Finely ground oats, with the hulls removed, or shorts, answer the purpose well. We use almost entirely the former food. Grains, like corn-chop or barley meal, are not suitable.

The food is mixed to the consistency of ordinary gruel, or until it drips from the end of a stick.

Will it Pay to Buy a Cramming Machine?

For the ordinary person, I think not. First-class chickens may be had by feeding in the crate from the trough only; indeed, I have had equally fleshy birds that have been fed for four weeks from the trough as where we have fed them two weeks from the trough and one week from the machine.

Where one has a special trade for high-class poultry, I am of the opinion that a more uniform product can be secured by using the machine. Machine-fed birds should realize at least one cent more per pound than trough-fed birds in order to pay for the extra labor, etc.

Birds that are fairly well fleshed when put into the crate will do better if put at once on the machine, instead of being crate-fed first.

Crate Feeding vs. Loose Pen Fattening of Chickens.

The term "fattening of chickens" has been in use for some time, but it does not exactly convey the meaning intended by the feeders of chickens. The object is to make the chickens more fleshy, with just sufficient fat to make the chicken cook well. The chickens are not intended to be abnormally fat, yet at the same time they carry considerable fat well intermixed with lean meat.

We have, for a number of years, conducted experiments with chickens in crates and in loose pens. We have tried about six different feeders and the results vary. With some feeders we had equally as good results with birds in crates as with them in loose pens. We have had two feeders in particular who could not feed birds to advantage in loose pens as compared with crates. We have had one feeder who could get slightly better returns in some cases, not all, with birds in pens as compared with crates.

In speaking to the buyers of chickens, the majority of them seem to think that the crate-fed birds are much superior to those fed in loose pens. Personally, I would prefer feeding birds in crates, for the reason that it takes less room, and I believe that I can feed them with less expenditure of labor and get a more even product. There are now many people who can get good results from feeding birds in box stalls, etc. No matter which method is followed, cockerels should be fed for two weeks or more before they are killed and sold.

How to Feed.

We receive a number of inquiries as to how we feed the birds that are being fattened. Most inquirers wish to know the exact amounts fed each day.

It will be noticed that we fed very lightly at the beginning—a very important point—and that the amount was gradually increased until such times as the birds refused to eat all that was given them. No feed was left in front of them longer than ten minutes after it was placed in the trough. Any food left after such time was removed.

Crate N.

Ration:—Equal parts of oat meal, corn meal, and barley meal mixed with sour milk.

	Lbs.	Ozs.
Weight at commencement	53	4
Weight at first week	55	0
Weight at second week	66	4
Weight at third week	70	2

Date.	Morning.		Night.	
	Meal.	Milk.	Meal.	Milk.
	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.
Oct. 17	12	1 8	12	1 10
" 18	14	1 8	12	1 8
" 19	1 0	1 12	1 0	1 12
" 20	1 2	2 2	1 2	2 4
" 21	1 4	2 8	1 4	2 8
" 22	1 6	2 12	1 6	2 12
" 23	14	1 12	1 8	3 0
" 24	1 10	3 0	1 12	3 4
" 25	2 0	4 0	2 0	4 0
" 26	2 5	4 8	2 8	4 8
" 27	2 0	4 0	2 0	4 0
" 28	2 8	4 8	2 12	5 0
" 29	2 8	4 8	2 8	3 8
" 30	1 4	2 8	2 12	5 0
" 31	2 0	3 8	2 0	3 8
Nov. 1	2 4	4 0	2 8	4 8
" 2	2 0	3 8	2 4	4 0
" 3	2 4	4 0	2 4	4 0
" 4	1 12	3 8	1 12	3 8
" 5	1 12	3 8	1 12	3 8
" 6	1 12	3 8	....	....

Rations for Fattening Chickens.

It is difficult to give a ration suitable for fattening chickens and that meets the requirements of every individual. Many of us have to use whatever foods are available, and for that reason we are giving several rations that have worked fairly well with us in a general way. It may be said that the grains in a ration should be ground as finely as possible; and further, some grit should be fed to the chickens at least once a week, and it is also desirable that the food should be mixed to the consistency of a pancake batter, so it will pour, and, moreover, the best results are procured when the food is mixed twelve hours previous to feeding.

The best ration that we have yet used is one composed of two parts of finely ground oats, two parts of finely ground buckwheat, and one of finely ground corn; to this is added sufficient sour milk to make a batter, or ordinarily about two to two and one-half pounds of milk to one pound of grain. We have gotten very good results from a ration composed of equal parts of corn meal, middlings and buckwheat meal. Frequently barley meal can be substituted for the buckwheat, or oat meal for the middlings. It is desirable, if possible, to always use milk, as much better gains are made with it than with any other food. Where milk is not available, blood meal, and beef scrap can be substituted, but we would not advise more than 15 per cent. of the grain ration to consist of these foods. We would advise soaking the blood meal, or beef scrap, in warm water for twelve hours previous to being mixed with the grain. We have gotten better results in some cases, and equally as good in all cases by feeding any of the above mixtures cool or cold rather than warm—that is to say, there were no better gains made by keeping the food at 70 or 80 degrees than at 30 or 35 degrees.

It is of the utmost importance that the birds be kept with keen appetites, as a little over-feeding on the commencement usually means indifferent gains. One should be careful to have the birds free from lice or other insects, and as far as possible to keep them in a cool, comfortable place, rather secluded, so as not to be disturbed by the visiting public or other chickens. The birds should be dusted with a small amount of sulphur or other insect powder in order to keep the lice in check. If the sulphur is used too freely it produces a scaly appearance on the birds when dressed.

We have each year a surplus of cockerels over and above those required for breeding purposes, and the most of these are fattened and killed; a few are sold to farmers or breeders. We also fatten the cull pullets. In 1908, from September to December, we put in the fattening crates 626 birds. The loss by death among these was two birds. The birds weighed (when brought in from the range, usually with full crops) 2,233 pounds. They were fed from four days to three weeks before killing.

We hoped to have fed them all three weeks, but at times the demand for dressed chickens required us to kill the birds shortly after cooping.

Rations.

The main ration consisted of barley meal, low grade flour, middlings and buttermilk. Some other mixed grains were used and a little shredded wheat. The 626 birds ate 2,057 lbs. of ground grain and 4,000 lbs. of milk.

Many farmers and others market their birds in a thin condition. We can, for the time it takes to feed, clean out the pens, etc., make at least 50 cents per hour over and above the cost of feed. We usually feed these birds by lamp-light at night, so that little valuable time is lost.

Financial Statement of Fattening Chickens.

626 chickens weighing 2,233 lbs. at 8c. per pound, live weight	$178 64
2,057 lbs. of grain at $1.50 per cwt.	30 85
4,000 lbs. buttermilk at 10c. per cwt.	4 00
Total cost	$213 49
624 dressed chickens, bled and plucked, but undrawn, 2,358 lbs. at 12½c. per lb.	294 75
Profit	$81 26

Birds that are starved ready to kill shrink 12 per cent. by bleeding and loss of feathers. We have figured frequently that the average profit per bird in three weeks' feeding was about 15 cents each; the above table shows nearly 13 cents. The profit would have been somewhat higher if all the birds had been fed at least two weeks.

Dressing and Shipping Poultry.

All fowls should be fasted from twenty-four to thirty-six hours before killing. Where this is not done, the food decomposes in the crop and intestines, the result being that the flesh becomes tainted and does not keep well.

There are two methods of killing that are considered proper. One is to kill by bleeding. This method is considered to be the better one in the Eastern States and also in some parts of Canada. The other method is to kill the bird by wringing or pulling the neck. This is done by taking the chicken in the hands, stretching the neck, holding the crown of the head in the palm of the hand, and giving a quick turn backward, and at the same time a steady pull. This method was favored by the exporters of dressed fowls, but is not now, owing to the discoloration where the blood collects in the neck. Where chickens are placed in cold storage this is a serious objection. It is claimed by the exporters that the flesh will keep longer and will not be so dry as where the birds are bled. I prefer the former method.

After the bird is killed, plucking should begin at once. Care should be taken to keep the head downward, to allow the blood to collect in the neck. Where the birds are allowed to become cool before being plucked, it is very hard to avoid tearing the skin; and the plucking is much more tedious. The birds should be plucked clean with the exception of about two inches of feathers adjoining the head.

After the chicken has been plucked it should be placed on a shaping board, as seen in Fig. 36. The weight placed on the top of the chicken is used to give it a compact appearance. This weight may be of iron, as seen in the cut, or a brick may be used in its place. If chickens are hung by the legs after being plucked it spoils their appearance, making them look thin and leggy.

Many good chickens are spoiled by being packed before they are thoroughly cooled. Care should be taken that all the animal heat is out of the body before the fowls are packed. We always cool the birds at least twelve hours before packing them.

The chickens are packed in boxes as seen in Fig. 37. The box is lined with parchment paper; and, if the chickens are to be shipped a long distance, each bird is wrapped in paper. This prevents the chickens from bruising each other, and, at the same time, to a considerable extent, checks decomposition. Do not use ordinary wrapping paper, as it draws dampness, and will cause the chickens to become clammy, which makes them more or less unsaleable.

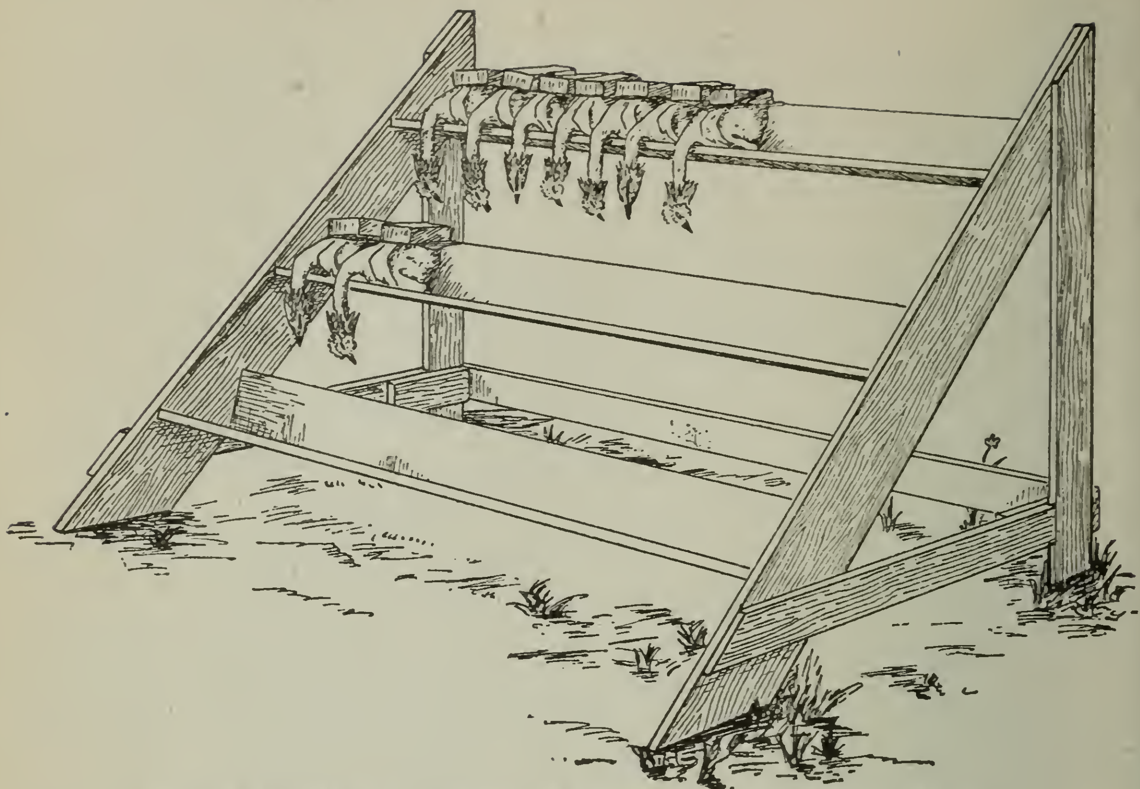


Fig. 36. Showing a number of chickens in the shaping boards.

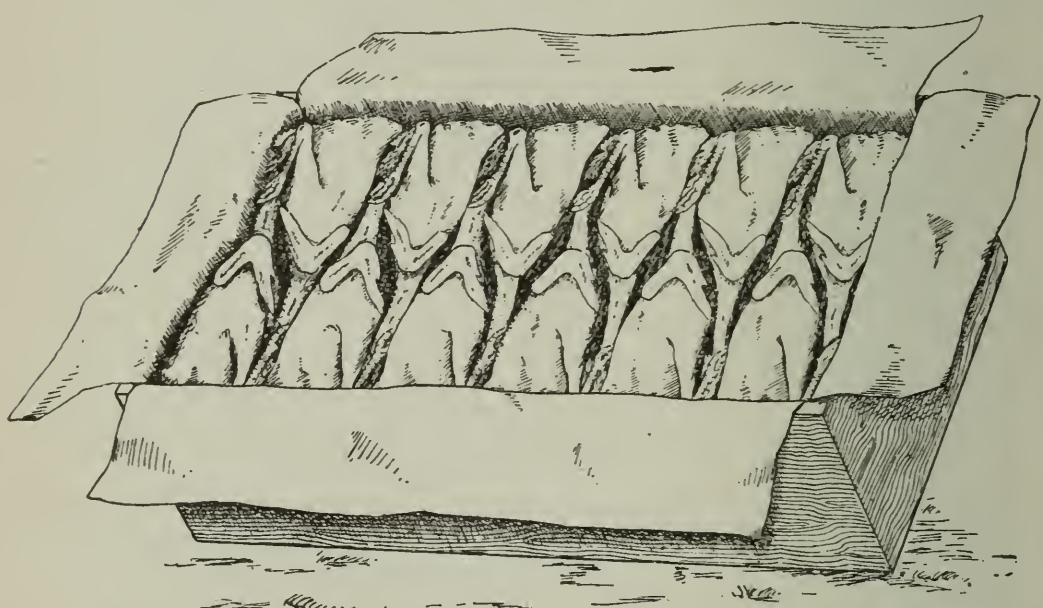


Fig. 37. Showing the top layer of chickens in a shipping case as used for local trade. This is one system of packing dressed poultry. The boxes are usually made 3 feet long, 17 inches wide and 7 inches deep for 24 chickens weighing about 5 pounds each.

There are several other kinds of boxes used for shipping poultry. Nearly every exporter has his own shape of box, and his own method of packing. For shipping locally, we use a box three feet long, twelve inches wide, and twelve inches deep. The chickens are packed similar to those seen in Fig. 37, with the exception that they are three tiers deep. The box will hold thirty-six $4\frac{1}{2}$-pound chickens. The boxes are made strong, so that we can have the dealer return them to be refilled. Do not use cedar in the construction of the boxes, as in some cases it taints the flesh. Basswood or spruce answers well.

EGGS FOR MARKET.

Yearly the egg consumption increases and our exports decrease; in fact we have practically ceased to be an exporting country in this line of farm produce. During the last year in particular the public have taken more interest in the egg supply, and in the kind of eggs that are consumed. The value of an egg as a food is gradually but surely being recognized. Probably no one food is its equal; it is relished by all, old and young. Few people realize how quickly and how easily an egg deteriorates in flavor or as a food.

There appears to be a general idea that the shell of an egg protects the contents against all kinds of germs and weather; that the outside of the shell may be filthy, but that the interior is not in the least affected by the filth on the outside.

There is nothing more disgusting than at the breakfast table to break a bad egg. No more eggs are wanted for days, perhaps for weeks, and consequently egg consumption decreases; or eggs are looked upon as a doubtful source of food. Many bad eggs are due to ignorance on the part of the producers and consumers, and many dealers are as careless in their methods.

The shell of an egg is porous, or is full of very small holes. The egg is designed to hatch a chick. The chick under favorable conditions grows inside the shell and finally bursts it open. The holes in the shell supply the chick with air as it grows, also allows the bad air to escape. Science has proved this, but we have ample illustration in practical work. Eggs that become badly smeared with broken eggs in the nest during incubation usually rot, owing to the breathing holes becoming plugged or blocked by the broken egg content. Greased eggs will not hatch for the same reason; and we might mention several other examples.

Knowing that the shell is porous we can readily understand how minute animal or plant life, or germs, may enter the eggs. Let us take a common case of mouldy or musty eggs. Frequently the paper fillers of egg boxes will become damp due to the boxes being left in a shower of rain or something of the kind. The fillers are only a little damp, and we think they will do. If no eggs are put in the boxes, and the boxes with fillers are set aside for, say, a week or so, when they are opened they smell musty, and if the fillers are examined we will see slight developments of moulds here and there. Now in cases where eggs are put in such fillers they soon go musty, and when they are left in for some time they become mouldy, not only on the outside of the shell, but on the inside as well. The writer has taken clean eggs on the day they were laid, and put them in dry paper boxes which were slightly mouldy, and set them aside in a dry cellar for a period of a few weeks, and at the end of this time many of the eggs had well developed mould on the inside of the shell.

Many eggs are spoiled by being partially incubated. Most people believe that an egg must be set under a hen, or put in an incubator before it will start to hatch. Eggs will start to hatch at less than 90 deg. of heat. Many eggs are submitted to this or higher temperatures for several hours, if not days, before reaching the consuming public. When the germ inside the egg commences to develop, the edible qualities of the egg are lessened, or the egg goes off flavor. Eggs may be kept at an incubating temperature for a day, when the chicks will start growing, next day the temperature may be so low that the chick is killed, and from that point decomposition begins, possibly slowly, but, nevertheless, the egg is gradually going bad.

There are almost innumerable ways in which eggs may start hatching during the summer, such as forgetting to gather the eggs daily, and leaving some under broody hens over night, leaving them exposed to the sun or in warm rooms, stores, cars, etc., or even in the kitchen cupboards.

No one can guarantee eggs to their customers during warm weather unless the males are removed from the flock. Unfertilized eggs are essential. We may at home take every precaution, but who knows where or how the cook may keep those eggs, even after they have passed from the dealers' hands. The allowing of males to run with the hens all summer costs the Ontario growers a very large sum of money. The writer stood by candlers in a large packing house, and saw over twenty of the thirty dozen eggs in a case that were more or less incubated, most of the eggs being about 48 hours on in incubation. The dealer is thus forced to make prices to meet this shrinkage; at times the public may get "bargain" eggs.

Filthy eggs, or even washed eggs, may be decomposed or rendered useless from the germs in the filth on the eggs. Washed eggs if used immediately are good, but they deteriorate very quickly after washing.

Flavor of Eggs.

Many of us forget that eggs will absorb odors. They will not absorb odors as readily as milk, but, at the same time, care should be taken in keeping the storage room for eggs free of strong odors. For instance, to put eggs alongside of onions, turnips, or similar strong smelling foods, would mean that the eggs would absorb more or less of these flavors.

Again, the food that a hen consumes very materially affects the flavor of the eggs. This can be very easily demonstrated by feeding mostly scorched grain, or giving large quantities of pulped onions in a mash food. One demonstration will convince anyone that eggs have been scorched, or taste of onions no matter how cooked.

When hens get but little grain food during the summer and are forced to hunt for their living over manure piles, and catch insects, the yolk will become almost red in color. These eggs make the consumer remark that winter eggs taste better than summer eggs. Frequently feeding as above produces a thin watery white, and the egg has not only a bad flavor, but has poor keeping qualities, and, moreover, is little better if as good as a fair pickled or cold storage egg.

Market Terms Used. A new-laid egg means an egg that is under five days of age, or at least not over one week old. It should be clean, and the boxes should be clean.

Fresh eggs are very hard to define. With some they mean eggs from one day to three weeks or even more of age, while with others they mean eggs just out of cold storage.

There are several other market terms, such as pickled, held, etc., which are used mostly by the dealers, and need no explanation here.

Where and How to Keep Eggs.

The nests in which the hens lay should be clean. These usually need cleaning monthly. The best material we have used for nests is shavings.

Eggs should be gathered twice each day, and placed in clean baskets, pails, etc.

The room should be cool, not higher than 60 degrees if possible, and it should be dry. A cool, dry cellar will answer nicely.

The dirties, small, extra large, and found nests of eggs should not be sold. Use them at home. The large ones break in shipping and the smalls and dirties are not wanted on the market. These sell the good eggs at poor prices.

Where one is trying to supply private customers, or a select wholesale trade, it is wise to stamp the eggs with your own initials, or the name of your farm. This is some guarantee to the buyer.

Never Try to Deceive the Dealer.

You may sell bad eggs to the grocers, but the honest people in the district do not get full value for their good eggs.

Some people hold their September and early October eggs, and then ship them later in the year to a dealer as fresh eggs. They, of course, expect the top price for new laids. Please do not believe you can deceive the dealer. By candling the eggs, which he always does, he can tell fairly closely what your eggs are like as to age, etc.

Candling Eggs.

Eggs are candled very easily. See Fig. 38. A new-laid egg when held between the eye and the light has a clear appearance, the yolk is practically invisible, and the air cell is about the size of a five-cent piece.

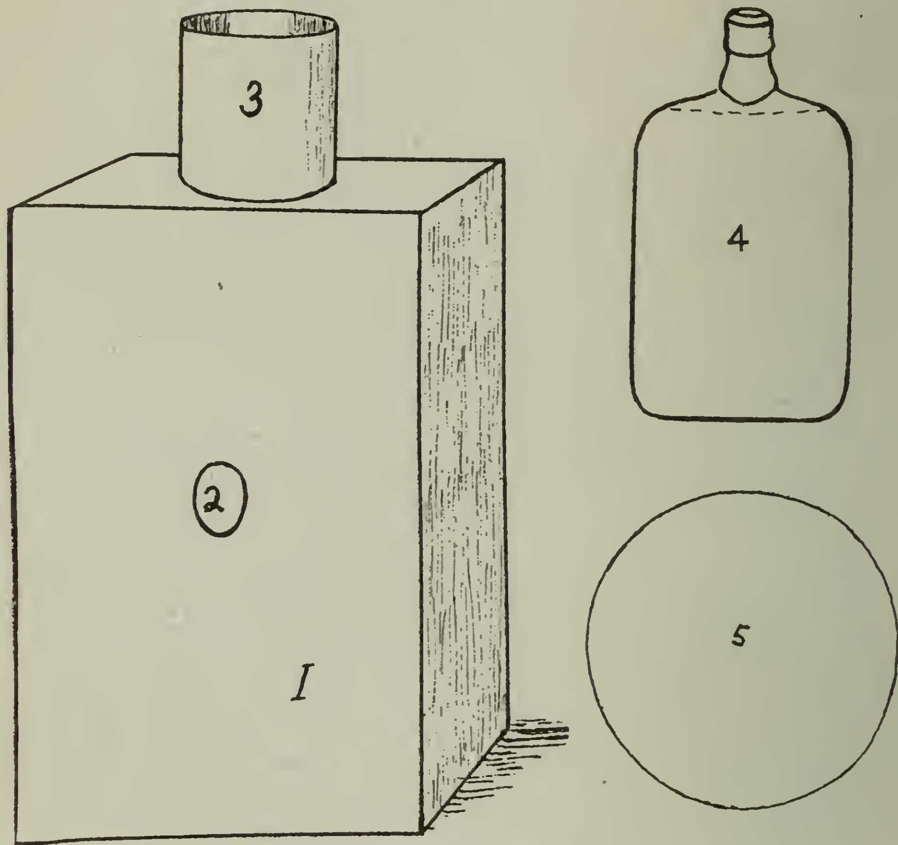


Fig. 38. The egg tester.

1. Egg-testing box.
2. Hole through which light shines and before which egg is held to be tested.
3. Chimney.
4. Bottle of water placed between light and No. 2.
5. Reflector to be placed behind light.

An ordinary lamp or electric light is placed in the box so that the light shines through No. 2. The bottle of water condenses the light, which makes the testing of eggs a comparatively simple matter.

Unless the eggs are put in pickle or held in cold storage, the air cell gradually increases in size, and the yolk becomes visible.

Cold storage and pickled eggs may have small air cells, but the yolks are conspicuous.

Fig. 39 is a photograph of a new-laid egg. It will be noticed that all portions of the egg are similar in appearance. There is a very small air cell at the large end of the egg which does not show in the photo; this air space is not larger than a five-cent piece.

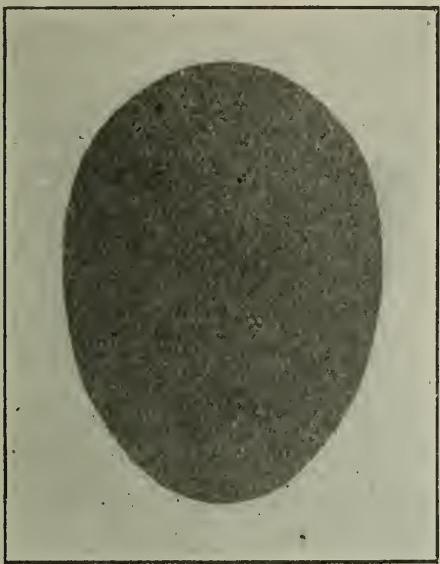


Fig. 39.

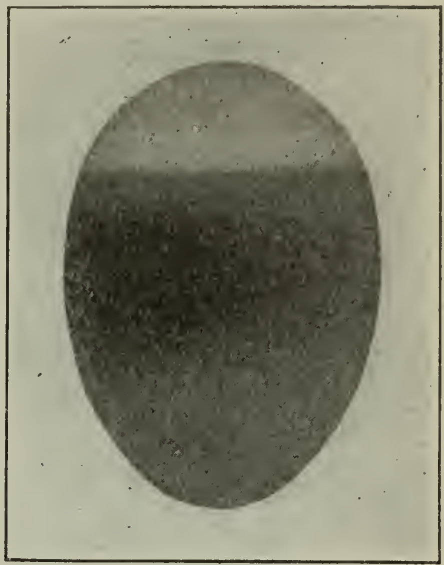


Fig. 40.

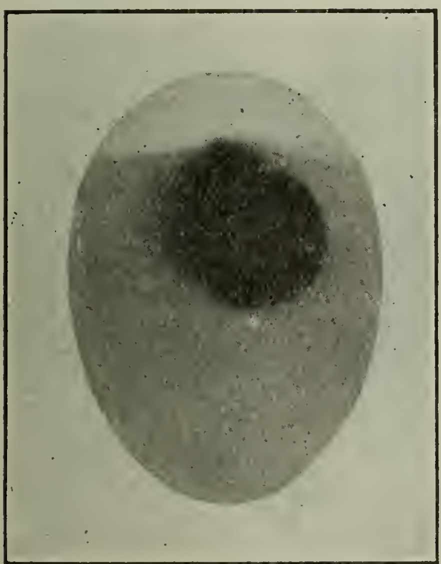


Fig. 41.

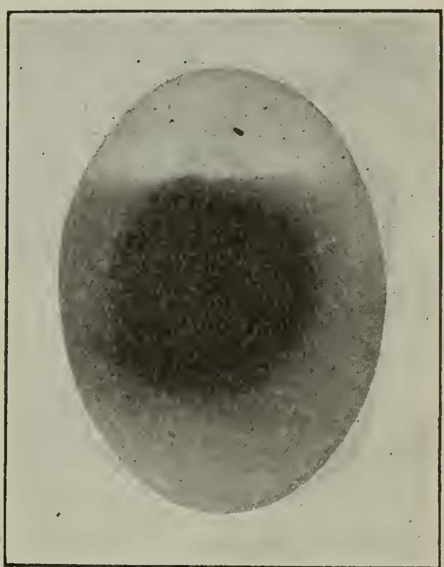


Fig. 42.

Fig. 40 is a photograph of a held egg, or one that is suitable for baking purposes, but not for boiling or packing. Notice that the yolk is conspicuous and the air space is very large. Pickled eggs usually show a conspicuous yolk but a small air space. Eggs that are two weeks of age usually show the yolk, and have an air space about the size of a twenty-five cent piece.

Figs. 41, 42, 43 and 44 are photographs of what the dealers term "spots," as they show various growths of moulds in the egg. These eggs are not rotten, but when opened smell musty. The mouldy portions are usually easily seen.

Fig. 43.

Fig. 44.

Egg Preservation.

Several methods of preserving eggs were tested in our Poultry Department during the year of 1900. The eggs for this purpose were taken early in June, and were tested in December. Many of the same methods that proved fairly successful in previous years were again tried.

Method No. 1. A solution composed of one part water glass (sodium silicate) and five parts water that had been previously boiled. This was a very strong solution, and unless an egg was absolutely fresh it would not sink in the solution.

The eggs from this solution were of fairly good flavor, and all were well preserved.

Method No. 2. This was similar to No. 1, except that eight parts of water were used instead of five parts. The eggs in this were nearly as good as those in No. 1. This is a good preservative where it is desired to keep summer eggs for winter use.

Method No. 3. This was composed of ten parts of water to one part of water glass. There were no bad eggs in this solution, but the eggs were inferior in flavor and in poaching quality to those kept by methods No. 1 and No. 2.

Method No. 4. This consisted of the same solution as No. 2; but in place of allowing the eggs to remain in the liquid, they were removed after having been in it for a week, except the last lot, which was put into the solution. This lot was left in the solution for the remainder of the season.

(*a*) The eggs, after being in the solution for a week, were removed and placed in an ordinary egg case in the cellar. They were all good when tested, but had evaporated considerably and were lacking in flavor.

(*b*) These are the second lot of eggs to be placed in the liquid. They were handled similarly to those in (*a*), and were of about equal quality.

(*c*) These eggs were allowed to remain in liquid. They were well preserved, all being good.

They were scarcely equal in quality to those from No. 2 method, but were superior to those from No. 3.

Method No. 5. A lime solution made as follows:—

Two pounds of fresh lime were slaked in a pail and a pint of salt was added thereto. After mixing, the contents of the pail were put into a tub containing four gallons of water. This was well stirred and left to settle. Then it was stirred thoroughly the second time and left to settle; after which the clear liquid was poured over the eggs, which had previously been placed in a crock or tub. Only the clear liquid was used.

These eggs were well preserved; but those from the bottom of the tub had a decidedly limey taste, and the yolk in them was somewhat hardened.

BREEDS OF POULTRY.

It is not the purpose of the writer to discuss all breeds of poultry in this bulletin, but simply to mention the general characteristics of some of the popular ones. The present high price of eggs and meat has done much to popularize poultry on the farm, and consequently we are frequently asked as to "What is the best breed of poultry?" It is impossible for one to answer this question satisfactorily, as some breeds are special purpose breeds, others general purpose breeds; and, moreover, there is probably more difference in strains of the same breed than there is between breeds.

We shall endeavor to classify these breeds, not according to the usual classification as adopted in various poultry publications, but more or less on utility lines. It may be taken as a general rule that all breeds that lay brown or tinted shelled eggs will set, hatch and rear their own young and all breeds which lay white shelled eggs, with the exception of

Dorkings are non-sitters and the eggs from these breeds have to be hatched artificially or by hens of other varieties. It will, therefore, be seen that the general purpose breeds lay tinted eggs and are good sitters and mothers.

General Purpose Breeds.

Plymouth Rocks. There are five varieties in this breed—three of which are common—Barred, White and Buff. The Partridges and Columbian are not so common. This breed is undoubtedly the most popular among farmers. The best strains are good winter layers, fair summer layers and make first-class roasters and fair to good broilers. It is one of the hardiest breeds. The standard weights are: Cock birds, 9½ pounds; cockerels, 8 pounds; hens, 7½ pounds; and pullets, 6½ pounds.

Wyandottes. There are several varieties in this breed among which might be mentioned White, Buff, Silver Laced, Golden Laced, Black, Columbian, Partridge and Silver Pencilled. The most popular variety from a commercial standpoint is the White. This breed has practically the same characteristics as the Plymouth Rock. but is more blocky in type and usually longer in the feather. They have rose combs, which to some is supposed to be an advantage in cold climates. Wyandottes make good broilers and roasters. They are also good mothers and good layers. The standard weights of these birds are one pound less than those of the Plymouth Rocks.

Rhode Island Reds. There are two varieties of this breed, Single Comb and Rose Comb. As compared with the Plymouth Rocks and Wyandottes they are longer in appearance and not so massive. They were originated by the farmers of the State of Rhode Island and are very popular in that State. They have also grown in popularity in this country to such an extent that they now rival the Plymouth Rocks and the Wyandottes. They are hardy, good winter layers, and fair summer layers. In color they are a rich, bright red, with black tails and more or less black in the wings. During warm weather our experience has been that they are more given to incubating than the two breeds mentioned above. The standard weights of this breed are: Cock birds, 8½ pounds; cockerels, 7½ pounds; hens, 6½ pounds, and pullets, 5 pounds.

Orpingtons. This general purpose breed differs from those previously mentioned in that they have white legs and skin, the other breeds having yellow legs and yellow skin. The common varieties of this breed are: Buff, White, Black, and Jubilee. At the present time, there are probably more Buff Orpingtons bred than any other variety, but the White may outrival the Buff. The Blacks are being bred more by the fanciers than by the farmers, for the reason that their black plumage and dark colored legs are somewhat against them for market purposes.

This breed is among the best winter layers; makes good roasters and broilers, but is probably more given to incubating during warm weather than either the Rocks or the Wyandottes. The standard weights are about one pound per bird above the Plymouth Rocks. For general farm use they might be more profitably bred with less weight for the reason that the largest birds are usually somewhat leggy and rough in appearance when weighing 4 to 5 pounds. When one wants very large roasters, weighing from 7 to 8 pounds each or better, the larger birds, of course, would be better.

Dorkings. This is one of the oldest English breeds and is popular in some districts. They are a large breed, long in the body and short in the legs. By many they are considered to be weak in constitution, although our experience would not bear this out entirely. They lay large white eggs and are good sitters and mothers. They are white fleshed and white legged. Their peculiarity being that they have five toes. This is, at times, a disadvantage, especially where the fowls have to scratch in straw where there is more or less binder twine, which is apt to get around the extra toe, and thereby occasionally fastening both feet together. This is not a very serious objection. Where there is high, dry ground and plenty of range and a person fancies the Dorking color or type, they are worthy of consideration.

Meat Breeds.

Brahmas. The feathered legged breeds are not very extensively bred. The most popular of these is the Brahma. This breed is very hardy, and lays very large brown eggs. They are rather slow to mature and the feathers on the legs are not altogether desirable from a farmer's standpoint, in that they are apt to get wet and freeze readily. Brahmas make the best roasters, but are somewhat slow to mature and the females, in our experience, have not been very good layers, although there are some females that do well. This breed is yellow skinned.

Langshans. Langshans are also of the feathered leg breed, but have white skin. They are longer in the legs than the Brahmas and are not so heavy.

Games. By many the Game would not be considered a chicken suitable to farmers. The exhibition Games, as they are known in the standard, are altogether too long in the legs and head, and too weak in constitution for the ordinary farmer, but the Cornish Games and what is known as the Old English Game are worthy of consideration. The Cornish Game is a very large, tight-feathered, full-breasted chicken, and probably carries more meat on its breast than any other breed. The objection to the Cornish Game is that it is a poor layer. The English Game, sometimes termed "Pit Game" is a hardy bird. They are fair layers and make fair roasters. The most serious objection to this breed from a farmer's standpoint is that there is a great tendency among the young cockerels to be very pugnacious. This is sometimes carried to such an extent that they kill one another. Other than this, they make a fairly good farm chicken, especially where the mothers are required to protect their young.

Special Purpose White Egg Breeds.

The high price of eggs during the last few years has increased the popularity of this class of chickens very much. Of all breeds in this class the Leghorns are the most popular, and of the Leghorn breed the White variety is bred more extensively than any other. Leghorns probably mature a little earlier, and eat less food than the heavier breeds; they make fair broilers, but are comparatively useless as roasters. They lay a large number of good-sized eggs during the natural laying period. As winter layers they are fair, but in our experience more susceptible to changes in temperature than are the heavier breeds. This much must be said in their favor, that their eggs usually hatch better than those of the heavier breeds, and the chickens are very hardy. Of the other Leghorn varieties the most popular ones are the Brown, Buff and Black, these varieties not being so popular from a market poultryman's standpoint, owing to the color.

Minorcas. There are three varieties of Minorcas. The Rose Comb Black, and the Single Comb Black are more commonly bred than is the White variety. This breed is larger than the Leghorn, and also lays a larger egg. They have very large combs and wattles.

Anconas. This breed might be termed a speckled or mottled Leghorn. They have all the characteristics of the Leghorn, and are black and white in color. This breed is gaining in popularity among the practical poultrymen.

Hamburgs. There are several varieties of this breed. The black is the most popular. They are inclined to lay an undersized egg. We have found the blacks to be good layers, and to lay a fair-sized egg. They have rose combs and are neat and active in appearance.

BULLETIN 190.] [MAY, 1911

Ontario Department of Agriculture

FRUIT BRANCH

Bee Diseases in Ontario

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

Bee-moths are often blamed for the ravages due to disease; but moths never destroy a healthy normal colony, as they only feed on the deserted combs after the bees are nearly all gone. Heavy winter losses can often be attributed to disease. In fact, whenever a colony is not doing well the exact cause of its failure should be carefully sought to make sure there is no bacterial disease.

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

The inspectors of apiaries can do a great deal for the health of bees in Ontario; but to be of real value their work must be supplemented by the earnest efforts of the individual beekeepers. Everyone should be his own inspector, carefully *examining every comb of every colony in the apiary at least once a year,* remembering that it is far better to detect it on the start in strong colonies than to wait until they are practically ruined and the disease has spread through the whole neighborhood. Only one cell of infectious disease makes it necessary to treat even the best colony in the apiary. And because one has kept bees for a number of years without seeing a case of disease is no reason why it should not make its appearance this year. Plenty of people have died of smallpox after having escaped it for fifty years.

When a case of infectious disease is suspected the beekeeper must first notify the Minister of Agricuture, Toronto, Ont., who will send word to the nearest inspector of apiaries; but if the case cannot have immediate attention the beekeeper should go ahead and treat the disease according to directions given in this bulletin.

Examining an Apiary for Disease.

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

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

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

In opening the hive just enough smoke should be used to keep the bees in subjection. Remove each comb in turn from the brood-chamber and examine the brood. It is best to sit on a box close to the hive with your back to the sun, and hold the comb so it will shine into the cells, and throw a strong light directly on the lower sides and bottoms of the cells. If there is no disease, the empty cells will be bright and clean, and the uncapped larvae will be plump in form and of a pearly white color. At first a number of cells of capped brood should be opened with the pick, until you are quite familiar with the outward appearance of healthy capped brood. Cappings which to any but the best-trained eye appear quite healthy often cover dead larvae. When diseased cells are present they are quite frequently found around the lower edge of the comb. If any of the brood cappings appear darker than the rest, or are flat, sunken, or perforated, they should be opened to see whether the brood they cover is dead. Healthy brood is sometimes found under flat, or perforated cappings; but there is a difference in appearance which experience soon teaches one to detect. Brood sometimes develops without ever being fully capped; this is not known to be an indication of infectious disease. When each hive is finished the pick used there should be left in the hive, and if any honey is daubed on hands or tools they must be washed thoroughly before opening the next hive.

There are three brood diseases prevalent in the apiaries of Ontario; American Foul Brood, European Foul Brood, and Starved or Pickled Brood. The first two are known to be infectious, the last is not so considered, although its cause is not well understood.

Distribution of Disease.

American Foul Brood is pretty evenly distributed over that portion of Ontario lying south and west of the Trent Valley. It has cost the Province of Ontario hundreds of thousands of dollars, not only in loss of bees and honey, but in its disheartening effect on the men engaged in the industry. Much, however, is being done, and more can and will be done, by the Department of Agriculture towards restoring a well grounded confidence in beekeeping as a business by various methods of instruction.

The greatest menace at present is European Foul Brood. This scourge is known to have practically wiped out the keeping of bees over a territory of perhaps three hundred square miles around Ottawa, and five hundred square miles in Northumberland, Hastings and Prince Edward; it has also gained a foothold at Fort Erie on the Niagara River. Much loss by this particular disease might have been saved if the beekeepers had kept Italian instead of common black bees, or if they had Italianized as soon as they were warned. As the situation now stands, it seems to be spreading from these districts like a blight, carrying all black bees before it. Only those who Italianize their bees can hope to save them, as no system of inspection can cure black bees of this particular disease. Men with the right strain of Italian bees are securing enormous yields of honey right in the centre of infected district. As the Irishman says, "It's an ill wind that blows nowheres," and there is not the slightest doubt that this wind of European Foul Brood, though ill enough, will blow money into the pockets of the men who will sit tight, get Italian bees, and weather the storm.

AMERICAN FOUL BROOD.

This disease is caused by bacteria known to scientists as Bacillus Larvae (not B. Alvei, as was formerly supposed). It reaches the healthy young larvae by means of infected food unsuspectingly fed to them by the nurse bees. In most cases the larvae dies when nearly ready to seal up, and most of the cells containing infected larvae are capped. The dead larva softens, settles to the lower side of the cell in a shapeless mass, at first white or yellow, changing to coffee-color and brown. At this stage it becomes glutinous, so that if it is picked with a toothpick the contents will rope out half an inch or so when the pick is slowly withdrawn. It adheres to the cell so it cannot be lifted out entire. It has the odor of a poor quality of glue. When the larva dries it forms a tightly adhesive scale, of very dark brown color, which cannot be removed without tearing the cell wall.

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

The Treatment.

Now, to be cured of this disease a colony must be freed from all this infected brood, comb and honey. To do this we simply take it away. But in the operation some precautions are necessary. We must see that the colony will get healthy food as soon as the unhealthy food is taken away, and have means for building new comb at once. So the operation should be performed during a honey flow, and to make it perfectly sure it is a good plan to insert a division board feeder of sugar syrup. We must take precautions against starting robbing, or causing the treated colony to scatter to other hives or swarm out, be lost, and carry infection to other places. So the operation should be performed in the evening, when the bees are settling down for the night, and the entrance should be covered with queen-excluding metal to hold the queen in case of swarming out the next morning. A regular queen-excluder laid on the bottom board under the brood chamber will answer the latter purpose. They should also be given a clustering space to occupy, as in the case of a natural swarm. Whenever bees are disturbed in their hives they will fill their honey sacs with honey from the comb. As this will happen when the hive is being treated, and some of this diseased honey may be stored in the new combs, it is thought best to remove these after three or four days and require them to make a second start.

Method of Treatment.

When there is a good honey flow on, go to the colony in the evening, taking a set of frames with one-half inch starters of foundation in them. Take the combs out of the hives, shaking the bees from them, back into the hive. If any fresh nectar flies out, it will be necessary to brush the bees off instead of shaking them. Get these combs immediately under cover, and clean up very carefully any honey that may be about, so that robbers from healthy colonies cannot carry home disease. If the honey flow is at all uncertain, it is better to put in a feeder with thin sugar syrup.

On the third or fourth evening after the first operation, remove the hive from its stand and set in its place a clean disinfected hive containing frames with full sheets of foundation. Now brush the bees from what combs have been built on the starters into the new hive. Even greater care must be taken than at first to avoid leaving any honey or bits of comb about. Positively no comb must be used or left in the hive in either the first or second treatment.

You have now made an artificial swarm of this colony. It must be given the conditions a new swarm likes, or it will leave and carry its disease to parts unknown, or perhaps into some healthy hive in the apairy. A new swarm likes plenty of ventilation and shade, and also room to cluster for awhile without having to crawl in between sheets of foundation at once. To satisfy this natural desire, it is best to place an empty hive under the one containing the frames of foundation. If for any reason this cannot be done, two or three frames can be left out of the brood chamber for a couple of days. The bees will cluster in this at first, just as a swarm clusters on a tree; but they will soon go up and take possession of the foundation, then the empty can be taken away. This simple precaution will generally prevent the swarming out which so often happens in treating foul brood; but as an extra precaution it is best to use the excluder on the entrance as well.

All combs from the supers as well as from the brood chamber of the diseased colony, together with the first set of starters and whatever comb is built on them, must be either burned or melted, and boiled thoroughly before the wax is fit to use again. The honey that is removed is entirely unfit for bee feed, even after it has been boiled for a full half hour it is not safe. The only safe way to dispose of it is to burn it, or else dig a hole and bury it deep enough to be out of the reach of any bees.

If directions have been followed carefully and thoroughly, the treatment should be successful. To make sure, however, the brood must be examined again in about three weeks and again the following season. Please note in this connection Section 6 of the Act.

Saving Brood.

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

Saving Combs.

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

Disinfecting.

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

EUROPEAN FOUL BROOD.

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

European Foul Brood has destroyed the apiaries in great areas of different States in the Republic to the south of us. It is now known to be rampant in at least three sections of Ontario. In one way it is much more to be dreaded than American Foul Brood, because it runs its course and destroys an apiary much more rapidly, and because the adult bees will carry out the disease scales and scatter them in the yard and farther, to find their way into healthy colonies.

In the part of Ontario where it was first discovered apiaries were wiped out at first something like this:

112 colonies reduced to 23 in two years.

180 reduced to 21 in one year.

60 colonies reduced to 44 in one year, and the balance all diseased the second year.

The following report in reference to European Foul Brood, received in the fall of 1910 from one of our apiary inspectors, will give an idea of the danger:

Inspector's Report for Peterboro, Northumberland, Hastings and Prince Edward.

Inspector W. Scott, Wooler.

"I travelled over the same ground as last year, and found that all the bees had been treated, except one apiary, but very little Italianizing had been done, and consequently the disease returned in every apiary and destroyed some of them completely. I found the disease spreading very rapidly; it has more than doubled since last year. The disease now covers fully 400 square miles; besides two outbreaks in Prince Edward County, also two in Hastings County, one in Roden Township, and one in Huntingdon Township. I think if the Department could encourage the beekeepers to Italianize ahead of the disease, it would prevent a great deal of loss, as the disease does not affect the Italians nearly so badly as the blacks. I think the disease could be prevented some if the law would forbid the moving of bees except by permission of the inspector. I found three cases in the past season, where the disease has broken out, caused by the moving of bees from a diseased territory to an undiseased one. Had this moving been prevented it would have taken it probably two years to travel of its own accord.

"I may say that $5,000 is not too large an estimate for the loss sustained by disease in my district last year, but these figures will be greatly increased next year as European Foul Brood is spreading very rapidly. Last year (1909) it covered about 100 square miles. At the present date it covers 400 square miles, besides an outbreak in Prince Edward County, also in Hastings County near Ivanhoe."

Symptoms of European Foul Brood.

The symptoms are easily distinguished from those of American Foul Brood, as there is very little ropiness, and the odor is different. The larvae mostly die without uncoiling from their natural positions. The color in the earlier stage is lighter than in the American Foul Brood. The odor is very pronounced and offensive, like decayed fish; in fact, on a warm moist morning it is noticed on entering the apiary, and, when a diseased comb is held up for inspection, is almost sickening.

Use Same Treatment and Italianize.

The same treatment already described for American Foul Brood is effectual if applied to the whole apiary at once, even though only a few colonies show symptoms. Even then the cure is only permanent when pure-bred Italian queens are introduced to the affected colonies. It is quite impossible to cure an apiary of black bees of European Foul Brood without introducing pure Italian queens to all colonies.

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

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

STARVED OR PICKLED BROOD.

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

The cause of Pickled Brood is not definitely known. It is not considered to be infectious. McEvoy asserts that it is caused by an insufficient feeding of the larvae, due to a sudden check of the honey flow, or a constitutional weakness of the workers. The latter he charges to in-breeding of the queens. Re-queening with vigorous queens from other apiaries will often effect a cure, and it often disappears of its own accord.

AMERICAN FOUL BROOD.

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

BRANT: Brantford, Dumfries South.

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

CARLETON: Goulbourn, Osgoode.

DUFFERIN: Garafraxa East, Luther East, Mono.

DUNDAS: Winchester.

DURHAM: Darlington.

ELGIN: Dorchester South, Malahide, Yarmouth.

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

FRONTENAC: Kingston Township.

GREY: Artemesia, Collingwood, Euphrasia, Glenelg, Keppel, Osprey, Proton, St. Vincent, Sarawak, Sydenham.

HALDIMAND: Cayuga, Walpole.

HALTON: Esquesing, Nelson, Trafalgar.

HURON: Grey, Morris, Turnberry, Wawanosh West.

KENT: Harwich, Romney, Tilbury East.

LAMBTON: Bosanquet, Moore, Warwick.

LEEDS: Bastard, Elizabethtown, Kitley, Yonge.

LINCOLN: Louth.

MIDDLESEX: Adelaide, Biddulph, Delaware, Lobo, London, McGillvray, Metcalfe, Westminster, Williams East, Williams West.

MUSKOKA: Draper, Macaulay, Muskoka.

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

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

OXFORD: Blandford, Blenheim, Dereham, Norwich North, Norwich South, Oxford East, Zorra West.

PEEL: Albion, Caledon, Chinguacousy, Toronto.

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

SIMCOE: Adjala, Essa, Gwillimbury West, Innisfil, Medonte, Nottawasaga, Orillia, Tay, Tecumseth, Tiny, Vespra.

VICTORIA: Bexley, Eldon, Mariposa.

WATERLOO: Dumfries North, Waterloo, Wellesley, Wilmot.

WELLINGTON: Garafraxa West, Guelph, Luther West, Nichol, Puslinch.

WENTWORTH: Ancaster, Barton, Beverly, Binbrook, Glanford.

YORK: Etobicoke, Gwillimbury East, King, Markham, Scarborough, Vaughan, Whitchurch, York.

EUROPEAN FOUL BROOD.

From the reports of the inspectors of apiaries we find that European Foul Brood is prevalent in the following counties and townships. As this disease is spreading rapidly, it is very likely to appear in the townships adjoining these during the season of 1911. All beekeepers should be very much on the alert and examine their bees carefully for the symptoms of this disease:

CARLETON: Fitzroy, Gloucester, Nepean.

HASTINGS: Huntingdon, Rawdon, Sidney.

LEEDS: Bastard.

NORTHUMBERLAND: Brighton, Cramahe, Murray, Percy, Seymour.

PRINCE EDWARD: Ameliasburg, Hillier.

RENFREW: MacNab.

WELLAND COUNTY: Bertie.

The names of cities and towns located in these townships are omitted for brevity, but as a matter of fact, bees in cities and towns are more often diseased than in the country.

AN ACT FOR THE SUPPRESSION OF FOUL BROOD AMONG BEES.

His Majesty, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows:

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

2. The Lieutenant-Governor in Council, upon the recommendation of the Minister of Agriculture, may from time to time appoint one or more Inspectors of Apiaries to enforce this Act, and the Inspector shall, if so required, produce the certificate of his appointment on entering upon any premises in the discharge of his duties. And the Minister shall instruct and control each Inspector in the carrying out of the provisions of this Act. The remuneration to be paid to any Inspector under this Act shall be determined by order of the Lieutenant-Governor in Council.

3. The Inspector shall, whenever so directed by the Minister of Agriculture, visit without unnecessary delay any locality in the Province of Ontario and there examine any apiary or apiaries to which the said Minister may direct him, and ascertain whether or not the disease known as "foul brood" exists in such apiary or apiaries, and wherever the said Inspector is satisfied of the existence of foul brood in its virulent or malignant type, it shall be the duty of the Inspector to order all colonies so affected, together with the hives occupied by them, and the contents of such hives, and all tainted appurtenances that cannot be disinfected, to be immediately destroyed by fire under the personal direction and superintendence of the said inspector; but where the inspector, who shall be the sole judge thereof, is satisfied that the disease exists, but only in milder types and in its incipient stages, and is being or may be treated successfully, and the inspector has reason to believe that it may be entirely cured, then the inspector may, in his discretion, omit to destroy or order the destruction of the colonies and hives in which the disease exists.

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

5. Any owner or possessor of diseased colonies of bees, or of any infected appliances for beekeeping, who knowingly sells or barters or gives away such diseased colonies or infected appliances, shall, on conviction thereof, before any Justice of the Peace, be liable to fine of not less than $50 or more than $100, or to imprisonment for any term not exceeding two months.

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

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

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

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

10. Every beekeeper or other person who is aware of the existence of foul brood, either in his own apiary or elsewhere, shall immediately notify the Minister of the existence of such disease, and in default of so doing shall, on summary conviction before a Justice of the Peace, be liable to a fine of $5 and costs.

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

12. Chapter 283 of the Revised Statutes of Ontario, 1897, intituled "An Act for the Suppression of Foul Brood Among Bees," is repealed.

BULLETIN 191.] [JUNE, 1911.

Ontario Department of Agriculture

FRUIT BRANCH

Bee-Keeping in Ontario.

ARRANGED BY MORLEY PETTIT, PROVINCIAL APIARIST.

DETAILED REPORT ON THE HONEY PROSPECTS IN THE VARIOUS COUNTIES.

For the purpose of reporting on the condition of bees in Ontario, and the Honey Crop prospects for 1911, blanks were sent to five thousand beekeepers last month by the Fruit Branch of the Department of Agriculture. Six hundred replies were received, from which this report has been summarized.

The total number of colonies reported for the Fall of 1910 was 23,730. For May, 1911, it is 20,414. This represents a winter loss of fourteen per cent., which is five per cent. more than that reported a year ago. This also means that the remaining colonies are weaker in proportion, and are less fit for the work of gathering honey which the clover fields, weather permitting, will provide. On the other hand, the condition of clover is reported almost uniformly good. A few counties report "poor" and "below the average," and some "extra good."

While a spring report is of value in determining the present prospect of the honey crop, there is no other farm crop so entirely dependent on weather conditions from day to day during harvest time. Any sudden change from hot to cold will often check the secretion of nectar in the flowers and reduce the expected honey crop by hundreds of thousands of pounds.

The following is the detailed report arranged by counties:

COUNTY.	No. of Beekeepers on list.	Reports received.	Crop prospects.	No. of Colonies reported—Fall, 1910.	No. of Colonies reported—Spring, 1911.	Per cent. winter loss.	General condition of Bees.
Algoma	14	2	Good	56	49	13	Good.
Brant	80	12	Fair to good	379	338	11	Fair to very good.
Bruce	202	20	Fair to very good	659	553	16	Fair to good.
Carleton	106	6	Good	342	290	15	Fairly weak to good.
Durham	38	5	Poor to good	266	232	13	Fair to extra good.
Dufferin	61	4	Fairly good	228	200	12	Not very good to very good.
Dundas	51	6	Good to excellent	298	249	16	Fair to good.
Elgin	123	19	Good	407	350	14	Fair to good.
Essex	196	10	Poor to good	325	248	24	Weak to good.
Frontenac	41	6	Fair to very good	194	175	10	Weak to very good.
Glengarry	129	15	Good to very good	1,422	1,345	5	Fair to very good.
Grenville	58	11	Poor to good	306	283	8	Fair to good.
Grey	215	32	Fairly good	1,186	911	23	Weak to fair to very good.
Haliburton	12	2	Fair to good	18	16	11	Good
Halton	66	9	Fair to very good	310	259	16	Poor to good.
Haldimand	96	16	Good to very good	811	718	11	Generally good.
Hastings	120	20	Poor to fair and good	711	627	12	Weak to fair and very good.
Huron	163	21	Fair	1,197	1,048	12	Weak to good.
Kent	70	8	Poor to good	307	239	22	Weak to good.
Lennox and Addington	52	7	Fair to good	412	394	4	Fair to excellent.
Leeds	154	22	Fair to very good	844	713	16	Fair to extra good.
Lanark	78	9	Good if it rains	224	203	9	Not good to fair and strong.
Lambton	187	29	Good to very good	786	701	10	Good to could not be better.
Lincoln	70	12	Not good to very good	452	400	11	Fair to strong.
Middlesex	322	33	Fairly good	1,853	1,403	24	Weak to very good.
Manitoulin	18	3	Average to good	178	138	22	Only fairly good.
Muskoka	26	3	Fair to very good	40	29	27	Average to good.
Nipissing	16	2	Very good	4	3	25	Good.
Northumberland	169	16	Poor to fairly good.	368	306	17	Weak to fine and strong.
Norfolk	309	18	Good	576	490	15	Below Average. Weak to good.
Ontario	155	13	Not good to fair and good	542	471	13	Fairly good to first class.
Oxford	180	15	Not good to fairly good	419	343	18	Fair to good.
Peel	89	8	Good	681	626	8	Fair to good.
Perth	203	11	Ordinary to good	481	412	14	Fair to very good.

COUNTY.	No. of Beekeepers on list.	Reports received.	Crop prospects.	No. of Colonies reported—Fall, 1910.	No. of Colonies reported—Spring, 1911.	Per cent. winter loss.	General condition of Bees.
Peterborough ...	48	4	Fairly good to a big crop	159	144	9	In good shape.
Prescott	97	11	Very poor to very good...........	523	482	8	Good to never was better.
Prince Edward..	64	8	Only fair	324	300	8	Fair to good.
Renfrew	92	11	Fair to good	695	648	7	Generally good.
Russell.........	52	6	Only fair	355	321	10	Good.
Stormont	67	14	General Report Good...........	700	597	15	Good.
Simcoe.	100	26	Fairly good.......	641	562	11	Fair to strong.
Thunder Bay ...	5	1	Fair	12	7	42	In splendid shape.
Victoria	72	21	Below average. Clover winter killed	1054	955	9	Fair to first class.
Waterloo	58	3	Good	21	19	9	Good.
Welland	99	10	Good but season late	371	245	34	Fair. More weak colonies than usual.
Wellington	122	19	Fairly good	363	286	21	Fair to extra good.
Wentworth	138	14	Good to very Good	293	246	16	Fair to in fine order.
York	222	26	Medium to good...	937	840	10	Poor, average extra good.
	5,105	599		23,730	20,414	14	

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Ontario Department of Agriculture

DISTRICT REPRESENTATIVES

Agricultural Co-Operation

BY S. E. TODD, B.S.A., DISTRICT REPRESENTATIVE FOR LAMBTON COUNTY.

INTRODUCTION.

Organization is the keynote of commercial success. Agriculture and its products is the most important division of Commerce. Therefore Agriculture must become one of the organized forces in the great whole. So rapid has been the advancement of organization in other branches that to-day there is scarcely an industry or trade that is not in a highly organized condition. But Agriculture has in all countries, till a comparatively recent date, remained unorganized.

The difficulty of organization increases as capital is divided amongst an increasing number of capitalists. The most highly organized industries are those in which a large aggregate of capital is controlled by a small number of capitalists. Agriculture is, perhaps, the most extreme case existing where a very large aggregate of capital is divided amongst and controlled by a very great number of capitalists. Therefore, Agriculture is difficult to organize. For the same reason the ordinary industrial methods of organization have not been found suited to Agriculture.

Again the homes and activities of agriculturists lie outside the great commercial world of cities. The necessary organization of the food supplies of the cities has resulted in the creation of a class who are enabled by means of organization to dictate prices, on the one hand to the urban consumer and on the other hand to the rural producer. These middlemen have thus been enabled to become the controlling feature—aside from the weather and other natural conditions—of the world's markets. The reasons why the middleman has become master in the manipulation of agricultural products are: 1st, the increasing complexity of city life resulting in the separation of producer from consumer; 2nd, the isolation of farmers both from urban inhabitants and from each other, which has made them easily controlled by the middleman; 3rd, the increasing complexity of trade brought about by the transportation of great quantities of food from one country to another.

Let us look closely at these three statements. First: Organization in other lines of production has gone on mainly in the cities. Many of the secondary acts in the production of goods are carried on by the urban population. As towns and cities increase in numbers and population, luxuries increase and life steadily grows more complex. The townsman growing up and living in the midst of this increasing complexity understands each step as it is taken and knows how to suit himself to the changing conditions. The countryman living on the farm does not understand the growing changes taking place in the towns. To him it is a Chinese puzzle. Secondly: As urban life became more complex and harder for the agriculturist to grasp, his position became more and more isolated. As the organization of the distribution of food amongst the urban population became more specialized and complex, the farmer found himself coming into contact less and less with his old time customer, the consumer. His customer now was a dealer trained in all the tricks of his trade and knowing minutely the requirements of the consumer. This gave him an immense advantage in dealing with the consumer on the one hand and the producer on the other. Another great difficulty is the wide range of country from which the food of a city is gathered. This has made it very difficult for farmers to get to know each other well enough to intelligently direct production. Too much or too little of certain articles are sure to be produced owing to the isolation of the producers. Thirdly: The transportation of products has made necessary the assembling of those products at some point in their production. As the producer was not organized, his product could not be organized by himself. This work was undertaken by the middleman. He gathered great quantities of produce from many points of production, classified and graded these products; these classes and grades he forwarded to the different markets studying closely the needs and demands of each market. In this way he rendered a great service to society but it was a *service* that presently gave him the *mastery*. Some have been bold enough to state that the middleman is unnecessary in our economy. This is a very debatable statement. Probably the truth is that the control of the food supply has so fallen into the hands of the middleman that it has induced an unnecessary number of people into the business and has made possible profits that are out of proportion to the importance of the service to society. The indications are that the middleman will long continue to fill a necessary place in the economy of commerce, but his place is that of agent of producer and consumer rather than that of dictator or master.

While the middleman has succeeded in organizing agricultural products to a considerable extent his position as a middleman utterly unfits him to cope with some of the greatest problems in the world's food supplies. For instance, Ontario has extensive tracts favorable to fruit culture. England has a large consuming public ready to buy Ontario fruit. But the point of production is eight to ten days distant from the point of consumption. The problem is one of transportation. Many factors enter into successful transportation, among the hardest to control being questions of variety, quality, quantity, care in handling, packing, etc., all of which are outside the control of the middleman. These are essentially questions for the producer and must be answered by him. He must become familiar with questions of transportation and marketing. He must enter the field of the middleman and study market conditions. He must become his own marketman. Agriculture must be organized.

There are two means by which Agriculture may be organized. 1. By means of a force from without, such as a middleman, working to secure the results of organization for his own benefit and always endeavoring to secure the advantage. Such organization, to be complete, must presently control the most elementary acts of production. Thus little by little the independence of the farmer would be lost and he must soon be reduced to the position of the workmen of the towns and cities. 2. By means of a force within, the agriculturist himself. Such organization would have for its object the securing of the results and advantages of organization to the farmer. As the organization became complete it would restore the independence of the farmer and secure to him the just rewards of his toil.

All successful industrial organization has come from within the industry. So too agriculture must organize its own forces. Such an organization must solve three problems. First: It must break the isolation of farmers by drawing them together under a common bond and community of interest. Secondly: It must place the farmer as nearly as possible on the same financial basis as his prosperous city brother. It must secure to him a fair share of the fruit of his toil. It must restore agriculture to its proper position and dignity which have been lost through bad business methods. Thirdly: It must replace bad business methods with good business methods. Because the farmer, from the nature of his work, can never become familiar with the minutiæ of buying and selling, organization must attach directly to farming interests, a class of men who shall assume this work and become the farmer's middleman. This class must be directly controlled by and responsible to the farmer.

Co-operation. What is it?

The foregoing is a short summary of the facts and conditions with which the agricultural population of every civilized country has been brought face to face. The solution of the problem has been earnestly sought by intelligent farmers in all countries. Many theories have been advanced, many experiments resorted to. Political organization has been attempted. Spasmodic attempts have been made to introduce that great machine of urban industry into the agricultural world, viz., the combine, but without success. Joint stock farming has been attempted; farmers stock companies to own and operate creameries and bacon factories; factories of many kinds have been organized; but none of these have answered the great question. Governments and scientists have attacked the problem from the standpoint of increased and scientific production, but they too have failed in materially affecting the situation. The problem of production seen from the farmer's viewpoint is one of marketing and the solution must be seen by the agriculturist from a market point of view before he will improve his ways. Scientific investigation has done great things for production, but science finds itself continually checkmated by the refusal of the agriculturists to adopt scientific methods. The fact is, farmers are seeking first to solve the great question of marketing before they take up the problem of scientific production. The scientist waits on the economist.

I have said that many experiments have been tried. Out of the many, one form is successful. In Germany, Denmark, France, Italy and many other European countries it has passed through the successive stages of experiment; has in each country proved its value and adaptability; has in every country proved to be the long sought answer to the problem of agricultural organization; has long since become so firmly established in the several countries as to have passed from the condition of being experimental to that of being the solution accepted by farmers, statesmen and economists. From these countries it is slowly disseminating and becoming established in agricultural economy all over the civilized world. The principle is that of Co-operation.

Co-operation is a term that in a broad way may be applied to many forms of organization, but in the strict sense this term is applied to a very special form of organization suited to certain conditions. It is my intention to place before you a short history of the movement and to study somewhat in detail its workings in various countries with especial reference to the Co-operative Fruit Associations of Ontario.

In order that we may have a definite knowledge of just what the Co-operative idea embodies I will quote from the work of C. R. Fay, "Co-operation at Home and Abroad," which is a first hand study of all forms of co-operation found in the different European countries. Mr. Fay defines a co-operative society as "An Association for the purpose of *joint trading,* originating among the weak and conducted always in an unselfish spirit, on such terms that all who are prepared to assume the duties of memberhip may share in its rewards, in proportion to the degree in which they make use of their association." Notice that it is an association for the purpose of trading. In the towns it is most successful as a means of supplying its members with food, clothing, etc. In the country its main field of activity is as a solution to the problem of marketing. It is the farmer's solution to the problem of how to overcome isolation in business, difficulties of transportation, and other conditions that so long have baffled him. In both town and country it has another field of great usefulness, *i.e.,* obtaining cheap credit as an aid to production. Let me insist, however, that aside from credit the chief field of agricultural co-operation is that of marketing. If, for instance, it undertakes the manufacture of butter it does so, or should do so, for the production of uniformity and excellence of quality merely as an aid in marketing. Wherever the object of marketing is lost sight of failure results. Witness the failure of co-operative dairying in Ontario where production is made the chief aim and marketing is not attempted. It is true that in France agricultural co-operation has partly taken the form of production, but this is due to peculiar political conditions resultant from the Revolution and not found in other countries

"Since Co-operation is *concerned with the conducting of business,* that is to say with trade, the Co-operative Society differs from the Friendly Society and the Trades Union. The Friendly Society teaches thrift and foresight, makes provision against death, accident, etc. It is concerned *not with business* of members but with fruits of *that business,* namely, savings. The Trades Union is intimately connected with the operations of trade but *cannot trade.* Its single object is to bargain with and if necessary to fight the employer on behalf of the employee." The Co-operative Society differs from the Trust, Combine, etc., in that it is an association of the many whereas the Trust is a union of the few. Co-operation especially aids and builds up the small producer; the Combine crushes the small producer. "Both no doubt seek first and foremost to benefit their own members. But while Combination is an association of the strong, bold, unyielding and exclusive, the Co-operative Society is an association of the weak who gather together and try to lift themselves out of weakness into strength." Agricultural co-operation cannot be said to be a monopoly. It does not tend to hinder anyone from entering the field of its activities, but only tries to organize its members as an aid to marketing. Wherever agricultural co-operation has become established the rural population has rapidly increased.

Co-operation in Europe.

"Like most great ideas Co-operation was born and fostered amid jeers and suspicion and when it justified itself in deed it was taken up by many who neither knew nor appreciated its early struggles." In Germany it began as a sort of philanthropic work by Schultze in the towns, and by Raffeisen in the country about 1849. These two men founded what are now known as the Schultze-Delitzsch and Raffeisen system of co-operative Credit Banks. The working classes of Germany at that time were under the heel of the Jewish money-lender. An experiment was made by these men consisting of loans to societies made up of small manufacturers, which later developed into the great Co-operative banking schemes that serve as models for the whole world. Under the wing of the credit societies there presently grew up Supply and Marketing Associations. The success of German agriculture to-day is largely due to the perfection of co-operative organization in the country.

In Britain co-operation has mainly taken the form of shop-keeping. German co-operation grew up under the patronage of philanthropists, but British co-operation in the towns is the result of the long and painful efforts of the working classes. Britain was the first nation to evolve a distinctive working class at the beginning of the "industrial revolution." The first society was a milling association (1795). Many similar societies followed and many failed. In 1833 there were 400 societies in England. At this time Robert Owen became active in the co-operative field and introduced socialistic schemes that temporarily ruined the movement. In 1844 the "Rochdale Pioneers" opened business as a Co-operative Store and from that time the movement in the towns has gone rapidly forward. The agricultural society was much later in the field in the British Isles. About 1888 the conditions of the farmers in Ireland drew the attention of Sir Horace Plunkett. He devised and put into action a co-operative scheme modelled on the societies of Germany and Denmark, which is rapidly revolutionizing Irish agriculture. In Great Britain the idea slowly began to make way among farmers but a definite organization campaign was not outlined till twelve years later. England in 1900 took definite action to push the Co-operative propaganda and Scotland followed the lead in 1905. The three distinct organizations known as the Irish, British and Scottish Agricultural Organization Societies are quasi-philanthropic societies, which aim to place the movement on its own feet as quickly as possible. This object seems to be in a fair way to be realized, as the British Government has now decided to do all in its power to encourage the movement. Their most profound students of agriculture are agreed that co-operation offers the best solution to the agricultural problem yet offered.

The Co-operative Movement in France dates from 1884. Previous to this time French law forbade associations of such a character, but in that year a law was passed favoring their formation. From that time the growth has been exceedingly rapid, as this form of organization seems to appeal to the mind of the Frenchman. While all forms of Co-operative activity flourish in France that country is the peculiar exponent of co-operative production. The movement in France has grown up under the protection of the Government and has from the first had its support and help. Perhaps this accounts for its rapid growth. Co-operation in Belgium began by act of Government in 1898. In Italy it began about twenty years ago. In both these countries the movement resembles that of France with special adaptations to the differing problems of each country. In both the movement is receiving the hearty support of their respective Governments, as it is recognized to be the long wanted solution of the agricultural problem.

It is in Denmark, however, that agricultural co-operation has perhaps reached its highest degree of attainment. It is to this country that all men point as the pattern of ideal co-operation. The movement began in 1866 by the establishment of the first Co-operative Store; the first co-operative dairy was establihed in 1882 and the first bacon factory in 1887. In 1895 the first egg-export society was formed and in 1906 the first shipping association. To-day eighty per cent. of the dairy products of Denmark and sixty per cent. of the bacon are handled co-operatively. The egg-societies are distinctly successful and the movement is recognized by all cognizant with the facts, as being the fundamental cause of the great prosperity of the country.

STATISTICS, 1906, AGRICULTURAL SOCIETIES.

Association.	Societies.	Members.	Business Done.
Germany.			
Credit	13,181	954,473	......
Separate Supply	1,072	141,804	......
Machine owning	280	6,423	......
Productive and Sale.....	3,264	239,729	......
Magazine	255	33,885	......
Denmark.			
Dairy	1,076	157,537	$45,000,000
Bacon Curing	33	91,000	18,000,000
Egg	500	......	1,200,000
Supply	(See page 13.)		
France.			
All kinds	3,553	677,150	......
Great Britain.			
All kinds	134	7,437	1,100,000
Ireland.			
Dairies	283	45,201	5,000,000
Supply	159	13,663	360,000
Poultry	29	458	7,000

This short and somewhat crude historical sketch gives little idea of the growth of the movement in the various countries but it should prove this one fact, *i.e.,* Co-operation is no new, untried experiment. In Europe it is accepted by all as an integral part of the economy of each nation.

URBAN CO-OPERATION.

The different forms that co-operative activity has assumed in the various countries of Europe is very interesting in that they illustrate the elasticity of the movement. It proves that the co-operative idea can be suited to the needs of very different conditions. It also proves that neither the old idea of *extreme individualism* on the one hand, nor the newer idea of a *close combine* on the other, is necessary to success in any line of commercial activity. Co-operation strikes the happy medium between the two extremes.

Three forms of activity are typical of urban co-operation in Europe. These are: In Supply, in Production, in Credit.

Supply.—Britain is the great home of Co-operative Supply. The system of stores which now covers Great Britain as a network is a living monument to the value of the idea. In Britain the industrial revolution brought about great changes. With the adoption of steam as motive power and machinery for hand labor, the work of production passed from the hands of the small manufacturer to that of the factory or mill owner. The great working classes became employees. As the mill owners came to realize the power they had become possessed of, they sought to still further enlarge this power by getting control of the shops. The task of the workman of Great Britain was, then, to free himself from the yoke of the factory owner. And here the co-operative idea found happy expression. After many experiments and failures it took the form of Co-operative Supply. The Rochdale Society opened business in 1844. They set forth as their objects: 1st, to establish a store for the sale of provisions, clothing, etc.; 2nd, the building or purchasing of houses for members; 3rd, to commence the manufacture of such articles as the society may determine upon. The growth of the movement has been phenomenal. In 1906 they had 1,448 societies, 2,222,417 members and made sales to the extent of $316,500,000. Each society owns and operates a store. The stores are nearly all affiliated with the British or Scottish wholesales which supply the retail stores with everything they need. As an example of the magnitude of their operations it is only necessary to mention the fact that the wholesales grow and blend their own teas, coffees, and cocoas. They manufacture nearly every article of common consumption.

In Germany a similar organization was attempted but has not been markedly successful. The condition of the working classes has been till very lately, so different in Germany that a similar need has not arisen. Co-operative Supply in Germany has taken another form. The money that Schultze secured by means of Credit Associations was generally invested by the tradesman member of the society in buying raw materials with which to manufacture his goods. The next most natural step was the formation of associations for buying raw materials in wholesale quantities. These associations have been wonderfully successful, and are now a very important feature of German Co-operation. The Germans express surprise that Britain has not adopted a like form of co-operation. But in Britain the small producer does not exist to any marked extent and so the need has not arisen.

Production.—France has excelled in co-operative urban production. This has been due principally to the attempts to realize the ideals of the revolutionary period, which aimed at the emancipation of the working classes. A peculiarity of French character has also greatly aided in the trend which co-operative activity has taken. The Frenchman is inclined to be communistic in production. He does not consider himself demeaned because he works under a superior officer. He still retains his social standing and meets his superior officer as an equal in every way, at the same time yielding willing obedience to that officer. This has made possible an extensive scheme of co-operative production. In spite of this pre-existing tendency of the French mind co-operation can scarcely be said to be the solution of the labor problem in France. Indeed some writers state that production pure and simple is not a legitimate form of co-operation. In Germany the industrial revolution came much more slowly than in England. When Schultze attacked the question of co-operative credit there were many small producers in the towns and this form of manufacture is still common there. Since then co-operative factories have made considerable headway. Now, however, the industrial movement in Germany seems to be replacing the small producer with the great privately owned factories. In Britain, the home of the co-operative store, Production is becoming an important auxiliary of Supply. The British and Scottish Wholesales are steadily increasing the number and kind of their factories, workshops, etc. The great bulk of this production is not truly co-operative, however. The Society stands rather in the position of private employer. To be sure, they treat their workmen well, their factories are scrupulously managed and the employees well paid; they divide a share of the profits with the employees of certain factories; but they are not co-operative and seem to be steadily working away from the ideal of co-operative production. It may be that production, from the standpoint of production only, is not a natural field of co-operative activity.

Credit.—Peculiar conditions have made Germany truly the home of co-operative credit. At the time Schultze undertook his great life-work the condition of the small producer, who was indeed the great producer, was pitiable indeed. The usurer had long become the scourge of the small capitalist of Germany. Money was scarce and dear. The "Jew" had money to lend but at exorbitant interest. Each loan obtained from a usurer simply led deeper and deeper into the mire. Schultze recognized that the ordinary philanthropic schemes were useless to solve such a problem. He conceived and interested the people in forming loan societies. Each member subscribed to a certain small amount of stock which he paid in instalments. Then the members signed articles in which each assumed unlimited liability for all loans made. Thus with a small bulk of capital and an unlimited liability bond a means of securing large loans at moderate rates of interest was secured. These loans were dealt out to the various members of the society at rates of interest very moderate in comparison with usury. These societies were very successful. Schultze had shown them that by "self-help" or co-operation they could solve the whole problem and eliminate the "Jew" who had so long fed in their midst. The history of the movement reads like a romance. The autocratic German Government resented Schultze's interference; they dogged him for years by placing every possible obstacle in his way, but the movement could not be stopped. The various forms of societies which presently sprang up formed unions of societies which again formed Provincial Unions. These have again united under one great head known as The General Union of German Co-operative Associations.

France, Belgium, Switzerland, Italy and Austria have followed the German lead and now do an immense business in co-operative credit. Other countries are learning the lesson and co-operative credit is now considered to be one of the greatest institutions of the workmen of the towns.

What then can Canadian agriculturists learn from the experience of the towns and cities of Europe and the British Isles in regard to Co-operative activity? Certain facts seem to stand out plainly. First. The co-operative idea is very elastic and can suit itself to a great variety of circumstances. How different is the situation of the British workman seeking to escape the bondage of the employer who also controlled his food supply, to that of the German small producer bent on maintaining his patrimonial institutions, and yet on escaping the " Jew " money lender! Again how different from either of the others is the position of the French workman, seeking an answer to the problem of production on a large scale and yet maintaining his cherished ideals of equality and liberty. Secondly. Co-operation is not a panacea for all social ills. It attacks certain specific problems which vary with the differing conditions to be found in its various fields of activity. A form which is very active and suitable for one country or set of circumstances is not workable in another place and *vice versa*. The need is the thing that determines its form of development.

Agricultural Co-operation.

A new form of activity enters the field here. I am not aware that urban co-operative producers market their goods co-operatively. If they do so it is on a small scale. The store is of course a sale society, but it is managed from the consumer's viewpoint only. But the agriculturist has long been looking for a solution to the great problem of how to market his produce in such a way as to secure a fair share of the returns himself. Co-operative sale has answered the question. Let us then examine co-operation in agriculture under the heads of Sale, Production, Supply, Credit.

Sale.—Denmark is the exponent of Co-operative sale. As circumstances have made certain forms of Co-operation peculiar to certain countries, so too have circumstances directed the course of co-operative activity in Denmark. Denmark is a country of farmers. In 1880 she had no great consuming market for her produce close at hand. The bitterness resulting from war and feud had cut her off from the great German markets. She was forced to seek a market overseas. The soil and climate was suited to only a limited variety of products. Grain had ceased to be profitable and the land was exhausted. The Danish farmer turned to co-operative production and sale as the way out of his difficulty. He recognized that in order to get reasonable returns for his product it was necessary to maintain control of the product until it reached the consuming market, which was Britain. Butter seemed to offer him a fair field for profitable activity. But he found that the heterogeneous product of the numerous farms would not market profitably in Britain so he turned to co-operative factories as an aid to marketing. Having learned the lesson of co-operative production as an aid to co-operative sale, he recognized at once that improved and scientific methods of production could be carried back from the factory to the stable and from the stable to the field. Thus by a series of logical steps he learned the relation of high prices and big profits to co-operative and scientific production. This fact is of prime importance as explanatory of the wonderful coincident advance of co-operation and scientific methods of production in Denmark. Co-operation solved for the Danish farmer the problem of marketing and taught him the value of science in production. Since 1882 the butter trade of Denmark has increased from $17,000,000 to $55,000,000 in 1908. The hog industry has been organized by means of bacon factories which maintain control of the product in many cases until it reaches the retailer. Some of these bacon factories spent as much as $15,000 in a successful co-operative campaign to break the "Pork Ring" in Britain. A number of these factories have stores in Britain. The poultry industry is being organized along similar lines.

In Germany co-operative sale has specialized in organizing the grain industry. The grain producers in Germany were forced "because of American competition" to adopt "superior methods of marketing." The Prussian government, partly because they did not want the new elevators. store-houses, etc., to become privately-owned concerns and partly that they wanted to help the co-operative movement, placed 5,000,000 marks as a loan at the disposal of farmers for the building of the necessary elevators, etc. This money became accessible to farmers only when associated in co-operative form. It would seem that the government aid was too lavish, as many elevators and store-rooms were built which did not pay their way. This gave the movement a severe check. Now, however, the co-operative marketing of grain in Germany is on a fairly firm basis and is recovering from the harm done by too lavish government expenditure. They are usually conducted in connection with a Credit Association which loan money on stored grain. There is at Pommern, Stetton, a kind of head society that dispenses the State loans, lets the "Corn Houses" and also conducts loaning operations on stored grain. In Germany also are found potato-distilling and wine societies which manufacture and market their crop. These are steadily, especially the potato distilleries, gaining in popularity with the people. There are two kinds of these: 1. Small farmers who bring their potatoes to a co-operatively owned distillery. These resemble the co-operative dairy. 2. A few big farmers own a distillery and store-house. They manufacture the spirit and raise loans on the stored spirit and also on the stored potatoes. These societies resemble the Corn Associations. In 1899 both forms of associations federated and formed a selling syndicate with a central office at Berlin. They have now five central sale depots.

France, which has essentially a home market, has five Provincial federations of societies for marketing purposes. The co-operative dairies of West France supply 24,250,600 pounds of butter annually to the Paris markets. They ship twice daily in refrigerator cars. Some federations *supply co-operative stores.* In Belgium some of the federations have founded special *co-operative markets* where they sell directly to the consumer.

In Britain, farmers are just learning the lessons of co-operative sale. So intense has been the individualism of the British farmer that he has been very slow to learn from his more advanced brothers on the continent. There are now numerous co-operative societies in Great Britain and Ireland that are looking to the organization of the marketing end of their business as the key to successful co-operation.

What has Co-operative Sale done for the farmer of Europe that he was unable to do when working alone? 1. It has gathered together the scattered products of the numerous farms, classified and graded them. It has taken these products and placed them on the market as the produce of one association or federation of associations of which the farmer is a member. It has retained the interest and control of the farmer over his products until they reach a consuming market. It has thus created a community of interest. 2. It has attached directly to the interests of the farming community a class of men who act as the farmers' middlemen, *i.e.*, the managers and sales agents of the associations. These middlemen are responsible to the farmer and are hired and paid by him to work for the farmer's interests. 3. It has relieved him of the business of marketing, thus leaving him free to give more careful attention to those things for which, by nature and training, he is better fitted. It has also taught him the value of science and improvement in production. 4. By means of all the aforementioned benefits it has greatly increased his profits and restored a sense of dignity to the calling.

Production.—In nearly every European country co-operative production is a part of co-operative sale. In several countries, however, production itself is being attempted aside from its value as an aid to marketing. In France the idea has advanced more rapidly than elsewhere. Co-operatively owned and operated vintries are quite common and the same is true of dairying to a lesser extent. In France, Germany, Belgium, Denmark, and some other countries are found co-operatively owned farms for the production of breeding animals and seed grains. They breed and distribute to societies and members stallions and mares, cows and bulls, sheep, swine, etc., thus greatly aiding in raising the standard of domestic animals. At Svalof, Sweden, is a splendid co-operative farm for the production of seed grain. There are 800 farmers in this association. But these latter societies are rather auxiliaries to the co-operative movement than bona-fide co-operative trading associations. Dairying in Ireland has been organized chiefly from a productive standpoint. It, however, has been valuable chiefly as a means of educating the Irish farmer to the need and use of more up-to-date methods of farming. Irish Co-operative Dairies are now looking anxiously towards federation of societies for marketing purposes.

Supply.—This form of co-operative activity seems to be successful in all countries. In 1844 when artificial fertilizers began to be commonly used in Germany, they were so adulterated by dealers that farmers were led to establish testing stations and afterwards buying associations. Little by little these societies enlarged their scope until now they handle nearly all of the great staples consumed on the farm. The Insterberg Society, one of the first in the field, was made up of big farmers. This was joined by *associated bodies of small farmers.* Thus has grown up all over Germany wholesale supply societies. Fay says the above instance has a treble significance: 1. It shows that the supply associations have an important place in large as well as in small scale agriculture. 2. Large and small farmers can successfully co-operate for supply, albeit similarity of status is essential to the rural bank. 3. One important society may shelter its weaker brethren until they are strong enough to stand in equal alliance.

In 1895 came the final stage of the development of the Supply Societies of Germany. They formed a "National Business Federation." The societies prepared in this way to combat the *great trusts* of the country. "Each wing of co-operative industry prepared for the change." All the agricultural co-operative societies joined the Central and made it their headquarters for supply. In 1898, 1,500,000 farmers were connected with it. The fight with the trusts was wholly successful. "Thus have German farmers been drawn together to form over and above their own supreme general unions this Supply Union which is a purely business machine, national in scope and registered at law as a "Joint Stock Company, Limited."

In France the Supply Society is almost equally successful. It is this form that Co-operation is largely taking in Britain. Manures, cattle foods, machinery and such staples are the goods mostly dealt in.

Denmark has carried the business of supply more nearly to perfection than has any other country. They have: (1) A United Supplies Association which consists of a federation of 800 societies. This society owns an immense wholesale house at Copenhagen and operates stores in nearly all the country villages of Denmark. They sell provisions and general household requirments, as well as raw materials. (2) A Farmers' Co-operative Purchase Association with 4,000 farmer members. This society buys feeding stuffs, seeds and manures; sells eggs, butter and garden produce through a single wholesale house at Copenhagen. (3) Feeding Stuffs Associations. There are six of these with a membership of 600 co-operative dairies. Besides these there are nine federations of seed purchase societies, one Creamery Requirement Association comprising 362 co-operative dairies. "With the exception of the United Supply Association these societies are rarely rivals in each other's districts for the same commodity."

Thus by means of organization the Danish farmer has freed himself from the dominance of the middleman, who on the one hand marketed his product and on the other hand sold him his supplies. He has not eliminated the middleman to any marked extent. The wholesale and retail store still exists but the farmer now owns both the wholesale and retail machinery of supply, as well as the wholesale means of distribution.

Credit.—In 1849 Herr Raffeisen of Flamersfeld, Germany, secured a loan of about $1,500, which he loaned to a few of the usury-ridden farmers of his native country. From this small beginning grew up the great system which has done so much for Germany. It has supplied the farmer with an abundance of credit with which to improve his farm. The young man without capital but with a good name has, by its aid, been enabled to secure sufficient means to start on his own farm. It has had a considerable influence in checking emigration from Germany. It has taught the German farmer self-confidence, good business methods and good morals. Each little village has its own association which is a member of a Provincial Union, which is again a member of the National Federation. From Germany the idea has slowly spread. In France some philanthropists, and afterwards the French Government, tried to launch great schemes supposed to resemble that of Germany. Both failed utterly. Wolff, in "People's Banks," makes the following comparison between the French and German schemes: "One can scarcely help remarking upon the striking contrast between that splendid enterprise, flush of funds, big with promise, hopefully watched by thousands of expectant Frenchmen—and yet doomed to end in nothing but smoke in less than two brief months; and, on the other hand, the modest little bank, scarcely daring to show its face, with barely a few hundred pounds of borrowed capital, unheard of outside its own small parish, and yet destined to grow up a flourishing institution, distributing millions through its thousands of channels and establishing plenty everywhere it set foot."

Since then the real credit society, self-owned, self-helped and self-sustaining, has become an essential feature of French co-operation. The co-operative leaders in Ireland have lately come to the conclusion that the movement would be much farther advanced had they made use of co-operative credit at the beginning as a means to supply the Irish farmer with much-needed capital. Co-operative credit is steadily gaining the confidence and favor of the British people, statesmen and government. It is now looked upon as being the most feasible scheme ever advanced for the supply of credit to British farmers. In Switzerland, Belgium, Austria, Sweden and Italy the Credit Association in some form has a prominent place in agricultural economy.

Forms of Organization in Europe.

In order to understand more clearly the workings of the societies I will describe characteristic forms as found in the various European countries. These descriptions will include only agricultural societies.

The Credit Association is a union of the members of single communities for the purpose of obtaining joint credit. The societies are confined to single communities because where the organization extends over a considerable area the members are not known to one another and the community of interest is destroyed. The essential feature to success is that each member shall be intimately acquainted with every other member so that confidence can be maintained. The members are associated under unlimited liability. The societies obtain money by borrowing in sums of such magnitude that they are able to secure a low rate of interest. Deposits by members also form an important source of revenue. Regular savings bank interest is allowed on these. No stock whatever is issued. They pay no dividends. They lend the funds thus obtained to members at as low a rate of interest as possible, usually about four per cent., for periods varying from one month to five years or longer. Each applicant for a loan must justify his claim before it will be granted. Where unlimited liability is employed, great care is taken to see that each loan is put to good use. The security is purely personal. Good character is made the basis of all loans. The management consists of a board of three directors and an advisory board, whose business is to assist the directors. The directors are not paid a salary but may be paid for time spent enacting business. A paid cashier is employed to keep the books and dispense the funds as directed. He has no control of the funds in any way. The books are audited twice a year. Travelling expert auditors go from society to society to do this work. By this simple means all the credit that can be desired is secured and the universal statement is, that never a dollar has been lost.

Over the individual societies are provincial federations consisting of unions of societies. These are associated under limited liability. Their business is to act as a safe deposit for the funds of the individual societies and to make funds mobile, *i.e.,* if one society has an excess of funds it is transported through the provincial federation to another society in need of funds. The provincial federations do not lend to individuals or have any dealings with the public, excepting through the associations.

There are also individual societies in several countries associated under limited liability, which are fairly successful. Their serious difficulty is that in order to raise sufficient capital they are forced to sell shares which naturally look for dividends. These societies tend always to settle down into pure business enterprises aiming to lend at as high rates as possible in order to swell the dividends.

The Dairy Societies of Denmark are associated entirely under unlimited liability. There is first the individual society consisting of a community. These are producing societies which manufacture the product of the members. These societies are associated under nine marketing associations, whose function it is to secure the highest possible price for the product of the producing associations. At the head of the nine federations is a Butter Quotation Committee who watch the markets and furnish quotations to the federations; they also make sales when desired. The price quoted to the federations do not fix the price of butter but rather act as a guide to the societies when making their sales. They, of course, secure higher prices than those quoted whenever possible. The Bacon and similar societies are modelled as nearly as possible after the dairy associations. The management consists of a board of directors and a manager for each society with a corresponding government for each federation.

The Egg Export Societies are organized somewhat differently. After several experiments the form adopted is to have small societies which employ men to gather the eggs of the members and deliver them to a railway station, from which they are shipped to the store and packing houses of the federation of societies that now takes the responsibility of marketing. At the packing house the eggs are candled, graded, crated and made ready for shipment to the various markets. Before the eggs leave the individual member he marks them with a number given him by the federation. If the egg is found to be "bad" it can be traced right back to the member who sent it in, *i.e.,* the candler—official tester—at Copenhagen finds that egg number 41 is stale. The number reveals the member who sent it. The societies are associated entirely under unlimited liability. A flat rate is paid for the eggs to the members at the time they are gathered. Later, when the returns for the shipments come, the difference between the price paid and the price received by the federation is returned to the members less the expense of management. Thus the federation is the factory, sales agent and distributor of the returns to the individual producer, the small societies serving only as a means of gathering the product. This has the advantage of economy in management, which is necessary where the yearly returns to the producer are small, because only a small amount of capital is invested in the business.

The Grain and Spirit Societies of Germany own great storehouses. They are thus enabled to hold their produce until they find it advantageous to sell. They usually work in conjunction with a Credit Association from which they borrow money on the stored goods when desired. They are associated under both limited and unlimited liability. Their method of federation is rather loose but consists of a union for selling purposes, and in the corn societies for dispensing the State loans. They are governed by boards of directors who are not paid but employ a paid manager.

The producing societies of France are associated under unlimited liability. Their object is simply to secure, through association, the economies of management, etc., always found in large establishments. They are organized into departments with managers in charge and are governed by men elected by the association to do the work. They are federated with other societies of a like nature and also with purely marketing associations for marketing purposes.

The Supply Societies have very different forms in different countries. In nearly all cases, however, they have a federation which is a wholesale society. It is the business of the wholesales to buy supplies for the individual associations. The government of the wholesales usually consists of a board of directors appointed by the societies. They, of course, employ paid managers. The board of directors may also be paid. In

Denmark, France, Germany and several other countries limited liability is employed. The wholesales own depots at central points. The individual societies may operate retail stores or may only have sheds for storage. They employ paid managers and are controlled by boards of directors who are not paid.

Associations employ various methods of organization according to the kind of society and character of the people. I shall discuss these under several heads:—

To Secure Capital.—When a co-operative society undertakes to do business from year to year it becomes necessary to obtain capital for investing in a plant or to supply working capital or both. This capital is obtained in one of three ways. 1. The Society borrows the money either from a bank, a private person, or a loan company. 2. It issues share stock as an ordinary Joint Stock Company. 3. It combines the two methods outlined or issues stock for a part and gives a mortgage on the plant if it has one for the remainder.

In order to borrow directly, *i.e.*, straight loan, the large amount necessary to finance, say a bacon factory, considerable security is required. The greater the risk the higher the rate of interest and *vice versa*. Recognizing this fact, the farmers of several countries in Europe associate in the form of unlimited liability associations. This form makes the borrowing of capital very cheap because each farmer assumes the responsibility for the whole debt. This kind of security removes every shadow of risk from a loan. Not all European farmers, however, are prepared to associate themselves in this way. In Ireland and in some parts of Germany and Belgium the second means is employed, *i.e.*, share capital. In this, however, the system differs from Joint Stock in that shares are rigidly confined to members, only one vote per member and profits are divided according to business done with the society. Experiments have proven this to be the only successful method. The trouble with this system is that farmers are not a monied class and it is often very difficult to raise sufficient capital. This difficulty often blocks organization. Some societies have share capital and unlimited liability. This gives them ample capital but the difficulty encountered here, as also where joint stock only is used, is that stockholders look for large dividends on their investments.

Unlimited liability.—Each member of a society assumes full responsibility for all the liabilities of the association. The bond declares "all for each and each for all." This system is universal in Denmark. Even federations of societies employ unlimited liability. The same system is nearly uniform in France, but in Germany and several other countries unlimited liability is confined to individual societies. Unlimited liability is the cheapest of all credit instruments in that capital takes no risk. It is the mark of high business training on the part of the farmers in the countries where it is found. It is a proof of the great interest taken in all the doings of a society or federation by individual members.

Farmers safeguard themselves by signing a bond in which each assumes a certain definite proportion of the liability of the society based on the value of his farm and the business done with the association. This amount is fixed by a board appointed for the purpose. By this means, if suit were entered against a society, the whole debt could be collected from one individual if necessary, but he again could collect from each member a certain definite share of the liabilities. Thus, while to the business world each member is responsible for the whole of the liability of the society, he is really only responsible for a certain definite share. Again, in many cases expenditure is checked by limiting the amount of money that may be invested in any given enterprise, by the manager or board of directors. Any project involving more than the stated sum must be submitted to a general meeting.

Certain peculiar conditions which deserve notice are found in those societies that employ unlimited liability:

1. Only people with considerable public spirit enter these societies. A narrow or suspicious person will not enter.

2. There must be a strong community of interest to induce people to severally and collectively assume such responsibility. Once this community of interest is established it steadily increases with each new communal investment. This has been found in practice to be one of the most remarkable and beneficial results of such associations.

3. There must be a high sense of obligation and honor on the part of individuals in such a society. A dishonorable or careless member is a distinct menace to the society and finds himself socially ostracized in such a community.

4. It tends to restrict the size of the society. Only the highest type in a community will enter such a society. These persons must carefully weigh the character of each new candidate for membership.

5. Only persons of good business ability enter such a society. They must see the business advantages and be clear-headed enough to see ways to safeguard their personal interests, while at the same time advancing the interests of the community.

Limited liability resembles that of any joint stock company except that it is found advisable to restrict shares to members. There is this fundamental difference between a Joint Stock Company and a Co-operative Society. A Stock Company sets out to earn dividends as the prime object of its being. Its services are measured wholly or in part by the dividends declared. Its investors or promoters are not its customers. It is not interested in serving its stockholders except to earn dividends. A *Co-operative Society*, on the other hand, *does not set out to earn dividends* as the primary object of its being. Its profits are measured rather by the service it is to the members as a whole than on the basis of dividends. Its members and promoters are its customers and the society is interested in serving the investors in other ways besides the earning of dividends. Dividends are fixed by the constitution and do not vary.

Federations of societies find limited liability a convenient form of association. The society is no longer under the direct observation of the individual. For this reason the strong community of interest is more or less broken and the actions of the federation are not controlled by individuals but by societies as units.

The analysis of the two forms of association may be summed up thus: 1. Unlimited liability is the cheapest form and tends to the highest development of the co-operative idea, but can only be adopted where there is a marked community of interest and a high degree of intelligence. 2. Limited liability is suited to those conditions where there is only a loose community of interest and where people are not trained in business and citizenship. With limited liability considerable care needs to be exercised in order to maintain the co-operative idea.

Division of Shares.—Where shares are employed the problem of their distribution is a serious one. In Germany where share capital is common the desire of the large stockholders to earn dividends offers a serious menace to the development of the societies. They tend to become money-making machines for a few stockholders. Many societies are now allotting a fixed number of shares to each member while others are limiting it to one share of a fixed amount. Britain and Ireland have all share capital and some of these societies as well as many in other countries show signs of separating into societies of big farmers where the amount of money invested by each is nearly equal; and into societies of small farmers where a similar condition prevails.

Distribution of votes.—Shares and voting power are closely connected. A farmer who owns many shares in a society naturally wants a corresponding control in the society. On the other hand, a poor farmer may have as good judgment as a rich farmer. He may also be more inclined to direct the policy of the society towards the general good. When a few men control a large bulk of the stock and votes, the whole society stands a good chance to suffer in consequence. This trouble is overcome by two methods: 1. In Denmark, France and in part of Germany one man has only one vote. This has been found to be perfectly satisfactory and in no case has hardship resulted in consequence. 2. Large producers associate in one society and as they have nearly equal amounts of capital invested each man has practically only one vote. Small producers associate in a similar manner with similar results. The two societies may then federate for marketing purposes. This second way has its limitations. When large amounts of capital are invested, as in bacon curing, it often requires two sets of costly machinery to do the work that one would do. The first method has no disadvantage except the unwillingness of a large investor to agree to have only one vote.

Responsibility of Management and Members.—The board of directors are directly responsible to members for expenditures and prices received for produce. They must settle all difficulties between managers and members. Managers are responsible to the board of directors. Their position does not differ materially from that of the manager of a joint stock company. Members are generally held strictly responsible to the society for their actions. If a member of a loan society in Germany misuses his loan the directors have the power to call the loan in at once. If a member of a Dairy Association in Denmark sends a poor quality of milk to the factory or if the quantity falls off abnormally, he must answer to the society for the defection. Very often a man employed by the society is sent to advise him regarding the matter. If deemed necessary, a fine is imposed, and this rule is strictly observed. Thus each society in each country has its special means of securing for the association the best efforts of its members towards making the societies a success. The perfection with which this can be carried out depends entirely on the strength of the movement in the particular section in question.

Division of Profits.—The plan that has worked out to best advantage in all countries (excepting with loan societies) provides a fixed rate to capital, either in the form of interest or dividends. All of the loan associations set a certain percentage of profits aside for a reserve fund. This plan is also followed by many of the other societies where considerable quantities of working capital are required. In marketing associations prices for each shipment are pooled and any remaining profits are apportioned to members on the basis of business done with the association. In the loan societies there are no profits outside of the reserve fund. The Supply Associations usually sell at regular retail rates and then rebate the difference between the selling price and the cost price to the members. Societies handling wholesale quantities of manures, seeds, etc., often charge their members only the actual cost price plus expenses of management. With this system profits appear only as savings on purchases to the members.

Federations of Associations.—The duties of the federations of the different societies have been discussed as each society was described. There are, however, many things of great interest connected with them not yet mentioned. In France all agricultural organizations are hinged to what is known as the "Syndicat," which is described as "a union between persons exercising the same profession formed for the defence and advancement of their common interests." Its objects are: 1. To attach the rural population to their homes by increasing the dignity of agriculture and to make it more remunerative. 2. To act as intermediary for members, to improve tillage and cattle raising. 3. To proceed with collective purchase of all agricultural requirements such as seeds, manures, machinery, etc. 4. To fill the role of an aid society, mutual insurance and provident society, and to establish co-operative societies. A peculiarity of French law exhibits itself here. All other agricultural societies must secure their legal standing through the "syndicat." Thus a general federation of all forms of agricultural societies has been created by law.

At first there was only one great syndicat, but as the differing interests of the several activities of the society began to clash, the syndicat has split into several, which have again divided under Provincial syndicats. To these smaller syndicats are attached the co-operative societies proper. There is now a movement towards a closer federation of the co-operative societies independent of the syndicat. This would indicate that federation should take place by the volition of the people from the bottom upwards rather than be created by law.

In Germany each branch of co-operation has its own federation. Over all these there is, as already noticed, the National Business Federation which acts as a connecting link between all branches of the movement.

Great Britain and Ireland have their organization societies which act in a paternal relation to the individual societies. These organization societies cannot trade. They can scarcely be called federations but rather parents. They are supported in part by the government, in part by philanthropists and in part by the individual societies.

"At the crown of the Danish co-operative union proper is the General Co-operative Union. It publishes a paper and holds a congress. It owns one small room and employs a lady secretary. This is perhaps the most striking comment possible on the development of Danish co-operation." It indicates the perfection of their system and also its simplicity of management.

Let us notice some of the particular activities of these federations under the following heads:

1. To further organization.—All of the great federations have special departments for pushing organization work. The British Societies employ paid organizers. The Germans have a similar but more elaborate scheme. In Denmark organization is taken so much as a matter of course that a similar driving force is not needed to the same extent. although much aid is given by the General Union. The Syndicat of France undertakes the organization of all societies and as before explained all societies must receive the support of the Syndicat.

2. For increasing quantity and quality of produce.—The Danish dairy federations co-operate with the government in their "surprise" butter contests. These are held every three weeks at Copenhagen. A manager of a factory may at any time receive a telegram requesting him to send a firkin of yesterday's make to Copenhagen at once. A certain number of factories contest each time. It is arranged so that each factory gets into the contest about three times annually. The short notice given and the entire ignorance of the manager of a factory as to when he will be called upon to enter the contest insures that he sends a sample of his commercial pack. The merit is apportioned according to the commercial value of each factory's make. When the butter reaches Copenhagen the firkins are locked into iron cases which show only the face of the butter. Thus, all possibility of collusion between the judges and the factory

managers is obviated. Judges are then chosen and merit awarded. The value of these contests can be readily seen, as the managers are continually expecting a call to the contest. Bacon federations arrange similar contests. In France the Syndicat furnishes ever-ready machinery for the organization of all kinds of improvement societies. The Organization Societies of Britain carry on a continual educational campaign in connection with their work. This work appeals to farmers because they see the close connection between improvement and profits.

3. Pertaining to markets.—Some years ago the Bacon Federations of Denmark undertook to break the "Pork Ring" of Britain. They established depots in all the important towns and cities of Britain and actually undersold the combine to such an extent that they broke the "Ring." In Germany the National Business Federation forced the prices of artificial manures down to such a degree as to break the great "Kartel" that had controlled these fertilizers for years. Thus the co-operative movement has aided consumers in maintaining an open market in which to buy.

Again, when Germany placed a prohibitory duty on the by-products of the Danish bacon factories, the federations at once started an educational campaign in their own country. They published recipes and gave demonstrations on new ways of preparing livers, kidneys, etc., for food. By this means they increased the consumption of these products at home to such an extent that they were no longer dependent on Germany for a market.

Danish experience points to federation of marketing facilities but at the same time to elasticity of functions. "For actual business the Danes have not one selling organization but nine, though they are obviously co-operative enough to work through one when they desire. For watching prices they have one organization of a national committee. In a word, the Danes are intensely practical in the division of their work. Butter making and butter packing is the work of the dairy; butter transport and butter selling, the work of its business delegates, who also readily effect bargains with private concerns when these latter render specialized services which they could not render more efficiently themselves."

The above instances show how that by federation the co-operative societies can act unitedly and with great effect when desired and still allow each society to maintain its own identity.

Government Interference.—A study of the attempts of governments to hinder or aid the co-operative movement reveals some interesting things. In Germany in the early days of the movement, Bismark attempted to crush it by placing endless legal difficulties in its way. The German people, however, were used to being hampered by the Government and continued doggedly on their way. Eventually they won complete recognition by the law, but even to-day there is endless "red tape" in connection with all their actions. Finding attempts to crush the movement futile, the government then set about to regulate and aid the movement. A law was passed requiring that all societies should employ "share capital" as a stock company does. The urban credit societies adopted this rule with the result that they seem to be losing their usefulness as co-operative societies. The agricultural credit societies issued nominal shares which they never paid. These societies have remained true to the co-operation ideal. Later on, as already noticed, the government attempted to aid the Grain Societies by making loans for building purposes. The money was to a great extent squandered. People began to think that a store-house for grain was all that was necessary to insure success, but they found that this provision was less than half the requirements of a good co-operative society. The loan is still provided by the government but is now placed directly in the hands of the federation of grain societies, which administers the fund much more wisely than the government did.

The French Government also attempted to launch a great credit scheme which failed utterly, because the people placed in charge of it belonged to a station in life so high that farmers were shy of coming to them with their financial difficulties. It has been found by long experience in all countries that the fundamental requirement of success in co-operative credit banking, is that the funds shall be controlled by persons of exactly the same station in life as those whom the scheme is intended to serve. Each director must be personally acquainted with every customer of the society and must be able to see the position of the applicant from a common viewpoint, which can only be acquired by living the life of the applicant.

Agricultural Co-operation, as it exists in France, is the result of a legal accident. In June, 1884, there was being read before the House of Deputies a bill providing for the incorporation of societies for the purpose of defending their profession. A member, coming in late, entered the room just as the professions included in this bill were being enumerated. "Et agricoles," he interrupted. His suggestion was adopted without comment, and so the great co-operative movement in France was made possible. By July 15th of the same year fifteen societies had been formed. The French farmers had just been waiting their opportunity.

In England the movement for many years was seriously handicapped by governmental restrictions. Even yet the associations must register under the Provident Societies Act. This, however, will shortly be changed.

The Danish Government seems to have left the movement to develop naturally, only passing such laws as were urged by the societies and giving such aid and regulation as the societies demanded. *A law has been passed requiring each association to adopt a registered trade-mark.* All goods are stamped with this trade-mark. Thus misbranding is made a very serious offence.

Agricultural Conditions in Europe.

We can discuss these conditions only very briefly as they are related to the movement. Farms in Denmark average in size from twenty to seventy acres. There are many very small and a comparatively few large farms. A number of years ago the large estates were broken up and divided among the people. The great bulk of the land is now owned by people living on the land. In France a somewhat similar condition prevails. The great number of very small farms seems to have had a tendency to turn the minds of the people towards co-operative production, in order to secure the economies of large scale production. In Germany land is held both by "occupying ownership" and by leasehold. The size of the farms varies a great deal, many being very small and devoted to dairying, gardening, vine-growing, etc. The large farms, which are very characteristic of certain sections, are usually devoted to grain and stock. In Ireland and Britain the co-operative society is being looked upon by many as a natural complement to the movement for dividing the land into small occupying ownerships. It is found to be the means of supplying unity and strength to the small farmers, so that they can buy supplies as economically as the large farmers and sell their produce with a like economy. The idea is finding favor more and more in the minds of large farmers for the very same reasons. The machinery-owning societies are mostly confined to associations of small farmers. The American should remember that the number of acres held by a farmer in Europe gives us little idea of the extent of his business or the capital invested. A farm of ten acres in Europe will often have as much capital invested and have as big an annual turnover as has the one hundred acre farm of America. There is not, therefore, the difference financially in the conditions of the farmer of Europe and the American farmer that would at first appear. The density of population, however, gives them a community of interest and the advantage of considerable numbers in each association not found in America, excepting in certain intensive lines of farming. While the size of farm has an effect on the forms the societies take, students do not think it has a serious effect on the movement generally. One thing that does seriously affect it, however, is the total amount of product of a certain kind, available for manufacture or sale. It is also easier to keep a society true to co-operative ideals where farms are small and members numerous, than where farms are large and members few. "Small farmers have achieved most success with co-operative vintries and dairies, while other products of the small farm are only occasionally and in a loose manner handled co-operatively. It was the big farmer who awakened to the fact that co-operation was a useful and suitable organization for all his purposes. Under his influence some parts of the co-operative movement are tending to settle down to self-contained business departments, more consciously interested in joint marketing action with non co-operators, than in the pursuit of a common co-operative ideal."

The smallest co-operative dairy of Denmark has 655 cows. In Ireland they average 600 cows. The average of Belgium is somewhat smaller. The French dairies cover large areas. The average membership is 540 and they have about 1,100 cows to the society. The large quantity of produce available on a given area is perhaps the most remarkable fact in connection with European agriculture as affecting the co-operative movement.

Conclusions.

The Co-operative Movement in Europe is essentially an organization for conducting business. In no case, where successful, has it posed as a panacea for all social ills. It has in all cases, where successful, answered an urgent need, attacked specific problems, dealing with them by the most advanced methods and making use of the sound business principles of any private business venture. It has emphasized the need of cheap capital, large production, strict economy of management not niggardliness, sound methods of marketing, the reduction of the numbers and position of middlemen, the need of the producer to understand market conditions and the need and value of improved methods of production.

While in many respects the co-operative society employs the same methods as does any business organization, yet it differs from it in certain essentials. The business organization would look upon the union of all the co-operative dairies of Denmark as the very perfection of the idea. The co-operative society has not viewed it so. In order that control may be maintained by the members of the individual societies and the true "working together" idea be preserved, they have found many federations more useful; although "they are obviously co-operative enough to work through one if they so desired." Simplicity and elasticity are the watchwords of Danish co-operation. The Credit societies have not found property security to be a necessity in the loan business. They have proven personal security to be much better and have thus been enabled to reach the poorest of the poor, provided they had good character. Thus the business enterprise has become an uplifting moral force. The co-operative movement has proved unlimited liability to be perfectly reasonable and safe in business association. It has shown that commercial enterprise is not necessarily a close combine benefiting only the few, or on the other hand, disorderly competition between individuals. It has shown that all the worthy features of commercial enterprise can be preserved, and at the same time give equal benefits to all the co-workers and eliminate the disastrous losses occasioned by extreme competition.

CO-OPERATION IN NORTH AMERICA.

Anyone who is familiar with the co-operative movement in the Old World and wishes to get an accurate idea of it in America, must take into consideration the wide difference in general ideas and aspirations between the people of Europe and those of America. The movement here is stamped with all the characteristics of our civilization. In the first place it is "new" and only in rare cases has it been worked down to anything like a regular system. In nearly every case where it is systematized it shows evidence of being tainted with "trust" methods of working. So-called co-operative organizations spring from oblivion and in a year or two are doing a business of millions. Quasi-co-operative societies are continually being organized, which eventually degenerate to a trust or fall apart altogether. Pure joint stock companies masquerade as co-operative societies and no one knows the difference between the two ideas. Governments send commissions to Europe to study the movement there. The members of the commission are usually chosen from the ranks of scientific producers, who study the question from the standpoint of producers, never dreaming that the movement is interested first in trading and only in a secondary manner in production.

In a civilization such as ours that is in the transition stage from the autocratic to the democratic idea of government, every precaution is needed in order to keep the co-operative—the "working together"—idea separate and distinct in the minds of the people, from our commercial idea which is distinctly autocratic. The commercial idea places large power in the hands of a few and attempts to hold them responsible for the proper use of such power. Bitter experience has shown that the human mind is not developed to that degree of perfection, where the ordinary individual is strong enough to resist the temptations which the possession of large power brings. The co-operative idea divides the power among numerous co-workers; its government is essentially democratic. The ordinary commercial organization seldom tends to the betterment of its employees; the co-operative society exists only to benefit its co-workers. The commercial idea may be summed up in the word *mastery;* the co-operative idea in the word *service.*

So prevalent are commercial methods that it is difficult for people to see the difference between the two ideas. It is essential, however, that the co-operative movement be kept strictly a movement "of the people, by the people, for the people." The government of the individual societies, the government of federations, the direction and control of the whole movement must be the united expression of the *individuals* in the movement, or the whole structure must degenerate and eventually fail. This is, in fact, the great internal problem of the movement in America. In a country of so vast an area and with a people whose minds are so steeped in the commercial idea, the problem of uniting the forces of co-operation and yet maintaining the control of the individual is one of tremendous depth and gravity.

Turning to its business aspect we have the same problem in America that exists in Europe, *i.e.*, what are the natural and successful fields of co-operative activity? In Europe it only attacked problems where a distinct need existed for the substitution of a better system for the one already in use. A form successful in one country was totally unfitted for use in another country. Production was only conceded to be a part of the movement wherein production directly affected *trading*. In America the same is proving true, but while in Europe careful students have from time to time analyzed its workings and pointed out the lessons taught by experience, nothing of a like nature has been done in America. It is probable that a careful study of the movement in its present stage of development in the United States and Canada, by a person with a thorough knowledge of the co-operative idea, would yield lessons much more valuable to the future of the movement in America than would further study of European co-operation. The basis and idea is the same in all countries, the details vary with every country and problem. We must preserve the idea intact and in its simplicity; we may vary the details to suit every condition.

Co-operation in the United States.

Farmers' organizations in the United States date back for many years. These have had various aims and objects. In many cases they were connected with party politics but all aimed to place the farmer on a better financial and social footing. Much has been done by legislation to control carrying companies and other matters pertinent to agriculture, and also by helping the farmer to see that in union there is strength.

Of late years farmers have begun to realize that their great lack is the proper organization of the business end of farming. As a result increasing attention is being given to joint marketing, both in buying supplies and in selling produce. Farmers of the Southern States were the first to attempt joint marketing action. Among the cotton growers jointly-owned gins and selling companies have been a feature for some time. Truck and fruit growers have also organized in a similar manner. Vegetable and truck growers in the Eastern States are lately coming into line, while in the West many large and successful fruit companies are doing business. The grain and cattle growing states are now organizing for joint marketing purposes, while the dairy industry has long been a favorite field of co-operative experiment. In this industry, especially, many abortive co-operative attempts have been made, but there is evidence at hand that the true co-operative dairy society is becoming established. Co-operative stores have now a firm hold in Minnesota, and the future in this branch looks bright.

The whole movement, however, lacks unity and definiteness. Very few of the companies are truly co-operative. Organizers for the most part have little conception of the co-operative idea and have organized the societies as joint stock companies. Many have fallen away from their original purpose. They started out with the intent to solve the question of marketing for American farmers, but only a few were constituted so as to be able to remain true to their ideal. The stock company is confounded with the co-operative society to such an extent that the majority of people think they are the same. In its present disjointed state it is impossible to range the movement under the different heads as was done with European co-operation.

Perhaps the most feasible method of examining the so-called co-operative societies of the United States is to outline the standards accepted by European co-operators, place alongside of it an outline of the essential features of a joint stock company and compare the American societies with these standards.

	Co-operative Association.	
Joint Stock Co.	*Form 1.	†Form 2.
Limited or unlimited liability.	Limited or unlimited liability.	Unlimited liability.
Capital secured by selling shares.	Capital secured by selling shares.	Capital secured by borrowing.
Shares held by general public.	Shares held by members only.	Loan secured from anyone.
Dividends on shares not fixed.	Dividends on shares fixed by Constitution.	Interest paid on loan.
Votes according to stock held.	One vote only per member.	
Proxies.	No proxies.	
Profits divided on basis of shares held.	Profits divided on basis of business done with Association.	
Profits divided only with shareholders.	Profits divided in part also with non-members dealing with Association.	
Object of company to earn dividends.	Object of Association to serve members.	
Two interested classes—dividend seekers and operators proper.	One interested class—operators, *i.e.*, members only.	

It will be sufficient for our purpose if we examine a few typical societies and study their methods of organization and management:

Co-operative Stores.—This is the only branch that has a properly constituted propaganda. The Right Relationship League, with headquarters at Minneapolis, is a propagandist and educative society aiming to establish co-operative societies of various kinds. Its main activities have been

*Rochdale plan. †Danish plan.

directed to the establishment of stores on the English Rochdale system. There are at present about 100 stores in the State of Minnesota organized on this plan. The shares are held indiscriminately by both town and country people. The greater number of the stores are in the small towns. The League recommends a constitution and by-laws to be adopted by each store organized under its auspices. It includes all the essentials of Form I, outlined in the comparison of joint stock and co-operation. These stores are very successful and this form of organization for stores is proving as useful in America as it is in Europe. It would seem that this branch of the movement in the State of Minnesota has been reduced to order and is assured of success.

Dairying.—In many of the States farmers' dairy companies have been anything but successful. The causes are practically the same as in Ontario, which will be discussed later. In the State of Louisiana dairies are now being organized on the Danish plan, which are said to be very successful. N. O. Nelson, who is pushing the propaganda there, gives as the form of societies: Unlimited joint liability, capital secured by borrowing; this is paid off by taking the returns from 5-7 per cent. of the milk furnished. Each member is bound to send a stipulated average amount of milk for two or three years. Societies are only organized in sections where sufficient milk is signed for to guarantee economy in management and success in business. Following the Danish plan the Directors are allowed to employ an Instructor to help and advise farmers in many ways and to push propaganda work. The Hammond Co-operative Creamery is empowered "to do business for other similarly organized Farmers' Associations, such as garden, truck, poultry and eggs, etc., on equal terms and pro-rated expenses." Where dairies are small it will often be found to be good business to organize other societies, as provided above, and in this way help out the expenses of management.

Truck and Fruit Growers' Societies.—The Long Island Potato Exchange in New York State is a pretty fair example of what is being attempted amongst farmers in the Eastern States. This is a company of about 600 farmer stockholders which has a capital stock of $20,000 divided into shares of $500 each. Its object primarily is to develop the potato industry in Long Island, but the company has branched into other lines, particularly in the supply of seed and fertilizer. There is nothing in the constitution stating who shall be members of the company. A person may not hold more than five per cent. of the stock; votes are according to shares held and may be by proxy. Shareholders are expected to sell through the Exchange.

The Exchange ships from eighteen stations. At each place there is a local board of directors and a manager. The central board and head office is at Riverhead. The general manager at Riverhead has charge of all the business of the Exchange under the control of the Board of Directors. There is nothing in the constitution or by-laws regulating the apportioning of profits or dividends.

This, then, is a joint-stock company, but certain limitations have been provided in the endeavor to keep the affairs of the Exchange from falling into a few hands. For the ten months ending November 1st, 1909, it handled 353,336 bushels of potatoes. The many apparent weaknesses in form, however, make it unsafe to take as a model for farmers' organizations.

Thirteen years ago the Grand Junction Fruit Growers Association of Colorado organized with a capital of $25,000. The fruits handled are apples, peaches, pears, prunes, apricots, and a few other products. The capital stock is now (1910) $200,000 and the membership about 800. This is one of the best of the Western societies. The statement of the manager for 1909 relating to fruit sold is interesting:

SUMMARY OF SEASON'S SHIPMENTS.

Varieties.	Carloads.
Apples	933
Peaches	388
Pears	182
Cantaloupes	112
Honey	3
Potatoes	39
Total	1,657

The total amount paid to the growers was $1,070,485.18. The members are all actual fruit growers and the stock is held by them only. Shares are distributed by the Board of Directors in proportion to the acreage operated by each member: if a member wished to hold only one share for the sake of getting the benefits of the association, he would be asked to take a number commensurate with the size of his plantation. Profits are divided on the basis of stock held and each share of stock has one vote.

This again is a joint stock company, but the system of dividing the shares aids materially in insuring justice in the division of profits, while at the same time forcing each member to assume his proper share of the burden of providing capital. Five per cent. is charged for handling the fruit, which barely pays expenses. Each member packs his own fruit, but the society employs inspectors to mark the grade on each package. A big supply business to members is done on which a liberal commission is charged. A jobbing business in oranges, lemons, salt, etc., is carried on, the society acting simply in the capacity of an ordinary consignment merchant. The manager considers this to be a great aid, as it affords annual employment to a number of hands and adds materially to the profits. They depend for profits almost entirely on the jobbing and supply business. As the business grew they found it necessary to increase the stock in order to secure credit to run the business.

The Colton Fruit Exchange of California has a useful system for securing credit by means of uncalled shares. To each member is assigned shares according to the acreage of fruit operated. Each share is valued at $2.00 but only fifty cents is paid in. Thus the society has a credit nearly equal to the total value of the shares apportioned, as according to law each person holding shares is liable to creditors for unpaid shares. On the strength of this credit security, money is borrowed with which to erect buildings and do general business.

These examples give a very fair idea of the kind of organization being attempted by truck and fruit growers in the United States. The modified stock company is the only form thought of. These are working fairly satisfactorily, but all of them contain elements of weakness which may at any time prove fatal.

The constitution of the Long Island Potato Exchange does not limit the sale of shares to growers only. In the cases of the Grand Junction Fruit Growers' Association and the Colton Fruit Exchange there is nothing to hinder a group of large growers from securing control of the affairs of the Association; the large grower is forced to take a large block of stock and votes are according to shares held. The system of dividing profits on the basis of shares held, is also likely to produce dissatisfaction. So long as the acreage of fruit held by each member is fairly uniform the above plans will give satisfaction, but this is liable to change at any time. As an organization becomes older, selfish interests tend to find the weak places and take advantage of these to further selfish ends. Care should be taken to guard against such a contingency.

Federations.—The large size of many of the fruit and truck societies is remarkable. The Long Island Potato Exchange ships from eighteen stations and has a local board at each station. The Grand Junction Fruit Growers' Association ships from four stations and has a warehouse at each. But these societies have not divided into small units each sending delegates to the central body, as is the case with the California Fruit Exchange. The former societies still have their annual meetings, where the whole society may be present and at which each member can exert a direct influence on the policy of the society. The latter society is said to handle 60 per cent. of the citrus fruits of California through one central office. They have worked out a system of distribution for their product that is indeed admirable. The form of federation, however, is open to criticism. On the central board only the managers and directors of the county organizations are represented. These are salaried men who naturally are inclined to adopt a policy which shall make their Exchange master over competing handlers. The practice of slaughtering markets in order to kill competitors is apt to be adopted, which brings heavy loss to growers but does not affect the salaries of the managers. The fruit has got so far away from the grower, when it passes into the hands of the central Exchange, that it is impossible for the grower to say whether it is being handled to the best advantage or not. Thus it will be seen that the simpler form of the Grand Junction Fruit Growers' Association has some strong features to recommend it. Each member may, at the annual meeting, register his votes and approve or disapprove of the policy of the management, thus exerting a direct influence on the future policy of the society.

It may be well at this point to compare the Danish method of federation with the Californian. Covering a somewhat similar area of country and value of product, the Danes have nine federations for marketing, whereas California co-operators have only one. "For actual business the Danes have not one selling organization but nine, though they are obviously 'co-operative' enough to work through one if they so desire." They have a "Butter Quotation Committee," whose business it is to supply each federation with a report of the latest prices and supplies on the world's markets at different points and thus avoid glutting by the federations. The California federation tends to separate the producer from his selling society; the Danish federations carefully preserve to the producer his power to directly influence the policy of the selling society.

Co-operation in Canada.

The general experience of co-operators in Canada is similar to that of those of the United States. A lack of understanding on the part of those attempting organization has been prevalent, and only lately has the true co-operative idea begun to make way. Spasmodic attempts have been made by farmers to market jointly, but in the matter of Supply, failure came through lack of business organization and in Sale, through the prevalence of the joint stock idea. In Production failure has been chiefly caused by misconception on the part of organizers of the part that production should play in co-operative organization.

The experience of Ontario farmers is typical for the Dominion. We will, therefore, confine ourselves to a study of conditions in this Province. Wholesale and Retail Supplies, Dairying, Bacon-curing, and Fruit Marketing have been the chief fields of organization amongst farmers. We will examine the causes of success or failure under the several heads.

Supply.—This, as an independent branch of co-operation, has been little attempted in a properly organized manner. The Fruit Associations are making this a strong feature and are very successful. The Patrons of Industry and the Grange, both quasi-political societies, attempted to do wholesale and retail buying, but both failed, chiefly through lack of proper business organization. The secretary of the society was expected to be the business manager of the buying section and usually worked gratis. This was unreasonable and resulted in careless business methods. The secretary was often entirely unfitted to run such a business and could not keep a proper set of books. The failure to pay on the part of people ordering goods was also another cause. These combined causes have resulted in general failure.

Dairying.—This is by all odds the industry that has suffered most through well-intentioned but ill-informed men attempting co-operative organization. In this industry the joint stock company, in the guise of a co-operative society, has done more to throw general discredit on the whole movement than has any other one factor. The main troubles have been: (1) An utter lack of knowledge of the distinguishing features between a joint stock company and a co-operative association. (2) A misconception of the place that production holds in the co-operative organization of an industry. (3) Factories doing only a small business.

The form of the society has in nearly all cases been joint stock. The prime movers in these societies have either been to Denmark or by reports have become much impressed by the Danish co-operative producing dairies. Very naturally, they considered what they saw and heard to be the whole of the co-operative system, whereas experience has proved that it was but a part of the whole. Production rather than marketing was emphasized. The underlying and fundamental idea of the Danish system—marketing—was, unfortunately, overlooked.

The smallest co-operative dairy factory in Denmark has 655 cows, and without this number or more the Danes do not consider it pays to organize; in this country one-quarter that number is thought to be sufficient. If the sections where dairying is the main industry will organize on the truly co-operative plan; if these associations will unite in a uniform system of marketing, form federations of societies, hold "surprise" butter contests, study markets and carry out the whole Danish programme, there is good reason to believe that abundant success will follow. In those sections where dairying is only a small part of the farming industry it is doubtful if success can ever be attained, unless the factory is worked along with some other lines of co-operation. This point will be discussed later.

Bacon Curing.—Several attempts have been made to organize farmers' bacon factories. All have been joint stock companies and nearly all have failed. There is one at St. Thomas that is a success, but it is noteworthy that this factory approximates to a co-operative society in its workings, although it has in it many of the weaknesses that may, in the hands of selfish men, ruin the company. There are over two hundred stockholders who market their hogs through this factory and who hold fairly equal shares of stock. Dividends are declared on the basis of shares held, but as long as the shares are fairly equally divided this will not be felt to be a serious disadvantage. Members are paid ten cents per hundred more than market price for their live hogs, which amounts in a partial way to applying the co-operative principle of dividing profits according to business done with the society. The proper way, of course, would be to have one vote per member, allow the shares to be held by an individual up to a fairly large percentage of the total; pay a fixed dividend on the stock, buy hogs from members at market prices, and then divide all profits according to the number of dollars' worth of hogs brought to the factory by each member.

This is a business which should adapt itself to a fairly sparsely populated country, as Ontario is. Unlike the dairy industry it is not necessary that a large number of patrons be within a short distance of the factory. The bacon factory has a large amount of capital invested, and gathers its material for manufacture from a considerable area. The hogs must be shipped by the car-load and a few miles more or less to travel does not make a serious difference. Properly organized, truly co-operative bacon societies should be successful in reaching a larger percentage of farmers in Ontario than is possible with the dairy industry under present conditions.

Fruit Marketing Societies.—The forward movement in farm business organization centres around the fruit industry. It offers peculiar conditions specially favorable to organization. Much of the product must be shipped to a considerable distance—either to Western Canada or Europe. The nature of the product is such that individual growers cannot hold it for an indefinite time. These conditions, previous to the organization of the societies, placed the marketing of fruit entirely in the hands of middlemen, with the natural result that great abuses crept into the marketing end of the industry.

Again, fruit farming calls for specialization in order to succeed. The ordinary mixed farmer is seldom a good fruit grower. The business also demands a high order of intelligence. Battling with insect and fungus pests has caused fruit growers to recognize the value of science in production, with the natural deduction that science in marketing must be of equal value. This point needs to be emphasized, because it has a great bearing on the success of the co-operative movement in fruit growing.

There are at the present time some thirty-six so-called Co-operative Fruit Associations in Ontario. These may be roughly divided into three classes: (1) Apple Associations, shipping mainly to distant markets. (2) General Fruit, *i.e.*, apples, pears, plums, peaches, cherries, berries, etc., shipping to home and distant markets. (3) Small Fruit, chiefly berries, shipping mainly to home markets.

These may be again divided into stock companies proper and co-operative societies, or stock companies operating after and seeking to realize the co-operative plan. Nearly all the Small Fruit and some of the General Fruit societies are rather loosely organized but truly co-operative. The others have all organized with co-operative intent, but, through lack of knowledge, have in several cases fallen short of what they sought. An examination of typical societies of each class will perhaps be the best way to study them.

Apple Shipping Societies.—The Forest Fruit Growers' Association offers one of the best examples of a simple form of organization. It is truly co-operative. There is no share capital and it depends on deposits of buyers for working capital. It rents a shed and packs most of the apples in this shed. Sales are made F.O.B.; each buyer is required to pay into the bank a certain percentage of the price before the fruit is shipped and the remainder within so many days. The society then pays to each member a certain price per barrel, reserving a little more than sufficient to pay expenses. At the annual meeting all remaining moneys are paid back to the growers, according to the business done with the society. The only person who is paid—besides necessary employees—is the secretary-manager, who receives a commission of five cents per barrel on the total pack. The average annual pack is about 7,000 barrels. There are about 45 members and the society is steadily growing.

The Oshawa Fruit Growers' Association is described by the manager as being a "double-barrelled" affair. A joint stock company composed of the members of the society own a central packing house and charge so much per barrel for handling through the packing house. All fruit is packed at this house. Revenue from charges for the use of the packing house is used to provide a fund out of which expenses are paid and also a fixed dividend of 6 per cent. on the stock. The society proper is co-operative and does not differ essentially in its workings from the Forest Association, except that sales are made largely by consignment. The value of the plant is about $5,000; the capacity of the frost-proof storage is about 8,000 barrels; the membership is 75, and the average pack about 8,000 barrels of apples.

The Norfolk Fruit Growers' Association, with the head office at Simcoe, Ont., resembles in form the Oshawa Society, but in this case the stock company owning the warehouse consists of only a few members of the association. How long this arrangement will remain satisfactory is a question. At present this is one of the most successful of the associations; it has a membership of 188 and an annual output of about 18,000 barrels of apples.

There are a number of smaller societies, as well as large ones, organized either on the Forest Fruit Growers' Association plan or as stock companies, having an annual output of from 1,000 barrels upwards. These societies in many cases have been the victims of lack of knowledge on the part of men who did not understand the principles of co-operation and business.

General Fruit Associations.—The Burlington Fruit Growers' Association is the oldest society in Ontario. It is remarkable for its simplicity of form. It has neither constitution nor by-laws, no warehouse or capital in any form, but only a verbal agreement between the members. Each grower packs his own fruit and it is shipped under his own name and on its individual merits. There is a manager who orders cars for shipment, directs growers when to deliver fruit, pays over to each grower the price that each shipment of fruit has brought, and attends to other details. For this he is paid a small commission. The officers of the society are a President and Board of Directors. The continued activity of the society is good evidence of its usefulness.

The St. Catharines Cold Storage Company is a joint stock company working towards the co-operative ideal. It is a good example of a company which, though organized in a wrong form, yet by working steadily in the direction of true co-operation, has evolved towards the co-operative form. This society was organized in 1896. It has a mechanical cold storage plant valued at $13,000 and a working capital of $2,000. A part of the capital was secured by selling shares which were held very unequally. The remaining capital was secured by mortgage on the property. The debt has been entirely paid off by the addition of new members, who took stock, and by applying the dividends on the stock to this purpose. Working capital has also been provided. The society is now endeavoring to effect an equal division of shares of the value of $50 per member. To do this it is transferring stock of the old members holding more than this amount to new members and to old members not holding so much. Thus the society will get down to the one-man-one-vote basis.

The fruits are shipped to all parts of Ontario and Quebec and to many places in Western Canada. These fruits consist of apples, pears, peaches, plums, cherries and grapes, with an increasing quantity of other fruits and vegetables. The sales of fruit amount to about $75,000 annually.

The society handles considerable quantities of supplies for its members and others. It handles fruit for, and sells supplies to, non-members and gives back to them one-half as much profits per dollar as it returns to members. The supply branch is a very important part of the business of the society. It handles all kinds of fruit packages, spray-pumps and other machinery, ladders, etc., seeds, fertilizers and spraying chemicals. It has now become the temporary wholesale for the federation of fruit associations. In 1008 the supplies amounted to about $27,000 and in 1909 to $40,000. The society charges a little less than regular market prices and then rebates to members and to non-members buying through the association and selling their fruit in the same way, a percentage based on business done with the society.

It will be seen from the above that this society, while being a stock company, is rapidly approaching form N.o 1 of the standard for co-operative associations.

The Grimsby Co-operative Association is a society of seven members, who own nearly 500 acres of land, largely planted with fruit. The stock is all held by the members and in equal portions. The management of such a society is very simple as compared with that of the St. Catharines Association.

The question of distribution is the great one in all these societies. Without any means of knowing where other societies and buyers are shipping on a certain day, glutting of markets is inevitable. Some kind of federation seems to be absolutely necessary.

Small Fruit Associations.—The Dunnville Fruit Growers' Association is perhaps one of the best examples of this class of association. There are about 35 members. Fruit is shipped to local markets. Each member grades his own and ships it under his own name. The society is incorporated without share capital. Its chief activity is in buying fruit packages, aiding in securing good markets for fruit and disseminating useful knowledge by arranging for meetings, etc. These societies are nearly all local branches of the Ontario Fruit Growers' Association, whose object is the advancement of fruit growing interests generally, but which is not a trading society. A number of these local units are slowly growing into co-operative societies for buying and selling purposes.

Management and Expenses.—All the associations have practically the same arrangements for government of the societies. A President, Vice-President, Secretary who is usually manager, Treasurer and Board of Directors, varying in numbers according to the size of the society and territory covered. Expenses are met by a straight charge per package. Some of the apple associations, that pack in the orchard, charge the time spent at each place to the individual. Some charge an annual membership fee. Directors usually work gratis, but some societies allow $1.00 to $1.50 and mileage for each meeting held. The President usually works gratis, but is sometimes paid from $20 to $70 per year.

One association with an output of from 1,200 to 1,500 barrels per year pays its manager $2.00 per day for superintending the packing and the loading of the cars. Four associations with packs running from 2,000 up to 8,000 barrels per year pay 10c. per barrel to the manager. In the case of the larger association this was not enough to hold a good man and the rate this year has been raised to 15c. per barrel with the manager paying the book-keeping expenses out of his own earnings. Two other associations with packs of 3,000 and 7,000 barrels respectively, pay at the rate of 5c. per barrel. In the case of the larger of these two, this is only for the shipping and selling and does not include looking after the packing. One of the largest associations with an output from 20,000 to 40,000 barrels per annum pays 20c. per barrel to its manager, but he is required to pay from that all of the expenses of inspection, book-keeping, etc., which would amount to at least $2,500 or $3,000 a year. Two associations with large outputs pay a straight salary of $1,000 and $1,500 per annum, allowing also a small percentage on all supplies sold to the members. Two of the smaller associations with outputs up to 2,000 barrels report that they have no paid manager, the work evidently being undertaken by the executive committee. Of the newer associations the majority are paying 20c. per barrel, the manager to defray out of this amount all bookkeeping and other office expenses. One association just starting has agreed to pay its manager $1,500 without consideration as to the number of barrels packed.

Federations of Fruit Associations.

As the individual societies in Ontario began to get in touch with one another, the need of closer relations was felt by the co-operative leaders. The questions of forms of associations, methods of management, scale of fruit, means of improving quality of fruit and many other such problems offered common grounds wherein it was felt that united action would be in the best interests of all. The Fruit Branches of the Department of Agriculture at Toronto, and Ottawa, in their endeavors to encourage the fruit industry in the Province, soon found that these societies offered one of the best mediums through which they could reach the individual grower. One of their great difficulties in advocating better quality had always been, that improved quality in many cases did not bring commensurately improved returns to the grower, because most buyers paid only a flat price, regardless of quality. The co-operative societies, however, paid to each member the full number of dollars due to him, according to the quality of the fruit. For these reasons the Departments of Agriculture and the societies began to work together.

In 1906, active steps were taken to unite the scattered societies into a loose form of federation. This was accomplished, thirteen societies becoming affiliated under the name of the Co-operative Fruit Growers of Ontario, with head office at Toronto. An annual fee of $5 for each association was fixed. The Secretary is P. W. Hodgetts, Chief of the Fruit Branch of the Department of Agriculture.

In the beginning the objects of the federation were: to discuss forms of organization and means of securing a higher grade of fruit, to keep the associations in touch with the prices being offered by buyers and prices received in the home and export markets, and to secure a more uniform distribution of the crops. The Secretary gathers from various inspectors and correspondents a report of conditions in the various fruit producing sections of the Province and Canada, and during the selling season the condition of the markets, the quality of the fruit being shipped, prices offered and received, and other items of interest are sent to each society in a weekly report. Before the apple associations make sales in the fall, a meeting of the federation is held, at which a range of prices is suggested as a basis of sales. This is adhered to as nearly as market conditions will permit.

As improved methods of production became general among the members of the associations, large quantities of spray materials, machinery, etc., began to be used. These were always high in price because they were sold only in retail quantities by a few local dealers. The St. Catharines society has, as already noted, been making a strong point of buying supplies for a number of years. In 1908 the federation determined to arrange for the purchase of supplies for all the societies. The saving in this way is immense, as carload lots of chemicals can be bought at a time of year when prices are at their lowest and held until wanted for use. Each society is asked to send to the head office an estimate of the amount of supplies required, which serves as a guide in buying. Other supplies as packages, spray machinery, etc., are bought in the same way and very great saving has been effected. Buying co-operatively has made it almost impossible for a combine of manufacturers to "corner" prices as was attempted in fruit packages a few years ago. The makers of baskets from whom the St. Catharines society has been buying, put the prices of baskets so high that the society determined to place their order in the United States. Their order was very large and the prices so favorable in the United States that they have ever since been able to make very favorable terms with Canadian concerns.

The chief difficulty the federation has to deal with in the supply business is lack of capital and of a central warehouse. To overcome this the St. Catharines society is acting as distributing agent for the federation. This association orders the supplies, holds them till wanted by the other societies, and then forwards to them, charging a small commission for the service. The federation is looking forward to becoming an incorporated body at an early date. A warehouse will be built and a regular manager employed when finances permit.

Thus it will be seen that the federation has two distinct lines of activity: 1. Advice and aid in production and marketing. 2. Buying supplies. Both of these are in perfect accord with the best European ideas of co-operation and both are capable of great development.

The further development of federation divides itself into three distinct problems according to the kind of society. Federation for marketing purposes, pure and simple is now the problem, and this problem differs with each kind of society.

The Apple Shipping Societies have their special problems. Proper storage and distribution are among the main questions for them to solve. The sections handling summer apples need cold storages and it is also likely that these would benefit those societies handling winter apples. A number of co-operative managers are advocating the sale of all fruit at the time of harvest. The reason generally given is that fruit growers want the money for their fruit at once. This appears to be a short-sighted policy. It places the best winter apples on the market at the season when inferior fruit is abundant and must be marketed.

It tends to lower the price of inferior fruit and weakens the market for the high-class product. Second grade apples will be an important factor in the fruit trade for years to come and it is important that fruit growers solve the problem of marketing these to the best advantage. If the better classes of apples were not placed on the market until the poorer stuff was largely consumed, weakening of the markets in the fall of the year would be largely avoided. Such varieties as Ben Davis and Stark if held in storage till spring would bring fair prices and would not tend to hurt the whole apple market as they do at present. Storage is plainly one of the great problems in co-operative marketing. These societies, however, are so scattered throughout the Province that at the present time a union of the whole is not possible or wise. Probably the better plan would be to unite the societies of a certain section, work out the questions occurring in those unions and from these form whatever larger federations may be advisable. By this means each step would be the natural sequence of a former one and thus a firm foundation could be laid.

The General Fruit Associations have a different problem to solve. The great bulk of their fruit must be marketed when it is ripe. Cold storage resolves itself mainly into a question of pre-cooling for shipping during the hot season; some work may also be done in holding grapes and some other fruits in storage. The great problem, however, lies in getting the fruit to its destination in the very shortest possible time, and properly distributed in order to avoid gluts.

The majority of societies of this class are in the Niagara District, and the amount of fruit shipped from each station is so great, that the establishment of pre-cooling stations ought not to offer very great difficulties once the need is demonstrated. Federation practically resolves itself into a union to regulate distribution. A federation such as the California Fruit Exchange is not feasible at present and it is questionable if it ever would be advisable. The better plan would be to first form a loose union by means of which the societies will be enabled to get together, study their problems, and find those points on which their interests are sufficiently in common to allow of joint action. From this it may be possible to work out an elastic form of advisory board, which will leave the sale of the fruit in the hands of individual associations, and yet be able to regulate distribution so that gluts will not occur.

Small Fruit Associations are doing so little in the way of joint marketing that federation for selling purposes is still a long way off. Undoubtedly much could be done to regulate the supplies coming to our cities and to insure that all the small towns are properly supplied. Federations of these societies, as with the others, should begin by uniting a few local societies situated near together and supplying the same markets. These small unions may form the nuclei of large ones.

Marketing.

Grading and Packing.—Three systems are followed: 1. Packing and grading by the grower; 2. Packing and grading by the grower with a system of inspection by the society; 3. Packing and grading by the society. The first system is very loose and the only satisfactory method of sale in this case is to sell each grower's fruit on its individual merits. This means a great deal of bookkeeping. The second method is the one adopted by many of the General and Small Fruit Associations. The Grand Junction Fruit Growers' Association and others that have tried it, claim that packing by the society is out of the question. Inspectors are employed, who examine each grower's fruit when it arrives, and mark the grades according to quality. The objection to this method is a lack of uniformity in the pack. The third system is the one usually followed by the apple and citrus fruits societies. Two methods are followed: 1. The fruit is brought to a packing house to be packed and graded by packers employed by the society. The Hood River Association of Oregon, packs in houses built in the orchards. The society employs experts to pack, and its rules are very strict. Hood River apples are famous for high quality in packing, and it is claimed that much of this is due to the system followed. The Oshawa Fruit Growers and several other societies in Ontario, pack at a central storage-house to which all the fruit is brought by the growers. This method allows of a very uniform pack, as the manager can keep a direct watch on the operations throughout. It also allows of the fruit being kept under good conditions until time of shipment. The same method is followed by the California Fruit Exchange. Each section has its packing house at which all fruit is graded and packed. The quality of the fruit sold by this society speaks well for the system. 2. The fruit is packed and graded in the orchard by packers employed by the society. The Norfolk association and a number of others in Ontario pack in the orchard. In some instances the society picks, grades and packs, while in other cases only the two latter operations are performed by the society. This method has the advantage of having the fruit graded right under the eye of the grower, who sees that the fruit which he thought would pack, largely No. 1 is really nearly all No. 2. Thus the grower is taught to recognize good fruit and to grow only a high grade article. The Norfolk society employs a number of packing gangs, and has inspectors who travel from gang to gang keeping strict watch, in order to insure high quality and uniformity in the pack. This means considerable expense, but the high prices received for fruit by the society justify the expense. This system of packing relieves the grower of the work of handling the fruit at a season of the year when he is very busy. It is significant that some of the societies employing the packing house system are beginning to pack a part of the fruit in the orchard.

Division of Returns.—Three methods are followed in Ontario: 1. Pooling all returns. 2. Pooling returns for certain varieties and fruits. 3. Pro-rating prices for each variety and grade. The first method was in the past the common one employed by societies in Ontario. Certain grades are established and a flat price is paid for all the fruit of this kind and grade. This price will be the average received by the society during a certain set period, In the apple societies it is usually for the year. This method has the disadvantage of not discriminating between poor and good varieties and is thus inclined to encourage the production of poor varieties. It is not fair to the grower of good varieties, because a part of the value of his fruit is taken from him and given to the man with the poor varieties. The second method is becoming popular. The varieties of fruit of a certain kind are divided into classes, those varieties of nearly equal quality being placed in the same class. The price is then pooled on each grade of each class. This does not favor the production of poor varieties, but rather educates the grower of poor varieties to grow a more valuable article. The third method is the one that gives absolute justice to the grower, but it entails such an elaborate system of bookkeeping that it is inclined to be cumbersome. In this method each grade and each variety is kept separate account of and the price is pooled on each variety and grade. Pooling is necessary, as one shipment may not sell so well as another, the fault being neither that of the grower nor the society. By following this method, each member gets the exact returns that each variety has sold for on the markets, and thus learns the market value of each. Some of the General and Small Fruit Societies pool each day's shipments, while others pool weekly shipments.

Laws and Rules.—For laws regulating grading and marketing, and for directions for grading and packing refer to Bulletins No. 11, 18 and 19, Dairy and Cold Storage Department, Ottawa. For rules as fixed by the societies refer to their by-laws:

Prices.—The average price paid for apples on the tree by buyers is not more than one dollar. The following table shows the prices received by a number of associations for the past three years. These prices are f.o.b. per barrel at the shipping station.

Name of Society.	Sales in 1907.	1908.	1909.	Prices in 1907.	1908.	1909.
Georgian Bay.....	13,000	4,200	9,500		Average, $2.30	
Simcoe	10,000	15,000	19,000	$2.60	$2.25	$3.00
*Watford	1,000	700	2,930	2.00	1.85	1.80
Burgessville	3,800	2,837	2,696		Average, $2.35	
Georgetown	2,500	1,050	2,050	$2.60	$2.00	$2.75
Owen Sound......	8,000	13,000	13,000		Average, $2.25	
Forest	8,000	5,000	7,000	$3.00	$2.50	$2.50

If about seventy cents per barrel is deducted from the above prices the value of the apples on the tree can be secured approximately.

Failures.

The writer has personally investigated the causes of failure in several of the fruit associations. Four causes seem to stand out: 1. Lack of knowledge of the co-operative idea. 2. The society was a joint stock company. 3. The acreage of fruit was so small that a successful business could not be built up. 4. Bad management.

The first is the fundamental cause. People generally do not realize the value of co-operation or know the principles involved. The general impression prevails that co-operation is intended to do away with the middleman. This is not at all the case. Co-operation aims to regulate the returns of the middleman and to *hire* him to do the farmers business. The middleman becomes the manager of the society. In order that a manager shall do his best he must be able to give a great deal of his time to the affairs of the society; this means that he must be paid a fair return, he must receive a fair share of the profits derived from co-operation. But many societies in carrying out the idea of the abolition of the middleman, have reduced the remuneration of the secretary-manager to a point where it is impossible to secure a good man. A good man will not work for less than a fair wage. Then again, the idea of working together is not understood, nor the moral qualities of unselfishness and mutual helpfulness appreciated in business. Private business is intensely selfish and has had its effect on human character. This is a common cause of the failure of societies. Some individuals want more than, and others are not prepared to assume, their full share of responsibility in the society.

*Prices are net to the grower.

The second cause has been discussed previously. It is sufficient to remark that the inequality of votes, due to the bulk of stock being owned by a few persons, was found to be a principal fault. When the control was in the hands of a few, interest soon flagged, the majority of the members feeling that they had little influence in the society.

The third cause is not operative in all cases of failure. In some cases the first two were the main contributors. But in other cases this has been a main cause. In one locality where a society had failed, the orchards would not average more than one acre to the one-hundred acre farm and there were practically no large orchards. In such a section it is impossible to work out a successful society dealing only in apples. for two reasons: 1. It is a poor business proposition. 2. It occupies so unimportant a part of the life of the member, the greater part of his time being taken up in other pursuits. As a business proposition it is poor because the total product is small, and in order to pay the manager a living wage, the charge per dollar's worth of business done is very heavy. This does not mean that a society may not be started in a small way, but rather that there must be the probability of establishing a good business eventually. The second reason is important. Unless the business the society is engaged in occupies a fair share of the thoughts of its members the society cannot prosper. Sustained enthusiasm must be maintained and this can only be kept up by making the business of such importance as to demand attention.

The fourth cause is the natural sequence of the first three. When the attitude of the members toward the manager is to pay him as little as possible, a good man cannot be secured. When the manager sees little chance of building up a good business his interest quickly flags, as his energies are turned in other directions in order to secure a living. Thus carelessness, inattention and in some cases fraud have resulted. In nearly every case the people simply get what they pay for; this fact cannot be too strongly emphasized.

Mixed Societies.

In some instances in the United States, in New Zealand and in Europe. societies or aggregates of societies doing business in several lines, are working successfully. In New Zealand an individual society may handle wool, mutton, beef, fruit, etc., even to doing a banking business for the farmer. A federation of six of these societies has established an agency in England. In the United States a few societies are doing a similar business. The best European practice is to duplicate the society for each branch handled. A separate society is created for each line, but all the societies may employ the same manager and occupy the same premises. Take for instance, a section producing beef, dairy products, fruit and eggs. A group of men may form a dairy society. They employ a sales manager, but as the business is small they can afford to pay only a small salary. This makes it difficult to secure a good man. The beef producers are buying large quantities of feeds. They form a buying society and employ the same manager. This greatly reduces the difficulty for both societies and adds to the chance of securing a competent man. The fruit growers organize in a similar manner, and employ the same manager. The egg producers may do likewise. The manager who can now spend all his time at the work, studies co-operative methods and principles, and becomes a great educator of the people, as well as their business expert. A farmer may be a member of all the societies, or of only one, according to the variety of his interests. Each society usually elects a different set of officers and directors. It is a good plan not to allow members of one board to serve on another.

The duplication of societies has several advantages. A man interested in only one branch of farming is a member of only one society, and shares only in the liabilities and the profits of one society. The man interested in all, shares in all. A great number of people become interested in the movement and each society benefits by the enthusiasm aroused by the other. Joint meetings may be arranged at which general questions of interest are discussed. The leading men in each branch of farming are drawn out, because there are so many offices to fill. It is said that the number of societies working harmoniously together in one neighborhood in Denmark, France and Germany, is bewildering to the uninitiated visitor.

This plan should be perfectly feasible in Ontario and offers a reasonable answer to the question of what to do with the one acre apple orchards, the small dairy herds, the scattered egg production and the buying of supplies. This plan should be the solution as to how to organize co-operation in the purely mixed farming districts.

How to Organize.

First of all study carefully the co-operative movement and get the idea. Learn the ethics and science of the movement. Having learned that co-operation calls for the highest moral qualities and best business acumen of its members, teach these principles in season. Get the advice of the best co-operative leaders. Remember, however, that conditions which make for success in one section may not exist in another. Do not blindly accept the advice of the manager or officers of any co-operative concern. Many of the societies are very faulty in construction, but this is not recognized by the manager or officers. In many cases the personality of some individual in the society is making it a success. When he drops out, trouble will come, because of faulty organization. Recognize, however, that the personality of certain men is a great aid to success; get the leaders in your section interested and half of the battle is won. Write to the Provincial Secretary for all information and directions relative to the formation of societies.

Study the business possibilities of your section and each branch of farming followed. Begin by organizing the branch that seems to offer the greatest likelihood of success. This may be a supply society for buying feeds, fencing material, drain tile, etc., or it may be an apple society. If a single branch offers the probability of growing into a good business, go ahead and develop this branch to its utmost. Remember, however, that the more people you can interest in the movement, the greater are the chances of success in any one branch. If one branch does not offer as good possibilities as it should, try to organize two or three.

Begin by advocating the idea privately and publicly whenever opportunity offers. Do not fear to wait for results, people must learn slowly whether by education or experience. Try to take advantage of some condition of trade. A great reason why the apple societies are successful is the wretched condition to which buyers had reduced the industry.

When the opportune time has arrived arrange a meeting of interested men and talk the matter over with them. Having secured their support, begin a house-to-house canvass. This takes time, and is best done in winter. Then call a public meeting. Have a chairman arranged for and discuss the question thoroughly. If necessary, continue the canvass and the meetings. Always be prepared with a definite plan of action, so that people will have something tangible to think about. The start need not be large, a few good members are worth more than many poor ones. Count your chances of success by dollars' worth of business, as well as by number of members.

Organizing.—When the time arrives to organize call another meeting and lay clearly before prospective members the difference between a joint stock company and a co-operative society. Explain the two forms of societies as previously outlined. Show them that the form of the society is very important. Where capital is needed, outline the two means of securing it; explain the Danish system, including the agreement signed by members of the society, limiting the liability of the individual. Plan No. 2 is undoubtedly the cheaper method of securing capital, but it may not be acceptable to the people. Point out the plan used by the Colton Fruit Exchange, California. Discuss plan No. 1. Then let the people choose which form they want. Provided that votes are restricted to one per member, the only serious difference the various forms of securing capital makes, is that of economy. If share capital is decided upon, be sure to fix the dividend to be paid on the stock. Provided there is only one vote for each member and a fixed dividend, it does not matter how much stock a member may hold, as the capital invested is sure of a fair return and the number of shares can exert no undue influence.

When these questions are determined, have a constitution and bylaws drawn up by a competent person. Refer to the by-laws attached to this essay. Cover all the points carefully. Appoint provisional officers and directors.

Incorporation.—Co-operative law in Ontario and the Dominion generally is in its infancy. The Ontario Companies Act has made special provision for the incorporation of agricultural co-operative societies, with and without share capital, but several important points have not been dealt with. There is a recognized legal difference between a co-operative society and a joint stock company; in the former no man can hold more than one thousand dollars' worth of stock. The question is in doubt whether or not a joint stock company's members may be restricted to only one vote, whereas, in a purely co-operative association it is one-man-one-vote. Seeing that the question is in doubt, it is probably best to limit the number of shares a member may hold, but by so doing the free sale of stock and provision of capital thereby is hampered.

Societies with share capital will find the same advantages accruing from incorporation as do joint stock companies. Even societies without share capital find it much to their advantage to become incorporated. It gives a legal standing and provides a trade name, which cannot be infringed upon by other business bodies. Under a special agreement with the Provincial Secretary, agricultural co-operative societies with a share capital up to $10,000, may now be incorporated for a ten dollar fee. Societies without share capital pay a fee of five dollars. If it is intended to establish branches in other Provinces a Dominion charter will be required.

Officers and Directors.—The President should always be a man directly engaged in the business in which the society is interested. If he is an enthusiast in the business so much the better. It is absolutely necessary that he be a liberal-minded man, with sufficient unselfishness to work for the good of the society and his fellow members. The same may be said of all the other officers and directors. Executive ability should not be overlooked and as this is often a somewhat scarce quality, care should be exercised in making a choice of officers. The number of directors should vary with the number of members and the area embraced by the society. If the society is scattered, be careful to have the directors represent the different sections. Details of this kind are important.

The manager, who usually is also secretary-treasurer as well, need not be directly interested in the business, outside of his interest as manager. He should possess good business ability and have a wide knowledge of markets and marketing. In fact, he should have all the qualities that any commercial firm looks for in a manager.

The plan of paying the manager a fixed sum per package in such as Apple Shipping Societies or a commission on the business, as in others makes him dependent for his wage on the crop. This has the disadvantage in an off year of lessening the manager's interest, just when he should be bending every energy to make the best of the situation. The better way is to pay a salary and a small percentage on the business done by the society over a certain amount. Thus in prosperous years the manager shares in the prosperity of the society, while again in a lean year he shares in the general calamity. The fixed salary guarantees to the manager a living wage, so that he can at all times place all his energies at the service of the society. Unless the directors have a big business to handle and a considerable distance to travel, it is best to have them work gratis. This tends to secure a change of directors every few years which is generally desirable.

Cost of Management.—In a society handling the produce of its members, expenses are best met by a direct charge per pound or package, regardless of grade or variety; it costs as much to handle one pound or package as another. In buying supplies a percentage charge on the dollar is usually satisfactory. A society doing both kinds of business may employ both methods.

The Moral Aspect of Co-operation.

Little has been said of the effect of co-operation on the morals of a community. In Europe this aspect is considered to be of a very great importance. Agricultural co-operative societies in the Old World select their members on the basis, not of wealth, but of morality and citizenship. The effect of this system of selection is said to be very marked indeed, and does more to raise moral standards and teach citizenship, than any other force which has ever been introduced into rural society. Members are educated in democratic government and taught to accept their proper share of responsibility, by the exercise of the duties which each member owes to his society. No better tribute can be paid to the value of Co-operation in a community than the following quotation from Wolff's "People's Banks."

" 'The moral results,' writes M. Rostand, after his second visit, 'are to my mind superior still to the material.' To apply Signor Wollemborg's apt illustration, the golden sunshine of thrift and co-operation, wherever it has cast its rays, has 'unveiled,' and brought to view in plenty, unlooked-for virtues which had long lain hidden like flowers shrouded by the night. The idle man becomes industrious, the spendthrift thrifty, the drunkard reforms his ways and becomes sober, the tavern-hunter forsakes the inn, the illiterate, though a grandfather, learns to read and write. It sounds like a tale from fairy land. Yet it is all sober fact. We find a Prussian judge officially reporting that litigation, especially in respect of claims for debts, has very sensibly diminished in his district—thanks to the establishment of a co-operative bank. We hear a German priest confessing that the new Loan Bank in his parish has done far more to raise the moral tone of his parishioners than all his ministrations. Learned Professors and Ministers of State, dry economists, parsons, men of business from all countries—all, in fact, who have had an opportunity of judging by the test of their own eyes, join in the chorus of laudation. One is not surprised to find foreign Governments steadily encouraging institutions, whose aim, in the words of one of their founders, Schulze-Delitzsch, is 'Peace'; in the words of another, M. d'Andrimont, 'Order and Economy'; while in practice they prove, according to the testimony of M. Léon Say, 'the most effective weapon against the development of Socialism.' "

APPENDIX

CONSTITUTION AND BY-LAWS.

The District Representatives of the Ontario Department of Agriculture with the consent of the Minister of Agriculture, have adopted the by-laws appended as the basis on which to form Co-operative Associations for the Province of Ontario.

The Provincial Secretary's Department advises that associations adopting these by-laws should be incorporated under the *general clause* of the Companies Act for Non-share Capital Associations. Thus, the by-laws would not be part of the letters patent and could be amended at any time to suit the needs of the Association, yet would be perfectly legal and binding to the members of the Association.

The by-laws are submitted in blank and are intended to be suited equally to a Co-operative egg circle, Fruit Marketing Society, a Society for buying purposes only, or in fact for nearly any form of Co-operative Association where capital is needed to carry on the business. They are not intended to be complete, and it is expected that additional by-laws to suit the individual case and circumstance will be added as necessary. The main bulk of the by-laws have been adopted from Mr. P. W. Hodgetts recommendations for Non-share Capital Associations.

The noticeable part of these by-laws lies in sections twenty to twenty-five inclusive. These sections provide for credit capital so that the Association shall at all times have funds available for any enterprize on which it wishes to enter. When an Association is formed, each member will give a note payable on demand to the Association, which becomes the property of the Association and is used by the Directors as collateral security. The Directors when they desire to buy supplies or to enter into any other business contract requiring cash, can deposit at a bank a sufficient number of notes to cover the necessary amount. Reliable bankers state that they are ready to advance from 85 to 95 per cent of the face value of the notes of the members at any time. When the supplies are paid for, or the debt discharged, the money will be paid to the bank. The notes will be released and will be again available for a future transaction. Thus the Society's capital will never be permanently impaired. If the Association desires to build a warehouse, a mortgage may be placed on the warehouse and the remainder of the capital can be secured through a Loan Company, by depositing the necessary collateral with the Loan Company. When the building is paid for, the collateral will, of course, be released and the credit capital of the Association is still the original amount.

The provision in section twenty-two for the renewal of the notes is intended to allow for changes in the value or amount of the property owned by individual members. It also assures that the credit capital of the Association shall be unimpaired. If the notes were not collected or renewed they would be outlawed at the end of six years. Section twenty-four provides that whenever any of the notes of the members are deposited as security for a debt, all the members shall individually share the liability in proportion to the value of the notes given the Association by each member. Thus, the burden will be equally divided, whether the debt is for a sum of Ten Dollars or a Thousand.

Sections twenty to twenty-five afford a simple and easy method by which societies organized as Non-share Capital Companies, can provide capital for all purposes by simply adding these sections to their by-laws. This should be the answer to the problem of providing capital for the small Associations, now without capital. Associations not needing capital at the beginning may adopt these by-laws omitting sections twenty to twenty-five. These may be added later to suit the needs of the Society.

Any one having experience in organizing Co-operative Associations will know that it is difficult to get farmers to subscribe Share Capital. There are many other disadvantages to Share Capital Associations, as before pointed out. This means of raising capital requires no actual cash, does not tie up any of the farmers money, and yet provides ample capital as the amount of the notes can be varied to suit conditions.

By-laws of the........................Marketing Association, incorporated under the Ontario Companies Act.

1. This association shall be known as the........................Marketing Association.

2. The objects of the association are for the production, grading and selling of........................products by its members, to purchase supplies, packages, machinery, etc., to buy and sell such other...........products during the season as opportunity presents itself, and to erect, buy, sell, own and control buildings and other materials as needed in its business.

3. The annual meeting of the association shall be held on.................. in..........................in each year.

4. Notice of the annual meeting shall be given each member in writing by the secretary not less than one week previous to the date of the meeting.

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

6. At any meeting of the association ten members shall constitute a quorum for the transaction of business.

7. At the annual meeting a Board of..........Directors shall be elected, of whom...........shall constitute a quorum at any Board meeting.

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

9. The officers shall be chosen by the Directors from among themselves at the first Board meeting after the annual meeting.

10. At the annual meeting two auditors shall be elected.

11. All the elections shall be by ballot, plurality electing, conducted by two scrutineers appointed by the chairman.

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

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

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

15. The Manager shall have charge of the business in detail under the direction of the Board of Directors.

16. The Manager and Treasurer and Secretary shall give bonds in such sums as may be acceptable to the association.

17. The Directors may select three of their number to act as an Executive Committee (the President to serve as chairman), to have general charge of the affairs of the association.

18. When a vacancy shall occur through any cause in any of the offices established by the by-laws of the association it shall be filled at the next regular or special meeting.

19. The annual dues of this association shall be................, payable on or before the date of the annual meeting.

20. Each member at the time of uniting with the association shall give a promissory note, payable on demand, to the association for the sum of......... Dollars and an additional..................for each and every........... owned by the member at the time of joining the association, but in no case shall the promissory note be for less a sum than...............Dollars.

21. At the time of uniting with the association and at the end of each three years after the incorporation of the association and not less than 10 days previous to the date of the next annual meeting each member shall file with the Secretary a true statement of the number of.........owned by the member at that time.

22. Within two weeks after the annual meeting at the end of each third year the Directors shall require each member to sign a promissory note payable on demand to the association, of the sum of..........Dollars and an additional..............for each and every..........owned by the member at that time, but in no case shall the promissory note be for a less sum than ....Dollars. In consideration for the same the Secretary shall deliver over to the member the note given previously by the member, duly cancelled and stamped with the seal of the association.

23. The notes of the members shall be the property of the association and shall be used by the Directors as collateral security with which to secure needed capital for the transaction of the business of the association.

24. Whenever the notes of any of the members are deposited as security for a debt, all the members shall individually share the liability in proportion to the value of the note given to the association by each member.

25. All the surplus moneys in the possession of the association to be divided amongst the members shall be proportioned to each member on the basis of the value of the business done by the member with the association.

26. Any...............producer in.............County shall be eligible to become a member by two-thirds vote of the members at the time the application is made.

27. All..........produced for sale by the members and acceptable to the Manager shall be delivered to the association as directed by the Directors and in prime condition for grading, packing and shipping. Other.........products may be delivered for sale as determined by the Directors.

28. The books of the association shall be audited before the date of the annual meeting each year. At this meeting a printed statement of the receipts and expenditures as audited shall be presented to each member.

29. These by-laws may be amended at any regular or special meeting by a two-thirds vote of the members present in the affirmative. Notice of such amendments must be given each member by letter at least five days previous to the meeting.

30. Any member having a grievance or cause of complaint as to treatment of his............or............by the association, may appeal to the Directors.

CO-OPERATIVE FRUIT GROWERS' ASSOCIATIONS, 1911.

Association.	Secretary.
Arkona F. G. A.	T. A. Lampman, Arkona.
Brant Packing Assn.	F. M. Lewis, Burford.
Chatham F. G. A.	W. D. A. Ross, Chatham.
Georgian Bay Fruit Growers, Ltd	G. H. Mitchell, Thornbury.
Gore F. G. A.	B. J. Palmer, New Durham.
Newcastle F. G. & Forwarding Assn.	W. H. Gibson, Newcastle.
Norfolk F. G. A.	Jas. E. Johnson, Simcoe.
Oshawa F. G. A.	Elmer Lick, Oshawa.
Owen Sound Fruit Co., Ltd.	Adam Brown, Owen Sound.
Sparta F. G. A.	J. A. Webster, Sparta.
Watford F. G. A.	D. G. Parker, Watford.
Grafton F. G. A.	J. G. Wait, Wicklow.
Alvinston F. G. A.	E. F. Augustine, Aughrim.
Burgessville F. G. & Forwarding Co.	W. H. Kneal, Burgessville.
Burlington F. G. A.	W. F. W. Fisher, Burlington.
Canadian Apple Exporters, Ltd.	F. R. Mallory, Frankford.
Clarkson F. G. A.	W. G. Horne, Clarkson.
Cobourg F. G. A.	S. W. Staples, Baltimore.
Hatchley Station F. G. A.	W. F. Robinson, Hatchley Station.
Ilderton F. G. A.	E. T. Caverhill, Ivan.
Mount Nemo F. G. A.	R. N. Spence, Nelson.
Orono F. G. A.	E. J. Hamm, Orono.
Forest F. G. A. & Forwarding Co.	D. Johnson, Forest.
Jordan Co-operative Assn.	J. A. Wills, Jordan.
St. Catharines Cold Storage & Forwarding Co.	Robt. Thompson, St. Catharines.
Grimsby F. G. A.	H. L. Roberts, Grimsby.
Winona F. G. A.	J. E. Henry, Winona.
Ontario & Western Co-operative Fruit Growers' Co.	C. J. McCallum, Grimsby.
Wyoming F. G. A.	E. J. Borrowman, Wyoming.
Wentworth F. G. A.	Roy Carey, 205 Herkimer St., Hamilton.
Brant F. G. A.	Wm. Dickie, Burford.
Prince Edward F. G. A.	Philip Greer, Wellington.
Oxford F. G. A.	J. F. Elliott, Oxford Centre.
Durham Co-operative Fruit Growers' Assn.	Wm. J. Oke, Port Hope.
Georgetown F. G. A.	....
Simcoe Fruits, Ltd.	R. A. Thomas, Barrie.

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BULLETIN 193.] [NOVEMBER, 1911.

Ontario Department of Agriculture

ONTARIO AGRICULTURAL COLLEGE

Tuberculosis of Fowls

S. F. EDWARDS.

INTRODUCTION.

During the past few years we have received in the bacteriological laboratory a large number of domestic fowls which *post mortem* examination showed were affected with tuberculosis. Although this disease is not new to Ontario, it is annually becoming more widespread among fowls, with consequent serious loss to the poultry industry of the Province and the Dominion. The control of tuberculosis of fowls is therefore a problem of considerable economic importance, and this bulletin is submitted for the purpose of spreading information about the disease and giving suggestions for its control.

Extent and Distribution of Avian Tuberculosis.

The first published report of the presence of this disease in Canada was in 1905. Higgins, at Ottawa,[1] in 1904, examined one fowl from Enderby, British Columbia, and one from Renfrew, Ontario. "In both cases the disease was well advanced, being generalized throughout the organs of the abdominal cavity." Previous to this publication, the disease had been identified by Harrison in this laboratory, in specimens received from Dalston and Marysville, Ontario, in August and September, 1903. Since that date there have been examined fowls from forty-seven other points in Ontario. The distribution of the disease in this Province is shown on the accompanying map (Fig. 1).*

In the United States avian tuberculosis was first identified and described by Pernot,[2] who in 1900 reported upon six outbreaks investigated by him in Oregon during the previous year. In 1903, Moore and Ward[3] reported on an investigation of avian tuberculosis in California, where

* The map shows only the places from which tubercular fowls have been sent for examination. The disease is probably much more widespread than the map indicates.

Fig. 1. Map of Ontario, showing places from which tubercular fowls have been sent for examination. The cities or towns are indicated by the stars.

two hundred and fifty fowls of a flock of fourteen hundred had died during the previous year. Burnett[4] in 1907 reported on an outbreak of tuberculosis among chickens in New York State. Morse[5] in 1907 reported on cases of the disease in Michigan, and a later report on the disease in that State has just been made by Marshall and Giltner.[6] Mack[7] in 1908 reported on three cases of tuberculosis from a small flock of fowls kept in the city of Reno, Nevada, and Beebe[8] in 1909 reported its presence in Minnesota.

In all these outbreaks the investigators have confirmed their diagnosis by microscopic examination and demonstration of the tubercle bacillus as described later in this bulletin. Several other writers report the finding of fowl tuberculosis in America, though they do not report

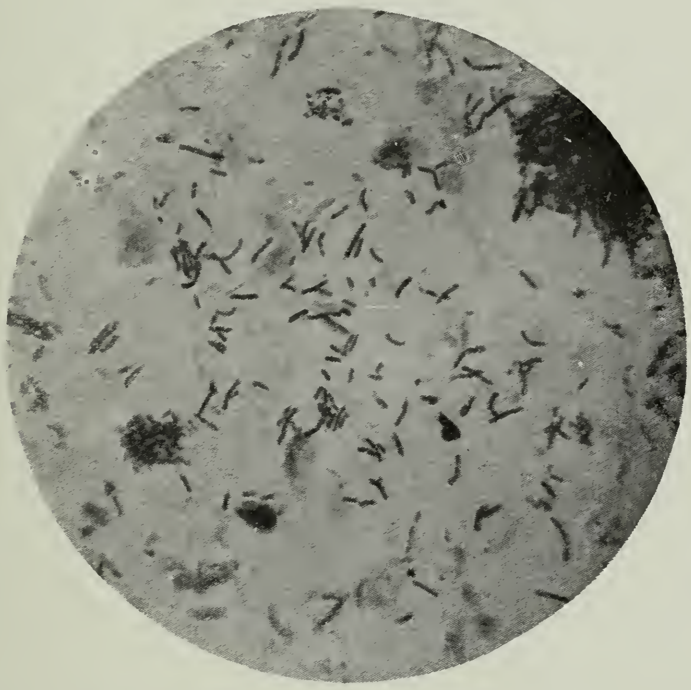


Fig. 2. Bacillus of tuberculosis from lung tissue of a fowl. Magnified 1,000 diameters.

bacteriological examination. In Europe, the disease has long been known and is reported to be widely distributed.

Nature of Avian Tuberculosis.

Tuberculosis of fowls is similar in many respects to tuberculosis of man and of cattle and swine. It is a communicable disease caused by a specific bacterial parasite, *Bacillus tuberculosis*. (Figs. 2 and 3.)

The germ is always the direct cause of tuberculosis, and no case can occur unless the germ is carried in some manner from an existing case to a susceptible individual.

Poorly lighted or poorly ventilated houses, insufficient or unwholesome food, errors in breeding, or the presence of mites, may become accessory causes by tending to lower the natural vigor and disease resisting power, thus increasing the susceptibility to attack; but before the disease itself can occur the germ *must* gain a foothold in the body of the bird.

Like tuberculosis of other animals, and of man, the disease in fowls is slow and insidious in its progress. It may exist for some time in a

Fig. 3. Bacillus tuberculosis from the liver of a hen. Growth on potato.

flock without detection. Unlike some other contagious diseases, the losses, especially at first, are only occasional, and the farmer ordinarily pays so little attention to the loss of a hen or two that it is not until there are frequent deaths, with more or less regularity, that he attempts to determine the cause of the trouble and the remedy. By this time the disease has gained such a foothold that drastic and sweeping measures must be adopted to eradicate it.

Seriousness of the Losses.

While there are no data obtainable as to the exact loss from tuberculosis in fowls, there is ample evidence to show that it is considerable. One farmer wrote us that he lost fifty fowls in seven months. Two others said they had lost a hundred in two years. Others write they lose about one a week. An illustration of how extensive inroads may be made in a flock is shown in the following paragraph from a recent circular from the Michigan Experiment Station.

Fig. 4. Liver of a tubercular fowl in the first stage of the disease. Only a few lesions are present.

"In January, 1911, a large flock of mixed Black Minorcas and Brown Leghorns was found in Livingston county badly affected with tuberculosis. In the spring of 1910 this flock consisted of nearly three hundred birds By January, 1911, there were about one hundred and sixty left. A positive diagnosis was made as a result of the examination of a bird sent to this laboratory. An arrangement was made whereby one hundred and forty birds were killed and dressed, and the remainder (those visibly affected) were sent to the laboratory for experimental work. Of the one hundred and forty birds killed forty were found to be tuberculous."

Birds Affected.

Tuberculosis of birds is confined mostly to chickens, although other domestic fowls may contract the disease. In this laboratory we have observed it in chickens and turkeys and in a pair of wild geese after two years in captivity.* It has been found in guinea fowl, pea fowl, goose, duck, dove, canary, and parrot. Among wild birds it has been reported in the swan, stork, crane, vulture, ostrich, pigeon, owl, pheasant, finch, grouse and partridge.

Dissemination—From Outside Sources.

Buying in New Stock. Probably the commonest method of spread of tuberculosis from flock to flock is by the transfer of infected fowls.

Fig. 5. Liver and spleen from an advanced case of tuberculosis in a hen.

A hen may be quite seriously affected without showing any external symptoms of the disease, and such an individual when introduced into a flock can serve as a source of infection for other fowls on the premises through the droppings as described below.

Transmission Through Eggs. There is considerable experimental evidence to show that transmission through eggs is a possible means of spread of the disease. As early as 1889 Maffucci inoculated eggs with

* Since this was written the author has seen the disease in a parrot and in hens from two other sources not shown on the map.

tubercle bacilli, incubated them and proved that although the presence of the germs evidently did not hinder the development of the embryo, the bacilli remained alive and later caused disease in the chick. Koch and Rabinowitsch[9] in examining four hundred and fifty-nine birds from the Berlin Zoological Gardens, found tuberculous ovaries and eggs containing bacilli "in a large number of cases." Rabinowitsch[10] from experiments with thirty-two eggs inoculated with tubercle bacilli of avian,

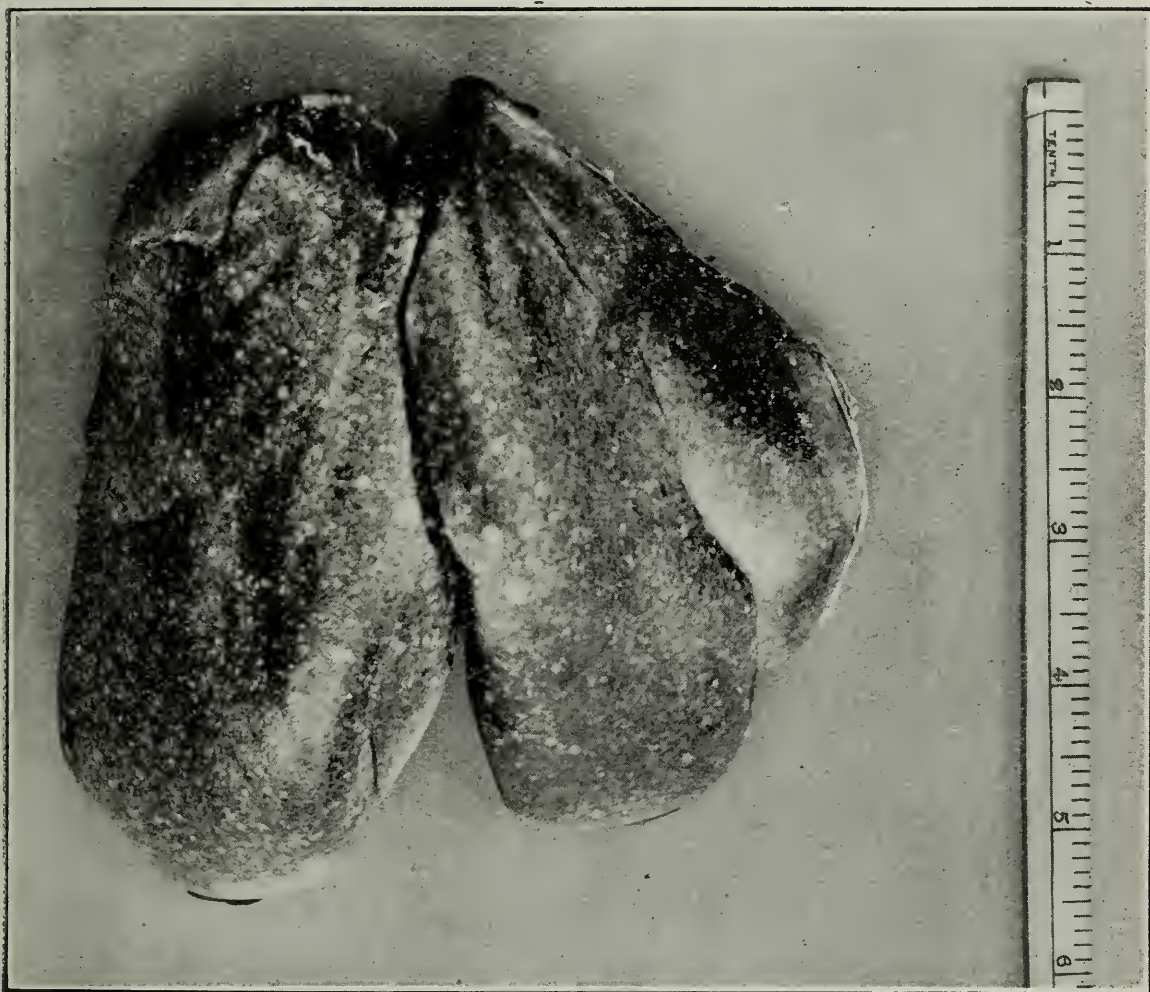


Fig. 6. Liver of a hen greatly enlarged and full of tubercular lesions.

human, and bovine origin, concluded that tuberculosis may be transmitted through the egg. Mohler and Washburn[11] report the infection with tuberculosis of guinea pigs inoculated with white of egg from a tubercular hen. In our own work, we have found tuberculous infection of the ovaries in six cases out of forty-six in which the ovaries were examined. Although hens in an advanced stage of the disease do not usually lay, the possibility of transmission through the egg must be recognized and guarded against in keeping a clean flock.

TRANSMISSION FROM HUMAN AND BOVINE SOURCES. The literature on this phase of the subject is contradictory. Moore,[12] Weber,[13] Shattock,[14] Zwick,[15] and others, claim that tuberculosis is not intertransmissible between the human or bovine and the avian species. On the other hand, recent researches by Koch and Rabinowitsch,[16] Drew,[17] Morse,[18] Arloing,[19] and others have shown that tuberculosis may be produced in fowls by feeding or direct inoculation with tuberculous material from cattle and from man. Experiments of Rabinowitsch,[16] O. Bang,[20] de Jong,[21] and others have shown that tubercle bacilli from avian sources can infect mammals. Our own investigation along this line has been very limited, but the results thus far obtained indicate that guinea pigs at least may be infected with tubercle bacteria from avian sources. Of six guinea pigs inoculated, two each with pure cultures of the tubercle bacillus from three different hens, one of each pair on post mortem examination one hundred days after inoculation showed positive though not extensive lesions of tuberculosis. The other three pigs are still alive and apparently healthy ten months after inoculation. Of six guinea pigs two each, inoculated with tubercular tissue from three different hens, one pair chloroformed and examined post mortem eighty days after inoculation, showed no sign of tuberculosis. The other two pairs are yet alive and apparently healthy six months and five months respectively after inoculation.

The possibility of infection of hens from "following" tubercular cattle was investigated to a limited extent. Seven one-year old chickens were turned into a shed where all the manure from a herd of twenty-five tubercular cows was stored. After fourteen months the birds were killed and examined, but none showed tubercular infection. Further work should be done along this line, however, before conclusions can be drawn as to the danger of fowls contracting tuberculosis from cattle by this method.

Summing up the results obtained from the latest and most extensive research, it is evident that tuberculosis is intertransmissible between the human or bovine and the avian species, to a certain extent, and that the avian bacillus so called must be considered as not a distinct species, but merely a variety, the differences in character of this organism from the bovine or the human type being due to environment.

DISSEMINATION—IN THE FLOCK.

The most common source of infection in the flock is undoubtedly the droppings of affected birds. When the intestines are affected, some of the tubercles on the intestinal walls may rupture and open into the lumen, discharging the bacilli into the intestinal canal to pass out with the droppings. When the intestines bear these open tubercles the bacilli may almost invariably be found in the droppings. We have made microscopic examinations of the droppings of fowls in twenty-nine cases in which the intestines were tubercular as shown by subsequent *post mortem* examination, and have found the bacilli present, sometimes in enormous numbers. In a feeding experiment to secure further proof on this point, we selected five healthy hens and two cocks from the College Poultry Department. These were fed droppings from tubercular hens. In all, eleven feeds were given at intervals extending over a period of twenty days. Of the seven thus fed, four died within six

Fig. 7. Liver, spleen and three pieces of intestine from a bad case of tuberculosis in a hen.

months, and autopsy showed them to be tubercular, the infection varying in extent. The other three lived for eleven, twelve and fourteen months respectively, dying from other causes and showing no tuberculosis on *post mortem*. While the number of birds fed was not large, yet the results are conclusive and confirm the general opinion that the tubercle bacilli are most often ingested with food soiled with the droppings of birds having lesions in the intestines. As a control on the birds fed in this experiment we have considered the college flock sufficient, inasmuch as there has never been a case of tuberculosis among the fowls in the college plant.

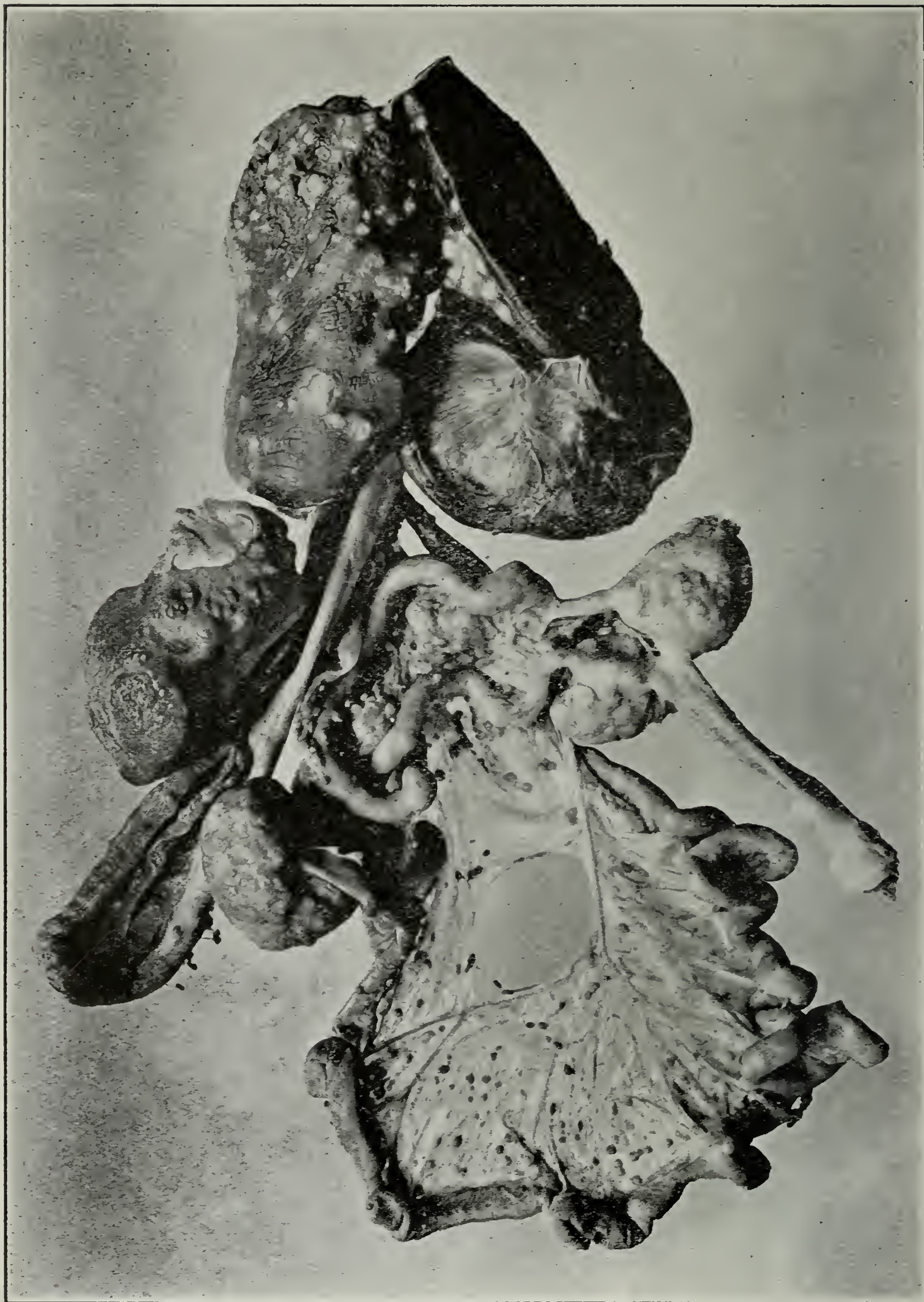


Fig. 8. Liver, gizzard and intestines from a tubercular hen. The liver is badly diseased and there are some very large, and many small tubercles on the intestines and in the mesentery

Detection of the Disease.

Symptoms. There are no definite symptoms of tuberculosis of birds in the early stages, and for this reason the disease is not usually detected until it has made serious inroads in the flock. Detection by the tuberculin test is unavailable, as shown by results of Ward,[22] of Klimmer and Saalbeck,[23] and in this laboratory. Results secured by the author in a test of seven tubercular hens, in comparison with six healthy hens, agreed with those of the two investigators mentioned. Temperatures of healthy and tubercular birds show little or no difference, either before or after the injection of tuberculin.

Usually the first symptom of tuberculosis noticed is emaciation, or "going light," accompanied often though not always with a pale appearance of the comb and wattles and the skin about the head. There is frequently, though not always, a persistent diarrhœa, the droppings appearing of a green or greenish white color. Lameness in one or both legs may occur, due to infection of the joints. In the latter stages of the disease, the feathers become dry and ruffled, the bird becomes weak and mopy and moves but little. The eye is bright and the appetite is usually good throughout the sickness and the affected fowls may eat ravenously until a few days before death occurs.

Post Mortem Appearance. The first thing noticeable on opening the bird for *post mortem* examination is the characteristic appearance of the liver, known to poultrymen and farmers as "spotted" liver. The liver is studded more or less thickly with rounded tubercles varying in size from a pin point to three-eighths or even one-half inch in diameter. The tubercles are circular in outline, although several, in growing close together, may coalesce to form an irregular area. The tubercles protrude more or less and can usually be readily separated from the surrounding liver tissue. The color of the lesions may be white, creamy white, or yellowish white. In consistency they may be either hard and granular, or they may be soft and cheesy. On section it will be found that the tubercles are not on the surface only, but extend throughout the liver tissue. The organ is usually enlarged, sometimes to more than double the normal size. In one case that came under our observation the weight of the liver was one-fourth the weight of the entire bird. (Fig. 6.) The liver appears to be the first point of attack; at least in one hundred and four cases we have found the liver affected in every case but one, and in a few cases it was the only organ affected. The appearance of the tuberculous liver is illustrated in figures 4, 5, 6, 7 and 8.

The spleen, which in the healthy adult chicken is a rounded, somewhat kidney-shaped, purple organ about half an inch in diameter, and lying under the liver, is almost as frequently affected as the liver itself. Of ninety-seven cases, there were macroscopic lesions in the spleen in all but seven. The spleen is also enlarged, sometimes very greatly, and the nodules may protrude so as to make the spleen irregular in shape and outline. In one case we examined the spleen was larger than the liver. (Fig. 9.)

Fig. 9. A healthy spleen, in the centre, and four tubercular spleens showing varying degrees of infection.

The intestinal system may be more or less involved. (Figs. 7 and 8.) There appears to be no portion of the intestinal track that is more vulnerable than others, as the nodules are found in different portions in different cases, and in bad cases may be distributed throughout the length of the intestinal canal and over the mesentery, the tubercles varying in size from a pin head to an inch or more in diameter. When the intestinal tubercles

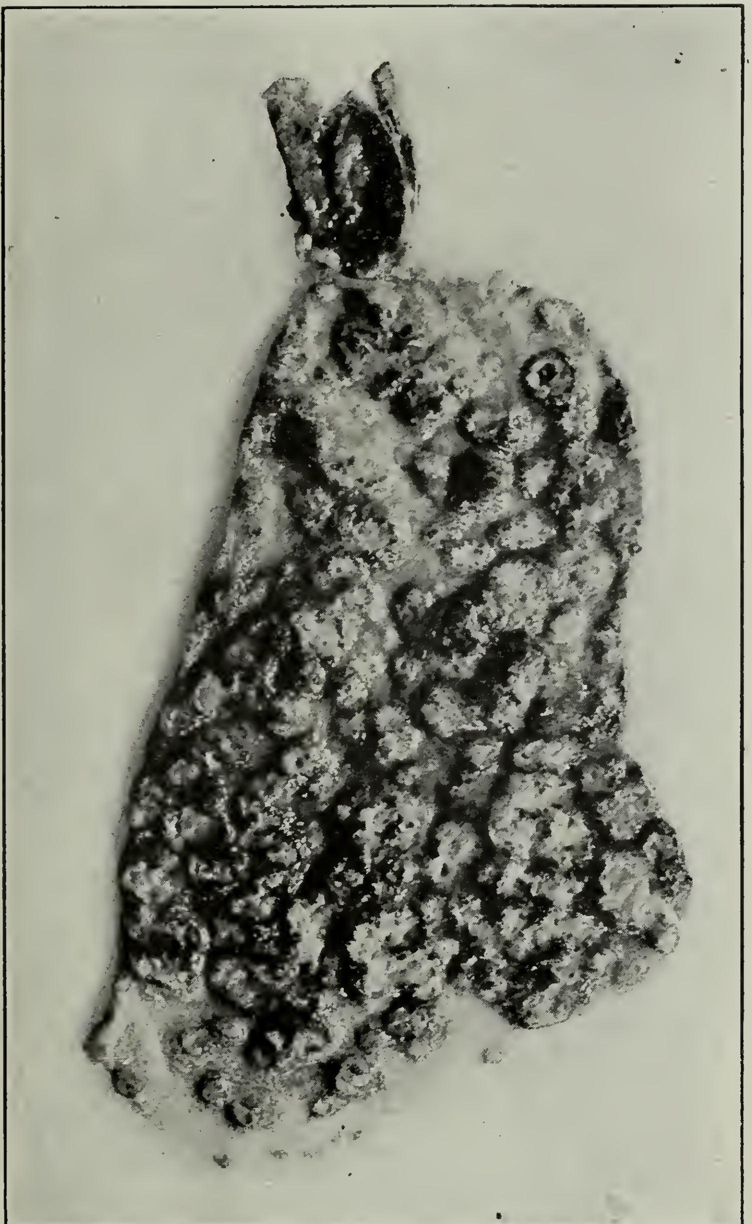


Fig. 10. The cloaca or lower bowel of a hen, cut lengthwise and laid open to show the tuberculous ulcers on the interior. The healthy cloaca should be smooth over its entire inner surface as shown at the lower border of the picture. The hen from which this was taken was excreting millions of tubercle bacilli daily in the droppings.

are examined they are found many times to have an opening into the lumen of the gut, and microscopic examination of the intestinal contents

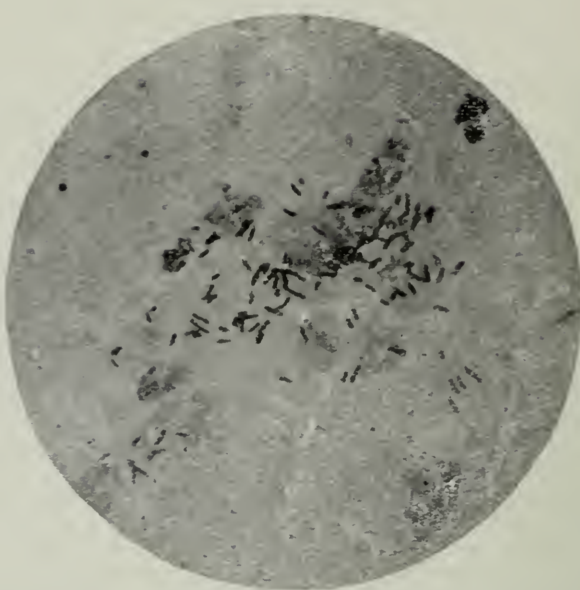


Fig. 11. Photomicrograph of tubercle bacilli in a stained preparation from the contents (droppings) of the cloaca shown in Fig. 10. The quantity of droppings containing this cluster of bacteria was far too small to see with the unaided eye.

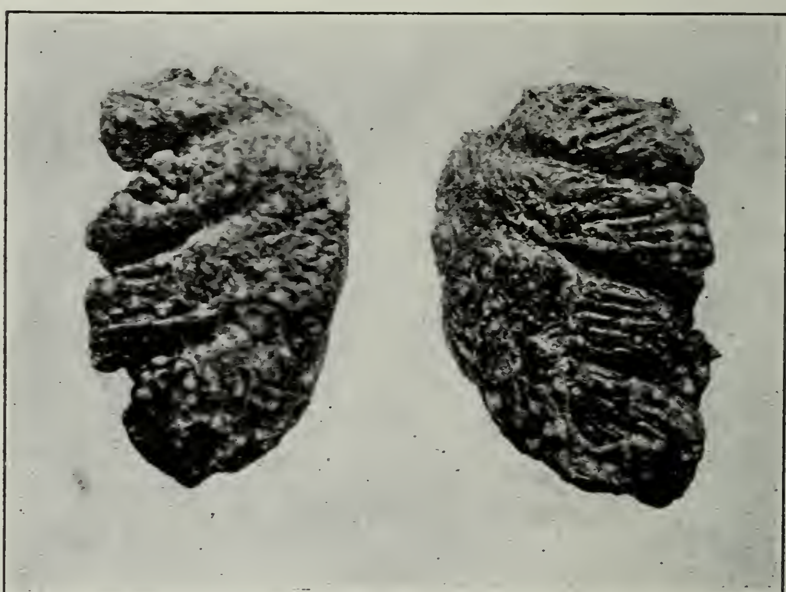
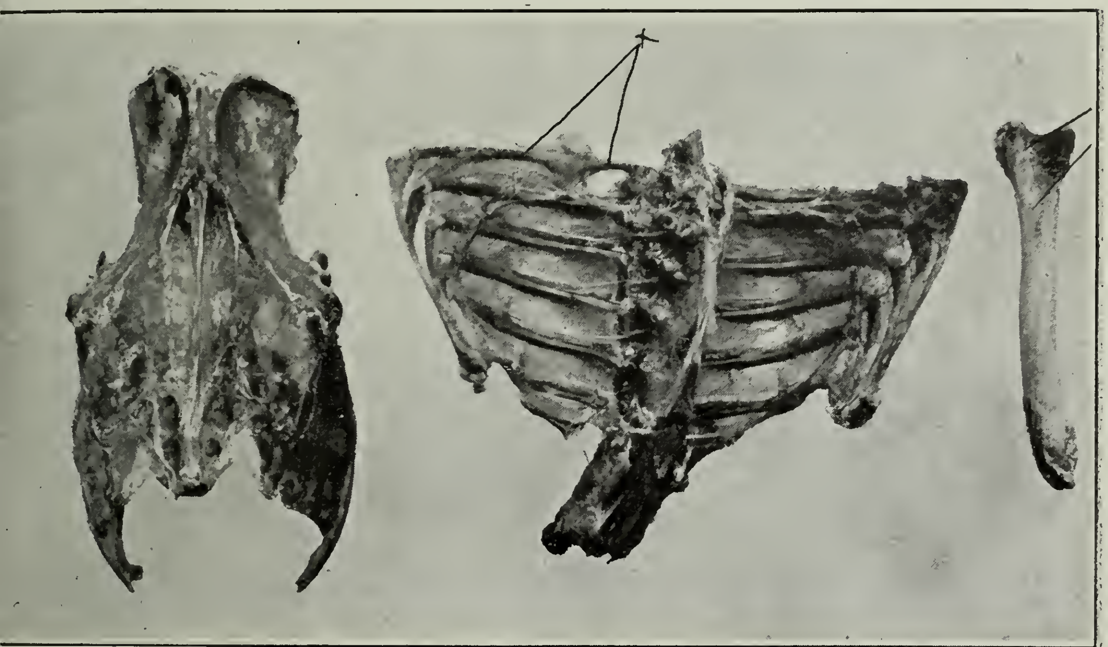


Fig. 12. Lungs from a hen showing many rounded white tuberculous nodules.

t this point shows the presence of the tubercle bacilli in great numbers. Ve have always found the intestinal lesions exceptionally rich in the acilli, and these, discharged into the canal, pass out with the droppings. Ve have often found these open tuberculous ulcers in the lower portion f the intestines and on the cloaca (the large lower bowel) itself, ı which cases the organisms are readily detected in smears made from he droppings. In one case the entire cloacal wall was covered with ıberculous ulcers, many of them opening to the interior. (Fig. 10.) 'he cloacal contents were extremely rich in tubercle bacteria. (Fig. 11.) 'his indicates how easily susceptible fowls may contract the disease by ıgesting the bacilli from infected birds with soiled food or water. We ound the intestines affected in sixty out of ninety-eight birds examined.

The lungs are more rarely affected than the liver, spleen, and intes-



ig. 13. Tuberculosis of the bones. The irregular white areas in the backbone, and the parts indicated by the cross (x) in the ribs and the long bone are the tubercular portions. There were numerous small tubercular lesions in the ribs which the photograph does not show.

ines. When affected, the tubercles are spherical, small and hard, and vhen present at all are usually numerous. (Fig. 12.)

Other organs less frequently affected are the heart, proventriculus, izzard, kidneys, ovaries, cervical lymph glands and skin.

The bones are often affected, especially about the knee joint, giving ise to the lameness or "rheumatism," so called, which is one of the haracteristic symptoms of the disease. The right knee is more often ffected than the left. Only the extremities of the bones usually show ny macroscopic lesions, although in bad cases there may be lesions throughout the length of the femur. In one case which came under observation, the disease had progressed extensively in the skeletal system, the parts affected including both knee and both hip joints, besides lesions in the shaft of the right femur, both shoulder joints, the backbone, the breastbone and ribs, lesions in the last three locations being very numerous. (Fig. 13.) When the bones are affected the lesion is yellowish white and lies just beneath the periosteum, there being no swelling of the surface, except in some rib lesions, in which there may be a marked enlargement in the rib at the location of the tubercle. A characteristic of the bone lesions is the enormous number of bacilli present.

The distribution of the tubercular lesions in the affected fowl is shown in the accompanying table.

TABLE I.—SHOWING DISTRIBUTION OF TUBERCULAR LESIONS IN THE AFFECTED FOWL.

Part affected.	Cases examined.	Affected.	Not affected.	Per cent. affected
Liver	104	103	1	99.1
Spleen	97	90	7	92.7 +
Intestines	98	60	38	61.2
Mesentery	95	20	70	21 +
Lungs	78	15	63	19.23
Ovaries	46	6	40	13 +
Heart	96	2	94	2.08
Gizzard	96	3	93	3.12
Kidney	46	6	40	13.04
Skin	46	3	43	6.52
Bones	46	20	26	43.47

Whenever a fowl dies a *post mortem* examination should be made. This may easily be done in a moment's time by laying the bird on its back, making a large opening in the abdominal cavity just back of the point of the breast bone and breaking the breast bone back toward the head, as shown in Fig. 14. The lungs, heart, liver, gizzard and parts of the intestinal system are thus exposed and any abnormal condition is readily noticed.

When such an examination is made, if the internal organs are affected as described and illustrated, and if the bird before death had been thin, droopy and lame, with a greenish diarrhœa, there is strong evidence that the disease is tuberculosis. A positive diagnosis cannot be made, however, without a microscopic examination to demonstrate the presence of the tubercle bacillus. This is done by subjecting a minute particle of the diseased tissue to a special method of staining, and examination under high magnification, when, if present, the bacilli may be seen as illustrated in Fig. 2. It is only by such a microscopic examination

Fig. 14. A *post mortem* examination of a fowl is easily and quickly made. A large opening is made just back of the point of the breast bone, the skin is torn back and the breast bone is broken backward toward the head. The heart, liver, gizzard and part of the intestines are seen at once, and the other organs are readily accessible. The liver, in the specimen photographed, shows the characteristic tubercular "spots."

that tuberculosis can be positively differentiated from conditions found in "blackhead," "beef scrap liver," "lungers" in chicks, or other diseased conditions. Diseased birds suspected of having tuberculosis may be sent to this laboratory, where a microscopic examination will be made and the result reported to the sender without cost.

Control.

There is little or no satisfaction in attempting to treat individual cases, and the use of drugs is a waste of time, patience and money. When once the disease gains a foothold in the flock, it is difficult to eradicate except by the adoption of drastic measures. The quickest and most effective method is to kill off all of the birds, disinfect the premises as thoroughly as possible, and start with new stock from a flock that is known to be free from disease. In small flocks this method would seem advisable. The fowls could be examined, and all that were found to be free from disease could be sold for market, thus lessening the loss. In large flocks, or where it is desired to preserve a certain strain in breeding, a modified Bang system may be carried out based on the same principles as employed in eradicating tuberculosis from a herd of cattle. All birds that show the least signs of illness should be promptly slaughtered and cremated. The well birds should be removed to new ground, and new houses built; or if the houses already in use are of sanitary construction they may be thoroughly disinfected and whitewashed, after which they may be moved to the new ground and used with safety.

Eggs for hatching should be secured from stock that is known to be healthy. If incubators are used the problem is simple. Keep the chicks entirely separate from the old fowls and only on clean ground, and as they grow up dispose of the old flock to the best advantage possible, again thoroughly disinfecting the houses and runs used by the old flock. If hens are depended on for hatching, the chicks should be taken away as soon as hatched to artificial brooders and raised as already suggested, entirely separate from the old flock. Precautions should also be taken to prevent the possible infection of the fowls from bovine sources by the feeding of offal from slaughtered tubercular cattle or hogs, or from human sources by picking up sputum carelessly expectorated on the ground by consumptive persons.

Care should also be taken in buying new stock to secure birds only from flocks that are known to be free from disease. An additional preventive is to increase and maintain the natural vigor of the fowls by care in breeding and feeding, and housing in open air houses. Too much emphasis cannot be placed upon the value of plenty of fresh air in the houses. The disease is most often found in flocks that are over crowded in poorly ventilated houses.

Disinfection of Premises.

The first thing to do in putting the poultry premises in sanitary condition is to scrape the roosts, walls, ceilings, floors and nest boxes of the houses thoroughly clean with a hoe or other convenient implement. Accumulated manure may be mixed with lime, spread on the land and plowed under. Loose litter, pieces of boards or other valueless material should be completely burned. When this has been done the entire inside of the houses may be washed down with some good disinfectant such as carbolic acid, one part in twenty of water, zenoleum, lysol, chloro-naphtholeum, or other disinfectants, in the strengths indicated by the manufacturers. Any of these may be put on with a spray pump. In place of these, quicklime in the form of whitewash may be used, prepared as follows. Slake the quicklime by adding water in the proportion of one and one-half pints of water to each quart of lime or by weight, sixty parts of water to one hundred parts of lime. The resulting dry powder is hydrate of lime. For use mix one quart of this with four quarts of water. This must be freshly prepared in small lots and used immediately. It is best applied by means of a spray pump, although it may be put on with a brush or broom. If a spray pump is used, the slaked lime should be put through a fine sieve or strainer in order to prevent clogging of the nozzle. It is important that every crack and crevice and every particle of surface be covered with the disinfectant. After disinfection, clean boards may be placed beneath the roosts to catch the droppings, thus facilitating the work of future cleaning. Slaked lime placed on these boards will absorb the moisture from the droppings besides adding to their fertilizing value. Disinfection of the houses should be carried out at intervals as long as any diseased birds remain in the flock.

To disinfect the runs is a difficult matter, because it is impossible to have the disinfectant come into contact with each minute particle of soil. The best that can be done is to completely cover the ground with freshly slaked lime and plow under. Sow some quick growing crop for green manure, lime and plow under again. By this method the soil can eventually be well disinfected. The fact must be kept in mind, however, that any tubercular fowls may be continually reinfecting the soil by voiding the tubercle bacilli with their droppings; consequently, it would be impossible to keep the soil free from infection so long as diseased fowls were kept on that ground.

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BULLETIN 194.] [TORONTO, DEC., 1911.

Ontario Department of Agriculture

FRUIT BRANCH

Apple Orcharding in Ontario

The apple industry of to-day has arrived at a unique state of its development. The farmer, the fruit-grower and a good many of our business men have at last realized that "the apple tree" has more right than merely the ground on which it stands. It is a recognized fact that the apple orchard, no matter in what part of Ontario it is situated, whether on a fruit, dairy or general farm, is now one of the most profitable investments on the farm, or will prove so if only the necessary amount of attention be given to it. Hundreds of orchards are undergoing a process of regeneration and thousands of young trees are being planted through the Province.

During the years 1908 and 1909, 1,924,000 trees were sent out from Ontario nurseries for the planting of these new orchards. Fortunately, there seems no present limit to the consumption of this fruit. Owing to long-standing neglect it will be many years before all of the old general-purpose, neglected orchards of this Province have been brought back to a profitable bearing state, and many will never regain their original thrift and productiveness, nor count for much in the total shipments. Our Canadian Northwest and the northern sections of Ontario are rapidly being filled up. The British and European markets continue to maintain an active demand, and the prospects are that these markets and the apple industry itself will develop at the same time, so that the most conservative can predict nothing but a big demand for good apples with paying prices for many years to come.

SELECTION OF VARIETIES.

In selecting varieties there are several things to be taken into consideration. First, the adaptability of a variety to a section in regard to hardiness, productiveness and the degree of development which the fruit attains before the close of the season. For instance, it is questionable if the Baldwin should be planted on the lighter soils which are found in some sections east of Toronto, as the tree kills out in a severe winter, like 1904-5, and hardly ever reaches old age. Again, the Spy in many years will not attain full size or color in some of the farther eastern counties. Second, the markets to which you intend to cater, whether Great Britain, Europe, United States or our home market. The first is more or less stable as far as demand and prices are concerned, but the altering of the tariff by European countries or the United States would affect the trade considerably. As a general thing, however, all our markets will take the same varieties, except, perhaps, in the instance of the

A combination of clean culture and sod.

Ben Davis apple, which is generally conceded to be most profitable for export only. Third, the number of varieties to plant and the ratio of each. Do not plant a greater number of varieties than is absolutely necessary to take care of your markets. Too many varieties are a nuisance. They are harder to market and many phases of the work are not as economically performed as when the orchard has fewer varieties. Plant your varieties in blocks so they may be pruned, sprayed and harvested with as little extra labour as possible. The only exception to this statement is that some authorities claim it is advisable to plant more than one variety in an orchard so as to get a sufficient fertilization of the bloom to ensure a good crop in varieties like the Spy, which may be self-sterile.

Varieties Recommended.

There are in Ontario several areas, which may be classed as divisions, in which the climatic conditions are practically distinct. Their suitability for the production of apples has been ascertained by ten years of experimental work, the results of which the Department has published in Bulletin 179. Within these divisions there are certain localities which, by some outstanding topographical feature, such as the influence of large bodies of water or contour in the land, are better suited to the production of fruit. Owing to such conditions, we find that in the colder sections of Ontario the production of our standard varieties of apples is

An orchard gang plow.

chiefly confined within the modifying influence of the lakes and large rivers.

General Lists.—After testing a large number of varieties of fruit at the various fruit stations, the Advisory Board for Fruit Stations has decided upon the following as the most desirable for general planting.

The term *Commercial* is intended to include the varieties most desirable for market purposes, and the term *Domestic* those most desirable for home uses, either cooking or dessert.

These lists are given, as far as possible, in the order of ripening.

It is realized that there are many varieties not included in these lists which may do well *under special conditions,* yet which are generally not considered so desirable as those mentioned.

The Advisory Board, recognizing the great disadvantage which faces inexperienced persons who desire to engage in fruit growing for profit, because of the very large and confusing list of varieties, has ordered the publication of these select lists of tested varieties which shall serve as a guide to intending planters. The practice in modern horticulture is to reduce the number of varieties of a fruit planted to within possibly a half-dozen varieties in an orchard. This is to be commended for the commercial orchard specially, and the following lists should be used from which to select such varieties.

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

Apples.

Summer.

Astrachan: Adapted to all sections except the extreme north.
Duchess: Adapted to all sections.

Fall.

Gravenstein: Adapted to all sections except the St. Lawrence River and other northerly portions of the Province.
Wealthy: Particularly valuable for northern sections.
Alexander: Especially for northern districts.
McIntosh: Adapted especially to the St. Lawrence River district, but can be grown over a much wider area.
Fameuse: Adapted especially to the St. Lawrence River district, but succeeds well over a much wider area.
Blenheim: Adapted to all sections except the St. Lawrence River district and other northerly portions of the Province.

Winter.

King: Adapted only to the best apple sections, and succeeds best when top-grafted on hardy stocks.
Hubbardston: Adapted to the best apple sections.
Greening: Adapted to the best apple sections.
Baldwin: Succeeds best on clay land, and is adapted to the best apple districts.
Northern Spy: Adapted to the best apple districts, but can be grown with success farther north by top-grafting on hardy stocks. This is also recommended for bringing it into early bearing.
Cranberry: Succeeds best in the eastern winter apple districts, the tree, however, being slightly tender when young.
Stark: Adapted to best apple districts.

Hardy Apples Recommended for Sections North of Latitude 46 Degrees.

Summer.

Transparent, Lowland Raspberry, Charlamoff.

Fall and Winter.

Duchess, Wealthy, Hibernal, Longfield, Patten, Whitney, Hyslop, Milwaukee.

Crab Apples.

Whitney: A large crab of high quality, suitable for planting in the extreme north where other apples will not succeed. May be used for dessert or cooking.

Martha: An early crab of fair quality.

Transcendent: Yellowish crab, season early autumn.

Hyslop: Dark, rich, red crab, of late season, quality only fair.

SITE.

If one is buying a farm in order to plant an apple orchard, he should, of course, exercise his judgment so as to secure the best shipping facilities. Then, in choosing a site for an orchard, choose the very best field on the farm. The apple crop, under proper management, will give profits much above any other crop grown and, therefore, the orchard deserves the best treatment possible in the selection of soil.

If this land is not well drained, this matter should be remedied at once (read Bulletins 174 and 175 on Farm Underdrainage). Should your farm be located in those districts where apples are extensively grown and where practically all varieties succeed, then the question of exposure does not seem to make much difference. Have the land sloping, if possible, towards the water, and if this is not present a northerly exposure is found to be the best.

Windbreaks.

Much has been said about windbreaks. Nearly every farmer appreciates the fact that a row of trees around the farm is a beautiful asset, and one which is no doubt a material advantage, but to plant a windbreak especially for an apple orchard is now seldom considered, particularly in the commercial apple sections of Ontario. The trees, when they have obtained their growth, act more or less as a windbreak for themselves. It is only during the first three or four years that the young trees will suffer any bad effects by the action of the wind in turning over the trees. This can be obviated by discontinuing the foolish practice of planting the largest trees obtainable regardless of age. The care taken in planting the young trees also exerts considerable influence in offsetting the action of the wind. This will be discussed under the heading of planting.

SOIL AND PREPARATION.

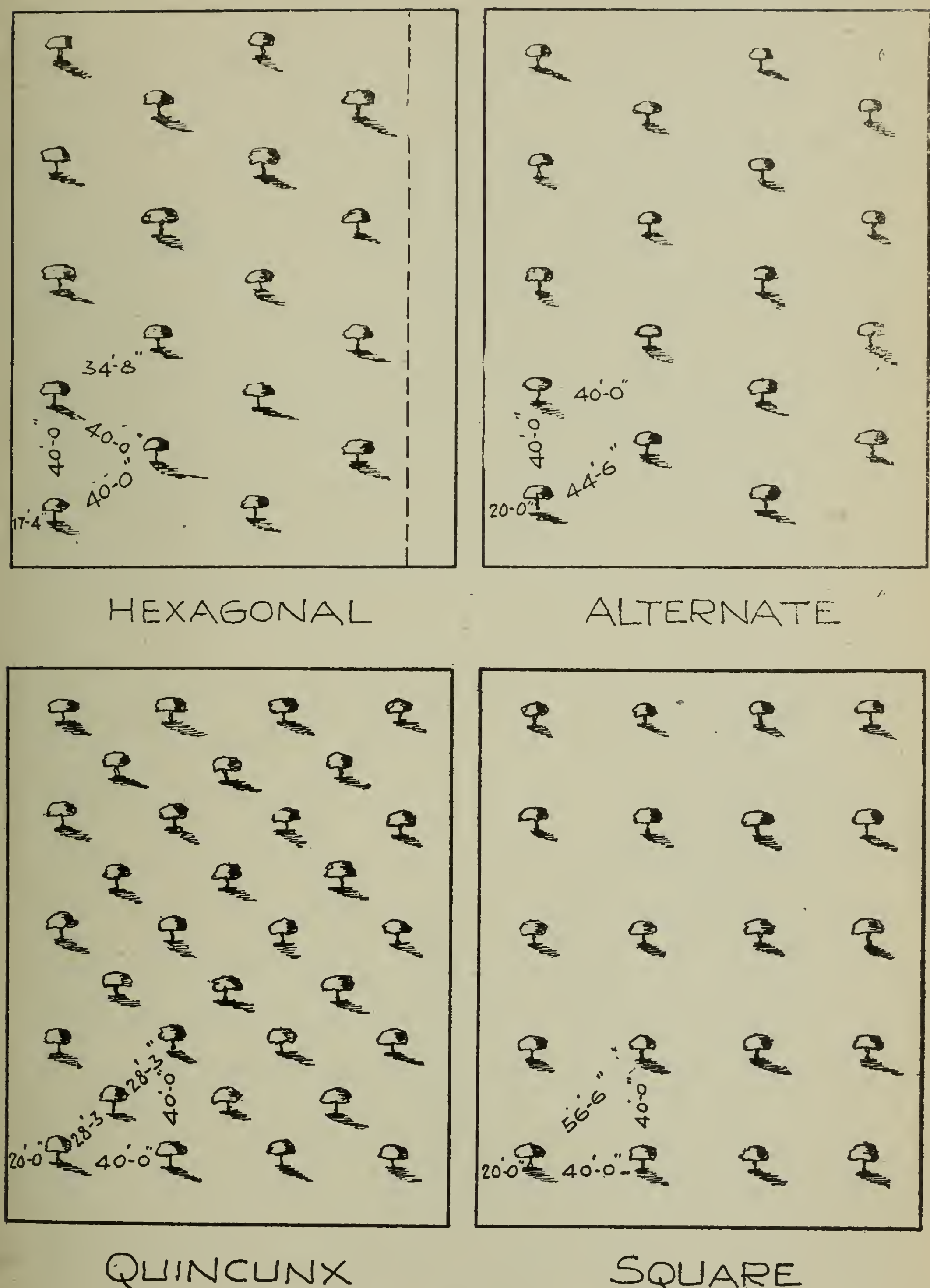
The apple is giving good results on nearly every kind of soil. Some varieties only attain a high state of perfection on certain soils, but as a rule our commercial varieties will give good results on all soils except the very heavy damp clays. A deep, sandy or clay loam with a porous subsoil is the best land for apples, but careful attention and treatment of the lighter soils will assure splendid results and yearly crops.

The first important factor is good drainage. A location that is higher than the surrounding land, with a deep, porous soil, will require very little, if any, tile drainage, providing the surface drains are kept open. Never plant on a shallow soil with a hardpan substratum, for apple trees have an extreme dislike for wet feet. The experience of successful orchardists has been that to secure the best results the soil should be tilled or cropped for one or two years before planting. Green crops, such as rye, vetch or clover, which penetrate deeply, add a large amount of humus if plowed under and leave the soil in the best possible condition. In all cases the preparation of the soil for planting should be commenced in the fall by good deep plowing, leaving it as rough and ridgy as is consistent with good plowing or by ribbing it up. By these methods the greatest amount of soil is exposed to the pulverizing action of frost, thus leaving it in the best mechanical condition. The thoroughness with which you prepare your land will be amply warranted by the superior thrift of the young trees and fewer blanks will result.

In the spring, before staking out, harrow down the ridges and follow with a cultivator. Further cultivating should be done later, for it is important that the young trees be planted as early as possible.

SETTING OUT AN ORCHARD.

There are several plans for setting out an orchard. The usual method is the square, whereby the trees are planted the same distance apart each way, four trees forming a square. By this method there is more room between the rows for the growing of other crops. The hexagonal plan gives the greatest number of trees per acre and divides the air and soil space more evenly. The alternate system sometimes used has no particular advantage except that diagonally the trees are farther apart. The disadvantage is that on a given rectangular area fewer trees can be planted, every other row lacking one tree (see figure). The quin-



Planting systems for the apple orchard.

cunx system is the same as the square, except that a tree is planted in the centre of each square. This system is used more often for the planting of fillers in the centres of the squares. The square plan is the most common. It might be more correct to call it the rectangular system from the fact that many planters set their trees farther apart one way than the other.

NUMBER OF TREES PER ACRE PLANTED UNDER TWO SYSTEMS OF PLANTING.

Distance apart each way.	Number of trees.	
	Rectangular.	Hexagonal.
20 feet	108	124
25 "	70	80
30 "	48	55
33 "	40	46
35 "	35	40
40 "	27	31

DISTANCE BETWEEN ROWS IN HEXAGONAL PLAN.

Distance between trees.	Approximate distance between rows.
20 feet	17 feet 4 inches
25 "	21 " 8 "
30 "	26 "
33 "	28 " 7 "
35 "	30 " 4 "
40 "	34 " 8 "

If the square plan is adopted, a base line should be located at one end of the field and the pegs put in at the desired distance. If your field is not too large, it would be well to stake out a line at the other end also. A wire may then be stretched between these two lines to find the positions for the trees. Secure a No. 10 gauge galvanized iron wire and solder or otherwise fasten washers to this wire at same distance apart as the trees are to stand in the row; then, with a man on each side, dig the hole under the washer, leaning the trunk of the tree against it. Some growers prefer to place stakes at each point on the wire, and having marked out the field afterwards use the planting board when setting the trees. Be sure you have your base lines correct and that the wire is made

Cutaway extension disc, an improvement on the useful disc harrow.

A home-made clod-crusher, useful in preparing land for planting.

to lie evenly and as straight as possible. If this is done, very little trouble will be experienced in getting good lines.

In staking out for the hexagonal plan, after the first row has been staked at the desired distance, the position of trees in the second row, and also the distance apart of that and the following rows, may easily be ascertained by taking two pieces of wire, fasten one end of each wire to a 2½-inch iron ring and to each of the two loose ends fasten another ring. When stretched out these rings should measure from centre to centre the same distance that your trees are to be planted apart. Then by placing one ring over the first stake and another over the second stake and pulling the wires taut and placing a stake through the third ring you will have the position of the first tree in the second row. By changing the rings to second and third stakes the position of the second tree is located, and so on until the entire orchard is planted.

The field should be partly or wholly staked before planting is commenced. If this is done, it will be found a much easier matter to get your lines straight. Some orchardists do not take the trouble to line out their trees in exact and straight lines. This is to be regretted, however, for as crooked lines in plowing are unmistakable signs of slipshod farming, crooked lines in an orchard are still more unmistakable signs of a rather careless fruit grower. A planting board is necessary in order to get the trees in the exact position of the stakes. This board is inexpensive and easily made.

Distance Apart to Plant.

The distance apart must be determined wholly by the final development of the variety. Soil, climate and pruning all bear some relation to it, but to the general orchardist this relation is so small that it is unnecessary to take these points into consideration. The question to ask oneself in deciding the distance is: "What is the habit of growth of the variety or varieties that I want to grow?" and "How large do the trees get when they reach maturity?" Give a tree plenty of room; it will always utilize it; but at the same time be economical with your ground. Forty feet both ways is not too much for our strong-growing standards in the best apple districts. Even in the northern and extreme eastern sections thirty-five feet should be allowed.

The following varieties might be taken as strong-growing varieties in the better apple sections: Astrachan, Baldwin, Cranberry, Fameuse, Golden Russet, Gravenstein, Greening, King, McIntosh and Spy. Trees of more medium growth are: Alexander, Ben Davis, Blenheim, Hubbardston, Ribston and Stark, while the following are smaller in habit of growth: Duchess, Wagener, Wealthy, and the various varieties of crab apples.

A great many discussions have taken place on the question of interplanting in order to utilize space and procure a paying crop of fruit from early-maturing varieties while the late-maturing or standard varieties are developing. There is no question whatever that interplanting is the most profitable and proper thing to do, but the grower's mind must be fully made up that these trees will be removed before they interfere with the standards of the permanent orchard. The great objection to interplanting with fillers is that the grower, in many cases, does not remove the fillers until they have done much damage, and in most cases this neglect is due to the fruit grower's disinclination to remove these trees which are producing a profitable crop. If a man is at all intelligent he ought to perceive that his object is to produce a profitable permanent orchard. He should not object to removing a tree from his orchard any more than cutting out a limb when pruning, providing that by so doing he is improving the ultimate condition and productiveness of his orchard.

There are two methods of interplanting: One being with varieties of tender fruits, such as peaches, pears, plums, cherries and small fruits; the other with early-maturing and slow-growing varieties of apples. The location has a lot to do with interplanting of the first class, but with the great demand for early apples it is a question if it does not pay in most cases to interplant with early varieties which fulfil the requirements. In interplanting it must be left entirely with the grower if he interplant the orchard in both directions or only along one direction. When general farming is practised and corn or root crops are grown between the rows, for the first few years perhaps it is more economical to interplant in only one direction so as to allow greater ease in working and harvesting these crops.

Ordering Trees.

Having decided upon the varieties you intend to plant and the quantity necessary, the next step is to order the best trees possible. To do this it is advisable to write direct to the nurseryman, sending the list and number of each variety, describing the kind of stock you require and asking for prices. This should be done as early as possible. Do not wait until the spring. Orders are filled in the order in which they are received, and generally the first served gets the best stock. Buy direct from nurserymen, or through your association. Do not let nurserymen substitute any variety in your order. Above all deal with reliable, well-established firms, and do not hesitate to pay a good price for good trees.

Kind of Tree to Plant.

The most common fault is that the biggest trees are usually planted. Trees more than two years of age have established themselves in the nursery, large roots and tops have formed, the latter pruned successively for several years with no thought given to the ultimate form of the tree or what the purchaser may require. It can readily be seen that such trees will suffer severely in transplanting. Therefore, it is best to plant one- or two-year-old trees. In the progressive apple growing sections in British Columbia, Washington and Oregon, the planting of one-year-old trees is strongly recommended and generally followed. The reasons given are that they are cheaper, cost less to ship, a greater proportion of them live and an ideal top can be secured. These reasons are very plausible, and where it is difficult to get low and properly-headed two-year-old trees it is certainly advisable to plant one-year-olds. When the trees are delivered it is of the utmost importance that they be carefully protected from exposure to the drying effects of wind and sun. Select a sheltered spot, remove the trees carefully from the cases, heel them in, covering the roots with plenty of moist earth. Do not lay out any more trees than are necessary to keep the planters supplied.

The planting-board in use, showing how to lean the tree.

Planting.

In the colder section of the Province spring planting is undoubtedly the best, but in sections where the climate will permit fall planting, and where a large orchard is to be set out, considerable time can be saved by planting in the fall; but be sure that your trees are fully matured when dug in the nursery. Where the trees are immature, or the land poorly drained, serious damage may be done during the winter.

Two men should work together in planting. Having placed the planting board the hole should be dug deep enough to allow the tree to be set about two inches deeper than in the nursery. The surface soil, which should be placed to one side, should then be very firmly packed about the roots, tramping well, then filling in with the remaining subsoil, leaving the top soil loose to act as a mulch to retain the soil moisture. A great many of our orchards suffer severely from the trees leaning away from the direction of the prevalent winds. A great deal of this is due to the fact that they were carelessly planted. Set the young trees sloping considerably towards the west, or north-west, from which come our strongest winds; in time they will straighten up.

Initial Pruning at Planting Time.

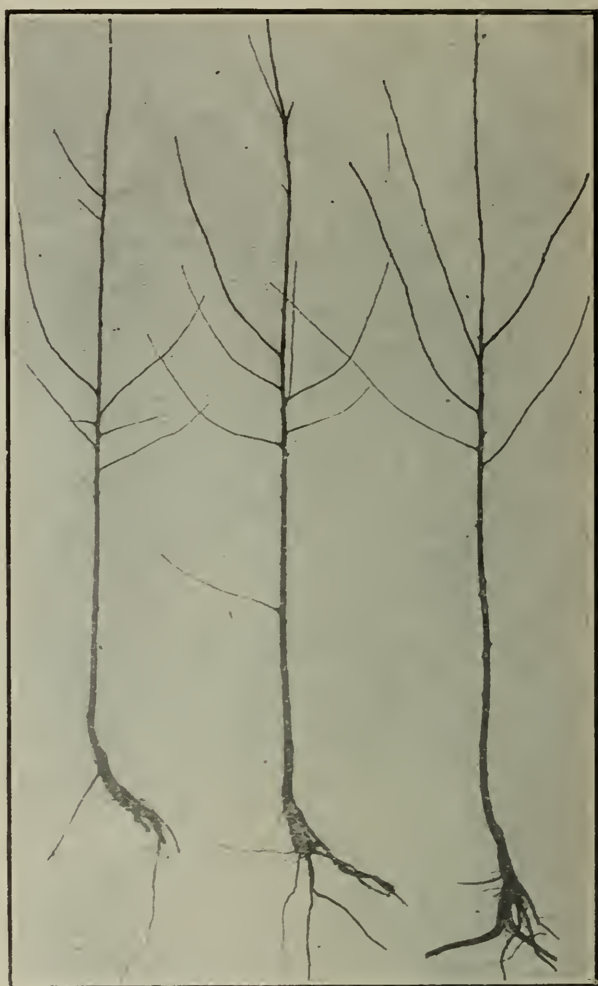
Pruning the roots is important, one-third to one-half of all tap roots over one-quarter inch in diameter should be removed, leaving a smooth surface showing living wood. Clean-cut surfaces very soon produce a callus of cambium from which young roots rapidly grow. Remove all broken and dead roots, cutting back also to living wood.

Pruning the top may be done before or after planting. In the case of apples it is preferable to do it afterwards, as the opportunity for discriminating in the final selection of a permanent head is greater. It is best in selecting your permanent branches to have them alternate and opposite. Do not tolerate a crotch under any consideration. Thousands of dollars are lost annually to the growers of this Province from trees splitting, due to the badly-formed heads. The usual plan is to select three or four branches to form the head of your tree. The grower must decide upon some ideal and prune as nearly as possible to that ideal. He must remember that absence of crotches, proper distribution of wood and symmetry are three very desirable features in a good, profitable apple tree.

Start your heads low, not more than three feet under any consideration, and twenty to twenty-four inches is more desirable. Low-headed trees economize in spraying, picking and thinning. The union of branch and trunk is stronger, the trees are not so easily twisted and shaken about by the winds, thus lessening the number of windfalls and broken limbs. Having decided on the height of the top, your next operation is to make the top conform to the ideal you have in mind. This is an important point; do not change your ideals once you have formed a correct one from experience or observation. Prune with the same ideal year after year and the final result will surely be gratifying. In pruning one-year-old trees very little can be done the first year, except to cut back the tops, being careful, however, not to cut them too low for fear they die back, thus destroying buds that were intended for the heads.

When selecting the three or four limbs to make the head, choose the strongest, providing they are spaced wide enough apart along the trunk and evenly distributed around the tree. A great deal can be done to form good heads by pruning upright growers to outside buds and spreading growers to inside buds. Always cut back to a lateral growing in the direction of the prevailing wind, as this is the only effective way of overcoming the relative position of the tree to the wind. With two year old stock, having cut out undesirable limbs, leave the rest either unpruned or slightly cut back. The reason for this is that buds near the tips of these limbs are more vigorous than those towards the base. In case of a dry season it will be noticed that trees severely cut back will often die, whereas those merely thinned out come through with a fair growth. Three or four year old trees will require to have about half their tops cut back to properly balance and form the head.

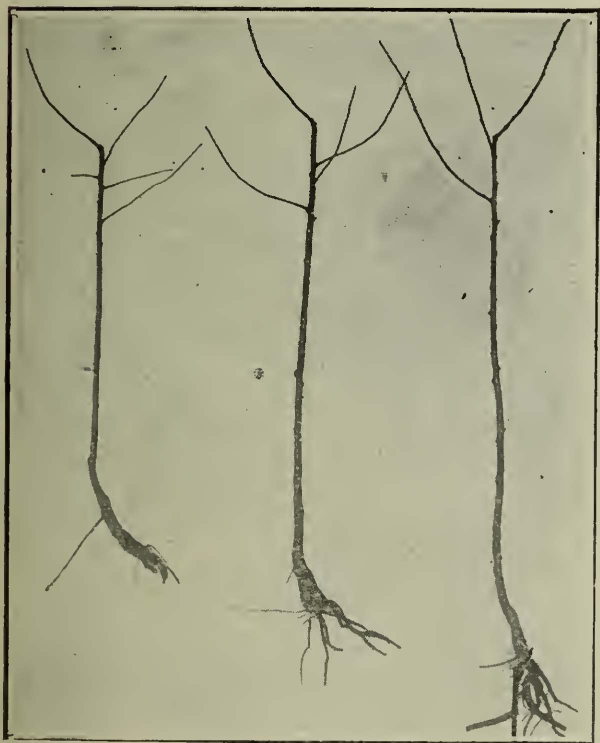
A good type of 1-year planted apple tree.



Two-year trees unpruned.

MANAGEMENT OF YOUNG ORCHARD.

In a newly-planted orchard, especially where interplanting is not resorted to, the amount of land that is not being used by the trees is too great to admit of special cultivation for trees alone. Besides this, the farmer or fruit grower cannot afford to allow this land to be idle. Throughout Ontario, especially east of Toronto, the general rotation of the farm is carried on with very fair results. These results would be greatly improved if the farmer had allowed his trees three feet of land on either side of the trees and kept this land cultivated. A good plan is to put the land in corn the first year, planting the corn between the rows and leaving a strip three feet on each side of the tree, and



Two-year trees pruned.

Top-working young trees.

the whole length of the row which should be cultivated along with the corn. The corn thus acts as a protection to the young trees in shielding them from sun and wind. The following year the land may be sown to oats and seeded down to clover, but an additional foot should be added to the strip on each side and kept cultivated. The third year a crop of clover hay is harvested. This may be continued for another year, but allowing the young trees still more room. In the spring of the fourth year the clover sod should be turned under, and the land may be utilized for a root crop. By this time the trees have attained a fair size, and cropping should be discontinued. This system may be modified to suit conditions, but where intercropping is being adopted the farmers are too eager to crop the land year after year, planting right up to the trees. This is a very grave mistake, and its disastrous results may be noticed in a great many orchards. If the above system is judiciously practised, and the space left for the trees kept well cultivated and fertilized, the trees will thrive and the cost will be reduced to a minimum.

Cropping with Small Fruits and Vegetables.

If the conditions are such that the farmer is able to go in for small fruits and vegetables he will find them most profitable, and they offer

A western type of scuffler.

almost an ideal condition for a young orchard. It must be borne in mind that, no matter what the method of intercropping may be, the tree rows should be left free and cultivated, and enough space should be allowed for the development of the trees every year. On no account give the trees a check, from which they may never recover. Young apple trees should be kept growing vigorously for the first few years, until a good bearing head has been formed.

Cultural Methods.

Cultivation in a young orchard should be fairly deep. It is often claimed that deep plowing does considerable damage by cutting roots. This is true in an old orchard that has been left in sod for years. This objection is not well founded where deep tillage has been practised from the start, for deep plowing encourages the roots to strike deeper into the soil. It is a doubtful question whether roots which are near the surface in sod orchards suffer from severe cold, but it is quite probable that they suffer a great deal from drought in dry seasons, and this at a critical time in the development of the fruit. In the St. Lawrence and Ottawa Valleys they overcome the winter damage to immature wood by mulching.

The following is a short description of cultural methods as recommended by Harold Jones, Maitland, for the St. Lawrence and Ottawa Valleys, and is applicable to Northern sections as well:

" Actual results have proved that it pays to cultivate our orchards, but the heavy losses we sustained about four years ago, brought out the problem that now confronts us in how far dare we go in this matter of cultivation and save our trees from winter injury in the colder sections of Ontario.

" Since 1904 I have been preaching a modified system of cultivation in my bearing orchards that is giving very satisfactory results in well ripened wood and well colored fruit of large size.

" To outline this system, I may say that instead of continuing clean cultivation until the middle of July or the first of August, as formerly, I plow as early in the spring as possible and about the 20 or 25th of May I harrow the ground level and sow to some cover crop either red clover or oats, as I find the fertility and the condition of the soil warrants. This leaves the ground in a level condition for the mower which is used at intervals during the summer to check any weeds or tufts of grass that are bound to appear during the season. The last cutting is made just before picking. If oats are clipped during the summer in this way they will remain quite green until fall.

" I find this system gives me an early vigorous growth, both in the wood and fruit buds, and the cover crop sown in this way does not draw any appreciable amount of water from the soil until the later half of the summer.

" When cutting, allow the material to lie where it falls as it all aids in supplying humus for the year following, and retards evaporation by wind and sun during hot dry periods. We have got a much shorter growing and ripening season than our neighbors to the west of us, and I find the system outlined above will give the early, vigorous growth that is necessary, followed by conditions very similar to sod during the ripening season.

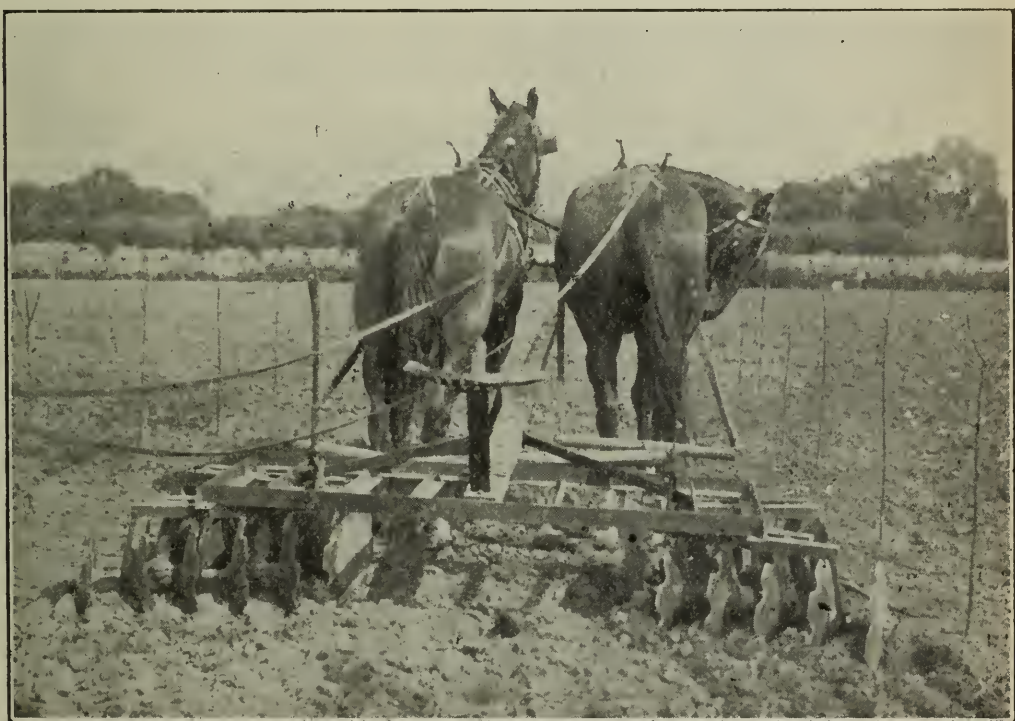
" Fertilizing and barnyard manure every two or three years spread at the rate of ten to twelve loads to the acre during the late fall or winter, with an annual spring application of about 100 lbs. muriate of potash, keeps the soil up to a high standard of fertility and also in a good mechanical condition."

When intercropping is given up or if the intercropping is done with fruit trees, methods that produce thrifty growth and proper maturing of wood should be carried on. In the colder sections of Ontario fall plowing is not to be recommended and even when it is practised, plow up to the trees just deep enough to turn under the weeds, etc. In the spring plow away from the trees, regulating the depth according to previous cultivation. Follow at regular intervals and after rains by thorough cultivation with harrows or cultivator until you desire growth to cease, then sow some cover crop. This is usually about the middle or end of July in the warmer parts and a week or ten days earlier in the more northern sections. The practice of fall plowing orchards has produced fatal results in numerous instances. In certain seasons of very cold and prolonged frosts orchards fall plowed bore no fruit, whereas orchards immediately alongside and receiving the same treatment throughout, except that they were plowed in the spring, came through the winter and bore good crops.

COVER CROPS.

Cover crops furnish the cheapest means of adding humus to the soil, and if a leguminous crop is used, such as the clovers or vetches, an addition of nitrogen is also obtained. Cover crops also assist in checking excessive or late growth thus maturing the wood. Where there is any likelihood of winter killing this is of obvious importance. They also conserve plant food, especially crops like the hairy vetch, or rye, which live over winter. While the tree roots are idle these crops are growing, thus preventing loss of food by leaching. Another benefit often noted upon hilly land, specially with loose soils, is that a good cover crop prevents washing of the land in spring and winter. Still another benefit is conferred upon the orchardist, more particularly in the southwestern counties, along Lake Erie, where the snow fall is light. The cover crop there holds the snow much longer than clean cultivation. This feature was most forcibly brought to the attention of the fruit growers in a winter of very low temperatures. Peach orchards were killed by root freezing. Exceptions to this were orchards in sod or under cover crop, and trees along fences where snow remained over the ground. Cover crops should be sown either broadcast or in drills just before the last cultivation, then thoroughly worked in, for at this season of the year germination and growth is usually slow.

The nitrogenous cover crops are the best on the average soil. They consist of all the legumes, such as clovers, vetches, beans and peas. The clovers and vetches have been found the most useful in Ontario. Of the clovers the common red and mammoth red are the best. They make a heavier growth and the catch is better as a rule. It is sown at the rate of 20 pounds to the acre after the last cultivation in July. Alsike clover, sown at the same rate per acre, has proven to be a very good variety in eastern Ontario. Crimson clover is an excellent crop for the southern counties, apparently adapted for improving exhausted soils. Alfalfa is sometimes used, but owing to lack of experiments it is not to be recommended for general use. Hairy vetch, though expensive, is one of the best cover crops for a bearing orchard. It lies close to the ground and forms a splendid mat of vegetable matter when sown at the rate of 25 to 35 pounds per acre. The growth in spring is very strong, but by early plowing with sharp roller coulter it is not difficult to eradicate. Rye is sometimes used, but only as a means of putting humus into improverished soils, rendering it more favorable for the growth of clover. Buckwheat will germinate no matter how late it be sown, adding a very large amount of humus. It is the best non-leguminous cover crop and is most used in eastern Ontario. Common peas sown with a nurse crop of barley make an excellent cover crop. Soy beans and horse beans are sometimes used with excellent results. As cover crops, weeds are better than nothing at all. They protect the land and have no injurious effect. Chickweed is perhaps the most ideal of weed cover crops. It re-seeds itself every year,



Double cutaway disc which breaks up the soil nearly as effectively as the plow.

forms a very close mat and is very desirable except that it does not store any nitrogen.

The value of cover crops to the colouring of fruit is attracting a lot of attention. It is held that by reducing the water content of the soil, the growth of the tree is checked with the result that greater color is developed on the fruit. Cover crops undoubtedly lessen the amount of water in the soil, particularly grain crops, and numerous instances of superior colouring have come under observation.

Cost of Cover Crops.

The following figures are comparative. The prices may vary considerably. Lower prices may be secured by buying through associations or in large bulk:

Cow peas, 1½ bus. per acre at $3.00 per bus.	$4 50
Mammoth Red Clover, 20 lbs. per acre at 18c.	3 60
Common Red Clover, 20 lbs. per acre at 17c.	3 40
Crimson Clover, 25 lbs. per acre at 14c.	3 50
Winter Vetch, ½ bus. per acre	4 25
Spring Vetch, 1 bus. per acre	1 80
Barley, 2 bus. per acre at 75c. per bus.	1 50
Peas, 1½ bus. per acre at $1.10 per bus.	1 65
Alsike, 20 lbs. per acre at 15c.	3 00

MAINTAINING THE FERTILITY.

In this matter the orchards are more thoroughly neglected than any part of the farm. With most soils in this Province to produce a profitable crop the orchard must be fertilized. Light sandy soils and also heavier soils which have been intercropped till the fertility has become exhausted show splendid results from fertilization. The most essential elements to production of fruit are nitrogen, phosphoric acid, and potash. Roughly speaking nitrogen encourages growth. Potash is essential to the development of the fruit and also is associated with the development of flavour in the fruit. Phosphoric acid is essential to the proper ripening of the wood and fruit. Lime is sometimes employed as a fertilizer for its secondary effect as it assists in the liberation of plant food.

Barnyard manure is more generally used than any other fertilizer. It supplies all the elements necessary to plant life and improves the physical condition of the soil. Where plenty of it can be had, commercial fertilizer will not often be necessary. In the vicinity of large cities, stable manure can be obtained in car lots at low price, and the freight rates are sufficiently reasonable to make it profitable to ship up to at least 100 miles. An application of 10 tons per acre given yearly should keep the orchard in splendid condition. The manure should not be piled around the base of the tree under any consideration. In bearing orchards it should be applied in the same manner as for field crops, covering the ground evenly in all direction. In young non-bearing orchards the best way to apply barnyard manure, when it is only desired to manure the trees, is to spread it around the trees, about as far as the roots will spread, leaving clear at least from one to two feet from the base of the tree. The old practice of piling manure up against the tree places the plant food away from the feed roots of the trees, and forms a harbor for mice in winter. As a tree develops, the greater proportion of the root feeding system is away from the trunk.

The use of commercial fertilizers is becoming more general among fruit growers, due largely to the fact that stable manure is somewhat scarce in many fruit growing districts. When this is the case the mechanical condition of the soil and supply of nitrogen should be kept up by the use of cover crops and by the judicious application of commercial fertilizers the other ingredients, phosphoric acid and potash, may be supplied.

A clover cover crop saves much money for fertilizers.

In order to get the best results from the use of fertilizers, the grower must study his soil, and by observing the results obtained from experimental applications he will soon find out which elements his soil lacks and which give him best returns. Commercial fertilizers are expensive, and require intelligent handling. Many growers have, without sufficient cause, condemned their use, while others, after studying their soil conditions are securing excellent returns for the money invested. There is no comparison between the labor involved in handling the same amount of available plant food in the form of stable manure and of fertilizer and labor is nowadays worth saving.

Commercial fertilizers being the subject of much controversy amongst leading horticulturists, it naturally follows that considerable differences arise. A certain investigator in the United States claims that fertilizers used on an orchard in New York State over a period of 12 years produced no appreciable increase in the yield of apples. The nitrogen content of the soil in this orchard, however, was sufficient for a great many years, hence many are of the opinion the experiment did not demonstrate that commercial fertilizers would not be of any use in an impoverished soil. The high cost of fertilizers makes their application a matter of serious consideration and forethought.

Young apple orchard, showing clean culture.

Bulletin 289, New York Agricultural Experiment Station, Geneva, N.Y., contains a suggestion on how to carry out an experiment to discover the best fertilizer. This is quoted as follows:

"The practical application of the information obtained by experiment is, that the apple grower should not apply manures in quantity until he has obtained some evidence as to what food elements, if any, are needed in his soil. Good evidence in this dirction is furnished by the trees themselves. So long as trees are growing well, adding a fair amount of new wood each year, and producing good crops of well-coloured fruit, it may be taken for granted that they need no additional food from fertilizers. Should the growth and behaviour of the trees be otherwise, it may be suspected that they need more, or other foods, and experiments should be set on foot to determine what and how much.

Plan for Home Test of Fertilizers.

"Such a test can easily be made by every orchardist, with but little additional outlay in time or money. The plan should be worked out, trees selected and fertilizers made ready for application during the winter season when regular work is not pressing; for if left until spring, the other demands will crowd aside this necessary and valuable work;—valuable not only from a financial standpoint, but also as a simple introduction to the spirit and method of scientific investigation by which alone the fruit grower can hope to keep himself master of the complexities of successful modern orcharding. Such a test should include six plats (seven, if thought best to include lime), each of at least five uniform bearing trees. On plat 1, use about 400 lbs. per tree of well-rotted stable manure; on plat 2, about 13 lbs. per tree of 14 per ct. acid phosphate or its equivalent; on plat 3, about 8 lbs. per tree of 50 per ct. muriate of potash; on plat 4 combine fertilizers as given for plats 2 and 3; on plat 5, a 'complete' fertilizer, made up, for example, of stable manure as on plat 1 with phosphate and potash as in plat 4 or use in place of the manure 13 lbs. of dried blood and 3⅔ lbs. of nitrate of soda per tree. On plat 6, if lime is to be tested, repeat plat 5 adding 25 lbs. per tree of good stone lime. Plat 7 (or 6, if lime is not considered) leave as a check. The fruit from these trees should be carefully weighed or measured, including culls and windfalls."

The commercial fertilizers most in use are nitrate of soda, bonemeal, muriate of potash, sulphate of potash, acid phosphate. In large quantities these materials could be obtained in 1911 at the following prices:

Bone meal (fine ground) less than 2 tons, per ton	$32 00
Bone meal (fine ground) 2 tons or over " "	31 00
Muriate of potash, 48 per cent., per ton	45 00
Nitrate of soda, per ton	57 00
Sulphate of potash, per ton	50 00
Acid phosphate, per ton	16 00

Certain firms in Toronto and other large cities handle all kinds of stable manure, and an idea of their cost may be obtained by giving prices quoted f.o.b. Toronto. For carload lots green manure is selling at present for 90c. per ton. Old decomposed manure sells as high as $1.50. The average car will contain from 32 to 35 tons. Summer prices are considerably lower, one firm advertising manure at 60 cents per ton this summer in lots of 10 cars.

PRUNING.

The training of an orchard should commence, as previously outlined, with the planting of the trees. The first few years should be given to the formation of a sturdy, symmetrical framework. This is only successfully accomplished by severe annual pruning of all wood not permanently necessary to the tree. Subsequent pruning should consist of removing cross limbs, maintaining the correct shape and holding excessive growth in check.

An ideal tree should be rather low set; the limbs should be strong and spread at a good broad angle from the trunk. The top should occupy all the space allotted to it without crowding. The limbs should be evenly distributed, allowing plenty of sunlight and air into the top. There should be an abundance of fruit bearing wood and an absence of crotches.

A four-year-old tree after pruning.

The advantages of such a tree are numerous, of which the following are most important: (1) The tree is more capable of developing and supporting a large crop. (2) The fruit will be of larger size. (3) Of higher color, and (4) more evenly distributed.

A few suggestions may be borne in mind, namely, that all cuts should be as clean as possible. Keep your saws sharp. Any wound over an inch in diameter should be painted with white lead. Pruning should be practised every year from the time of planting. If this is done the work will be greatly simplified and the cost very slight.

Time to Prune.

Pruning is better done in the spring, preferably before growth starts, but in case it is impossible at that time it may be done immediately after they leaf out. It is desirable to have the wounds heal as rapidly as possible to prevent decay, particularly large wounds. When it is done in the autumn or early winter the cambium layer is likely to die and the wood

Modern pruning tools.

dry out and split. It is obvious then that pruning should be done when the healing process is about to commence. This applies particularly to northern sections. In southern Ontario no serious damage has resulted from winter pruning. A moderate summer pruning of small branches will not hurt as these heal up quickly. This summer pruning is often practised and observations go to show that it induces the formation of fruit buds; on the other hand pruning in the dormant season tends to increase growth. The difference in results is not great and owing to rush of work in the summer months, winter and spring pruning is generally preferable.

RECLAIMING OLD NEGLECTED ORCHARDS.

There are a great many neglected orchards which, if they were properly pruned, sprayed and cultivated, would produce paying crops. As a matter of fact, the finest Spy apples at the Horticultural Show this year were grown on old trees carefully reclaimed.

All dead wood should be removed; high limbs cut back and cross branches cut out. This pruning will induce an abundant growth of suckers upon the large limbs. Those most favorably situated should be selected and cut back to form new fruit-bearing wood, and lower down on the trees and at points where no fruit buds have previously grown.

Trees in a neglected orchard require skilful treatment to bring them back to shape.

The long bare limbs may be made in time just as fruitful as the top and outside branches.

It is advisable in reclaiming these old orchards, in case they are in sod, to do the plowing in the spring after pruning; shallow at first, increasing the depth each year. Where tillage has been neglected the roots feed near to the surface and deep plowing the first year will destroy a great many of these feeders.

A thorough overhauling of the orchard should be undertaken. All rough bark should be scraped off because it covers many insects that are hard to reach with spray materials. A hoe is a convenient tool to scrape with—an ordinary handle for reaching the higher limbs (it is not often necessary to scrape higher than a man can reach with an ordinary hoe, standing on the ground), and a short handle for the trunk and lower branches. If the centre of the hoe is filed out to make a circular edge it will do better work, and not slip so often. Do not scrape deep enough to expose the live yellow bark.

Pruning now is not done the same as many did it 20 years ago. To-day it is allowed that low-headed trees are most profitable—they are easier to prune, spray and pick. Some old orchards have the main branches destitute of bearing wood 12 or 15 feet from the ground. When trees have been pruned as described part of the top branches should be cut off, always cutting back to a lateral. Cutting back the

Crotches in the head are sure to result disastrously.

head has a tendency to force out sprouts on the bare lower branches. There are some trees so high that it is next to impossible to spray or pick. There is no profit in growing apples that cannot be sprayed, and apples shaken off are almost without value.

Such high trees as those described should be lowered. Twenty-five feet is a high tree, rather lower is better. There are many trees in Ontario forty-five feet high. Such high trees should not be lowered to twenty-five feet in one season. That would be a terrible shock to the tree and it might die. In pruning it really takes more time to determine what to cut off than to do the cutting. This suggestion to some may look like a waste of time, but it is not really so.

Look carefully round the tree and determine where there is a likely place to head back to. About five or six feet in one season would be lowering a tree very fast. The pruner should make up his mind when on the ground about where he means to cut back to, but after looking at the top of the tree he may find it necessary to cut slightly higher or lower because of the lateral branches not being exactly as he thought they were when on the ground.

First cut back the centre, then the outer branches to laterals corresponding in height to the centre. The centre of the tree should be highest, gradually sloping lower to the outer branches. In every case cut

Apple tree second year after grafting.

back to a lateral. The following season those still high should be lowered more to the next lateral, several feet lower, and so on every season or every other year until the tree is the desired height.

When trees are so closely planted that the branches are growing into each other, these trees should be cut back all around, leaving at least three feet of space free from branches. That much space or more is necessary for sun and air and to enable free driving with the spray outfit. Cutting back all side branches of large trees has a tendency to make the branches stiffer so there is less danger of fruit being rubbed by swaying branches. The sprouts that will likely come on lower branches after such top pruning should be left on where necessary to fill vacant spaces, others cut off at once. Cut back those sprouts that are to be left to a length of six inches, leaving the last bud pointing in the direction the branch is desired to grow. Sometimes it is necessary to tie a sprout and force it to grow where it is needed. These sprouts, if cared for, will bear fruit in three years. As a rule there has not been nearly sufficient labor put on the outside of the tree. To have fine apples they must have light and room. A safe rule is, never leave a branch or twig that can rub or touch another branch when loaded with fruit.

Baldwin tree thinned out to let in the sun.

Thorough pruning of large neglected trees is a slow and expensive business. A first-class pruner has been as long as eight hours on one tree. Many districts are spraying thoroughly, but few can be called well pruned. It is not advisable to cut large branches if it can be avoided. Occasionally, there is a large branch so low that a team cannot get close enough to plough or cultivate. In such a case cut the branch off.

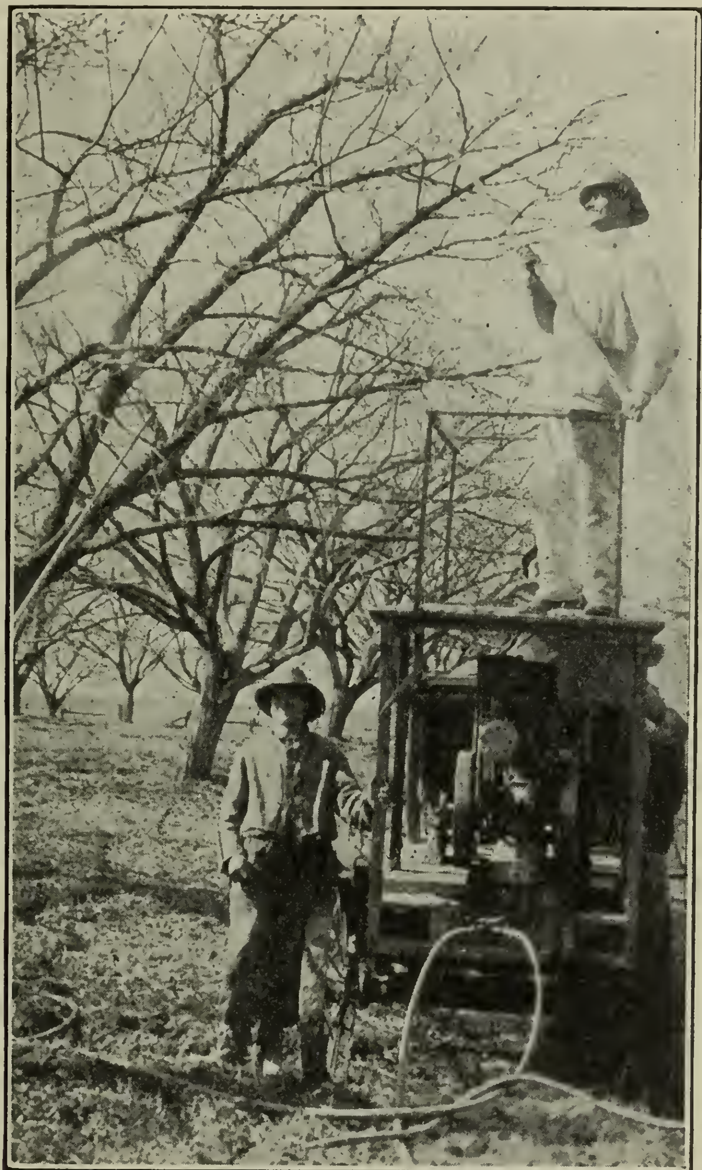
There is no tool the equal of a fine-tooth, sharp saw for pruning. When the branches can be reached, clippers may be speedier, but do not make such clean work. There is a saw manufactured in the States that is superior to anything yet made in Ontario. This saw has a blade half an inch wide and about eighteen inches long, with a strong back about three inches from the blade, so there is little or no friction. Last season some of these saws were in constant use during a long pruning season and never required sharpening. (Spare blades can be got for these saws.) What is generally known as a long-handled pruner is to be used where saws cannot reach. These pruners are of various lengths. Eight feet is a convenient length, with one twelve feet long for very high trees. In every case cut as close to the branch as possible. Shoulders or stubs are unsightly and the wound does not heal so well.

The pruner should be very careful not to bruise or break the bark with rough boots or ladders. Broken bark is a most likely place for spores of black rot canker to start. In some districts there are a great many trees injured with this disease, and if not cut out or treated the tree is likely to die. If the disease has gone completely round the branch, cut it off about twelve inches below the injured part. Burn all black rot canker at once. When only a small portion of the branch is infected, it can be treated and brought back to a healthy condition. With a sharp knife cut off all the discoloured bark and anything that looks unhealthy; then disinfect with corrosive sublimate at a strength of 1 to 1,000. Corrosive sublimate can be procured from any drug store. Apply the solution with a small stiff brush, rubbing well into the bark. When the wound is dry, paint with two coats of white lead and raw oil paint. This paint is only for protection until bark grows over the wound.

SPRAYING.

While spraying is not a panacea for all the ills of the fruit grower, it is absolutely necessary to the production of fruit free from blemishes, and to the vigor of the tree for protection against insects and fungous diseases. To be of any value the mixtures applied should be of proper strength, applied at the correct time, and the work thoroughly done. Until quite recently it was believed that trees should just have a misty covering. Too much stress was laid on this claim with the result that the work was not thorough and results were not uniform, and often very discouraging. The trees must be thoroughly sprayed—every part completely covered.

A steady high pressure is indispensable to accomplish good results, not only from an economical point of view, but for efficiency. A pressure of from 100 to 150 pounds should be used, and this is most easily obtained and maintained with a gasoline or some other power machine. Hand pumps of the double acting kind can give a pressure of 100 to 125 pounds, but unless the operator is closely watched this pressure will not be continued for any length of time. A 2½ horse power gasoline engine with two lines of hose can discharge from 1,000 to 1,500 gallons per day, depending upon the convenience of tanks and water. The amount of spray required per tree varies considerably. Five or six gallons per tree is a fair estimate, although in very large trees the amount will be more. Of course, in a season of a short crop a less amount may be applied for coddling moth; and trees devoid of bloom may be left until



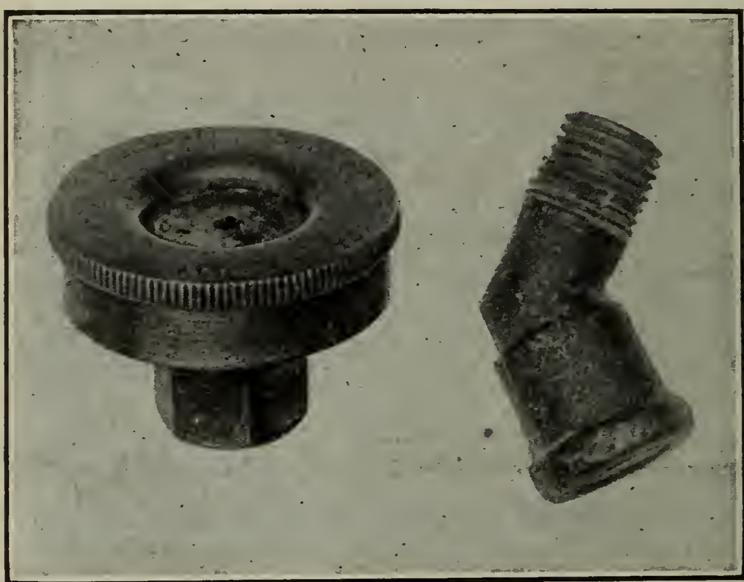
Type of gasoline spray outfit for large orchards.

the others are done, and then as time permits these may be gone over to protect the foliage from insect and fungus attacks.

The wind is seldom too strong for spraying. In fact a stiff breeze is preferable in that it carries the spray into the tree. Spray with the wind, and do as much of the tree as possible. Spraying three-quarters of the tree with one wind is possible. One side of the tree can be sprayed as it is approached. For large trees it will be found convenient to stop again directly opposite, and then complete the other side at the third stop. Medium sized trees can be covered by stopping only twice. Spray as much of the tree as possible with one application for the wind may not be favorable when it is necessary to complete the other side.

Spray Outfits.

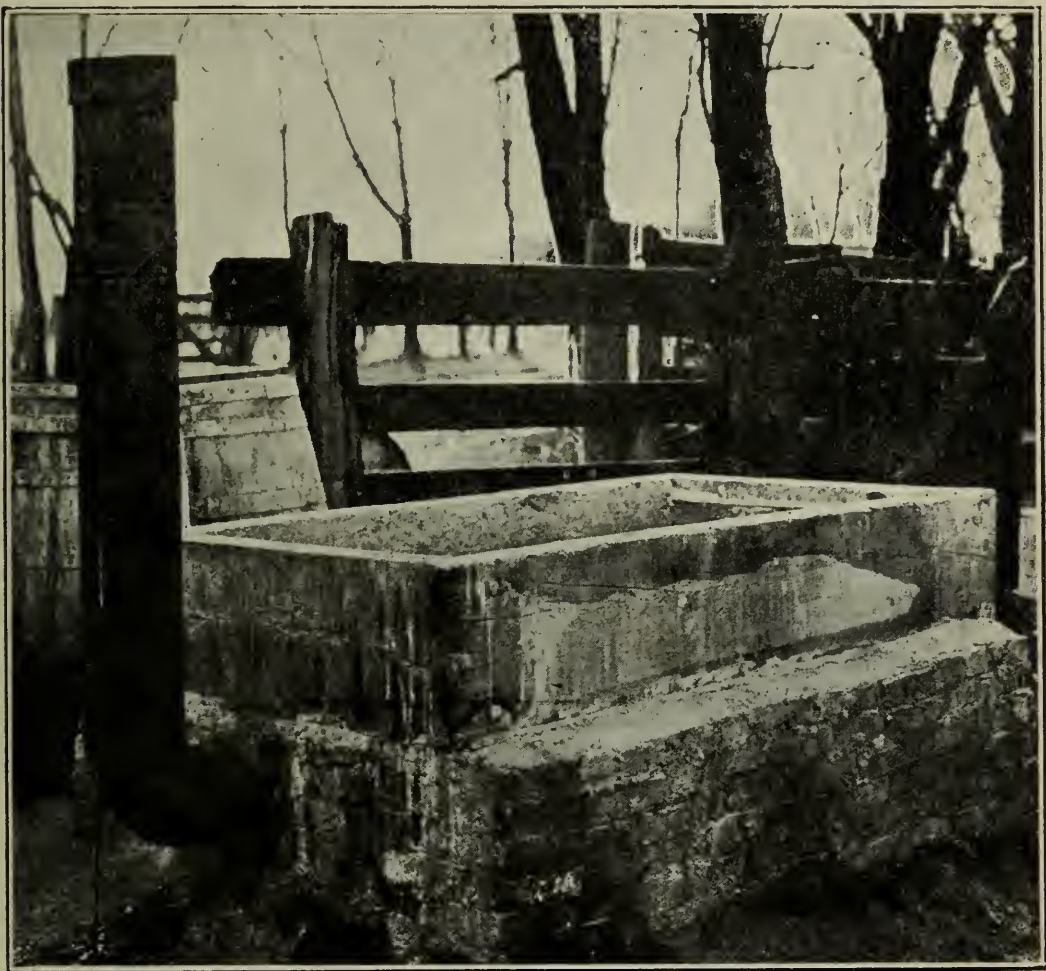
For orchards up to ten acres a double acting hand pump will answer the purpose. These may be secured with complete outfit including 150 gallon tank for from $60.00 to $80.00. Good pumps of this kind are very popular with the smaller fruit growers, and have the advantage of



Friend type of nozzle, and a small brass elbow found very desirable in spraying. Both natural size.

being constructed for connection with an engine if desired. Barrel pumps are still quite popular and serve their purpose very well for small home orchards. These can be bought complete for from $20.00 to $25.00. For orchards of 10 acres and over one or more power machines will be found indispensable. These cost from $275.00 to $325.00 complete with waggon tank, etc. A good gasoline engine will pay for itself in a couple of years by the labor saved and in efficiency of work, besides being of great use for pumping water or sawing wood when not used at spraying time.

Since high pressure is necessary for good results, the quality of the fittings, such as rods, hose and nozzles, should be of the best. Use nothing but the strongest kind of hose, and have an extra supply on hand together with plenty of brass hose couplings. Two lines of hose are necessary in almost all cases, one for the man on the ground and another for a man on the tower. Of course, in young orchards the tower may be dispensed with and the spraying done from the top of the tank. For the tower man a hose 10 to 12 feet long and a rod 8 feet long are best; for the man on the ground 25 to 35 feet of hose and a 10 foot rod.



A cheap but efficient boiling plant for making the lime sulphur wash.

The most widely used nozzles are probably of the "Friend" type, particularly for the lime sulphur spray. Vermorel cluster nozzles are somewhat apt to clog and their use cannot be recommended except for thin washes free from paste. Brass elbows which set the nozzle at an angle are particularly recommended while spraying for codling moth, where it is necessary to direct the spray downward into the fruit clusters.

Considering these points in successful spraying of large orchards it is apparent that the first essential in a pump is its ability to maintain a pressure of not less than 150 pounds with two lines of hose and four large nozzles. Only pumps that are high grade in every other respect can maintain this pressure.

Spray Mixtures.

Lime sulphur is now the most important and widely used spray. There are four forms in which it can be had: (a) commercial, (b) home-boiled, (c) home-made concentrated, (d) self-boiled. The commercial form is manufactured by several firms in Ontario, and sold in barrels containing 40 or more gallons, which should be diluted to a standard ascertained by an hydrometer. This mixture, while it is somewhat more ex-

Steam Cooking Plant.

pensive than the home-boiled wash, has found favour with the grower who does not wish to make it himself. The use of home-boiled spray is being extended specially since the home made concentrated mixture has been devised. The mixture is easily made and the boiling outfit is inexpensive. A very efficient and simple device is made as follows:

Make a tightly-jointed box of 1½-inch boards or 2-inch plank, 3 feet wide, 6 feet long, and 15 or 18 inches deep. The bottom should be made of heavy sheet iron closely nailed and extending about an inch beyond the edges. This is placed upon a cement, stone or brick foundation, high enough to permit of a good fire being kindled beneath. A chimney of some kind is placed at one end to create a good draught. This cooker will boil a barrel of the mixture very quickly, owing to its large heating surface. It will be necessary to make a cover of boards running lengthwise, with a space between the two centreboards for stirring. Insert a faucet at the most convenient corner, slightly above the bottom, to prevent sediment from escaping.

How to Make the Wash.

The formulæ generally used for the ordinary home-boiled mixture are 15 lbs. sulphur, 20 lbs. lime, 40 gallons water, and 18 lbs. sulphur, 20 lbs. lime, 40 gallons water. Fill the receptacle about half full of water. While this is boiling make the sulphur into a paste by gradually adding water and stirring. Measure out the lime, add it to the boiling water and while slaking vigorously, add the sulphur. If the boiling is so vigorous as to splash over add a little cold water, or in the case of steam plants, turn off the steam. It is particularly necessary that boiling be vigorous, but if the barrel or box be filled too full a great loss of material will occur. It is well to keep the receptacle covered with an old sack or boards. To obtain good results and render the greatest proportion of the sulphur into solution it is necessary to boil for from 45 to 60 minutes, and stir constantly. As soon as the boiling is done, either hot or cold water should be added to make up to 40 gallons, and the solution strained through a fine wire screen. The mixture is much better applied hot. In case the mixture has unavoidably been allowed to stand until next day, it should be reboiled to dissolve any crystals that have formed.

Concentrated lime sulphur is made by increasing the amount of lime and sulphur in solution. The advantages of the concentrated wash are that large quantities can be made at one time and that it can be stored for long periods by excluding the air. A small quantity of mineral oil added will float over the surface, thereby rendering it air-tight. The fact that this concentrated wash will keep has induced a great many growers to manufacture it especially in view of the fact that it can be made early in the spring before the rush of other work is on.

The methods of procedure are similar to the preparation of the ordinary spray. The proportions used are 1 part lime to 2 parts sulphur. The common formula is 50 pounds best lime, 100 lbs. flour or flowers of sulphur made up to about 40 or 45 gallons. Sometimes the ingredients are used in the proportion of 60 to 112, or 65 to 125. So it is seen that they vary somewhat. A very convenient way is to use 1 bag of sulphur (112 lbs.) and 1 bus. of lime (70 lbs.). This does away with the trouble of weighing and the extra handling necessary.

To about 10 gallons of boiling water add the lime. While this is slaking make the sulphur into a paste and carefully break up all lumps. If this is neglected a considerable portion of this sulphur will remain in the sediment. While slaking is going on add this sulphur paste, stir constantly and then add enough boiling water to make up the 40 or 45 gallons when completed. Color tests are not reliable. From 45 to 60 minutes boiling will be sufficient.

When good materials are used and cooking carefully done very little sediment will remain. If any considerable amount of sludge is left it should be washed and this water used in the preparation of the next batch.

Rules for Diluting Before Spraying if a Specific Gravity Hydrometer is Used.

Put the hydrometer in the clear liquid when it is cool and the sediment has settled. Note the reading. Suppose this is 1.240 sp. gr. The proper strength for use before the buds burst is 1030, but if San Jose Scale has to be combated it is better to make it 1032. To determine how much to dilute a wash reading 1240 to get a strength of 1030 divide the first three figures to the right of the 1 by 30, that is 240 divided by 30=8. This means that each gallon of the wash may be diluted with water to make 8 gals. of the strength of 1030. For San Jose Scale divide by 32 instead of 30, that is 240 divided by 32=7½; so that in this case each gallon may only be diluted to 7½ gals.

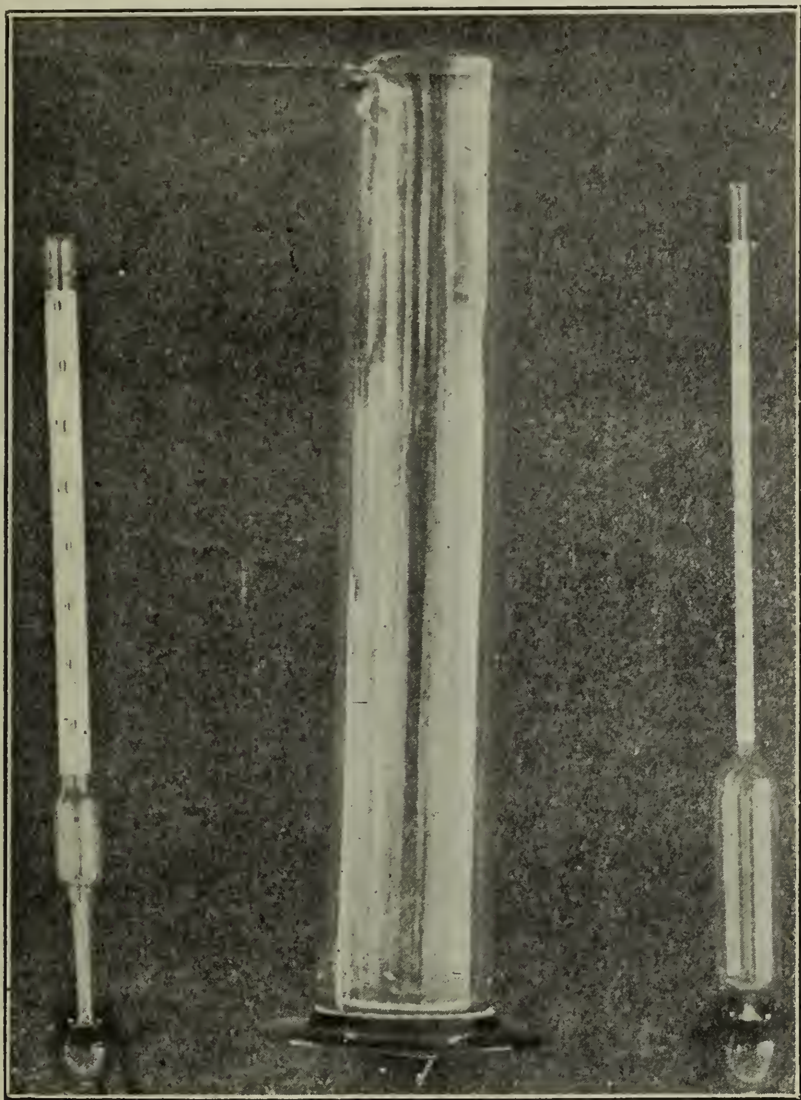
For use on apples and pears just before the blossoms burst the proper strength is about 1009. To get this strength from a wash reading 1240, divide in the same way the first three figures to the right of the 1 by 9, that is 240 divided by 9=26⅔. This means that each gallon of such a wash for this application may be diluted with water to 26⅔ or 27 gals.

For the application just after the blossoms have fallen and for any subsequent applications, if any are given, a strength of about 1008 is satisfactory. To get this we proceed in the same way as above and divide the 240 by 8, which gives us 30, thus indicating that for this application each gallon may be diluted to 30. *In brief the rule is: Take the reading of the wash and divide the three figures to the right by 30 (or 32 if for the San Jose Scale) for the first application; by 9 for the second and by 8 for the third, and dilute each gallon with water to the number thus obtained in each case.*

Bordeaux Mixture.

Owing to the good results given by lime and sulphur as an insecticide and fungicide there has been a great falling off in the use of the Bordeaux mixture. There is now no question about the value of both these mixtures, but the latter has lost in popularity owing to its russeting the skin of the apples in many of our best standard varieties. Perhaps too little attention has been given to the preparation of Bordeaux. The general way is to mix it by guesswork, the grower forgetting that the best results are only attainable where care is exercised in the preparation of any spray mixture.

Bordeaux is a long-established mixture, and we have varying proportions of its ingredients. This is due in part to the desire to arrest the injurious effects above mentioned. The standard formula is 4 lbs. bluestone, 4 lbs. lime, 40 gallons water, known as the 4-4-40. However, formulæ 4-4-50; 2-4-50; 3-5-50 apparently have given good results. Some authorities claim that it is not the strength of the application that



The hydrometer, a necessity in using the lime sulphur mixture.

does the injury, but that too much spray has been applied. This is a point of considerable interest, for it has been noticed where thorough heavy spraying with Bordeaux is done the greatest injury has resulted.

The point to be most careful of in making is not so much the formula used (if it has been tried), as the way to mix it. The effective part of a good mixture is the blue precipitate which will settle to the bottom of the tank when allowed to stand. This is the portion we are most concerned about. To be of most benefit, then, this precipitate should be as fine as possible, or in other words, remain in suspension as long as possible.

To get the copper sulphate crystal into solution most quickly break it into small particles, place in a bag and suspend in water. If possible, secure the sulphate in the granular form as it is more easily dissolved. The most convenient way is to mix proportionate amounts of bluestone and water; dissolve 50 lbs. in 50 gallons of water. Then when this is wanted for use the desired amount can be taken out by measuring, as a gallon of the liquid contains one pound of bluestone. It is necessary to use a tub or barrel to contain this mixture as it is very corrosive to tin or iron.

While the copper sulphate is dissolving, slake the lime, which should be perfectly fresh and in large lumps, by adding small amounts of warm water until it is powdered, then make into a paste. The important operation now is in mixing, or rather in not mixing the concentrated solutions, for when concentrated solutions are mixed a very heavy precipitate is formed. For this reason the bluestone should be diluted to 20 or 25 gallons with water, the lime to a similar amount, and then the two liquids poured at the same time into the spray tank. Always strain the liquid through a fine wire screen into the tank.

POISONS.

Arsenical poisons are generally used in order to eradicate or keep in check the biting insects. They are usually applied in conjunction with the fungicide. The chief poisons in commercial use are paris green, arsenate of lead and arsenite of lime or white arsenic.

Paris green has been the old standby. It is used in the proportion of from 4 to 6 oz. to 40 gals. of water. It should be made into a thin paste by a gradual addition of water. Its greatest drawback is that it settles very quickly owing to its heaviness, and a proper distribution of the poison is not effected unless the mixture is constantly agitated. A variation in the percentage of free arsenic in the composition of this poison sometimes leads to disastrous effects on the foliage. A good brand should not contain more than 3 per cent. of free arsenous oxide. Paris green should not be used in conjunction with lime sulphur.

Arsenate of lead has practically supplanted paris green in many sections, owing to its safety. It is used at the rate of 2 to 3 lbs. to 40 gals., 2 lbs. however, of any good brand being enough. The paste should be rubbed into a thin milk by gradual addition of water before being added to the spraying mixture. It is very finely divided and offers a thorough distribution, moreover, is valuable owing to its sticky nature. While expensive, it gives the best results, and is the only arsenical poison which can be safely used with the lime-sulphur mixture. Good arsenate of lead contains no free arsenous acid and about 15 per cent. arsenic oxide, which is the valuable ingredient. Guaranteed brands can now be bought at from 10c to 12c per lb.

Arsenite of lime might be used more extensively with the Bordeaux mixture. This poison is much the same as arsenate of lead, in that the distribution through the mixture is thorough. In addition, it is very cheap and easily made. There has been considerable burning of the foliage, but this has been due to a lack of care in preparation and application.

Formula:—White arsenic, 2 lbs.; sal soda, 2 lbs.; water, 1½ gallons. Add the arsenic and soda to the water and boil, stirring the mixture until the arsenic is dissolved. Then add 3 lbs. of fresh lime and boil for a few minutes; allow to cool and make up liquid to 2 gallons. Use one quart of this mixture to 40 gallons water.

Some growers use a combination of the poisons, especially paris green and arsenic. It is not economical and nothing is to be gained by it. A comparative idea of the cost of the spray material may be gained from 1911 prices as given below. These are in most cases f.o.b. factory or warehouse.

Bluestone, granulated, in 450 lb. bbls.—	
Less than bbls., per 100 lbs.	$ 6 00
1 barrel lots	5.00
Two or more barrels	5 00
Sulphur No. 1, in 112 lb. sacks, per sack	1 96
Lime Sulphur, concentrated in barrels	8 00
Soda Ash,—	
In 300 lb. sacks, per cwt.	1 25
In 100 lb. bags, per cwt.	1 50
In 50 lb. bags, per cwt.	1 90
White Arsenic,—	
In 550 lb. bbls, per cwt.	4 75
In 100 lb. kegs, per cwt.	5 25
In 50 lb. boxes, per cwt.	5 50
In 25 lb. boxes, per cwt.	5 75
Arsenate of Lead,—	
500 lb. bbls, per cwt.	10 00
100 lb. kegs, per cwt.	11 00
50 lb. kegs, per cwt.	11 50
25 lb. kegs, per cwt.	12 00

COST OF SPRAYING.

An approximate idea of the cost of spraying may be formed from figures to follow. Of course there will be considerable variations and difference of opinion regarding this subject, but for trees thirty years of age and planted about thirty to the acre, the following figures will give a fairly accurate estimate of the cost of spraying ten acres with a power outfit:—

10 acres, 400 trees.	
3 men at $1.50 per day	$4 50
1 team at $2.50 per day	2 50
	$7 00

Lime sulphur applied with power sprayer averages 1,000 gallons per day. 1,000 gallons applied per day at cost of $7.00 for labor gives us cost of .7 cent per gal. Lime sulphur at $9 per barrel delivered, diluted 9-1 will make about 400 gallons spraying mixture, thus costing 2.25c per gallon. Now the cost of mixture on the trees per gallon will be .7 plus

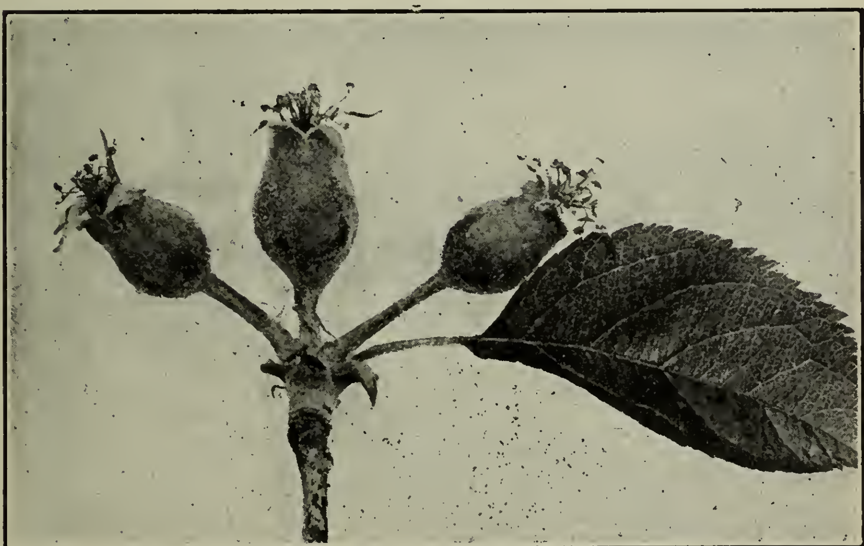
Blossoms off, calyces open, and ready to spray.

2.25, which is 2.95 cents per gallon. An ordinary tree will require about 4 gallons per application. 4 gallons at 2.95 cents per gallon will cost 11.80 cents per tree for the first spraying. The second spraying diluted to 1-30 will make 1,240 gallons, at cost of .72 cents per gallon for mixture and .7 cents per gallon for applying. Now adding the 2 lbs. arsenate of lead per 40 gallons, at 10 cents per lb., the poison would cost .5 cents per gallon. This totals up for second spraying 1.92 cents per gallon, 6 gallons per tree (due to the fact that the leaves are opening), costs 11.52 cents. The third spraying will be the same as the second. The first spraying at 11.80 cents; the second at 11.52 cents, and the third at 11.52 cents gives us a total of 34.84 cents per tree. Three hundred trees would cost $104.52.

Summary of Spraying Rules.

Apple trees should be sprayed three times each year and in some seasons a fourth application, the same as the third, may be necessary.

Calyces closed; cannot get the poison inside now.



Calyces nearly closed, rather too late to spray.

(1) Just before the leaf buds are bursting. This is to control San Jose scale, oyster-shell scale, and blister mite, besides assisting against scab and canker. Use lime-sulphur, either commercial or home-made of a strength as noted below.

(2) Just before the blossoms burst. This is to destroy tent caterpillars, case bearers, canker worms and bud moths. Use Bordeaux mixture (4-4-40) and 2 lbs. arsenate of lead to each 40 gallons, or use lime-sulphur (commercial) 1-30 with 2 lbs. arsenate of lead.

(3) Just after the blossoms fall. This is to destroy the codling moth and scab and help against lesser apple worms and plum curculio. Use Bordeaux (3-3-40) with 2 lbs. arsenate of lead or commercial lime-sulphur, 35-40 to 1, with 2 lbs. arsenate of lead.

For aphids examine twigs and buds just before latter burst, and if present, spray at once with kerosene emulsion or whale oil soap.

1.—Kerosene Emulsion.

Kerosene (Coal oil)	2 gals.
Rain water	1 gal.
Soap	½ lb.

Dissolve the soap in water by slicing and boiling; take from fire, and while hot pour in kerosene and churn vigorously for five minutes. For use dilute with 9 parts of water, so that the above 3 gallons of stock emulsion will make 30 gallons of spray mixture.

2.—Whale Oil Soap.

For brown or black aphids, 1 lb. in 4 gals. For green aphids, thrip and leaf hopper, 1 lb. in 6 gals.

Disinfectants (for pruning tools and for wounds on trees).

One pint formalin diluted to 2 gallons with water; or corrosive sublimate 1 part to 1,000 by weight=1 tablet to 1 pint of water. Apply with a swab on end of a stick.

TOP GRAFTING.

The question of the value of top grafting has been attracting a great deal of attention. Previously top grafting had its chief advantage as a resource to the grower when he discovered that he had certain varieties of fruit that were unprofitable, and wished to renew the top with some more desirable kind. By many, however, it is believed to promote earliness of bearing. This latter point has very little conclusive proof to back it up. The adoption of top grafting in order to secure hardiness is a valuable point. For instance, such hardy, vigorous stock as McMahon, Tolman, Baxter may be planted and top worked with varieties which are good but shortlived in that section owing to lack of hardiness. Such stock also has the value of having a very strong union of branches to trunk. Varieties like King or Canada Red form weak crotches which canker badly. For this reason hardy stocks are grown and scions of these varieties inserted into their branches.

The practice of top grafting then is valuable only when there are varieties which for some reason it is desirous of changing to some other variety and in sections where it is desirous to grow varieties which are not very adaptable to those sections owing to lack of hardiness and in perpetuating some special strain. The factor of shortening the time before the tree reaches the bearing stage is still questionable as well as the degree of influence which the stock has on the development of colour of fruit produced by the scion. It is, therefore, not advisable to produce varieties by top working which are admirably suited to a section without this expedient, as the variety on its own stock will in every probability produce just as good fruit and the orchard itself will have a much more uniform appearance.

Top-working of small trees.

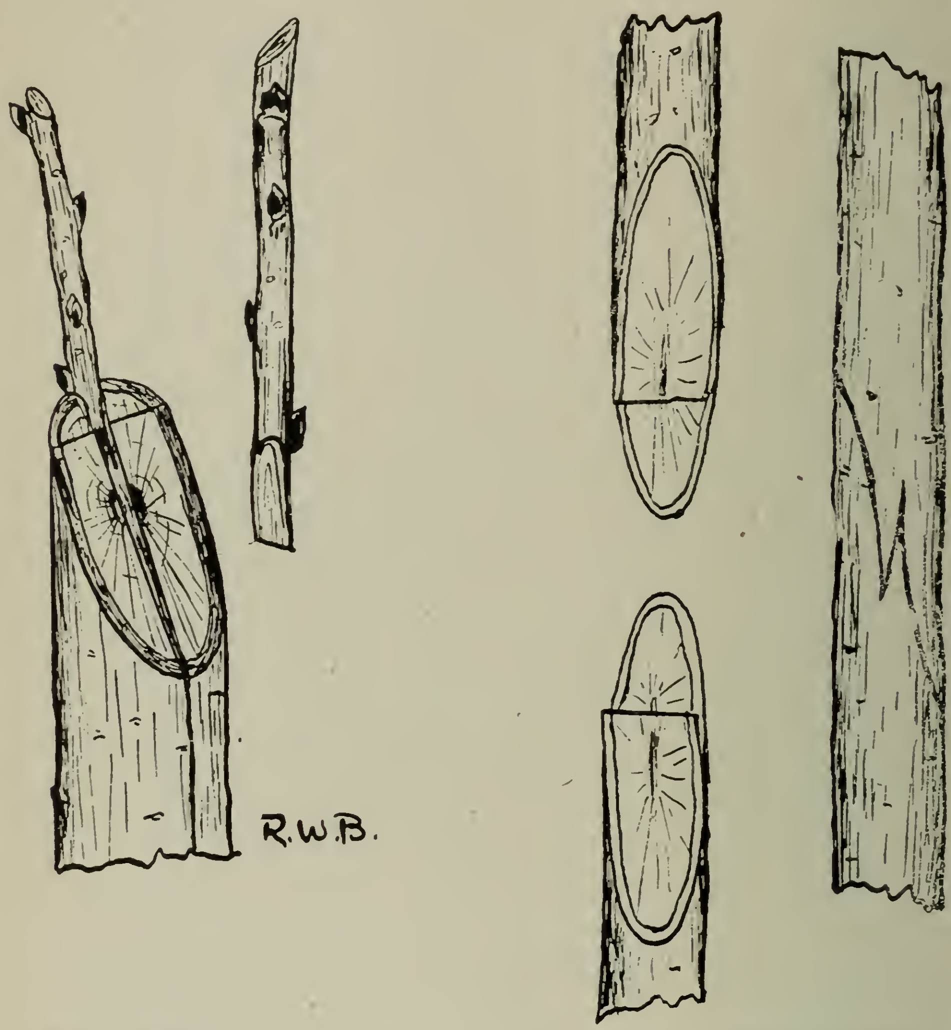
Grafting should be done in the early spring, preferably in the latter part of March. Much of the failure has been due to grafting too late in the season. Scions should be made from last year's wood, cut into 3 or 4 bud lengths.

Preparation of Tree for Top-Working.

Cut main limb off as low as possible, bearing in mind that a limb more than 2½ inches in diameter is not very successfully top-grafted. If handling mature trees it is well to spread the period of conversion over two or three years so as not to have too sudden a change. If possible, always make your cut above some small laterals so as to have the lateral utilize some of the sap. Trees up to six years may be top-worked in one year. The grower, however, must use his discretion judging from size of tree and vigour.

Inserting Scions.

It is of prime importance to have the cambium or sap layers of stock and scion in contact with each other in such a way as to promote a good



Cleft grafting. Tongue grafting.

Methods of grafting commonly employed.

flow of sap as soon as possible. Insert the scion at a slight angle, the top pointing outwards. It is not advisable to insert more than two scions. In large limbs to split them both ways makes a wound which seldom heals over properly. In working over the entire top of a large tree do not insert all the scions vertically. Choose some limbs growing horizontally and set the scions in these correspondingly. Having split the stub with a grafting iron the split is kept open by the upturned edge of the iron; the scion is inserted and the whole cut surface covered with wax. In the case of large limbs any undue pressure upon the scions should be relieved by wedging the split, allowing just enough pressure to hold it firmly in place. The best way to cut the scion is to start opposite the bud, cut it wedge shaped about one inch long, leaving the bud edge wider than the inner edge. This will insure a firm contact with the cambium layers. Set the bud slightly below the top of the stub.

Whip or Tongue Grafting.

This is practised on small limbs, usually on two or three year old trees. Choose a scion as near the same size of the stock as possible. Cut each with a long slanting cut. Both parts are now cut into and the tongue of one fitted into the notch of the other. Bind firmly with strong string or raffia and cover the whole with wax.

Wax.

A very good wax is made of the following: One part tallow, two parts beeswax, four parts resin. Melt these together, pull and cut into convenient size for use. This may be easily handled by first applying grease to the hands when using. Some grafters find it more convenient to melt it and apply it with a brush. Waxed cloth is also used. This is made by dipping strips of cotton into the hot mixture until saturated. The wax for this purpose should be made a little thinner by adding more tallow.

Top-Working of Young Trees.

Hundreds of young trees of hardy varieties have been planted in order that they may be worked over. The best age to graft these trees varies, but if desired, as soon as the limbs are about a half inch in diameter, they may be worked over. The same attention must be given in the formation of head as in the case of any orchard. The limbs should be properly distributed and crothches avoided.

Care of Grafts After They Have Taken.

Most of the growers put in the grafts and leave them, and as a result, if they all grow, the head of the tree is like a thicket. The grafts usually make a rapid upright growth and start to branch three or four feet from stock causing the head to be higher up than it was before, which is a great drawback. The graft should be headed back and if one is enough to cover the surface of graft, all others should be removed. If this is followed the union will be stronger and the work more uniform. The second and third years the tops should be removed, leaving the grafts only.

Selection of Scions.

There is invariably some tree which is outstanding in the quality of its fruit, colour and productiveness. The grower should always endeavor to get his grafts from trees like this, remembering that the graft will produce the same as the parent and a splendid opportunity is offered the grower to establish an orchard of guaranteed unifomity and embodying an excellent quality which has been proven and found to be valuable.

Top-Working by Budding.

Budding is not practised very much by the average grower for the simple reason that it is not understood as generally as grafting and is only adapted to small trees. Budding is usually done in September, just at the season when the flow of sap is not too great. The buds are cut from the same season's growth and from trees with desirable qualities. It is removed from the wood by an upward stroke, taking as little wood as possible. The leaf is cut off leaving about a quarter of an inch of the stem. To insert it a long cut is made through the bark of the stock and at the lower end a short cross cut is made; the bark is loosened with the bone end of the budding knife. The bud is inserted, pointing upwards and then pushed up or down into place. It is then tied firmly with raffia, strong or waxed cloth. The raffia is removed in the course of two or three weeks, or as soon as the buds are firmly knit.

Bridge-grafting.

Bridge-grafting is practised in cases of injury by mice and rabbits or implements. The injured bark is removed and the portion bridged by cutting scions wedge-shaped at both ends and inserting the ends under the bark. Both unions are then waxed over. In some cases this is very beneficial, but in complete or nearly complete girdling it is well to cut down the tree, and if no sprouts appear above the union of the nursery to dig it out and plant another tree, or to bud or graft the best shoot from below the union, if such is available.

SUNSCALD.

Sunscald is confined principally to northern districts. It is an injury caused by the alternate freezing and thawing of parts exposed to the hot sun in early spring. The bark on the southwest side looks unhealthy and dies and splits when dried. It occurs mostly on young trees, and very often seriously on the large limbs. In districts where sunscald is apt to occur low headed trees are of a decided advantage, as the branches afford shade to the trunk. Corn stalks, building paper, wood veneer or newspapers are used to protect the trunks in early spring. Since the large branches suffer also it is a mistake to cut away very much of the small growth in the tops of the trees. It is a serious injury which often ruins valuable orchards, and care should be exercised to prevent it.

THINNING.

Modern orcharding takes into account every possible means to increase the quality of the fruit produced. Briefly stated (1) thinning lessens the drain upon the tree occasioned by overloading, and as a result the trees are encouraged to bear annually. (2) The fruit is of more uniform size, which is a very important factor, especially for box packing. (3) The fruit is more uniformly coloured. (4) Trees are less likely to break under the strain of overloaded limbs. (5) The percentage of culls is greatly reduced. These are potent facts and the success of profitable box packing depends very considerably upon proper thinning.

One thinning is sufficient if done severely. The great trouble with beginners is that they do not remove enough fruit. If the tree is heavily loaded the apples should be thinned to a single fruit, if a light crop do not leave more than two together.

Commence to thin your apples immediately after the June drop, choosing the heaviest laden trees first, and thin to from 4 to 6 inches apart. The heavier the load the farther apart. Remove all wormy and misshapen fruits. The quickest and easiest way is to use the thumb and forefinger, shears are clumsy and slow to work with. Jarring or any other indiscriminate method is not advisable, since by these methods all grades are removed. Hand work is, without doubt, the best. Step ladders should be used around the base of the trees, while boys, if taught, can do the work in the tops of the trees. This work will necessitate in heavily laden trees the removal of one-quarter to one-half the fruit which may seem an enormous amount.

W. H. French, Oshawa, writes as follows:—

"We remove as much fruit as five good pickers will pick in the fall in the same time when wages are dearer.

"By removing one-half of the apples in the summer I reduce the fall picking one-third. This enables me to let all the fruit get thoroughly ripe before gathering it.

"During one season I thinned 100 trees in an orchard of 200. When I compared results I found by removing one-half crop on heavily loaded trees, that on the average I had doubled the quantity of No. 1's with very few culls.

"Where trees have only a light crop, remove what will be culls and poor No. 1's. *This year's experience on heavily laden trees has fully convinced me that thinning is as necessary as cultivation, fertilizing, pruning or spraying of the orchard.*"

Jos. Gilbertson, of Simcoe, writes:—

"Although I found the expense of thinning in 1908 averaged five cents per barrel, the cost of picking and packing was much reduced in not having to pay for the handling of small and inferior fruit. My entire crop of eight hundred and eighty barrels was picked and packed for twenty cents a barrel, and, including the cost of thinning, was handled cheaper than in the previous year.

"From the method adopted for the first time in 1908, I reached results otherwise unobtainable, for only seven per cent. were found 'seconds' while ninety-three per cent. were marked as 'firsts.'

"Therefore, in conclusion, my advice to the fruit growers of this country is to thin apples, peaches, and in fact all fruits where the vines or trees are overloaded."

If two thinnings are to be undertaken the first should remove only wormy and unshapen fruits, the second should be done to properly space and remove small specimens. Early thinning is best, beginning three or four weeks after the fruit sets, even if the June drop is not quite over.

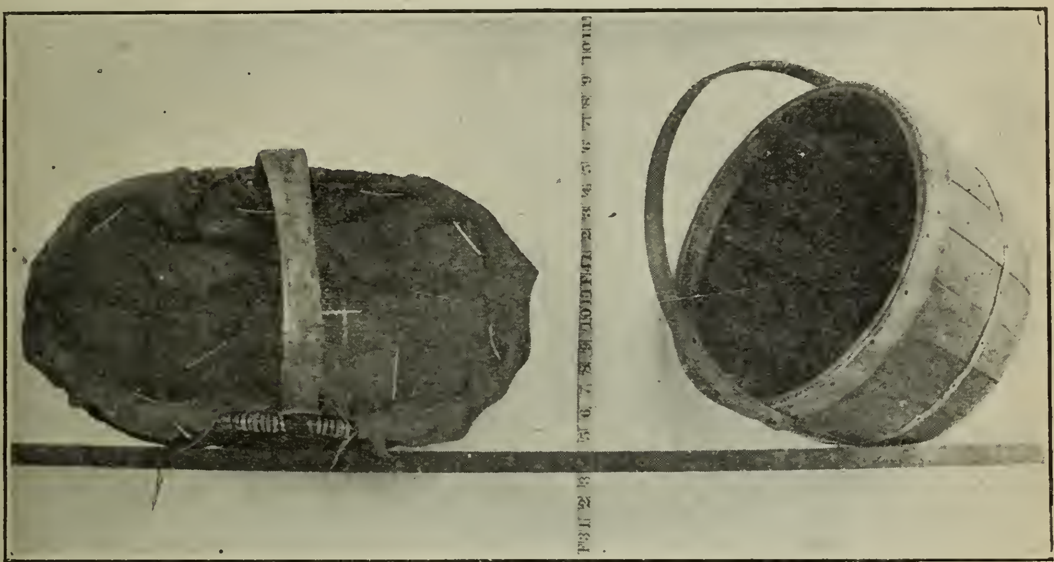
The cost of thinning will vary greatly, depending upon size of crop and trees. Large heavily laden trees will cost as much as forty or fifty cents. This cost though will not appear so great when the lessened cost of handling the ripened fruit is taken into consideration. The opinion of our most up-to-date and successful orchardists is that judicious thinning pays. This much is certain that if we wish to make a success of box packing we must thin.

PICKING.

Turning from the labour and expense of the season's operations to harvesting the crop is a pleasure indeed. A bountiful crop stimulates one to further efforts and study for the following season. Successful growers who have worked out a system of picking for themselves after long experience are exercising a great deal more care in the handling of their fruit than formerly. The test of carefully picked apples is in the storage after being stored until May. If you will examine decayed apples in a storehouse you will find a large percentage of them have a small puncture of the skin in the centre of the decayed spot. It may be a stem puncture, an insect bite or a puncture caused by being dropped into an unlined wicker basket. Whatever the injury is from, it causes decay. It is quite certain that the method of handling the fruit has more to do with the profits than most growers will concede.

Picking Utensils.

Light ladders are the first essentials, as they are easily handled. Heavy ladders take time to move, are a worry to the pickers, and owing to their unwieldiness when moving, a great many apples are bruised and limbs broken. Very handy ladders are now being made especially light and strong. Those with the sides coming together in a point at the top are the best. Three legged ladders for picking in the lower part of the tree are also necessary. Various kinds of baskets are in use, but the best are those made of oak or elm splints. They are superior to the wicker baskets for the reason that they are smoother and bruise the fruit less. A very convenient basket is one made of oak splints with a swinging handle. All baskets, even the smooth ones, should be lined with several thicknesses of canvas or gunny sacking. Attach an iron hook of quarter inch material to the handle. Ordinary wooden pails are sometimes used, but they are of doubtful convenience. Where three-legged step ladders are used they have been found to be handy, and are used very extensively on the Pacific Coast. Patent picking buckets are very good, but unless tried and not too expensive, one should not get them. Canvas bags fastened over the shoulders, with an opening at the bottom sometimes



Picking baskets.

controlled by a draw string, are also used. They hold a large number of apples, but in reaching and coming down the ladder a great many apples are bruised against the rungs and limbs.

Picking for Storage.

In a large orchard the proprietor should devote all his time superintending the pickers, insisting upon careful handling of the fruit and trees. Careless pickers break a great many limbs and destroy countless fruit buds.

Apples should be picked with the stems on, not torn from their stems. Torn skin will admit decay germs more readily than bruises, and as this is a source of considerable loss the pickers should be mindful of it. Give the apples a twist and upward or downward pull. If this is done, few stems will be pulled out.

It is commonly believed that unripe apples keep best. This is not the fact. Our experience has been that properly ripened apples keep much better than immature ones. An apple to keep long should be well coloured for the variety and require a firm pull to pick. Apples that separate from the tree by being slightly raised are overripe and should be marketed at once.

Where the fruit is to be stored for later packing it should be sorted in the orchard at once to remove all culls. The good fruit may be placed in barrels and the heads put in, using very little pressure when heading up. For immediate shipment, grading and barreling can be done in the orchard. Another good method is to place the fruit in open bushel crates, stacking these in the packing house till required. A cleat on each side of the top will prevent bruising. Apples should never be piled on the ground, nor picked when wet. Whether storing in cellar or cold storage or for shipment, handle them quickly.

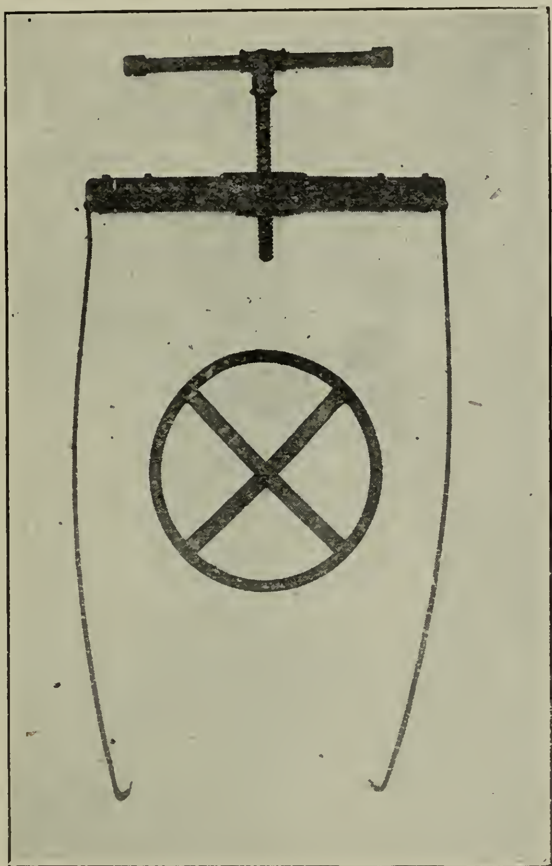
MARKETING.

To one of the methods which has been adopted and is still in operation in the marketing of our apples is due the unstable condition of the apple market and has been heretofore the chief reason for the lack of interest which the farmers have apparently shown towards their orchards. This system may, for convenience, be called the "Lump system." As soon as the apples have become fairly well developed the apple dealer drives around the country buying up the fruit on the trees for a lump sum. If the season is not very favourable at this time he holds off, unless some competition arises in the shape of other buyers. This system of selling is a mere gamble, with the farmer generally losing. In the majority of cases the crop is under-estimated. The farmer gets a price that is below the normal market value. He probably has to board a lot of pickers, who, besides being an expense to him in this manner, are usually careless and break a great many limbs and destroy countless fruit buds.

Undoubtedly the best method of marketing is co-operatively. Successful co-operation in marketing gives the farmer every dollar and cent that is in the fruit. Specific instances can be given to show by comparison the advantages of this method and where once adopted and the association properly organized very few instances of failure can be shown. For further information as to this method, consult Bulletin 192.

Apple buying under any other system than a straight price per barrel or handling by associations is speculation pure and simple. The ultimate prosperity of the apple business must be founded on firmer principles than speculation. Quality in fruit and honesty in packing are the only means required to keep up the demand and create new markets. The best way to secure this is by the formation of associations. By this method the farmer has more time to handle the fruit, the picking is more carefully done, and upon receiving the report from the packing house the grower is brought directly in touch with the grade of fruit he is producing. This arouses an interest, through comparison with the returns of his neighbour, in the production of better fruit. There are at present thirty-eight co-operative associations in operation in Ontario. As a general rule they have been very beneficial. In the past they have met with a certain degree of opposition from the buyers, but this is rapidly dying away as the most reliable buyers realize that by purchasing direct from these associations they are saved the expense and worry of buying the orchards, and handling, picking and packing the fruit.

Experience has taught us that to market fruit out of season is the worst kind of folly. Take the Fameuse, the Christmas holiday season will



Barrel press with proper head iron.

take all that are produced at good prices, but you cannot give the variety away in March or April. To ask a man to eat a Ben Davis in January is to destroy his appetite for apples, but give it to him in June or July and he will say it is good. This feature of the question is important. Of course the individual grower cannot handle his fruit in this way. He is usually compelled to ship all varieties at once. Co-operative associations are the apparent remedy, provided they are properly equipped with storage facilities.

CO-OPERATIVE FRUIT GROWERS' ASSOCIATIONS.

Association.	Secretary or Manager.
Arkona F. G. A.	T. A. Lampman, R.F.D. Thedford.
Brant Packing Assn.	F. M. Lewis, Burford.
Chatham F. G. A.	G. McGetchie, Chatham.
Georgian Bay Fruit Growers' Ltd.	G. H. Mitchell, Thornbury.
Gore F. G. A.	B. J. Palmer, New Durham.
Newcastle F. G. & Forwarding Assn.	W. H. Gibson, Newcastle.
Norfolk F. G. A.	Jas. E. Johnson, Simcoe.
Oshawa F. G. A.	Elmer Lick, Oshawa.
Owen Sound Fruit Co., Ltd.	Adam Brown, Owen Sound.
Sparta F. G. A.	J. A. Webster, Sparta.
Watford F. G. A.	D. G. Parker, Watford.
Grafton F. G. A.	J. G. Wait, Wicklow.
Alvinston F. G. A.	E. F. Augustine, Aughrim.
Burgessville F. G. & Forwarding Co.	W. H. Kneal, Burgessville.
Cobourg F. G. A.	S. W. Staples, Baltimore.
Hatchley Station F. G. A.	W. F. Robinson, Hatchley Station.
Mount Nemo F. G. A.	R. M. Spence, Nelson.
Orono F. G. A.	E. J. Hamm, Orono.
Forest F. G. A. & Forwarding Co.	A. Lawrie, Forest.
Jordan Co-operative Assn.	J. A. Willis, Jordan.
St. Catharines Cold Storage & Forwarding Co.	Robt. Thompson, St. Catharines.
Ontario & Western Co-operative Fruit Growers' Co.	C. J. McCallum, Grimsby.
Wyoming F. G. A.	E. J. Borrowman, Wyoming.
Wentworth F. G. A.	Lorne Carey, 205 Herkimer St. Hamilton.
Brant F. G. A.	Wm. Dickie, Burford.
Prince Edward F. G. A.	Philip Greer, Wellington.
Oxford F. G. A.	J. F. Elliott, Oxford Centre.
Huron F. G. A.	D. F. Hamlink, Goderich.
Port Burwell F .G. A.	R. H. McCurdy, Vienna.
Durham F. G. A.	Wm. Oke, Port Hope.
Tillsonburg F. G. A.	Geo. Elliott, Tillsonburg.
Simcoe Fruits Ltd.	R. A. Thomas, Barrie.
Milton F. G. A.	E. W. Snelgrove, Milton.
Georgetown F. G. A.	W. F. Bradley, Georgetown.
Lambton Fruit Growers' Co-operative Assn.	D. Johnson, Forest.
Johnson F. G. A.	Geo. French, Sarnia.
Grimsby F. G. A.	H. L. Roberts, Grimsby.
Winona F. G. A.	G. E. Henry, Winona.

PACKAGES AND PACKING.

Some of our apples are graded and packed in the orchards and shipped direct to market. The majority are roughly graded, packed in barrels and sent to the storehouse where they are re-packed. The chief package is the barrel, which, for some years to come, will be the standard for our ordinary grades of such varieties as Greening, Baldwin, Russet, Stark and Ben Davis. The box package, so much admired, is the standard for western growers, and where we come into competition with them it is likely that we will have to adopt their style of package for our fancy fruit. Undoubtedly apples present a much more beautiful appearance when properly packed in boxes, and it is quite certain they hold up longer and show fewer bruises. Our fancy grades should all be boxed, especially the early and tender kinds, such as Fameuse and McIntosh, and the better grades of Spy, King, etc.

Barrel Packing.

The greatest objection the consumer has to a great deal of the barreled fruit is dishonest packing. The packer very often does not realize that fruit should be packed according to grade *i.e.,* No. 1 fruit should be strictly No 1, and No. 2 should not contain No. 3's.

In packing a barrel of apples the top must be carefully faced with apples representative of the contents of the barrel. The tail also should be properly levelled and arranged. This practice is very often questioned, but the more attention given to the packing of our fruit, the more will our reputation be enhanced. The apples should not be given more pressure than necessary to keep them from getting slack. A great many of the packers have a tendency to press their barrels too tight, with the result that the greater portion of the apples are bruised and the market value and keeping qualities are greatly impaired. The barrels should be frequently racked on a two-inch plank and the apples should be level with or but slightly above the top of the barrel before pressing. This will do away with excessive pressing and the apples will come out in better condition.

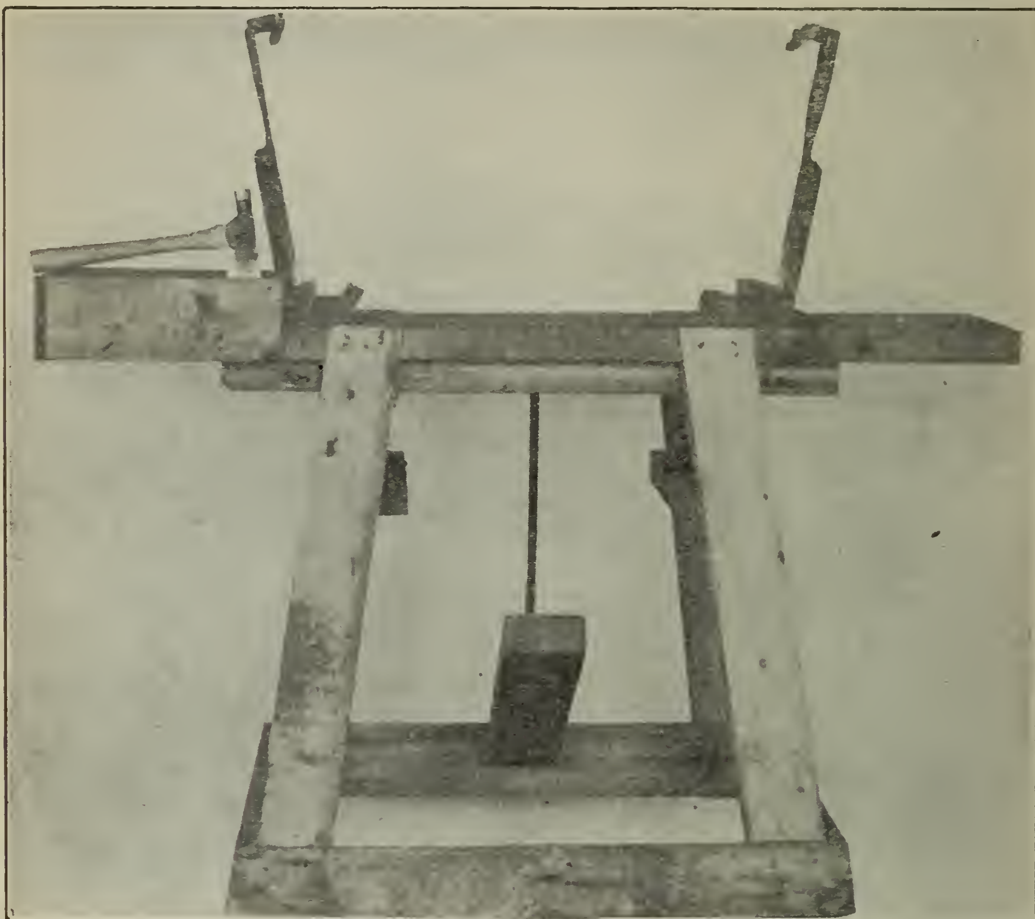
The following instructions to packers are in use by one of our most successful shipping associations:

"Drive all quarter hoops down firmly and nail with three nails in each upper quarter hoop. Then drive hoops well down on the end of the barrel with poorest head and nail with four nails. Then head line by using four nails in each headliner. Exercise care in headlining and drive nails slanting. If nails show through to outside of barrel don't clinch but take out and drive right so it does not show through. Now, take out the other end of the barrel and clinch the quarter hoop nails. Use 1½ inch wire nails.

"Next stencil your barrel.

"Now you are ready for packing.

"If using paper, place this in the end of barrel. With great care pick out and stem your facers, not the largest but average size of grade you are packing. See that every apple is a perfect one with the very best colour you have to choose from. You should not have any difference in size in your facers, but if you should have, place your smaller apples to the outside row and the larger ones to the centre. A good many inexperienced packers do the opposite. Always place stems down, with the exception of long slopey varieties, as Gilliflower and Bellflower which lay red cheeks down. The sorting must be done carefully, and reject all worms, scabs, bruises and unshapely apples both for No. 1's and No. 2's. Now, place your barrel on a plank and after each basket of apples is emptied, give the barrel several quick short shakes. You will have to be governed according to the size of the apples you are packing how full to fill the barrel before using the leveller. At all times level so it will take one row, blossom end up, on top and leave your apples about ½ inch above staves. Care must be exercised in racking down very carefully. Nail and headline your barrel and same is ready for shipment."



Home-made box press.

When apples have to be shipped to the storehouse to be repacked very little pressure should be given and the barrels need not be faced. In harvesting an apple crop for storage, very little attention is given to grading, this being completed in the storehouses. Some buyers recommend this practice and their reasons presumably are lack of labour and shortness of season, but it is quite obvious that if the apples are run over a table in the orchard and culled, the expense of rehandling these culls would be avoided and the margin of profit increased.

Box Packing.

The packing of fruit in boxes by the Ontario growers is on the increase. Local markets in Ontario and Quebec are using more boxes than before. The western markets are asking for their fancy fruit in this package, and if our growers are to participate in these markets for high priced goods he must ship the greater percentage, if not all, of No. 1 fancy fruit in boxes. The demand for boxed fruit in Great Britain is increasing also, but that country, together with other European importers, will continue to take the bulk of their fruit in barrels. Box packed apples may meet with poor returns at first, but once introduced to the trade, they should and undoubtedly will give better net prices to the grower. Any failure may be attributed largely to low quality and poor packing.

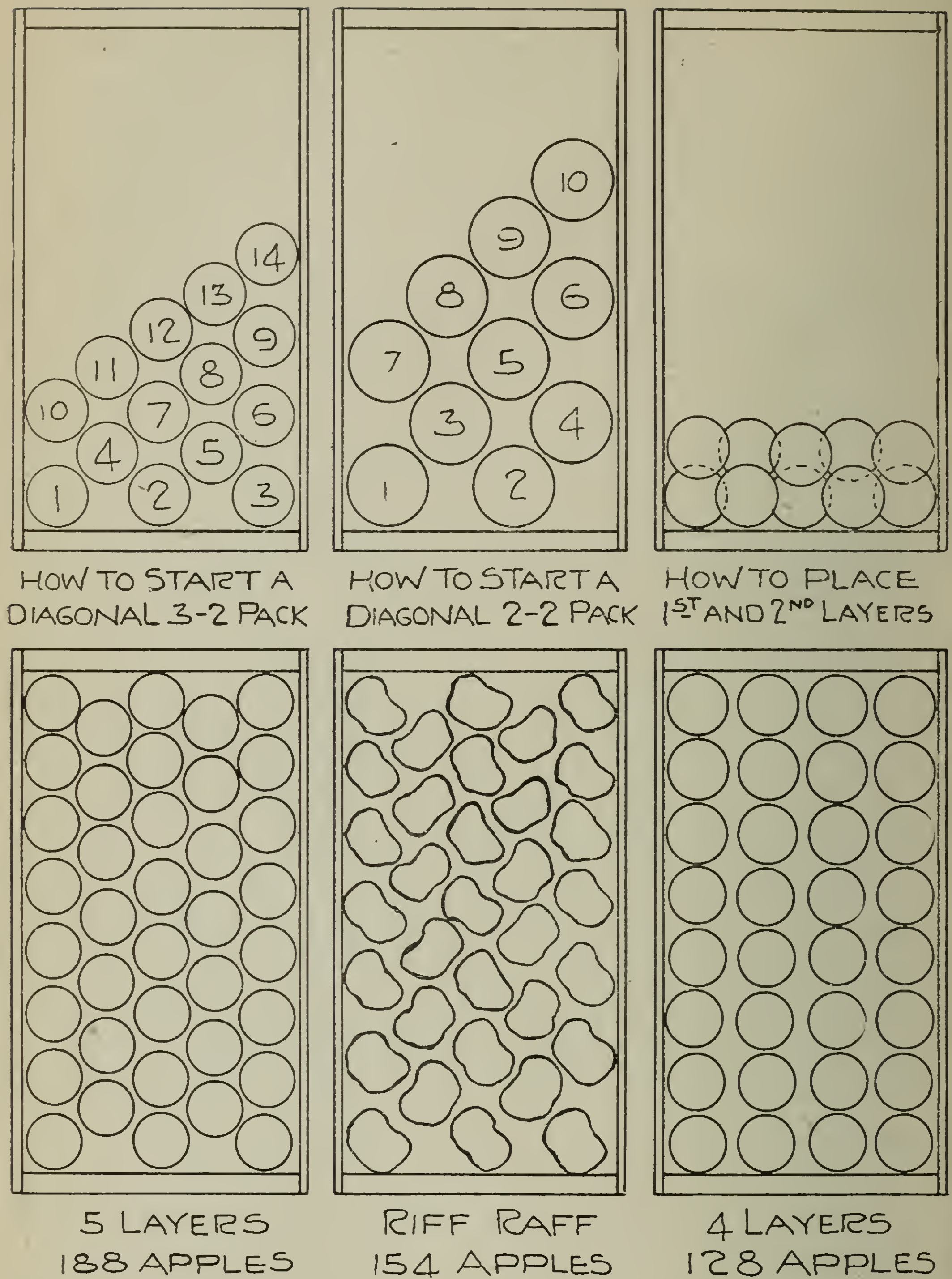
All summer and early fall apples should be sold in our markets in boxes. The fruit carries better and finds a readier market, especially in the west. In our local markets, and to some extent in our western markets, there is a good demand for our summer apples, such as Astrachan and Duchess, put up in baskets. The fancy and No. 1 grade of apples will always bring better prices in boxes and baskets than in the barrel. The fruit being soft suffers far less from bruising in the smaller package.

Boxes.

The standard box is 10 inches deep, 11 inches wide and 20 inches long, inside measurement. It should be made of good clear spruce lumber, the ends 7/8 inches thick, sides 3/8, top 1/4 inch; cleats 3/8 inches thick and 7/8 inches wide. Good cleats will be a saving of both time and patience. Pine should never be used as the wood taints the fruit. In most cases the boxes are bought set up. Where they are to be shipped a long distance it will be a great saving in freight to buy them in the flat. It is not an expensive operation to nail them together and they occupy much less space in the fruit house. Too many nails should not be used and only as many as are absolutely necessary to put the box strongly together. If the sides, tops and bottoms are in two pieces, four nails in each end will be enough. If they are in one piece, three is all that is necessary. The tops and bottoms should be nailed with the cleats. Inch and three-quarter gummed box nails for the sides and two-inch nails for the tops and bottoms will hold much better than ordinary nails. Before using, the cleats should be soaked for a couple of hours in water to avoid splitting.

Box Press.

There are several of these devices, the object of which is to press the ends of the lids down firmly in order that the nailing may be done easily and neatly. The following figure shows a good type of press and may easily be made by any carpenter.



Box packing pays for the fancy apples.

Packing Tables.

A great many make-shifts can be used for tables. They must be so arranged that the stand for the box is close to the fruit so as to facilitate speed for the packing. The small portable tables made on the principle of the folding cot with a position on each side for a box are useful for the individual grower. In large packing houses long stationary tables built of heavier material are best. The surface of a table for two should be about three feet wide and not more than five feet long, as anything larger would not allow two packers to reach all points of it without unnecessary stretching. The table should be high enough to allow a packer to work with comfort, avoiding back bending in all cases. Three feet is about right. The covering should be of strong canvas allowed to hang rather loosely. The edges of the table should be padded to prevent bruising of the fruit. Care should be taken to have the table cleared of fruit six or eight times a day, otherwise the fruit will be considerably bruised by continual handling.

Packing and Grading.

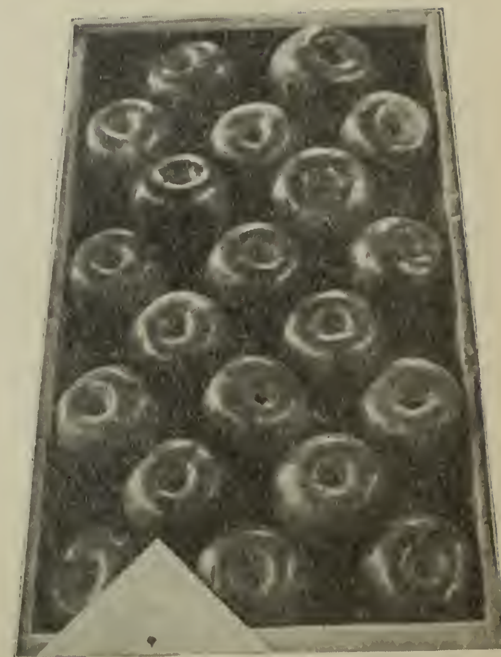
To make a success of box packing a great deal of time and patience at the start is necessary. Some of our growers have not succeeded sufficiently to make it worth while changing from the barrel pack. This is to be regretted and it is safe to say, had they persevered, very good results would have been shown. The most important point in box packing is to aim for the same standard of quality that has obtained for the western growers their markets and high prices. We have the flavour in Ontario, so our next concern is to get well coloured, clean fruit. The apple should be graded closely, according to size. This not only facilitates packing, but also improves the appearance of the box when opened. Box packing requires considerable practice and skill to reduce the cost to a minimum.

High grade fruit should be wrapped; use a light Manilla paper. Much of the paper at present in use is too thin, and where the apples sweat it presents afterwards a very untidy appearance. No time is lost by wrapping, for while the packer is reaching for the apple with one hand he picks up the paper with the other. Then, too, a wrapped apple remains in place and the shifting so troublesome in unwrapped apples is overcome. The boxes should be paper lined as it insures keeping dirt and odors away from the fruit and adds to the attractiveness of the package. Pads are sometimes used in the tops and bottoms of the boxes. The thick patent pads made with excelsior filling are clumsy and occupy too much space. Single and double corrugated cardboard or heavy soft cardboard or paper will answer the purpose, especially for export, and will prevent a good deal of bruising.

The two ways of packing most used are the diagonal and square methods. The diagonal is preferable for the reason that it causes less bruising. One apple fits in between two in the form of a triangle and allows more pressure to be applied diagonally across the box instead of having to jam them as in the square pack.

3-2 diagonal; 4 layers—70 apples.

2-2 diagonal; 4 layers—112 apples.



3-2 diagonal; 5 layers—100 apples.

The bottom of the box when packing, is the top when opened in the case of unwrapped fruit, but if the fruit is wrapped the box is top side up and the last layer is the face. If there are to be four tiers in the box and a wrapped diagonal pack is used, start the apples two across; the second tier three; the next, two; or three across, then four, etc. This is to ensure the fourth tier, or face, opening up with an apple in each corner. If the fruit is unwrapped, start the face by placing an apple in each corner; the second tier then will start with two.

INSPECTION AND SALES REGULATIONS.

The following sections of the Inspection and Sale Act will be of interest to fruit growers:—

INTERPRETATION.

319. In this Part, unless the context otherwise requires,—
(a) 'closed package' means a box or barrel of which the contents cannot be seen or inspected when such package is closed;
(b) 'fruit' shall not include wild fruit, nor cranberries, whether wild or cultivated. 1 E. VII., c. 27, s. 3.
(c) 'culls' shall include fruit that is either very small for the variety, or immature, or the skin of which is broken so as to expose the tissue beneath, or that is so injured by insects, fungi, abnormal growths, or other causes, as to render it unmerchantable.

THE MARKING OF FRUIT.

320. Every person who, by himself or through the agency of another person, packs fruit in a closed package, intended for sale, shall cause the package to be marked in a plain and indelible manner, in letters not less than half an inch in length, before it is taken from the premises where it is packed,—
(a) with the initials of his Christian names, and his full surname and address, or, in the case of a firm or corporation, with the firm or corporate name and address;
(b) with the name of the variety or varieties; and,
(c) with the designation of the grade of fruit, which shall include one of the following four marks, viz.: Fancy, No. 1, No. 2, No. 3.

2. Such mark may be accompanied by any other designation of grade or brand, if that designation or brand is not inconsistent with, or marked more conspicuously than, the one of the said four marks which is used on the said package.

321. No person shall sell, or offer, expose or have in his possession for sale, any fruit packed,—
(a) in a closed package and intended for sale, unless such package is marked as required by the provisions of this Part;
(b) in a closed package, upon which package is marked any designation which represents such fruit as of
(i) Fancy quality, unless such fruit consists of well grown specimens of one variety, sound, of uniform and of at least normal size and of good color for the variety, of normal shape, free from worm holes, bruises, scab and other defects and properly packed.

(ii) No. 1 quality, unless such fruit consists of well grown specimens of one variety, sound, of not less than medium size and of good color for the variety, of normal shape and not less than ninety per centum free from scab, worm holes, bruises and other defects, and properly packed.

(iii) No. 2 quality, unless such fruit includes no culls and consists of specimens of not less than nearly medium size for the variety, and not less than eighty per centum free from worm holes and such other defects as cause material waste, and properly packed.

(c) in any package in which the faced or shown surface gives a false representation of the contents of such package; and it shall be considered a false representation when more than fifteen per centum of such fruit is substantially smaller in size than, or inferior in grade to, or different in variety from, the faced or shown surface of such package.

FRUIT PACKAGES.

325. All apples packed in Canada for export for sale by the barrel in closed barrels shall be packed in good and strong barrels of seasoned wood having dimensions not less than the following, namely: Twenty-six inches and one-fourth between the heads, inside measure, and a head diameter of seventeen inches, and a middle diameter of eighteen inches and one-half, representing as nearly as possible ninety-six quarts.

2. When apples, pears or quinces are sold by the barrel, as a measure of capacity, such barrel shall not be of lesser dimensions than those specified in this section.

3. When apples are packed in Canada for export or for sale by the box, they shall be packed in good and strong boxes of seasoned wood, the inside dimensions of which shall not be less than ten inches in depth, eleven inches in width and twenty inches in length, representing as nearly as possible two thousand two hundred cubic inches.

PROFITS.

The recent developments in apple culture have brought many inquiries as to the cost of production and profits to be derived from them. The following figures have been compiled to give information on this point, but while they may be disputed, nevertheless they will be found for the most part reliable:

10 acres for $5,000. Interest at 5%		$250 00
Taxes		10 00
Investment in		
1 team horses	$400 00	
1 power sprayer	300 00	
1 gang plow	22 00	
1 harrow	20 00	
Ladders	15 00	
Pruners	8 00	
Incidentals	35 00	
Total	$800 00 at 5% int.	40 00

Depreciation on $800.00 investment at 10%	80 00	
Pruning	60 00	
Gathering brush	10 00	
Harrowing (6 times)	9 00	
Plowing (once)	7 00	
Spraying (3 times)	139 36	
Cover crops, 200 lbs. red clover, 18c.	36 00	
Cover crops, to sow	4 00	
Fertilizer	140 00	
Picking, packing, hauling 800 bbls. Nos. 1, 2 at 80c. per bbl.	640 00	
Sale of 800 bbls. Nos. 1, 2 at $2.50		$2,000 00
Sale of 70 bbls. culls at 75c.		52 50
Balance	627 14	
	$2,052 50	$2,052 50

Balance $627.14 shows net profit of $62.71 per acre.

The following figures of yields and profits in Northumberland County show comparison between 15 sprayed and 15 unsprayed orchards.

Sprayed, cultivated, etc.—1907, 117 bbls., $150.10; 1908, 65.6 bbls., $94.20; 1909, 82.3 bbls., $131.00; average for 3 years, 86.5 bbls., worth $125.10 net per acre.

Unsprayed, cultivated, etc.—1907, 87.4 bbls., $101.55; 1908, 52.6 bbls, $62.70; 1909, 62 bbls., $79.80; average for 3 years, 67.3 bbls., worth $81.35 net per acre.

The following figures are given by Mr. Robert Thompson, St. Catharines, to show the profits realized on an apple orchard.

10 acres of bearing orchard (standard varieties) worth $5,000.

Interest on capital invested at 5 per cent.	$250 00
Taxes	10 00
Management	150 00
Pruning 50 days at $1.50 a day	75 00
Gathering and burning brush	10 00
Spraying with lime sulphur	65 00
Two sprayings with lime sulphur and arsenate of lead	160 00
Fertilizer	150 00
Delivering 800 bbls.	80 00
Depreciation	100 00
Total cost	$1,050 00

Returns: 800 bbls. average per annum at $1.50 a bbl., net $1,200.00 (cost of bbl. and picking deducted). Returns of $1,200.00 less $1,050.00 expenses leaves $150.00 net profit. It is to be pointed out that the figure $150 under the heading of management meant the manager's salary, which in all cases should be taken into account, and that the net profit $150 was a clear gain.

These figures make no allowance for cultivating as the orchard was in sod. Ordinarily the figures for interest on capital invested, management and depreciation would not be taken into account, in which case the average net profits would be increased to $65.00 per acre; interest, $250; management, $150; depreciation, $100, and net profit, $150; total, $650 for the ten acres or $65 per acre.

KEEPING ACCOUNTS.

This figuring costs is very interesting, and even if figures lie they at least bring up a very interesting point, namely, bookkeeping.

A great many, in fact the majority of farmers, keep no systematic accounts of their business. They work year after year without knowing where they are making money or where they are losing it. This fact is

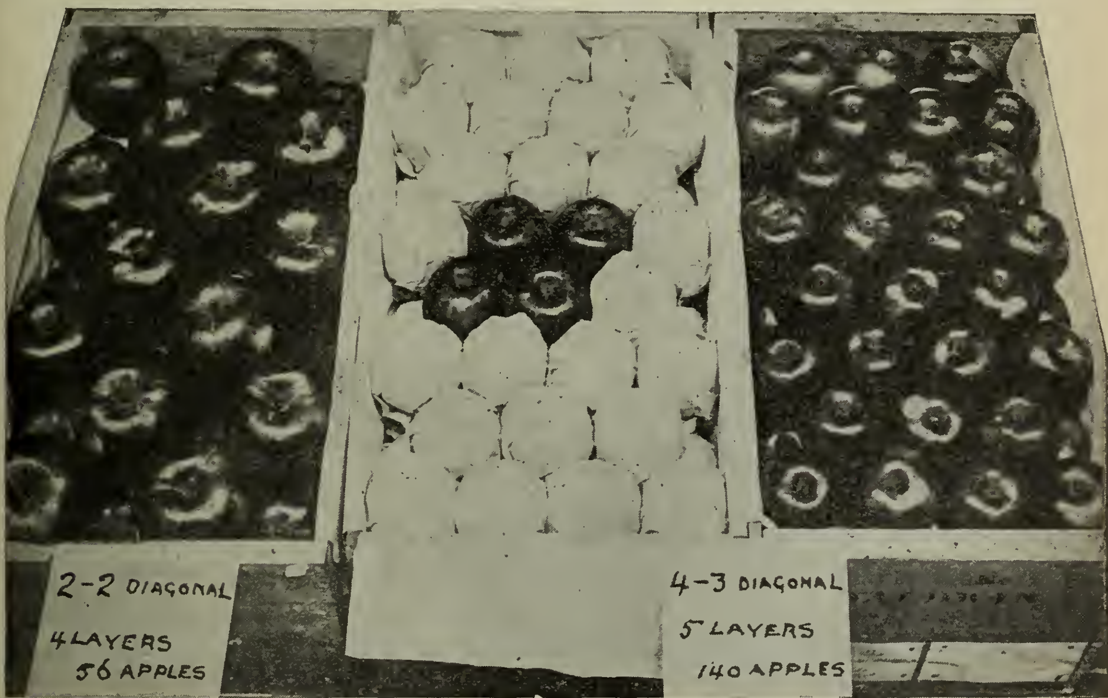
deplorable for the simple reason that many otherwise capable men have been held in poverty by growing the wrong crops. In some cases these same men have adopted a system of keeping accounts and in a short time have got out of debt and are living in comfort. If you think that any of the above figures do not agree with your own keep accurate account of the cost next year and see where the difference lies.

As farms become smaller and specializing becomes more widely followed, the necessity and value of accounts will become apparent.

For this reason fruit growers possibly keep more accurate account of their expenditure and returns than any other class of agriculturists. The employment of a lot of hands at certain seasons of the year makes this necessary. Pickers who are paid by the day and by the basket and who work irregularly require special attention in keeping track of their labour. The high price of land and perishableness of their products compel a careful and exact accounting. The fluctuations in the market price of their produce from day to day; the fact that they supply private customers, commission houses, dealers and canners, makes the necessity of keeping track of each order imperative.

The estimates of the cost of producing apples that are published from time to time in different periodicals vary so much that it is quite evident no actual record has been kept and that these estimates are merely the result of a casual endeavor on the part of the grower to answer an often asked question.

Some system of accounts should by all means be kept whereby every item of expense connected with each crop is recorded. For orchard work your accounts should open with the first expenditure after the apples are



picked and the season closed. The first item is most likely to be plowing surface drains, etc. Pruning and spraying follow in the spring. Such items as hauling, barrels, boxes, spray materials, manure, etc., should all be charged against the orchard, likewise teaming the fruit to the station or association packing house. The financial year should close with the sale of fruit, charging up for any apples retained for home use

The simplest way is to write down each day what work has been done, the number of hours work of each man, including your own time, which, however, should be charged according to wages paid as a foreman. The cost of horses' work can only be calculated by figuring out what it costs to keep them per year and then charging that against actual number of days worked, by which method you can arrive at cost of horses' work in the orchard. The cost of spraying should be carefully calculated. Keep account of the number of barrels of actual spray mixture used, and the number of gallons applied each day together with the labor for the corresponding day. In this way you can tell how much mixture was used and should know the reason why any particular day's work was not as big as it should have been

COLD STORAGE.

The commercializing of our apple orchards necessitates the careful handling of the crop in every particular, not the least of which is storing. Cold storage is something everyone cannot have on his farm, but with the formation of co-operative associations we may look to the ultimate establishment of cold storages in a great many apple shipping centres. The chief advantage cold storage has, so far as fruits are concerned, is to prolong their season which, of course, means increased consumption. A certain amount of waste will occur, but by choosing the right varieties at a proper stage of maturity and handling them just right this loss can be greatly controlled.

In Western Ontario the greening is largely grown, but owing to its poor keeping qualities there the fruit is marketed early and often suffers from low prices due to gluts. This variety keeps much longer in cold storage when stored promptly after picking, and will hold until long after the new year. It is in good demand in all of our Ontario markets on account of its excellent cooking qualities, and would sell at much better prices if the season was extended. As a result of extensive experiments Mr. J. A. Ruddick, Cold Storage Commissioner at Ottawa, has proven that this and other varieties from Western and Southern Ontario can very profitably be cold-stored, both for local markets and for export.

Aside from the generally accepted idea of the benefits of cold storage, there is another phase of the problem which is deserving of consideration. This is the equalizing of prices. In May and June apples are almost out of the market, and good ones cannot be had even at exhorbitant prices. With cold storage convenient to the farmer a higher price could be paid him in the season of good crops, and by storing, an abundant supply could be offered the consumer at greatly reduced prices. This is plainly of advantage to both. A practical and inexpensive cold storage for fruit growers is becoming more and more a necessity for the handling of the crop at the most profit. The crude, old-fashioned ways of storing apples in pits, etc., though still practised, are fast giving way to more modern methods.

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Ontario Department of Agriculture

ONTARIO AGRICULTURAL COLLEGE

INSECTICIDES AND FUNGICIDES.

By R. Harcourt, Professor of Chemistry,
and H. L. Fulmer, Lecturer in Chemistry.

OBJECT.

Year by year the damage done to the crops of the farm, orchard, and garden by insects and fungous pests seems to be increasing. Some of these pests may be a blessing in disguise, in that the remedies used for their eradication have been beneficial in other respects; but, in order that they may be successfully combatted, it is essential that the farmer know how to fight them to the best advantage, and that he have a clear idea of the nature of the remedies employed and the precautions that must be observed in their use. The literature on the subject is voluminous, but it is scattered and not always accessible to those who require it. In this bulletin an attempt has been made to gather the information obtainable on the subject into one publication and present it in a manner that will be helpful, in the hope that it will fill a long felt want.

INTRODUCTION.

To spray with any degree of success requires, besides a knowledge of the acting principle of the remedy which is being employed, a rather intimate acquaintance with the enemy which is being combatted. The different classes of insects and fungous diseases do not show similar characteristics. If it were so, then the question of remedy would resolve itself into a very simple one; the discovery of a single successful one would end our labors. As it is, a great many of these remedial compounds are required in plant economy, the absolute number needed depending entirely upon the different ways in which insects and fungous diseases attack their food or host plants. This results largely from differences in anatomical and physiological structure of these little but often highly destructive animals and plants.

Classes of Insects.

Practically all insects can be divided into two leading groups: (*a*) those which actually chew and swallow their food and have what the entomologist calls *biting mouth parts,* and (*b*) those which obtain their food by piercing the outer tissues of the plant and sucking up the juice, called insects with *sucking mouth parts.* The first group of insects, among which we find grasshoppers, cucumber beetles, codling moth larvæ, currant worm, and a great many others, can be poisoned by covering the surface of the plant upon which they feed with some poisonous material; while the second group, since they do not eat the surface of the plant, but feed only on the inside juices, must be destroyed by means of some substance which will act upon their bodies, as caustic washes, or something which will act upon their breathing pores, smothering them, such as a gas.

This, then, divides insecticides into two groups: *food poisons* and *contact insecticides.*

There are some insects, however, owing to their peculiar habits, inaccessibility, or other causes, which require special treatment, such as the cut worms, which work underground, and the grain weevils, which affect stored products; the ones which feed inside the bark or within the stem of the tree or plant, such as the apple tree borer or the raspberry cane borer; the household pests; and the animal parasites.

Classes of Fungi.

A fungus is a plant which feeds upon other plants, and is thus a parasite. It begins with a seed (spore) which germinates and produces a great number of small threat-like structures which correspond to the roots, stems, and leaves of an ordinary plant, and called the mycelium. Sometimes this mycelium develops wholly upon the surface of the plant or fruit, as with the powdery mildew of the grape; while at other times the germ tube of the spore penetrates the skin and produces its mycelium within the tissues, just as happens in the case of the grain rusts and smuts, downy mildew, and a great many others.

Fungi, then, can be classed as *external* and *internal,* and the method of dealing with them varies accordingly. Those of the first kind can be attacked and destroyed by use of proper materials, but the second kind can only be prevented.

INSECTICIDES.

Food Poisons.

Food poisons are that class of compounds which contain some poisonous substance that if eaten and absorbed by the system will cause death. The most commonly used material that produces this toxic effect is arsenic, but other materials may be and are used.

"*White Arsenic*," known also as ratsbane, arsenious oxide, (As_2O_3), is the basis of many food poisons. It is a white powder, but occurs also in two crystalline forms. It is sparingly soluble in water, the solubility varying with circumstances. If water at 15° C. be shaken for a long time with the solids, 100 parts of the water will dissolve .28 parts of the crystalline and .92 parts of the powder, while if saturated solutions at 100° C., be cooled at 15° C., 2.18 parts of the crystalline and 3.33 parts of the powder form remain in solution. Water containing carbon dioxide, however, dissolves much greater quantities than does pure water. White arsenic completely and readily dissolves in solutions of caustic alkalies, such as ammonia, and in solutions of alkaline carbonates, such as washing soda. To both plants and animals it is, along with its compounds, a powerful poison, two or three grains being sufficient to cause death with the human being. Cultural solutions containing 0.0002% will destroy plant life.

Arsenic pentoxide, (As_2O_5) also called arsenic oxide, is likewise the basis of many food poisons. It is a white, solid substance slowly soluble in water. It is also a strong poison, but not so active as the arsenious oxide. Cultural solutions containing as much as 0.02% will alow the growth of plants to still continue.

What is important to know about arsenious and arsenic oxides in this connection, however, is that with water they form acids. For this reason they cannot be used directly as sprays for they would burn and destroy foliage; they must have their acid or scorching property removed. This is done by combining them with such substances as calcium, copper, lead, barium, etc., which change them into *salts*. These salts retain the poisonous property of the arsenious and arsenic oxides and can be sprayed on to foliage without fear of doing any considerable harm.

But all salts of arsenious and arsenic oxides cannot be used for spraying purposes. Those which are *soluble in water*, such as sodium arsenite and sodium arsenate, cannot be employed. *Only those which do not dissolve but remain in suspension as solid particles* are of use.

Arsenical Compounds.

Paris Green.

This substance is used as an insecticide more largely than any other in the Province of Ontario, due to the fact that it was the first introduced, and, therefore, better known. It is an olive green material consisting of a combination of arsenic, copper, and acetic acid or "vinegar," called by chemists copper aceto-arsenite, along with varying quantities of other substances present as impurities. Theoretically, pure Paris green contains 58.65 per cent. arsenious oxide (As_2O_3), 31.29 per cent. copper oxide (CuO), and 10.06 per cent. acetic acid. Commercially, however, these proportions do not obtain, since there is always a small amount of moisture present in the green together with some sodium sulphate or Glauber salt, a compound formed in the process of manufacture and never afterwards completely removed. This latter substance has no insecticidal value, and if present in more than normal quantity only increases the cost of the green and should be classed as a mere "make weight." If care is used in the manufacture, there is no reason for it being present in more than very small amounts, say one half of one per cent.

Free or Soluble Arsenious Oxide in Paris Green. It is on account of the presence of this substance in Paris green that we sometimes find that after spraying the leaves of the plant treated turn black, having the appearance of being burnt, or even, in more extreme cases, drop off altogether, leaving the plant defoliated. This, of course, is very objectionable, since the physiological functions of the plant are thus severely checked, a case where the cure is as bad as, or worse than, the evil.

To account for the occurrence of this scorching, J. K. Haywood, of Washington, D.C., states three causes.*

(1) There may be a certain amount of arsenious oxide over and above that combined with the other constituents. This is "free" arsenious oxide and until recently it has been considered the only cause of the scorching of the foliage by Paris green.

(2) The greens may be poorly made, so that the constituents are very loosely held together. When such greens are brought in contact with water, especially water containing carbon dioxide, they soon break up and arsenious oxide is set free. Between the water of the spray and the action of dew and rain, enough oxide may be liberated to severely scorch the foliage.

(3) The green may be extremely fine. The best greens when ground to a fine powder and applied to foliage will scorch. This is doubtless due to the fact that more surface is exposed to the action of water which, containing carbon dioxide, would soon set enough arsenious oxide free to cause serious damage.

Following up these statements, however, Mr. Haywood says: "It is a very common occurrence to secure a commercial Paris green that scalds because of one of the first two causes, but the writer has never found a commercial sample of green that scorched because it was in too fine a condition."

As to the breaking up of Paris green when in contact with water, with the liberation of free arsenious oxide, Colby, of California,† ex-

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*U. S. Department of Agriculture, Bureau of Chemistry, Bull. 82, pp. 5-6.
†College of Agriculture, Bull. 151, p. 19.

presses some doubt, since, as he says, "aceto-arsenite of copper, as manufactured to-day, is instantaneously precipitated from complex solutions containing alkali and often excessive quantities of various acids." However this may be, we do know that Paris green often destroys foliage, and that it is likely due to free arsenious oxide. There is no sure and ready method by which the free arsenic content of Paris green can be ascertained. Reagents, such as ammonia, which dissolve Paris green also dissolve the oxide almost or quite as readily. The microscope has been highly recommended, especially for the detection of "white arsenic" which has been added as an adulterant, but not for that which has been retained in the process of manufacture. No doubt this is a valuable aid, still the actual amount present cannot be determined in this way, and the only way to decide whether this substance is present in injurious quantities or not is by chemical analysis.

Precautions in the Use of Paris Green. Since the method of estimating the free arsenious oxide of Paris green is not within the ready reach of all, it is well to assume that it is present in harmful quantities and to use something to alleviate the difficulty, if such there be. As before stated, arsenious oxide, or "white arsenic" may be combined with other substances which will neutralize or destroy its acid or burning property. Lime is one of these substances. *If an equal quantity of good, freshly slaked lime be added to the Paris green, in suspension in the water, some little time before spraying, it will combine with the free arsenious oxide and overcome its leaf-scorching power to a great extent.* It is well also to know that some kinds of foliage are much more susceptible to the destroying power of arsenious acid than others; thus the peach tree has foliage which is remarkably tender, whereas the foliage of the apple is very hardy.

From investigations carried on in 1902-3, the results of which are embodied in Bulletin 82 of the Bureau of Chemistry, Washington, D.C., J. K. Haywood was enabled to make out a schedule showing the amount of free arsenious oxide which the foliage of the more common fruit trees will withstand. His results, which also give figures showing the influence which lime exerts, and are thus doubly valuable, are summarized in the following table:

Average Percentages of Soluble Arsenious Acid Allowable.

	Apple	Pear	Peach	Plum
Without Lime	6	6	0	4
With Lime......................	7	7	4.5	6

This shows plainly that the orchardist must consider the kind of foliage he is spraying as carefully as the kind of Paris green he is using.

Total Arsenious Oxide in Paris Green. Since Paris green owes its insecticidal value to the arsenic which it contains, it follows that the larger the proportion of arsenious oxide there is present in it, the more effective it will be when used against insects. The value of any arsenical is determined by its arsenic content. Pure Paris green contains 58.65 per cent. As_2O_3. Any quantity above that must be present in the free state, and any quantity below that lowers the insecticidal, and, thus, the market value, just to the extent to which it is deficient. The commercial article is never ideal; in reality its manufacture is difficult, and many chemicals enter into the process. However, from analyses which we have made here and from results obtained elsewhere, most Paris greens contain at least 56 per cent,. and there is no reason why they should contain less than 56 per cent. of arsenious oxide, providing any reasonable degree of care be exercised in the making.

Total Copper Oxide in Paris Green. Copper aceto-arsenite contains 31.29 per cent. CuO, which bears a relation to the total arsenious oxide present of 1 : 1.87. Since it is necessary that arsenious oxide be combined with copper in order that it be not in the free state, then, any result of analysis showing a greater factor than 1.87 indicates free arsenic. White arsenic cannot be added as an adulterant without seriously disturbing this ratio.

Physical Conditions. The best grade of Paris green is a powder which will pass through a sieve of not less than 100 meshes to an inch. A coarse green is one that will settle rapidly from its suspension in water and will require constant agitation during the spraying operation in order that it may be distributed evenly over the foliage.

Adulterants and their Detection. The more common ones occurring in Paris green are white arsenic, barium carbonate, barium sulphate, gypsum, and road dust. The white arsenic may be added to bring the arsenic content up to the standard, but the presence of any of them is fraudulent, and they can only be classed as mere " make weights " which increase the cost of purchase for actual insecticidal value received. As previously stated, white arsenic may be detected under the microscope, when it appears in the shape of white octohedral crystals. The other adulterants mentioned are all insoluble in ammonia, thus any quantity of residue left on dissolving the green in ammonia gives good ground for rejecting a sample on account of adulteration. This test is simple and can be applied by any one. A teaspoonful of the sample is placed in some receptacle, preferably glass, and about ten teaspoonfuls of strong ammonia (sp. gr. .90=25° Bé.) added and the whole then thoroughly stirred and left to stand for half an hour. The Paris green readily dissolves to form a deep blue solution, whereas the adulterants present are left as solid particles in the bottom of the vessel. As before stated, white arsenic is also quite readily soluble in ammonia, and a complete solution does not show the absence of this material.

Paris Green in Ontario.

The consumption of Paris green in this Province amounts to between 100 and 120 tons annually. Although the demand is so good, still the product put upon the market is of a very favourable quality. The Inland Revenue Department at Ottawa reports that the samples which they examined in 1902-3 were 95.8 per cent. genuine. The samples analyzed in this department were also of a highly satisfactory standard.

Some Paris Greens Analyzed in 1905.

No.	Moisture 110°C	Sand	Sod. Sulphate	Copper oxide	Total arsenious acid As_2O_3	Acetic acid by difference	Soluble arsenious acid As_2O_3
1	1.29	.11	.34	30.68	56.55	11.03	2.36
2	.99	.23	.13	31.62	56.91	10.12	2,73
3	1.25	.26	.37	30.59	56.8	10.73	2.11
4	1.26	.15	.36	30.39	56.12	11.72	2.85
5	1.29	.71	.57	30.23	56.01	11.19	2.73
6	1.41	.12	1.80	30.29	56.33	10.05	4.35

Probably these greens are all as satisfactory as we can expect the commercial article ever to be. No. 6 contains somewhat more sodium sulphate than there is any need for, and is also somewhat high in free arsenious acid; otherwise there are none of them but could be highly recommended for spraying purposes.

London Purple.

London purple is prepared by boiling a purple residue from the dye industry, containing free arsenious acid, with slaked lime. In this way calcium arsenite and calcium arsenate are formed, and these are the poisonous compounds of this insecticide. As the dye residue has accumulated some dirt during the process of manufacture, a sandy substance will always be present in the London purple. It will thus be seen that London purple consists of calcium arsenite, calcium arsenate, a dye residue, and small amounts of sand and moisture. In case not enough lime is added to the dye residue, or the boiling is not continued long enough, varying quantities of the arsenious acid will be left in the free condition, and thus in a form which will scorch the foliage to which it may be applied.

According to Haywood,* about one-third of London purple is made up of the dye residue, sand, and moisture, and that it contains from 31 to 51 per cent. of total arsenic, figured as arsenious oxide; whereas Paris

*U. S. Department of Agriculture, Bureau of Chemistry, Bull. No. 68.

green contains the equivalent of about 56 per cent. of the arsenious oxide. The value of these two insecticides will thus be in proportion to these figures. However, one other point must be considered in valuing this substance, that is, its effect on foliage. According to Haywood, a very much larger amount of the arsenic of London purple is soluble in water than with Paris green. It seems probable that a part of this is made up of calcium arsenite and arsenate, which have gone into solution, but at the same time, it is safe to say that Paris green is the safer insecticide. *The addition of lime to the water mixture of the London purple is even more essential than with Paris green.*

Commercial Substitutes for Paris Green.

The fact that the use of lime along with Paris green and London purple has been so generally recommended has given the manufacturer of arsenical insecticides an excuse for making and offering for sale many mixtures containing widely different forms and quantities of arsenic compounds. Many of these substances are poor substitutes for good Paris green. Some of them contain very little arsenic or any other form of poison, while in others there is a large amount of arsenic; but unfortunately, it is not always in such a state of combination as to be safe for use as an insecticide.

Among the mixtures poor in arsenic, the following have been analyzed in our own laboratory:

Black Death: One of the newer insecticides recently offered for sale in this Province is "Black Death." It is sold at 2 cents per pound, or 15 pounds for 25 cents. The composition of this substance, according to our own analysis, is as follows:

Moisture	10.42
Sand, etc.	6.37
Carbon	17.39
Sulphur trioxide	23.72
Calcium oxide	23.30
Magnesium oxide	2.16
Carbon dioxide	7.90
*Paris green	0.43
Undetermined (volatile matter, water of crystallization)	8.31
	100.00

This insecticide is composed almost entirely of charcoal, sand, and gypsum. The only substance present which will poison insects is the Paris green. If mixtures with so small an amount of poison will kill insects, it will be cheaper to buy a pound of Paris green and mix it with

*Copper Oxide, .13 per cent.; Arsenic trioxide, .12 per cent.

200 pounds of gypsum. Paris green can be bought for 20 cents per pound. In Black Death it costs $3.86 per pound.

Potato Bug Finish: "Bug Finish" is another insecticide that is now on sale in various localities. It is sold at the same price as "Black Death." The following is the composition of the sample analysed:

Moisture	12.49
Sand, etc.	17.57
Insoluble organic matter	0.69
Sulphur trioxide	30.47
Calcium oxide	25.79
Carbon dioxide	5.77
Magnesium oxide	1.49
*Paris green	1.06
Iron and aluminum oxides	1.13
Undetermined (water of crystallization, volatile matter, etc.)	3.54
	100.00

One hundred pounds of this mixture contains only a little over one pound of Paris green; the remainder is largely sand and gypsum. The Paris green in it costs $1.56 per pound.

Kno Bug: The manufacturers of this insecticide claim that it kills the bugs, stimulates the plant, and improves the quality of the crop. It sells in 20-pound boxes at 6 cents per pound. According to our analysis, it has the following composition:

Moisture	10.89
Insoluble matter	10.55
Sulphur trioxide	26.10
Calcium oxide	26.73
Carbon dioxide	11.95
Magnesium oxide	3.09
Iron and aluminum oxides	4.03
Potash, nitrogen-potassium nitrate	4.50
†Paris green	2.49
	100.00

It is essentially crude gypsum with 2½ per cent. of Paris green, and potash and nitrogen equal to about 4.5 per cent. of potassium nitrate. The latter is a valuable plant food; but, as there is only about 25 cents' worth in 100 pounds of the mixture, it does not add very much to its cost.

*Copper oxide, .32 per cent.; Arsenious oxide, .70 per cent.

†Arsenious oxide, 1.46 per cent.

Anyway, it would appear to be a better practice to keep insecticides and fertilizers separate. Without allowing any value for the other materials, the Paris green in this mixture would cost $2.41 per pound.

Slug Shot: Slug Shot is essentially crude gypsum mixed with small quantities of Paris green, tobacco, and carbolic acid. It is sold in Guelph at 10 cents per pound, or 3 pounds for 25 cents. In larger quantities it can be bought for much less. The detailed results of our analysis are as follows:

Moisture	13.55
Sand, etc.	3.53
Insoluble matter (sulphur, tobacco, etc.)	5.69
Calcium oxide	30.10
Sulphur trioxide	37.93
Iron and aluminum oxides	0.80
Carbon dioxide	2.79
*Paris green	2.13
Phenol, soluble organic matter, etc. (by difference)	3.38
	100.00

Carbolic acid is a poison, and as such will, no doubt, destroy insects as well as the Paris green; but this mixture at even 5 cents per pound is rather an expensive substance to use in destroying potato bugs.

Bug Death: Another insecticide, containing no arsenic, that has recently come into great prominence, is Bug Death. It is claimed that it kills the bugs, feeds the plant, increases the yield, and improves the quality It is sold at the rate of 12 pounds for $1, or 100 pounds for $7 The following is the composition of samples secured in 1902 and 1903:

	1902.	1903.
Moisture	0.32	0.38
Volatile matter	2.67	2.87
Sand, etc.	3.17	4.26
Lead oxide	3.17	4.70
Zinc oxide	87.47	83.04
Iron oxide	3.84	4.09
	100.64	99.34

It is composed largely of crude zinc oxide with small quantities of lead oxide and iron oxide. It also contains nitrogen equivalent to about one-half of one per cent. of ammonium sulphate. This latter substance is a plant food; but there is so little of it in the mixture that it cannot have much value. Bug Death has considerable fungicidal value, and destroys

*Copper oxide, .64 per cent.; arsenic trioxide, .82 per cent.

the bugs. It has to be applied in fairly large quantities and it is rather an expensive substance; but it has given good results when used on potatoes.

The *most important* Paris green substitutes are those which contain large quantities of arsenic such as the arsenates and arsenites, commonly called commercially the "arsenoids." Among these we have copper arsenite (green arsenoid), lead arsenite (pink arsenoid), barium arsenite (white arsenoid), calcium arsenite and lead arsenate, the latter two being the only ones extensively used. We will thus mention only calcium arsenite and lead arsenate in detail.

Lead Arsenate.

This arsenical is becoming very popular and is replacing Paris green to a great extent. This is because lead arsenate is much safer to apply than Paris green, especially on the more tender foliage, such as peach; and further, because it stays longer suspended in water on account of its extremely finely divided condition, and that it adheres more firmly to bark and foliage, and therefore exerts its influence over a longer period of time. It is also the only arsenical which can safely be mixed with lime-sulphur solution.

There are two forms of lead arsenate, the PbH or acid lead arsenate ($PbH\,As\,O_4$), and the Pb_3 or neutral lead arsenate ($Pb_3\,(As\,O_4)_2$). It is not known definitely which is the better form to use; they are both quite insoluble in water if well made. The former is richer in poisonous material and would thus seem to be the better; but, on the other hand, it seems to be the general opinion that the neutral arsenate is the safer to use with lime-sulphur solution, since it is not so likely to decompose the wash nor to itself break up and liberate soluble arsenic acid. The formation of soluble arsenic acid, of course, would make the wash destructive to foliage.

In the light of present knowledge, therefore, it is recommended that the neutral lead arsenate be used when applying lead arsenate along with lime sulphur wash. When using lead arsenate alone, however, it does not matter which form is used, either the neutral or acid being suitable when mixed with water only.

Some investigators claim that a third form of lead arsenate exists, viz., the pyro arsenate of lead ($Pb_2\,As_2O_7$). Its presence or the extent to which it occurs in our lead arsenates is unsettled. It is a form which is fully as rich in poisonous material as acid arsenate of lead is, but it is not such a stable substance as the latter and would readily break up when mixed with water, especially alkaline water, and with lime-sulphur solution, and liberate arsenic acid and would thus be extremely destructive to foliage. Not enough complaint is on record, however, to warrant us in believing that any quantity of this pyro arsenate is present in our lead arsenates.

The amount of lead arsenate to use in spraying varies all the way from 1 to 6 pounds per 40 gallons (either water or lime-sulphur solution). The amount to use depends on the insect to be attacked, the season of the year and the kind of plant. Full information on this point can be found in any reputable spray calendar.

Commercial Lead Arsenate.

This term is applied to those brands of lead arsenate which are manufactured by various chemical companies or firms. The commercial brands come on the market in two forms, as the *paste* and as the *powder.* The former has enough water in it to keep it in a moist and pasty condition, whereas the latter is dry and ground to a powder. The manufacturer of the paste usually sells on the 40% water basis, *i.e.,* that his product will contain 40 pounds of water in every 100 pounds. But this will vary slightly up and down for the same brand. Among different brands the range runs from 25 the 50 per cent. of water. The powders run about ½ to 1%. In arsenic ($As_2 O_5$) the powders are fairly constant, varying only with the form of the lead arsenate, whether it be neutral or acid; while the pastes, besides varying from the same factor also vary with the water content, and thus show a wider difference in arsenic content. If a limit were given for arsenic content it would be that the pastes should not go much below 15 per cent. and the powders 23.5 per cent. $As_2 O_5$. The advantage claimed for the pastes over the powders is that they work up more easily with water and in a much more finely divided condition, and thus require less agitation in the spray tank and also adhere more firmly to bark and foliage. This advantage is largely over-estimated. The powders can be worked into a paste with a small quantity of water, if care be exercised before putting it into the spray tank, which will put it into practically as good a physical condition as that possessed by the pastes. Further than this the powders are less bulky to handle and ship. They are also more uniform in their composition, varying only within narrow limits in regard to their moisture content, whereas the pastes vary as much as 25 per cent. among different brands. This latter point is very important when it comes to weigh out the required quantity of lead arsenate to use. A pound of lead arsenate paste containing 25 per cent. of water will contain half as much again of actual lead arsenate as a pound of lead arsenate paste containing 50 per cent. of water. If the manufacturer of pastes would ship his output with always 40 per cent. of water in it as nearly as he can make it, and if the user would keep it from drying out after he buys it, the above difficulty would of course be overcome. If the buyer uses the paste form he should keep a layer of water over its surface all the time in order to keep it from drying out and to maintain its water content uniform.

The composition of some of the more common commercial lead arsenates is given in the following table:

Composition of Lead Arsenates.

Sample No.	Manufacturer	Water %	Lead Oxide PbO %	Arsenic Oxide As_2O_5 %	Figured to dry basis		Lead arsenate as:	
					As_2O_5 %	PbO %	PbH %	Pb_3 %
347	Graselli Co., Cleveland.	40.49	40.335	16.744	28.14	67.78	44.00	53.00
348	Chemical Laboratories, Toronto	42.81	41.285	13.886	24.28	72.19	......	100.00
349	Sherwin-Williams, Cleveland	50.48	35.020	13.678	27.62	70.72	29.66	69.84
306	Niagara Brand Spray Co., Burlington	24.23	54.492	18.544	24.47	71.92	......	98.00
372	Hemingway London Purple Co	48.32	32.904	16.634	32.18	63.67	92.50	6.50
373	Swifts	45.14	34.803	17.774	13.40	63.44	95.60	2.00
436	May & Baker, London, Eng	47.24	30.564	16.429	31.14	57.93	100.00	......
555	E. Merck, Darmstadt, Germany	1.01	73.425	23.632	23.87	74.17	......	100.00
346	Graselli Co., Cleveland.	0.528	68.14	27.147	27.29	68.50	33.64	62.58

The 6th and 7th columns showing the composition when figured to dry basis illustrate how the per cent. of lead (PbO) and arsenic (As_2O_5) vary as the form of the lead arsenate varies. The higher the quantity of neutral arsenate the lower is the per cent. of arsenic and the higher the per cent of lead, and *vice versa*.

Lead arsenates should be of such a quality that when mixed with water they will give only inappreciable quantities of soluble arsenic, not more than 0.75 per cent. Samples which, when boiled with ammonia water, will give in the filtrate a precipitate with lead acetate and acetic acid, are as a rule injurious to foliage. The addition of a solution of lead acetate or nitrate to such arsenates till there is an excess of lead, as shown by potassium iodide paper (see under home-made lead arsenate), would be beneficial.

Home-made Lead Arsenate.

If one cares to he can make his own lead arsenate at home. The only drawback to this is the assurity of obtaining materials of suitable quality. Bulletin 131, Bureau of Chemistry, U.S. Dept. of Agriculture, gives the following directions:

Formula A.	Ozs.
Sodium Arsenate (65%)	8
Lead acetate (sugar of lead)	22

Formula B.

Sodium Arsenate (65%)	8
Lead Nitrate	18

"If the sodium arsenate employed is 50 per cent. strength, use 10½ ounces instead of 8. Of the pure crystallized salt 14 ounces would be required to furnish the same amount of arsenic oxide as would be furnished by the given amounts of the 50 and 65 per cent. grades if they actually contained these per cents. In only one technical sample examined, however, was the arsenic oxide content over 45 per cent. The formulas are based on lead acetate containing 60 per cent. of lead oxide and lead nitrate containing 66 per cent. of lead oxide.

"*Dissolve each salt separately* in from 1 to 2 gallons of water* (they dissolve more readily in hot water), using wooden vessels. After solution has taken place, pour slowly about three-fourths of the lead acetate or nitrate into the sodium arsenate. Mix thoroughly and test the mixture by dipping into it a strip of potassium iodide test paper,† which will turn a bright yellow if lead is in excess. If the paper does not turn yellow, add more of the lead acetate slowly, stirring constantly, and test from time to time. When the solution turns the paper yellow sufficient lead salt is present, but if it should occur that the paper does not turn yellow after all the lead salt has been added dissolve a little more and add until an excess is indicated. The great advantage of this test is that it is not necessary to filter the solution or wait for it to settle.

"If the paper is not at hand, the test may be made by adding a few drops of a solution of potassium iodide, when, if lead is in excess, the instant the drops touch the solution a bright yellow compound, lead iodide, will be formed.

"It is very essential that the lead salt be added in *slight excess,* but a large excess should be avoided.

"If the material has been carefully prepared with a good grade of chemicals it will not be necessary to filter and wash the lead arsenate formed, though it would be a safe precaution to allow the lead arsenate to settle, then decant the clear solution and discard it. Approximately 1 pound of actual lead arsenate will be obtained by using the amounts of chemicals specified, which is equivalent to practically 2 pounds of commercial lead arsenate in the paste form. It may be made up to 40 gallons with water if a formula is being used which calls for 2 pounds of commercial lead arsenate to 40 gallons, or if a stronger application is desired add less water.

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*The solution of lead acetate may have a milky appearance. This will be no objection, and it need not be filtered.

†If potassium iodide test paper cannot be obtained, it may be prepared by dissolving a few crystals of potassium iodide in about a teaspoonful of water and saturating filter paper or blotting paper with this solution. After the paper has dried, cut into strips and keep dry until needed.

"As these chemicals are all extremely poisonous, vessels in which they have been dissolved or mixed should be plainly marked, and not used for any other purpose."

The authors of the above publication claim that Formula A will produce neutral lead arsenate and Formula B acid lead arsenate.

The economy of making home-made lead arsenate will depend on the cost of materials, labour, convenience, ability to secure the chemicals of suitable quality, etc.

Calcium Arsenite.

This is a home-made substance and several formulæ have been published for making it. There seems to be no doubt about the insolubility of the compound when it is used immediately after it is prepared, but when allowed to stand for days or weeks before applying there may be some decomposition take place and soluble arsenites be formed which will destroy foliage.

The following method can be followed in making it:

White arsenic (As_2O_3)	5	pounds.
Washing Soda, crystallized ($Na_2CO_3 10H_2O$)....	5	pounds.
Water (soft, such as rain water)	2½	gallons.

(In place of the crystallized washing soda one can use instead 1½ pounds of the anhydrous washing soda. It is a white powder. The crystallized washing soda changes into it after long exposure to the air, so that it is a common thing, therefore, to find that the crystallized washing soda after bought changes, if kept in an open container, to the anhydrous form. The so-called soda ash, which can be bought and which looks like anhydrous washing soda, is not suitable for making calcium arsenite.)

The washing soda and white arsenic are added to the water. The mixture is then brought to the boiling point and boiled till everything is dissolved. This takes about five minutes of boiling. When solution is effected, about 8 pounds of good fresh lime are added. When slaking has ceased, continue boiling for 10-15 minutes. This mixture, when diluted with water, will make about 800 gallons of spray. It can be made in smaller quantities if so desired, by reducing the quantity of white arsenic, washing soda and lime given above, but still retaining the same proportions.

The chief advantages of the calcium arsenite preparation is that it is cheap, the materials are easily procured, it is easily prepared, and that it is a reliable and fairly safe insecticide.

Contact Remedies.

As previously stated, these remedies are employed to destroy sucking insects which must be killed by contact. They will kill by clogging the breathing pores of the insects, and, to some extent, by their corrosive action. *To be effective, the plant or tree must be very thoroughly covered.* In the case of the San José Scale, which may exist in a spot no larger than a pin-head, one scale left untouched may produce as many as a million offspring during the season. Consequently, *thorough spraying is essential to success.*

Sulphur.

Sulphur is a yellow substance which melts to a thin straw coloured liquid at 114.5° C., and boils at 448.4° C., changing to a brownish yellow vapour. When these vapours strike a cool surface they are condensed and deposited as a fine amorphous yellow powder, called "flowers of sulphur." Sulphur also appears on the market in sticks called "sulphur rolls." When sulphur rolls are ground to a fine powder we have it in the form known as "flour of sulphur." *Flour* and *flowers* of sulphur are the two forms which are used for combatting insects. They are used as a dust or, more often, boiled up with lime and water and applied as lime-sulphur solution. Flour of sulphur is somewhat cheaper to buy than flowers of sulphur.

A form of sulphur, known as Atomic Sulphur, put up by the Thomson Chemical Company of Baltimore, Md., and which is said to be "pure sulphur in a paste form combined with arsenate of lead," has been used as a fungicide and insecticide by some investigators in the United States, and has given reported good results.

Lime-sulphur Washes.

These washes have come into use during the last few years in combatting the San José scale. They have also been found to be very effective in destroying other kinds of the smaller insects, and are considered by many to be one of the best general "cleaning up" sprays that have been devised. In addition to their insecticidal value, they are efficient fungicides.

A disagreeable feature of these washes is that they are very caustic, and their application is often attended with considerable discomfort, especially in windy weather. Some of the irritation to the face and hands of the operator may be avoided by smearing the former with vaseline and covering the latter with rubber gloves. Leather is easily corroded by these washes, and care should be taken that the spray does not come in contact with the harness. Unless it is a still day, the horses should be covered with blankets, or always kept to the windward.

Home-made Wash.

A number of formulæ have been recommended for the preparation of this wash. Those usually adopted in Ontario, as given by Prof. Lochhead,* are as follows:

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*Thirty-sixth Annual Report of the Entomological Society of Ontario.

Fresh lime	20 pounds.
Sulphur (flowers or flour)	15 pounds.
Water	40 gallons.

" With warm water make the sulphur into a paste, put in the lime and add about 15 gallons of warm water with stirring. The sulphur paste may be added after the lime has been slaked. Boil *vigorously* for an hour in a kettle, or, in a barrel with live steam. Make up to 40 gallons with water; strain into spray tank and apply while warm."

Self-boiled Wash.

To make this wash it is essential to have a freshly burned quick slaking lime. The directions for making it as given by Mr. W. M. Scott, of the Dept. of Agriculture, Washington, D.C., are:

Lime	40 pounds.
Sulphur	40 pounds.
Water	200 gallons.

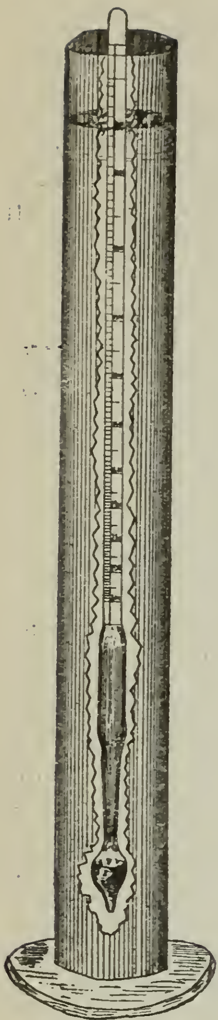
" Place the lime in a barrel and pour enough water (about 3 gals. per 20 lbs.) to start it slaking and to keep the sulphur off the bottom of the barrel. Then add the sulphur which should first be worked through a sieve to break up the lumps, and finally enough water to slake the lime into a paste. Considerable stirring is necessary to prevent caking on the bottom. After the violent boiling which accompanies the slaking of the lime is over the mixture should be diluted ready for spraying, or at least enough cold water added to stop the cooking. Five to fifteen minutes are required for the process according to whether the lime is quick acting or sluggish. Only a small percentage of the sulphur—enough to improve the adhesiveness of the mixture—goes into solution, but if the hot mass is allowed to stand as a thick paste the sulphur continues to unite with the lime, and at the end of thirty or forty minutes enough of the reddish liquid is produced to burn peach foliage and even apple foliage in some cases. Hence the necessity for cooling the mixture as soon as the lime is well slaked."

This wash has been specially developed for summer spraying—it does not contain enough of the calcium polysulphide to cause any foliage injury.

Concentrated Wash—(1) Commercial:

The commercial concentrate is, as its name indicates, a wash manufactured by a commercial concern. It is made in large quantities and by several firms and forms a very ready and convenient source of the lime-sulphur wash. The common brands on the market are: Vanco, Niagara, Rex, Graselli and Sherwin-Williams. These do not differ materially from each other, the quality being practically uniform.

The concentrate is strong (concentrated) and needs to be diluted with water before spraying. To dilute properly it is necessary to use a hydrometer and obtain the specific gravity of the *clear liquid*. The greater the


An hydrometer suspended in a cylinder of water.

sp. gr. is, the larger is the quantity of water that must be added. A suitable hydrometer for this work should have its scale graduated from 1.000 to 1.400, and preferably should also have the Beaumé scale marked on its spindle. A hydrometer of this kind can be secured from Parke & Parke, druggists, of Hamilton, Ont., for 85 cents. The proper quantity of water to be added is found by dividing the decimal portion of the specific gravity by .028 for the winter wash, and .008 for the summer wash.

e.g., Specific gravity of concentrate = 1.320, $\therefore$ each gallon can be diluted to

(a) $\frac{.320}{.028} = 11.43$ gals. for winter wash,

and (b) $\frac{.320}{.008} = 40.00$ gals. for summer wash.

The dilution for the spray, both winter and summer, will vary, however, depending on the fungus or insect being sprayed for, the nature of the foliage and the severity of the infection. A spray calendar should therefore be consulted in order to find the correct figure to use in place of .028 and .008.

In case of the clear concentrates, *i.e.*, those which contain no sediment or "sludge," it is sometimes desirable to add lime. The main function of the lime is to act as a marker so that the thoroughness of the spraying can be controlled. This is especially important when an inexperienced or careless man is at the nozzle. But it has other uses besides: (1) It prevents a great deal of waste by dripping, (2) some claim that it improves the sticking quality of the wash, (3) lime possesses in itself marked insecticidal and fungicidal properties. If lime is added it should be slaked first, worked up to a thin batter with water, strained free of large particles and then poured into and well mixed with the diluted wash. Never add it to the concentrate before dilution. The amount used varies from 2 to 6 pounds of stone lime per 40 gallons of spray.

(2) Home-made:

It is quite possible to make the concentrated wash at home if one wishes to go to the trouble and expense. After some experience the wash can be made of as good quality as the commercial kinds and at less expense. Directions for making and handling are as follows (See Bull. 92, Penn. Expt. Station):—

50 lbs. best stone lime,
100 lbs. sulphur (flour or flowers),
40-45 gals. of water, *at finish.*

"Put 8 gallons of water in kettle and start fire. Place lime in kettle. After slaking is well started, add the dry sulphur and mix thoroughly, adding enough water to maintain a thin paste, which requires about 5 gallons. After the slaking and mixing is completed, add water to the height of 40 gallons on the measuring stick, bring to a boil and stir until the sulphury scum practically disappears. Then add water (preferably, but not necessarily, hot) to the 55 gallon height, and boil to 45 gallons. The material should be kept well stirred, especially during the early stages of the process, and any lumps of sulphur or lime should be thoroughly broken up.

"The total time of actual boiling should be about one hour, though a ten-minute variation either way is not objectionable providing the sulphur is evidently dissolved. This fact is best determined by dipping and slowly pouring some of the material. The amounts of water indicated above are ample for one hour's fairly vigorous boiling, with the finishing volumes as indicated. If it is not at the desired height at the close, it may be made so by more water or more boiling, and either the amount of water in the second addition or the vigor of boiling can be so modified in later trials as to enable the total to be brought to the desired height approximately at the end of the hour.

"The finished product may be immediately poured or strained into a barrel or settling tank or into the spray tank. The straining is merely a safeguard to prevent any possible clogging because of imperfect materials or failure to break lumps in the sulphur. When properly made the amount of sediment left in the strainer is insignificant, being less than one per cent., as shown in Table I, and may be thrown away. To avoid any considerable loss of materials, however, the sediment in the strainer can be washed with part of the water used in making the next lot, simply pouring the water through the strainer into the kettle, and any lumps of sulphur discovered may be broken up and used again.

"If the straining is not done, the whole product may be put into a settling tank or barrel, and the clear liquid drawn off later as required. This process, however, is likely to lose efficient liquids in the sludge, as well as the fine sludge itself, which may be of value in several ways, and is of no apparent hindrance in the spraying.

"The crust which forms on the finished material is prevented by immediately covering the solution with a layer of oil about an eighth of an inch thick, and avoiding unnecessary exposure to air in the transfer from kettle to storage tank. An ordinary paraffine oil was very satisfactory in our work, but there is no reason be believe that any other oil, not injurious to trees nor likely to take fire at boiling temperatures, may be used with equal success.

"The crust may also be prevented by immediate storage in tight, closed vessels, filling them completely. But partially filled vessels are likely to develop some crust upon continual exposure."

Lime of good quality should be used for making the home-made concentrate. Beachville lime (0.6 per cent. impurity) is of ideal quality and any lime with not more than 10 per cent. impurity would be suitable, such as Ottawa, Coboconk, Trenton, Amherstburg, Caledon, etc.

Freshly burnt lime should also be used, because air-slaked lime combines with sulphur very slowly. The latter is very good for making the ordinary home boiled wash where the amount of lime used is usually greater than the amount of sulphur, but for the manufacture of the concentrate it is wholly unsuitable.

Lead Arsenate and Lime-Sulphur Wash Combined.

In summer spraying with lime-sulphur wash it is often essential that an arsenical should be sprayed also, and in order to overcome the bother of two sprayings the two are mixed and applied together. Neutral lead arsenate is very useful for this purpose as it does not hurt the wash nor itself become affected to any appreciable extent. From 2 to 4 pounds of the paste per 40 gallons of lime-sulphur wash are the usual proportions to use. The paste is worked up to a thin batter with water and then poured into and well mixed with the diluted lime sulphur solution, and the combination is then ready to spray. The agitator must be kept continually running just as when the lead arsenate is mixed with water only, so that there shall be a uniform distribution of the arsenate.

Other Insecticides Recommended for Destroying the San Jose Scale

With the spread of the scale, a large number of remedies of various kinds have been placed on the market. Among the more important of these are "Kil-o-Scale," and "Anti-Scale," or "Scalecide," "Emulsified Con-Sol" (also known as "Target Brand Scale Emulsion,") "Con-Sol," the "Webcide Solutions," "Zanoleum," and caustic soda and water. From the results of experiments conducted in this Province and elsewhere, it does not appear that these insecticides are any more effective, if as much so as the lime-sulphur washes in destroying scale. Prof. C. O. Houghton states that* the so-called "soluble oils," "Kil-o-Scale" and "Emulsified Con-Sol," give satisfactory results when applied in the spring. Fall applications of "Kil-o-Scale" were satisfactory in one case, but not entirely so in another. "Scalecide" applied once as a fall spray was quite unsatisfactory so far as could be determined after a period of three months had elapsed. Applied to apple trees as a summer spray, at the rate of 1 part to 28 parts of water, "Scalecide" gave valuable results. "Con-Scale," the "Webcide Solutions" and caustic soda in water failed to give satisfactory results in any instance.

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*Delaware Experiment Station, Bull. No. 74, 1906.

Crude Petroleum.

This material was first recommended for use against scale enemies by Dr. J. B. Smith, of the New Jersey Experiment Station. In the hands of many orchardists, however, it has been found to be decidedly damaging to many kinds of foliage, especially the more tender varieties, the apple and the pear being the only ones able to withstand its destructive power to any successful degree.

It is a very effective remedy, nevertheless, and whenever applied destroys the scale; but because of its general destroying tendencies, it cannot be recommended except for the most hardy trees.

If the crude petroleum can be emulsified, however, *i.e.*, put into a form in which it will mix with water, it could be used with perfect safety, for it could then be diluted down to a suitable strength. Formulæ have been published for doing this, but these relate more to paraffine oil, a distillation product of crude petroleum, than to crude petroleum itself. Still, some investigators claim that they have satisfactorily emulsified crude petroleum and we will therefore reproduce one of these formulæ. It consists of two parts, one for making the emulsifier and the other for making the soluble oil. (See Bull. 54, Storrs Agri. Expt. Station, Storrs, Conn.)

The Emulsifier:

Carbolic Acid (liquid crude, 100 per cent.)	2	quarts
Fish Oil (Menhaden)	2½	quarts
Caustic potash (granulated)	1	lb.

Heat to 300 degrees Fah., remove from fire and immediately add

Kerosene	3½	quarts
Water	5	quarts

The heating should be conducted in an iron kettle and away from buildings, as the mixture is inflammable.

The Soluble Oil:

Emulsifier	8	parts.
Paraffine Oil	35	parts
(or Crude Petroleum, 20 to 30 parts.)		
Rosin Oil	5	parts.
Water	1	part (more if necessary.)

After the materials have been brought together in the above proportion they should be vigorously stirred with a garden hoe or some other suitable instrument. If the soluble oil has been successfully made a few drops poured into a glass of water will give a milk-like emulsion.

For spraying, 1 part of the Soluble Oil is mixed with 15 parts of water, or more or less if it is desirable to have a weaker or stronger spray, respectively.

Kerosene Emulsions.

The Kerosene Emulsions of various kinds have been recommended for destroying many forms of insect life. The kerosene is, of course, the killing agent. Dr. James Fletcher gives the following formula:*

Kerosene (coal oil)	2 gallons.
Rain water	1 "
Soap	½ pound.

"Boil the soap in water till all is dissolved; then, while boiling hot, turn it into the kerosene, and churn the mixture constantly and forcibly with a syringe or force pump for five minutes, when it will be of a smooth creamy nature. If the emulsion is perfect, it will adhere to the surface of glass without oiliness. As it cools it thickens into a jelly-like mass. This gives the stock emulsion, which must be diluted with nine times its measure of warm water before using on vegetation. The above quantity of 3 gallons of emulsion will make 30 gallons of wash."

Recently the *K-L* (*Kerosene-Lime*) *Emulsion* has been more or less strongly recommended for destroying San José Scale. It is a mixture of kerosene, hydrated lime, and water, the lime acting as a carrier or emulsifier of the kerosene. Prof. C. P. Close gives the following directions for its preparation:† "Pour the kerosene and lime into a barrel and stir together well with a paddle. Add ten or twenty gallons of water, and stir to loosen the kerosene and lime from the bottom and sides of the barrel. Pour in water until the barrel is more than three-fourths full, and with a hoe or dasher, churn, splash and pound the K-L four or five minutes to emulsify it, then fill up the barrel with water, and spray. A long up and down stroke of a hoe or dasher is best, and if the hoe is held just right the blade goes straight down instead of glancing to the side of the barrel. *A terrific splashing can and must be made in this way.* A burlap bag or canvas should be thrown over the barrel to prevent the emulsion from splashing out. A board cover is better than burlap or canvas, and is easily made by nailing strips at the end of thin boards three feet long and boring a two-inch hole in the centre. Through this hole the hoe handle projects and the churning is more easily done than when a bag is used.

"Very small lots of two or three gallons can be emulsified by pumping the K-L back into itself through a nozzle throwing a small solid stream, but this method is not recommended for larger quantities. In fact, *the fruit grower is hereby warned not to attempt to make lots larger than two or three gallons by pumping, nor lots of any size by stirring, but always*

*Central Experimental Farm, Ottawa, Bull. 52, 1905.
†Delaware Agricultural Experiment Station, Bull. 73.

to make K-L by the most violent churning, pounding and splashing with a hoe or dasher.

The prepared hydrates of lime on the market, or good stone lime dry slaked, are best for making K-L. Air-slaked lime is not desirable, but may be used. If the lime is fresh four pounds per gallon of kerosene will be ample, but if old, more may be required. Use enough lime to take up all the kerosene and mix into a thin, sloppy mass. If drops of kerosene gather on the top in less than a minute sprinkle on more lime.

Proportion of Kerosene, Lime and Water.

"K-L is kerosene, lime, and water, and the proportion of each in 50* gallons of different strengths, is as follows:

"For	10%	K-L use	5	gals. kerosene,	20	lbs. lime,	44½	gals. water,
"	12½	"	6¼	"	25	"	43	"
"	15	"	7½	"	30	"	41½	"
"	17½	"	8¾	"	35	"	40	"
"	20	"	10	"	40	"	38½	"
"	25	"	12½	"	50	"	34½	"
"	30	"	15	"	60	"	30½	"

"The K-L-B is kerosene, lime, and Bordeaux mixture. It is made exactly like the K-L except that the Bordeaux is used instead of water. We use the 4-4-50 Bordeaux formula. Four pounds of copper sulphate are dissolved and diluted with water to 25 gallons. Four pounds of stone lime are slaked and diluted with 25 gallons. Four or five pounds of hydrated lime or fresh dry slaked lime are usually substituted for the stone lime. The copper solution is then poured into the milk of lime and the mixture is well stirred with a paddle.

"The K-L-B-P is kerosene, lime, Bordeaux, and poison. It is made exactly like K-L-B except that poison is added to the Bordeaux. Paris green is about the most reliable poison, and one pound is used in 75 gallons of Bordeaux."

Fresh lime is not conveniently obtainable in all parts of the Province. Mr Frank T. Shutt, Chemist at the Central Experimental Farm, Ottawa, has shown that flour may be used instead of lime with equally good results. With reference to the preparation, Prof. Shutt writes as follows:† "The preparation with flour is most simple. The requisite amount of kerosene is placed in the vessel (pail or barrel)—which is preferably dry—and flour added in the proportion stated, viz., eight ounces to the one quart, the whole thoroughly stirred and the water added, two gallons for every quart of kerosene. This is then vigorously churned. The time necessary to churn will vary from two to four minutes, according to the quantity to be emulsified, and the emulsion is then ready for use.

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*Wine Measure.

†The Canadian Horticulturist, May, 1905.

"When the emulsion is required for immediate use, the quantity of flour may be further reduced. It was found that as small a quantity as two ounces would emulsify one quart of kerosene, but that on standing a few hours a perceptible layer of kerosene had separated.

"It has, further, been found that by scalding the flour before adding the kerosene a less weight is required. An excellent emulsion, which showed not the slightest separation of kerosene after one week, was prepared by scalding two ounces of flour, mixing the resulting paste with one quart of kerosene and emulsifying with two gallons of water.

"The flour emulsion is smooth, readily and easily atomized, and does not clog the nozzle. Any separation into layers (no free kerosene will appear for several days, at least) may be readily overcome or remedied by simply stirring the mixture. It is equally effective, as might be expected, as an insecticide with the lime-formed emulsion, and amongst other advantages that may be claimed for it there is no perceptible whitening of the tree or foliage; and, further, in some places it may be found cheaper and easier to make than the lime emulsion. Its use is suggested as an alternative where good lime is unobtainable and also for making the emulsion when intended for ornamental trees, shrubs, etc., where the whitening of the foliage is objectionable. The flour emulsion can be added to Bordeaux mixture, Bordeaux and Paris green, if desired."

*Soap Washes.**

"The most effective soap wash is made with whale-oil soap, one pound to from four to six gallons of water. The term whale-oil soap is merely a trade name for fish-oil soap, made with either potash or soda. The potash soaps, which are the best, because even stronger solutions remain liquid when they cool, are soft soaps. The soda soaps are hard. Of the two, the potash soaps are considered the best to use on vegetation, as well as being more convenient. Both kinds should always be dissolved in hot water.

"When bought at retail prices, these soaps cost from 15 to 20 cents per pound, according to the locality, but if obtained in large quantities, can be got at from 3 to 5 cents per pound. Fifty-pound kegs are supplied at 5 cents per pound. Two well-known brands of potash soft soaps which have been much used in Canada, and have given good satisfaction, are those made by W. H. Owen, of Port Clinton, Ohio, and by Good & Co., of Philadelphia, Pa. If thought desirable, these soaps can be made at home; but it is very unpleasant and dirty work, and it is, besides, doubtful whether such good or cheap results can be secured as by buying from firms which make a special business of manufacturing soaps with only the required amount of moisture and the proper grade and amount of potash. It has been found in experiments carried on at Washington that what is required for spraying purposes is a caustic potash and fish-oil soap, made with a fairly good quality of fish-oil, and from which water has been elim-

*Central Experimental Farm, Ottawa, Bull. No. 52.

inated by boiling, so that it does not exceed 25 or 30 per cent. of the weight of the soap. Soaps made with caustic soda instead of caustic potash are unsuitable for spraying purposes. Dr. J. B. Smith (New Jersey Experiment Station), in his circular No. 5, "Whale Oil Soap and Its Uses," says: "Whale-oil, or fish-oil, soap is one of the most reliable materials for use against plant-lice, and generally against sucking insects which can be killed by contact insecticides. It kills by clogging the spiracles, or breathing pores, of the insects, and also to some extent by its corrosive action. The advantages of fish-oil over ordinary laundry soap lie in the greater penetrating power, in the fact that it remains liquid when cold, at much greater strengths, and that fish-oil itself seems to be more fatal to insect life than other animal fats. A good soap can be made as follows:

Concentrated potash lye	3½ pounds.
Water	7½ gallons.
Fish-oil	1 gallon.

Dissolve the lye in water, boil, and to the boiling solution add the fish-oil; continue to boil for two hours, and then allow to cool. Any grade of fish-oil will answer.

"Whale-oil soap may be applied in the strength of one pound in four gallons of water for brown or black plant-lice, and one pound in six gallons for green plant-lice; warm water should always be used when dissolving it.

"Soaps of all kinds are very useful in adding adhesiveness to liquid mixtures when it is necessary to apply these to such vegetation as cabbages, turnips, peas, etc., which have their leaves covered with a waxy secretion which prevents water from lying upon them. Any kind of soap will answer for this purpose, and it may be remembered that one quart of soft soap is about equal to one pound of hard soap."

Another method for making home-made fish-oil soap is given by Van Slyke and Urner, and is as follows:*

Formula for making Forty Pounds of Fish-Oil Soap.

Caustic soda	6 pounds.
Water	1½ gallons.
Fish-oil	22 pounds.

"The caustic soda is completely dissolved in the given amount of water and the fish-oil is added gradually under constant and vigorous stirring. The combination occurs readily at ordinary summer temperatures and the operation is soon completed. The mixing may be done in any receptacle sufficiently large to contain the whole amount of material. It would probably not be desirable to attempt to make more than 20 to 40 pounds at a time, since the difficulty of thoroughly stirring a larger mass

*New York Experiment Station, Bull. No. 257, 1904.

would tend to make a complete combination less sure, thus rendering liable the presence of too much free alkali. *Complete and thorough stirring is essential to success.* Caustic soda should be handled with precaution, since in concentrated form it easily injures the skin.

The authors show that when caustic soda can be got for 4½ cents per pound and the fish-oil at 29 cents per gallon, the material for 40 pounds of soap costs $1.14, or 2.85 cents per pound.

Hydrocyanic-Acid Gas, HCN.

This insecticide is used largely in the fumigation of nursery stock. It is also used for destroying scales on orchard trees and for ridding mills, stores, and elevators of grain pests and rodents. The applicability of it was first demonstrated in California, where it was found useful in combatting the cushiony scale affecting citrus trees, but it has since found a very extended use against other insect enemies.

The gas is not bought as such, but is prepared at the time of use from a substance known as potassium cyanide (KCN). The cyanide is a solid body and when treated with sulphuric acid (H_2SO_4) is decomposed or broken up and the gas liberated as:

$$KCN + H_2SO_4 = HKSO_4 + HCN$$

Pot. cyanide. Sulphuric acid. Pot. acid sulphate. (Hydrocyanic acid gas).

The gas at low temperature is condensed to a liquid and is then called *prussic acid.* The liquid boils at 26.5° C., and thus is easily changed into the gas again. Being quite light, the gas rapidly diffuses and penetrates to every little nook and corner of the fumigating enclosure. For this reason it is very effective, and, when supplied in sufficient quantity, leaves nothing undone.

Fumigation of trees is best done while in the dormant state; if trees in foliage are treated, night should be chosen as the time of action, since the actinic or light-giving rays of the sun have a very damaging effect on leaves for some time after they have been surrounded by the gas.

As the gas is *extremely poisonous,* great care should be taken that it be not inhaled; and before a building or tent is entered after the operation, a thorough airing should be given.

For generating the gas, an open glazed vessel is used, an ordinary crock serving the purpose admirably. The water is first placed in the vessel, the sulphuric acid is then added, and last, the potassium cyanide is dropped in and the door quickly closed. All ventilators, cracks and openings should be tightly closed to prevent any leakage or waste of gas. The amounts of the different materials employed are as follows:

Potassium cyanide (98 per cent.)	1 ounce.
Sulphuric acid (1.83 specific gravity)	1 fluid ounce.
Water	3 fluid ounces.

Enough will be supplied by these quantities to fill 150 cubic feet of confined space. If there are 300 cubic feet of space, then twice the quantities given will have to be employed; if 450, then two and a half times; and so on up. The factor to be used can always be found by dividing the cubical contents by 150. For fumigating greenhouses where such tender plants as the tomato are present the following amounts of materials will be found ample to produce enough gas to exterminate the white fly and yet leave the foliage unharmed:

Potassium cyanide (98% pure)	¼	oz.
Sulphuric acid (1.83 sp. gr.)	½	fl. oz.
Water	1	fl. oz.

for each 1,000 cubic feet of space.

It is interesting to know that the residue left in the vessel after the action is completed is a valuable fertilizer, and should not be wasted. It should either be placed at some depth in the manure or compost heap or buried near the base of some tree or shrub. At any event, do not leave it lying around, as it is both acid and poisonous.

Carbon Bisulphide, CS_2.

As the formula indicates, this compound is made up of carbon and sulphur,one atom of the former and two of the latter. In the pure form it is a clear liquid with a pleasant odour, but when impure it is somewhat coloured and possesses a highly disagreeable smell. It boils at 64.2° F., and thus volatilizes or changes to a vapour or gas very readily at ordinary temperatures. This gas ignites at a temparture of 297.5° F.

The vapours are very *poisonous,* and thus are very valuable in dealing with grain weevils, and the pea bug; and also for overcoming subterranean workers. Its use was first discovered in France, where it was and is employed against the grape phylloxera. The wine districts there were saved from complete annihilation by its introduction.

Since the vapour is 2.63 times heavier than air, it tends to work downward very rapidly, and will thus penetrate to some depth in the soil. In dealing with grain pests the liquid is placed in shallow dishes on top of the pile and then as the evaporation goes on, the vapour will work downward and penetrate the whole bulk.

Dosage: (1) For grain weevils, use one pint (1½ lbs.) for every 1,000 cubic feet of space. Place in shallow pans on top of the grain, using at least one pan in every 25 square feet of surface. Thus a bin of grain 25 feet long, by 5 feet wide, by 8 feet deep, would require 1 pint to be distributed in five pans. Larger quantities would not be harmful and would be more effective; the fluid is cheap, therefore employ an overdose rather than an insufficient quantity.

(2) For pea bugs use 1 pint for every 100 bushels of peas.*

*See Ontario Agricultural College Bulletin, No. 126, pp. 26-27.

(3) For subterranean workers (root maggots, etc.) inject small quantities into the soil around the base of the infested plant, 2 or 3 teaspoonful in a place.

As with hydro-cyanic-acid gas, all openings should be well sealed to prevent escape and waste. Inhalation should also be avoided as much as possible, although small quantities breathed in will produce no harm except in cases of a weak heart. Fresh air is the cure, and when one begins to feel a dizziness, it is wise to seek at once the open atmosphere. Before entering a room where it has been used, thorough ventilation should be given.

Precaution:—As one volume of carbon bisulphide vapour mixed with 14.3 volumes of air forms a highly *inflammable* and *explosive* mixture, *never allow a light or even a spark,* or a lighted pipe or cigar to be brought near it.

Carbolic Acid, Phenol C_6H_5OH.

This substance is an oxygen derivative of benzene, one of the members of the aromatic series of the carbon compounds. It has a permanent but characteristic and pleasant odour, which seems to be quite distasteful to many insects. In the undiluted form this acid is very active, and will burn and blister the flesh and cause much pain, but in the diluted form, as 1 part to 40 or 50 parts of water, it makes an important disinfectant that is extensively used in medicine. In the form of an emulsion with soap and water it is very useful in destroying the eggs and young maggots which infest onions, radishes, and similar garden crops.

The emulsion is made thus:

Carbolic acid	1 pint.
Hard soap	1 pound.
Water	1 gallon.

Dissolve the soap in the boiling water, and while boiling add the acid and continue the boiling for a few minutes, stirrng thoroughly. Put the emulson away in a tightly closed vessel and label *"Stock Solution of Carbolic Acid—Poison."* Before using, dilute 1 part of the stock solution with 50 parts of water.

Carbolic acid is also used in the form of what is known as "Carbolized Plaster," in which case the acid is mixed with land plaster (gypsum), road dust, air-slaked lime or some other diluting medium, and is then sprinkled or dusted on in the dry state.

Carbolic acid	1 pint.
Diluent (land plaster, etc.)	50 pounds.

This mixture is said to be very effective against flea beetles, cucumber beetles, etc.

Tobacco.

A strong decoction that is very obnoxious to insects and at the same time poisonous (nicotine) can be made from tobacco (stocks, refuse leaves, sweepings, etc.), by steeping in water for a prolonged period. This could be made a very valuable source of an insecticide by those people living in a tobacco district, or near a tobacco or cigar factory.

A good way to use the strong extract, although it can be sprayed as it is after it is diluted with water to about the colour of strong tea, is as follows:

Hard soap	1 pound.
Water	8-10 gallons.
Strong tobacco extract	1 gallon.

Dissolve the soap in boiling water, add the decoction, and then make up to 8-10 gallons.

White Hellebore.

This is a powder obtained by grinding up the dried roots of a plant known as Veratrum Album. The powder is of a light yellowish colour and possesses a rather pleasant odour, and contains as its active principle a very powerful alkaloid called Jervine. It kills both by poisoning the insect and by stopping up the breathing pores, and can thus be classed as both a food poison and a contact insecticide. Hellebore is much less poisonous than the arsenicals and soon loses its poisonous action when exposed in the air; thus it can be used on plants bearing fruit which is just about ready for market, with much more safety than can be the mineral poisons. This volatility of the alkaloid also shows the necessity of using a fresh article and one that has been kept away from the air in a tightly sealed receptacle.

Use either the dry powder or with water, 1 oz. to 2 gallons warm water.

Pyrethrum (Insect Powder, Buhach).

This powder is also called Dalmatian Insect Powder and Persian Insect Powder. It is also, like hellebore, obtained from plants, being the pulverized flowers of the botanical genus Pyrethrum. Value as an insecticide is due to the presence in it of an oil which is exceedingly poisonous to most insects, but practically harmless to human beings and the higher animals. It can be used with impunity, therefore, and on account of this fact is of special value.

The oil which imparts the killing power (largely by contact with the body of the insect) is very easily disseminated into the surrounding atmosphere and thus lost. For this reason these powders must be fresh and have been kept in tightly sealed receptacles, else they will be ineffective.

Application can be made in a number of ways:

1. *In solution*: 1 oz. to 3 gallons of water.

2. *Dry*: Apply while dew is on in the morning or after a rain.

3. *Dry, with dilution*: Mix with some flour or other light powder to any extent desired. Apply as 2.

4. *In fumigation*: Dust over live coals; for dealing with mosquitoes and flies.

FUNGICIDES.

It has long been known that chemical compounds are useful in combatting fungous diseases. As early as 1807 it was found in France that copper sulphate would prevent the germination of the spores of corn smut, but this discovery, one of a very important nature, was not appreciated or made known till a much later date. Sulphur was long used in the same country, but was not nearly so energetic as desired. No advances were made, however, till 1882, when the value of the compounds of copper became known. Since then great strides have been made in improved methods.

As indicated above, copper is a very important ingredient in fungicides. Nearly all the leading remedies contain it in some form or other; and so widely are its compounds used that we have come to term the combinations in which it occurs as "The Copper-Salt Fungicides."

Copper-Salt Fungicides.

Bordeaux Mixture.

This substance derives its name from the city of Bordeaux, in France, as it was in the vineyard district surrounding this place that it was first found useful. Therefore the name gives no indication as to what ingredients are present.

The source of the copper in this fungicide is copper sulphate, or what is commonly known as "bluestone." Now copper sulphate is an "acid salt," *i.e.*, it is a salt which shows an acid reaction and will turn blue litmus paper red. This property of bluestone is due to the fact that it is a compound formed by the combination of a weak alkali ($Cu(OH)_2$) with a very strong acid (H_2SO_4), the outcome being that of a salt in which the acid property predominates. Being acid, therefore, copper sulphate cannot be applied to foliage, because it exerts a burning or destroying influence. Like white arsenic, it must be changed to some other form, a form which will not be injurious. Bluestone can be applied to foliage without doing harm, but in such a dilute form that it is not very effective.

The material used to overcome the acid property just mentioned is slaked lime or milk of lime. A good sample of lime is secured and slaked with a minimum quantity of water, thus changing it into the hydrate, as:

$$\underset{\text{Lime.}}{CaO} + \underset{\text{Water.}}{H_2O} = \underset{\text{Slaked lime.}}{Ca(OH)_2}.$$

This slaked lime is then added to the bluestone, which has been dissolved in water, whereupon the following theoretical reaction takes places:

$$\underset{\text{Copper sulphate}}{CuSO_4} \;-\; Ca(OH)_2 \;=\; \underset{\text{Copper hydrate.}}{Cu(OH)_2} \;+\; \underset{\text{Gypsum.}}{Ca(SO)_4}.$$

Providing enough lime has been used to act on all the copper, the latter will now all be present as copper hydrate, a precipitate or sediment of a beautiful sky-blue colour, and which is practically insoluble in water. In this form, as a solid in suspension in water, it is sprayed on to the foliage.

Being in a solid form, copper hydrate, or Bordeaux, as it is called, is inert and will not act on the fungus. It must be changed to some form on the leaf which will be soluble in water. This change is brought about by carbon dioxide of the air and by that contained in dew and rain, or even by that which comes from the leaf itself.

How to make the Bordeaux Mixture. The first thing to do in the manufacture of the Bordeaux mixture is to decide on some recommended formula. The formula which has long been advocated in Ontario is known as the 4-4-40 formula. It is as follows:

$CuSO_4$ (crystallized copper sulphate)	4 pounds.
CaO (quick lime)	4 "
Water	40 gallons.

With good lime it only needs about one pound to act on all the copper; the excess given, three pounds, cover all danger which might arise from the use of a poor article. A large excess of lime is a disadvantage,—it causes the Bordeaux mixture to exert a low fungicidal action, it is apt to cause the machinery to clog and to cause an uneven application, and the particles of lime offering more resistance to rain, will cause the mixture to be more rapidly washed from the trees. It may be an advantage, however, in a very wet season, by causing the Bordeaux to retain its efficiency longer and by allowing less injury to be done to foliage. Orchardists are inclined to use a less proportion of lime, and the following formula is recommended:

$CuSO_4$ (crystallized copper sulphate)	6 pounds.
CaO (quick lime)	4 "
Water	40 gallons.

As both copper sulphate and lime dissolve and slake, respectively, much quicker in hot water than cold, it is better to use heated water in order to save time. The very best lime obtainable is used, and if freshly burned, all the better. In slaking do not use an excess of water, but just enough to keep the lime moist. When the action is completed enough water is added to make a thin whitewash and then the whole is strained through coarse sacking to remove any lumps which would clog the nozzle of the spray pump. This done, enough water is added to make the volume up to one-half of what the final mixture will amount to. The copper sulphate solution is diluted to the same extent. The two are now mixed, the operation being best performed by two men, each with a bucket, one handling the lime and the other the copper sulphate. They are poured into the spray tank, two bucketsful at a time, until the whole is brought together. In this way a precipitate is obtained which will remain in suspension with only occasional agitation. If mixing is done before dilution, a very coarse precipitate is formed which settles rapidly to the bottom of the spray tank and requires almost constant stirring.

If large quantities of spray mixture are going to be used, it is an excellent plan to make up " stock " solutions of the copper and lime. This can be done by dissolving, say, one pound of copper sulphate in each gallon of water and making up a barrel full of it. Each gallon of the solution taken then represents one pound of the bluestone. The salt can be conveniently dissolved by filling the barrel with water and then suspending it therein, enclosed in a canvas sack. The lime can be handled in the same way, being sure, of course, that the contents of the barrel are thoroughly stirred up before dipping out any portion. Keep the barrels covered when not in use.

Precautions to be Used in Making. Before Bordeaux mixture is sprayed, it is absolutely necessary that all copper should be in the form of the sky-blue precipitate, *i.e.,* enough lime must be used to act on all the bluestone. Formulæ advocated by the experiment stations always contain enough lime to precipitate all the copper, but it may sometimes happen that such a very poor quality is used that there will be some of the sulphate left unchanged. There are several simple ways by which one can tell when enough lime is present. Those who are very familiar with the reaction which occurs can tell by the colour of the precipitate, it having a greenish* tinge when an insufficiency of lime is present instead of the deep sky-blue colour. However, those who are not familiar with the process must use more decided tests. Three simple ones can be employed, as follows:

1. Take some of the clear solution which is left on top when the sediment settles and place in a white saucer. Add a few drops of a solution of potassium ferrocyanide to it. If a reddish brown precipitate or colouration appears, more lime is needed.

2. Take a portion of the clear fluid as before, and blow the breath gently over the surface. If a thin white pellicle or covering forms over the top, enough lime has been added.

3. Take a bright piece of steel, such as a knife blade, and hold it in the mixture for a minute or more. If it becomes coated with copper, more lime is required.

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*The green precipitate is basic copper sulphate, $CuSO_4\ Cu\ (OH)_2$, which would break up on the leaf under the influence of CO_2, and leave free copper sulphate.

Test number one is the most reliable and is the one recommended.

In handling copper solutions use only wooden, brass, and copper vessels; all other receptacles would be corroded and destroyed by them; besides, the fungicide itself would be injured.

Copper compounds are *poisonous,* and therefore should not be left lying around where children or animals can get at them.

Combined with an Insecticide. Bordeaux mixture is quite often combined with Paris green to impart to it an insecticidal value. In this case the mixture takes the place of water for holding the green in suspension. Other recommended arsenicals can be used for this also, such as lead arsenate and calcium arsenite. But if soluble compounds of arsenic are used, such as sodium arsenite, it would be necessary to slightly increase the amount of lime used in making the original Bordeaux mixture.

Bordeaux Paste.

This substance is merely the ordinary Bordeaux mixture from which the excess of moisture has been removed. It, as a fungicide, is made on the same principle as lead arsenate paste. By the addition of water a spray of any desired strength can be made from it.

The sample which we analyzed contained 6.42 per cent. of copper oxide (CuO), an amount which is equal to 20.23 per cent. crystallized copper sulphate, or bluestone ($CuSO_4$, $5H_2O$); and 19.85 per cent. of lime (CaO). Therefore, one pound of this paste would make two gallons of spray equal in strength to ordinary Bordeau mixture. Its flocculent condition has been destroyed to a great extent, however, and it settles about ten times as rapidly in the spray tank as does freshly prepared Bordeaux.

Soda Bordeaux.

This fungicide is made from copper sulphate just as the ordinary Bordeaux mixture. It differs, however, in that caustic soda is used to neutralize the acid property of the bluestone instead of lime; and that the final mixture contains sodium sulphate instead of calcium sulphate (gypsum). The resulting form of the copper, copper hydrate, is exactly the same, and exerts the same fungicidal power. The reaction which occurs may be represented by the following equation:

$$\underset{}{CuSO_4} + \underset{\text{Caustic soda.}}{2NaOH} = \underset{\text{Copper hydrate.}}{Cu(OH)_2} + \underset{\text{Sodium sulphate.}}{Na_2SO_4}.$$

The main point in connection with this mixture is that caustic soda is an extremely active alkali, and any amount of it added over and above that requred to combine with all the copper will destroy foliage. Therefore, in making Soda Bordeaux, it is *important to add just the exact quantity of the soda required to change all the bluestone to copper hydrate.*

This is done by adding the soda solution slowly to the copper solution, mixing thoroughly after each addition, and testing for the neutral point with litmus paper. The moment the litmus paper takes on a faintly blue tinge is the time to stop adding. The copper is then all in the form of a sediment and any more alkali added will be left in the free state.

The following tentative formula can be given:

Soda	2 pounds.
Copper sulphate	6 "
Lime	5 ounces.
Water	40 gallons.

In making, add three-quarters of the soda solution at once, mix thoroughly and then add the rest gradually, mixing and testing until the proper quantity is present. It may not require the whole amount recommended, and it may require more, depending upon the quality of the soda. When the alkaline value of a sample of soda is once ascertained, then one can proceed with much more rapidity. The small amount of lime is added to make the mixture decidedly alkaline, and, therefore, safe, and to cause the precipitate to remain blue instead of changing to dark brown or black, which it does after standing some time where an excess of soda is used.

Caustic soda can be bought retail or in drums of one hundred pounds, from or through any chemist, while Gillet's lye, which is familiar to everyone, is a convenient form of soda for use in making Soda Bordeaux.

Soda Bordeaux has an advantage over the ordinary Bordeaux in that it is just as good a fungicide, and, at the same time is made without the labour of slaking and preparing of lime. There are disadvantages, however:

1. Great care is necessary in the addition of the caustic soda. Any added in excess is dangerous to foliage; an excess of lime is not harmful, although not advisable.

2. Unless exactly neutral, the addition of an arsenical to Soda Bordeaux to impart to it an insecticidal power, is dangerous. Any free alkali will act upon the arsenic compound and form sodium arsenite, which, being soluble, will scorch foliage.

This last difficulty has already been experienced by orchardists in the Niagara fruit district, and for this reason they may be prone to condemn Soda Bordeaux. However, if care enough be exercised, no harm can result from this source.

Woburn Bordeaux.

The Woburn Fruit Experiment Station* (England) have a method for making Bordeaux mixture which they claim gives a far superior spray to that obtained by the methods just mentioned. In their method lime-

*Eighth and Eleventh Reports of the Woburn Experimental Fruit Farm.

water is used in place of milk of lime, and also much less copper sulphate is used.

The method is as follows:—

Formula.	A.	B.
Copper sulphate (crystallized)	2 oz.	1 oz.
Lime water	13½ pts.	6¾ pts.
Water (soft) to make to	9½ gals.	9½ gals.

Dissolve the copper sulphate in a little water and then pour the lime water into it and mix thoroughly. After it stands and settles for a time take a little of the clear liquid from on top, put into a white saucer and add to it a few drops of potassium ferrocyanide solution. If a brown or red colour appears a little more lime water must be added, and the operation of stirring, settling and testing repeated.

To make lime water.—Take 2 or 3 pounds of good stone lime, slake it in a little water and then add this to 120 gallons of soft water. (If hard water is used, use more lime.) Stir the lime and water up 2 or 3 times at intervals of several hours, and leave it to settle till the solution becomes quite clear. Run this clear liquid off and keep it covered from the air. The clear liquid is the lime water.

Formula A gives a spray corresponding in strength with that of ordinary Bordeaux; formula B gives a spray one-half as strong and is the strength now recommended for spraying.

Copper Carbonate.

This valuable fungicide can be readily and easily made at home at much less cost than for what it can be bought on the market. The following method of making is recommended: A barrel is partly filled with water and 25 pounds of copper sulphate are dissolved in it and into this is poured a solution of 30 pounds of sodium carbonate (common washing soda) when the copper is thrown down as a pale green precipitate of "basic" copper carbonate. This precipitate rapidly settles to the bottom and after a time the clear solution above can be siphoned off. The barrel is filled with water again, the precipitate stirred up and allowed to settle, and the clear solution again drawn off. This washing removes the greater part of the impurities (sodium sulphate) and leaves behind about 12 pounds of basic copper carbonate. This can be removed from the barrel and dried in the air, after which it is ready for use.

The following quantities can be used for spraying:

Copper carbonate	1 pound.
Water	40 gallons.

Ammoniacal Copper Carbonate.

This spray is made from basic copper carbonate the preparation of which has just been outlined under "copper carbonate." When ammonia is added to this material, it dissolves to form a deep blue solution, and this solution diluted with the requisite quantity of water forms the well-known sprayng compound.

This fungicide is of use in that it can be applied to trees when the fruit is well advanced in the stage of maturity without causing any disfigurement, such as would result from the employment of Bordeaux. This last material leaves a coating if sprayed just a short time before the fruit is picked, which does not enhance marketing qualities, and which, further, might cause poisoning.

Following are the quantities of material to use:

Copper carbonate	5 ounces.
Ammonia (sp. gr. 26° Baume)	3 pints.
Water	45 gallons.

Eau Celeste.

The name of this material indicates that it was originated in France, and it was there, in 1885, it first came into use. It has decided action against fungi, but it exerts quite a caustic action on foliage, and for this reason cannot be much recommended. It is made in the following way:

Copper sulphate	1 pound.
Hot water	2 gallons.

When the crystals are dissolved and the liquid has cooled, add:

Ammonia (sp. gr. 22° Baume)	1½ pints.
Water, to make	25 gallons.

When the ammonia is first added a precipitation occurs, but on the addition of the excess this precipitate disappears and a deep blue solution results.

Copper Sulphate.

As was stated when dealing with Bordeaux mixture, this compound can be used to combat fungous diseases on plants, but if used in a solution concentrated enough to be of material benefit would destroy the foliage. Nevertheless, for dormant wood it can be used quite freely, and is recommended in the following strength:

Water	15-25 gallons.
Copper sulphate	1 pound.

In dealing with grain smuts, however, where the strength of the solution is not so necessarily guarded, this substance has been found to be decidedly beneficial. The Experimental Department of this College has done some extended work in dealing with smutted grain, and report the following results in connection with bluestone treatment with oats:*

(*a*)	Copper sulphate	1 pound.
	Water	25 gallons.
(*b*)	Copper sulphate	1 pound.
	Water	1 gallon.

In solution (*a*) smut affected grain was immersed for a period of 12 hours; and in (*b*) for a period of 5 minutes. After treatment the grain was dried and sown in test plots, along with a check plot of some left untreated. An average of three years' trial gave these data:

	Percentage of smutted heads.
(*a*) treatment	0.2
(*b*) treatment	1.1
Untreated	7.0

These results show that bluestone has a very decided action in checking smut, and this is especially marked with treatment (*a*).

Pyrox.

This is a combined fungicide and insecticide, being constituted largely of Bordeaux and lead arsenate mixed together, the mixture containing enough water to keep it in a pastey condition. It would evidently fulfil collectively the same functions as its two ingredients would accomplish singly. It has been used experimentally with very satisfactory results.

Following is the analysis as given by the Bureau of Chemistry, Washington, D.C.:

Water	50.00	per cent.
Lead oxide (PbO)	27.00	" "
Copper oxide (CuO)	2.50	" "
Arsenic oxide (As_2O_5)	9.00	" "
Sulphur trioxide (SO_3)	0.70	" "
Calcium oxide (CaO)	.75	" "
Insol. matter, water of crystallization and undetermined material	10.05	" "
	100.00	

*Ont. Agri. College Bulletin 140, pp. 14-15.

It will be seen that pyrox contains arsenic equivalent to 35.21 per cent. of lead arsenate ($Pb_3(AsO_4)_2$), or about 55 per cent. as much as is present in the pure lead arsenate pastes; and enough copper is present to produce from 100 pounds of the paste about 80 gallons of spray equal in strength to ordinary Bordeaux.

Fungicides Containing No Copper.

Lime-sulphur Wash.

The lime-sulphur wash is a very active fungicide and is displacing the copper salt fungicides to a great extent. It has to be applied in a very dilute condition. The method of diluting is outlined under the previous discussion of the wash on a preceding page; the extent of the dilution will vary, but can be found in any good spray calendar.

Formalin.

Formaldehyde is derived from marsh gas (Methane, CH_4), the same gas which everyone has seen emanating from all swamps and low places where there is stagnant water, in the form of air bubbles. The formaldehyde is a gas, which under the influence of cold condenses to a clear mobile liquid that boils at —21°C., and has the formula CH_2O. If this liquid be mixed with water until it forms 40 per cent. of the volume, we have a commercial article known as " formalin," and which is used and is valuable as a fungicide. It is especially useful as a treatment for grain smuts and potato scab.

Using the following strengths of formalin and method of treatment:

(*a*) Formalin	½ pint,
Water	21 gallons,
(Immersing for 20 minutes),	
(*b*) Formalin	½ pint,
Water	5 gallons,

(sprinkling and stirring till thoroughly moistened), Prof. C. A. Zavitz (Bull. 140, pp. 14-15) obtained the following results with oats, the figures giving the percentage of smutted heads in the crop obtained from sowing the treated grain:

(*a*)	.0	per cent.
(*b*)	.0	"
Untreated	7.0	"

These results show that both treatments with formalin entirely destroy the smut spores adhering to seed grain. These formulæ will also serve for the treatment of wheat.

Corrosive Sublimate.

This chemical is made up of mercury and chlorine; one atom of mercury in combination with two atoms of chlorine, represented by chemists as $HgCl_2$. It is medicinal in small doses, but large doses are *extremely poisonous;* and its solution in water sprayed onto plants would, for this reason, make a very deadly food for biting insects. As an insecticide, however, it is not much used, on account of its corrosive action, but as a remedy for potato scab it is very valuable when used in the following quantities (handle in a wooden vessel):

Corrosive sublimate	1 ounce
Water	7 to 8 gallons

The solution and treated potatoes are both highly poisonous.

Liver of Sulphur, Potassium Sulphide.

This substance is a compound of the elements potassium and sulphur (K_2S) and its solution possesses considerable value as a treatment for certain fungous diseases, such as the gooseberry mildew; but it is not nearly so energetic as are the copper compounds. It is used to some extent in treating grains for smut, for which the following quantities are recommended:

Potassium sulphide	1 pound.
Water	24 gallons.

This solution should be used in a wooden vessel, and must be applied soon after making, since on standing in contact with air the sulphide becomes oxidized to the sulphate and thus loses in strength.

Acknowledgments.

The reports, bulletins, etc., of the Dominion and Provincial Departments of Agriculture, as well as those of the United States Department of Agriculture and the Experiment Stations of the various States of the Union, have been freely used in gathering the data embodied in this bulletin. Where possible, reference has been made to the source of the information, but in all cases the original source of the data could not be obtained.

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Ontario Department of Agriculture

TOMATOES

A. G. TURNEY.

About the beginning of last August I was appointed to investigate the tomato industry of this Province. The investigation is simply the result of inquiry and observation, and has nothing to do whatever with practical experience. I will first give you an idea of the extent of the industry as I find it in this Province. By far the larger area is devoted to producing tomatoes for the canning factories. In 1891 there were about 800 cars of canned goods shipped; last year this increased to about 8,000; from 1904 there was approximately 3,000, so that it has increased 5,000 cars in the last five years.

HISTORY.

The tomato plant is of South American origin, and was apparently cultivated there for many years prior to the discovery of the country by Europeans. As early as 1554 we find that in Europe certain varieties of tomatoes had been described. From that year to 1860, fifteen distinct varieties were described and we have records of tomatoes being successfully produced under glass in Europe in 1820.

The first mention on this continent of the tomato being grown for culinary use was in Virginia in 1781. During the following twenty years futile attempts were made to popularize the use of the fruit. However, it is on record that the fruit was regularly quoted on the market in New Orleans in 1812, and that the seed was first offered for sale as that of an "edible vegetable" six years later. From that time on the increase in its popularity and culture has gradually proceeded, until to-day the tomato ranks with the more common fruits found on the markets of this continent, either in the natural or canned state. But while the majority of these more common fruits have been in great demand for some decades past, yet the same cannot be said for the tomato, for it is only during the past few years that it has assumed such a prominent place in the list of necessary articles of food.

Recent Growth of the Industry.

By far the larger portion of the area devoted to the crop is employed in supplying fruit for the canning factories, and it is the demand of these canning factories which more than any other factor has, during the past few years, supplied the great impetus to tomato culture.

As an article of trade canned tomatoes were first introduced on this continent in 1848, by Harrison W. Crosby, Steward of the Lafayette College, Easton, Pa. The cost then was fifty cents per can. Since that time the cost of producing the finished article has decreased steadily, whilst the output has increased enormously, and to-day three-lb. cans of tomatoes can be bought retail for nine and ten cents.

Some idea of the increase in the extent of the business during the past few years in the United States and Ontario may be obtained from the following record of the total output in cases of twenty-four 3-lb. cases:

	United States.		*Ontario*
1887	2,800,000	1887	....
1891	3,322,000	1891	83,000
1892	3,223,000	1892	144,000
1903	10,500,000	1904	310,000
1906	....	1906	793,000
1907	13,000,000	1907	575,000
1908	....	1908	875,000

A still better idea of the growth of the industry in Ontario may be obtained from the following statements: The acreage under production for the canning factories has increased from 800 in 1891 to approximately 8,000 in 1908. For the same period, the total number of bushels paid for by the canning factories has increased from 132,000 to 1,400,000, the cases from 83,000 to 880,000, the cans from 1,992,000 to 21,124,000, the value of the pack from $190,000 to $1,672,000, and the price paid to the growers from $26,400 to $386,600; and during the past five years the number of factories packing tomatoes has increased from twenty-seven to fifty-three.

The Production of Canning Tomatoes.

In Ontario the canning of tomatoes upon a commercial basis dates back some twenty-seven years. In 1881, Messrs. Wellington Boulter and Gilbert Barker erected and started into operation canning factories at Picton and Bloomfield in the county of Prince Edward. To these men, then, belongs the credit of pioneering an industry which, in the comparatively short period of a quarter of a century has made such a remarkably rapid growth.

The districts in this Province producing canning tomatoes, or what is commonly known as the main crop, naturally fall into four districts, viz.: Prince Edward County, which is practically an island on Lake

A typical Earlianna vine.

Ontario; Eastern Ontario, exclusive of Prince Edward County; Western Ontario and Southern Ontario. The following table compiled from 1906 figures will indicate somewhat the comparison between the districts.

District.	Acreage.	Total Yield	Average Yield	Total Cases	Price paid to growers
		Bush.	Bush.		$
Prince Edward County.....	1,950	414,000	212	245,600	103,500
Eastern Ontario............	1,135	181,000	159	116,400	45,250
Southern Ontario..........	2,130	464,000	218	290,000	126,000
Western Ontario...........	1,570	237,500	151	142,000	59,375

Note: While 1907 figures are available, that year was a poor one, hence 1906 figures are given.

A glance at the list of factories canning tomatoes will indicate the towns they are situated in. Perhaps it would be well at this point to refer briefly to the features of each district, although there is no vast difference between them.

Prince Edward County. Being practically an island, more southerly situated than the rest of Eastern Ontario, and containing considerable areas of sandy and light clay loam of good fertility, this district has become famed for the quality and quantity of its tomatoes. It is the pioneer county in the canning industry of the Province, and to-day boasts of twelve factories, all of which pack tomatoes. With a view to early maturity more seed selection has been practised in this district than in Eastern and Western Ontario and the county boasts of as high an average yield as the famed Niagara district, in 1906 the average going over 200 bushels to the acre. The plants are largely grown by experienced and conscientious greenhouse men and sold to the farmers, hence a better class of plants is produced. This fact, together with more years of experience and more attention to detail largely accounts for the superiority of this district over Eastern and Western Ontario.

Eastern Ontario. This district extends from Napanee to Oshawa, some 100 miles, a length almost equal to that in the Western Ontario district, but on account of its more northerly and eastern situation the area of land suitable and used for tomato growing is confined to the narrow strip on the lake shore and the actual acreage is only one-half of the other districts and supplies but seven factories. In point of average yield it equals Western Ontario, but falls considerably below the other two districts. The causes for this lower yield are attributable to a poorer supply of the young plants; in a few cases to a want of confidence between the grower and the canner leading to slovenly methods, and in general to the growing of the crop upon soils not very favorable to its culture, without any attempt to counteract the disadvantage by special attention to detail. Since the causes for failure apply to all four districts it will be better to deal with them later on under a separate heading. Cutworms have caused considerable loss to the growers in Eastern Ontario and Prince Edward County.

SOUTHERN ONTARIO. Southern Ontario comprises the district in the neighborhood of Hamilton, together with the strip of land extending from that city to Niagara Falls and lying between the lake shore and the mountain, and also a small section around Dunnville. In point of number of acres grown in conjunction with the average yield it is the first of the four districts. It contains eighteen factories which pack tomatoes, but the number would not be so large except for the presence of abundant fruit. Of the four districts the climate of this one approximates nearer to that of the native home of the tomato; the soil is for the most part very favorable and in many cases where the crop is grown as a filler in newly planted orchards, the soil is exceedingly favorable to the production of a high quality and quantity. As in Prince Edward County, stockier, hardier and better grown plants are used, and more constant cultivation is practised, the result being evidenced in the higher average yield.

WESTERN ONTARIO. This district extends along the line of the G.T.R. from London to Windsor, and includes a number of favorable sections lying to the south between the railroad and the lake shore, the county of Essex and sections around Alvinston in Lambton County, and Dresden in Wallaceburg in the north of Kent County. There are thirteen factories in this district. Many of these are of recent origin and in starting up these factories in new districts the owners had to contract with inexperienced growers, with the result that the average yield is lower than climatic and soil conditions alone would account for. In Southern and Western Ontario cutworms do not appear to have been anything like so formidable as in the Eastern districts.

PRODUCING THE MAIN CROP.

General methods of production followed throughout the Province:—

The young plants are either procured from professional growers at prices ranging from two to ten dollars per thousand, or are grown by the farmer himself. In the first case the seed is started in greenhouses, and the plants grown there the majority of the time, being generally hardened off in cold frames. If grown by the farmer the seed is sown in hotbed and pricked out into cold frames. When about six weeks old the young plants are transferred to the field, the date of this transplanting ranging from May 21st to June 12th and depending largely on the business methods of the grower. The soil upon which the crop is to be grown generally receives an application of from eight to twelve loads of well rotted manure, which is usually plowed under in the fall. A number of growers prefer to manure the previous crop and aim to plow both in the fall and spring. If the soil is light and quite porous, most growers work the manure in from the surface, believing that by so doing they lose less of its fertilizing elements.

In the spring the ground is more or less efficiently worked up with disc and straight toothed harrows. When planting time arrives the field is marked out with a corn-marker usually 4 feet by 4 feet, sometimes 4 feet by 5 feet, 5 feet by 5 feet and 3½ feet by 5 feet. The spade and furrow systems of planting are both used, the former being much more general. Some few hours before the plants are to be taken from the cold frames they are well watered, thus when the time arrives they are cut around with a sharp spade and the soil being fairly moist a good chunk of it adheres to the roots of each plant. In this way they may be transferred to the field with a minimum disturbance of the roots and the least possible wilt. When set in the field if the soil is dry, water is applied, about two quarts per plant.

The growers generally aim to give the first cultivation on the preceding day or within two or three days after setting. The best growers cultivate after heavy rains to prevent baking of the soil and throughout the season will cultivate in all about four times each way, using the spring tooth or other form of one horse cultivator. With few exceptions the crop is only hoed once, this generally being done shortly before the size of the plants renders horse cultivation detrimental. Harvesting lasts from the middle of August to the middle of October. The first pickings being light are gathered in baskets and afterwards placed in bushel crates. Later pickings, when the ripe tomatoes are numerous, are gathered right into crates. The number of crates hauled to the factory at a time depends largely on its proximity and the area under crop.

Cost of Production.

It would seem to be one of the first, if not the first, essential of profitable production that the cost of producing the article upon the sale of which we depend for a profit should be definitely known. But it is a well known fact that of the various foods raised for human consumption probably the least is known concerning the cost of producing those crops raised on the ordinary farm. While this may, to some extent, be accounted for by the nature of the business, so largely affected by individual circumstances, yet in the main it must be credited to a lack of application of business principles to practical agriculture. The men to-day growing tomatoes for the canning factories who have kept any reliable track of their cost of production may be counted on the fingers of the two hands. Again, if a grower who has not kept track of the cost of production is pressed to place his estimate on the expense item by item he becomes alarmed at the large account he is running up, and almost invariably places some ridiculous estimate upon certain items, thus lowering the actual cost. From that standpoint he refuses to recede and his estimate therefore loses in reliability.

Of the cost of production of tomatoes, even so great an authority as W. W. Tracey says: "Under usual conditions the growing of an acre of tomatoes and the gathering and marketing of the fruit will cost from $18 to $90." From this statement, and from the fact that a host of conditions of the soil, location, labor, and proximity to markets combine to render the cost of producing this crop very variable, it is impossible to quote an estimate, or estimates that will agree with all the different conditions prevailing throughout the Province. It should be plainly borne in mind that the following figures deal with the cost of production as incurred by the ordinary farmer growing tomatoes for the canning factories, as we find them in Prince Edward County, Eastern and Western Ontario and to a lesser extent in Southern Ontario, for in this latter district the price of land often runs considerably higher, and thus the cost of production is increased. These figures have nothing to do with the cost of raising early tomatoes and do not apply so much to market gardeners. From records kept by a few growers and assuming average conditions to prevail, with the aim of producing at least 400 bushels to the acre, the cost of production would be as follows:—

	Estimate No. 1.	Estimate No. 2.
	$ c.	$ c.
Rent of land	5 00	5 00
Eight two-horse loads manure	6 00	6 00
To applying same	4 00	2 50
To 250 lbs. fertilizer	4 00	4 00
To applying same	1 00	1 00
Plowing, Harrowing, Rolling, Marking	5 00	3 15
3,000 plants	10 00	10 00
Setting plants	4 00	4 00
Cultivating 5 times each way:		
2 times twice in a row	3 00	3 50
3 times once in a row	2 00	
Hoeing once	1 00	1 00
Pulling weeds	50	50
	45 50	40 65

In Estimate No. 1 the cost of a man for one day has been placed at $1.50, one man and one horse at $3.75, and a man and team at $4.00. At the time of season when this labor is required it cannot be obtained for less than the prices quoted. However, many farmers argue that the actual cost is not as great to them, and place their estimate of cost of one man and a horse for a day at $2, and a man and a team at $2.50 per day. On this latter basis an estimate, No. 2, is also given, showing the difference it makes to the cost of production and profit.

Profit According to Estimate No. 1.

	200 bushel yield	300 bushel yield	400 bushel yield
Initial cost	$45 50	$45 50	$45 50
Cost of picking at 3c. per bushel	6 00	9 00	12 00
Cost of hauling at 2½c. per bushel	5 00	7 50	10 00
Total cost	$56 50	$61 00	$67 50
Amount received at 27½c. per bushel	55 00	82 50	110 00
Profit per acre	$1 50*	$21 50	$42 50

* Loss

Profit According to Estimate No. 2.

	200 bushel yield	300 bushel yield	400 bushel yield
Initial cost	$40 65	$40 65	$40 65
Cost of picking at 3c. per bushel	6 00	9 00	12 00
Cost of hauling at 1½c. per bushel	3 00	4 50	6 00
Total cost	$49 65	$54 15	$58 65
Amount received at 27½c. per bushel	55 00	82 50	110 00
Profit per acre	$5 35	$28 35	$51 35

There are some sections of the Province, to wit, in portions of southern Ontario and Essex county, where the price of land is higher, manure is more scarce and the crops grown are harder on the soil, thus increasing the items of rent of land and manuring or fertilizing in the estimate of cost of production. Thus in some of these sections referred to the cost of production might approximate to $75 per acre. It may be argued that the total cost of manuring should not be charged to the crop of tomatoes alone. This may be so, but in order that due allowance may be made, a thorough knowledge of the individual conditions and the rotation of crops practised in each case is necessary.

THE POSSIBILITIES OF THE TOMATO PLANT AND THE COST OF PRODUCTION IN RELATION TO THE PRICE PAID BY THE CANNING FACTORIES.

The average yield of the main crop in this Province is about 175 bushels to the acre. The actual yields vary all the way from 50 to 700 bushels, numbers of growers regularly producing 400 bushel crops. Estimating the cost of production at from forty-five to fifty dollars, then the average yield is bringing the grower no profit whatever. A 300 bushel yield costing to produce $61 is bringing the growers a profit of $21.50 per acre. A 400 bushel yield at the estimated cost of production of $67.50 is bringing a profit per acre of $42.50. Now the growers claim that the present price paid, viz., 27½c. per bushel of 60 lbs., is not enough, whilst the canners stoutly affirm that it is more than they can afford. The profits quoted are being obtained by men who are producing as other crops beside tomatoes, grains, roots, corn and potatoes.

Plentiful. Pink variety.

The following table gives some idea how the profit obtained per acre from these different crops compares with those obtained from tomatoes:—

Crop.	Fair yield in bushels.	Price	Value	Cost of Production	Profit
Fall wheat............	30	$0.94	$28 20	Since the cost of production	
Barley	34	.55	19 25	for these crops is not de-	
Oats	45	.30	18 00	finitely known, the profit	
Peas...................	20	.87	17 40	from the yield of toma-	
Beans	20	1.75	35 00	toes compares very favor-	
Corn (in ear)..........	85	....	....	ably with the total value	
Potatoes..............	150	.75	112 50	of the yield per acre of	
Turnips	350	.10	35 00	the other crops.	
Tomatoes..............	400	.27½	110 00	$67 50	$42 50

It is thus clearly seen how favorably the tomato crop grown on the ordinary farm in canning districts compares with the other crops. Even as far east as Prince Edward County a number of growers have expressed their firm belief that the tomato is their best paying and surest crop. These men, however, have made a study of the crop and know their business pretty thoroughly.

Taking the average yield throughout the Province at 175 bushels per acre, then from what has already been said on the cost of production the present price, 27½c., is certainly not high enough, but if the price were raised, at 30c. it would still be inadequate. But we cannot expect the canners to set their prices so as to ensure even the most slovenly and indifferent growers, producing very meagre yields, a fair profit. Whilst these latter at the present price paid are losing money, as already pointed out, others are reaping substantial profits, and are by no means discontented with existing conditions. As soon as the poor grower clamors for a higher price the canner immediately points to the successful grower as proof that the present price affords ample room for a good profit.

Again, we must admit that the tomato plant is capable of enormous yields, and has been known to yield in the field as high as 1,000 bushels per acre. As early as 1840 the Royal Horticultural Society of London reported the obtaining of over forty pounds of marketable fruit from a single vine. Even as far north as Guelph, this year, from plants not set out till June 10th, and harvesting ceasing on September 30th, twenty varieties were tested and gave from 26½ to 35½ pounds to the vine of good, sound, ripe fruit. Nine plants of each variety were set 5 by 4 feet and no special treatment accorded, and the figures quoted above are an average of the nine plants.

Perhaps it would not be fair to conclude this question without referring to the "risk" which so many growers claim is too great in the production of the crop. They claim that they are so largely dependent on the nature of the season and the length of it, as determined by the dates of early and late frosts. My investigations in the different districts hardly substantiate these claims. Under favorable conditions the tomato plant will develop from the date of sowing the seed to ripe fruit in from 85-120 days of full sunshine, with a constant day temperature of from 75 to 90°F., and 15-20°F. lower at night. Cloudy days and lower temperatures lengthen the period required for maturity in this country to such an extent that the time required is generally from 125 to 175 days, and more generally from 150 to 175. Allowing about forty-five days in which the young plants are being grown, and during which time they may be protected against frost, this leaves us from 100 to 130 days reasonably free from frost, in which to mature the crop. June, July, August and September are generally free from frost. If to this we add the last week in May, it gives us almost 130 days from the time of planting out. This is without counting on October at all. The season in the four districts is amply long, provided the weather is moderately favorable, and the proper attention has been given to the crop. The task of producing any crop or article of trade might be said to be just as great a risk if marked by lack of proper business methods. I have met plenty of growers who considered the season amply long, and who by seed selection have hastened the maturity of the fruit to such an extent that they always count on delivering their entire crop to the canning factory by the end of September, and this as far east as Prince Edward County.

Again, it is claimed that the contracts are in many cases altogether too favorable to the canner, safe-guarding him to the extent that in the event of a sudden glut of the fruit at the canning factory, combined with a shortness of labor or cans, he has the power to refuse as many loads as he sees fit, in some cases resulting in a loss to the grower of half his crop. Thus the contracts which are worded that the canner undertakes to receive the produce of so many acres, not exceeding 200 or 250 bushels per acre, certainly do not encourage the grower to aim for a heavy yield. Such claims as these, whilst based on actual occurrence, are exceptional, and generally come from the poorer and dissatisfied growers. While the contracts are certainly not worded to safeguard the interests of the grower, yet as a matter of fact they exist only as a formal necessity, and are very rarely enforced. The really good growers are able to practically make their own terms. Quite a number of contracts are made by the bushel, not by the acre, and these are more favorable to the farmer, since if he contracts to supply 1,000 bushels, the amount of land from which he shall produce them rests entirely with him, and thus is a stimulus towards the maximum yield.

There is, perhaps, one more phase which should enter into this question, but which I am not prepared to discuss here, and that is the comparative profits derived from a bushel of tomatoes by both grower and canner. All things considered the growers should certainly receive 30c. per bushel, and if they can obtain this price then they should be satisfied. Those who cannot reap a profit at that price should be content to leave the business to more careful and progressive growers. The chances of obtaining this rise in price in the immediate future are, because of lack of co-operation, not very bright.

Some Points to be Considered in Growing Tomatoes, Showing Wherein Lie the Causes of Failure.

Location: While of considerable importance in the production of the early crop, this consideration does not so largely affect the main crop. Southern slopes and suitable spots affording shelter from too great exposures, as far as is consistent with the rotation, might be taken better advantage of. It is advisable to point out here, that too many indifferent growers are raising their tomatoes five and even six miles from the canning factory, and the long and expensive haul thus incurred, largely affects the cost and profit of the crop. A minimum transportation expense is highly desirable, and should always be aimed at.

Preceding Crop.

The consensus of opinion throughout the Province favors clover sod, and this seems to be substantiated by the experience of United States growers, and, speaking in general, the best crops seen this summer were produced on clover sod. However, the choice of the tomato ground to a considerable extent depends upon the rotation of crops in vogue, and one cannot always sow on prepared clover sod. Whilst tomatoes have been grown successfully year after year on the same soil, and I have seen occasional fair crops so produced this summer, the practice is not to be commended, nor is the practice advisable of growing tomatoes on land which was in potatoes the year before, because both these crops are heavy consumers of potash, and considerably reduce the immediately available amount of that element in the soil. Failing a clover sod, the next best will be the second crop after clover, and of the other preceding crops those of a leguminous nature are to be preferred.

Choice and Preparation of the Soil.

The best soil is a deep, rich, light loam, over a well drained subsoil. Such a soil gives chances for a maximum yield at a minimum expense, for it contains the necessary fertilizing elements in a readily available state, will drain and warm up quickly after rains, and being light can be cheaply worked, no small consideration in a crop demanding so much labor, and moreover is not so apt to puddle under the frequent cultivations as is a clay. The fault to be found with many growers is that when they are forced to select a soil not as favorable to tomato production as might be desired, they do not attempt to offset the disadvantage by seeking to improve its physical condition, and therefore its available fertility to better meet the requirements of the crop. Good crops can be produced on almost all kinds of soil—but these soils must have good tilth, fertility and drainage conditions, and no matter what the soil, whether light, medium or heavy, unless these conditions exist a large yield will not be obtained. The growers do not study sufficiently the plant they are growing. They do not know its characteristics. The roots of the tomato plant are very short and abundant, and can only gather the essential plant food and water from a very limited area. In contrast, the bean plant, while much smaller than the tomato plant, has an extensive root system, and thus a greater area from which to draw its nutriment. In addition to their shortness, tomato roots are exceedingly tender, and incapable of penetrating a soil in any way hard or compact. A knowledge of these characteristics shows us how essential to success is the proper treatment and preparation of the soil. Avoid soils with much clay in their make-up; unless thoroughly underdrained, they are sure to be cold. I have seen fields of tomatoes which wouldn't begin to pay for the picking—the soils were clayey, poorly underdrained, and heavy rains early in the season had left the young plants standing for days in inches of water, spelling sure ruin to the crop. The plants thus treated make very little subsequent growth, and their fruits are very small and rot while still green.

Cultivation.

Here again, is where a number of growers fall down. The best growers all emphasize the necessity for frequent cultivation, and this necessity can be readily understood when we realize that the period of the active life of the tomato root is short. The young plants, on account of their coarse, open cellular structure, are at first capable of transmitting plant food and water very rapidly, but these transmitting media very soon clog up and lose their activity, hence the necessity for frequent cultivation in the early stages of growth. The most successful growers cultivate four or five times each way during the season, and aim to keep the surface soil in loose friable condition as long as possible. The more cultivation during the two weeks following the setting of the plants the better the results. Since the task of planting out must needs result in compacting the soil to a considerable extent, the first cultivation should take place the next day and be deep and thorough. I have been through field after field of tomatoes where the soil of a clayey nature has been very hard, and consequently the plants were sickly-looking, stunted things.

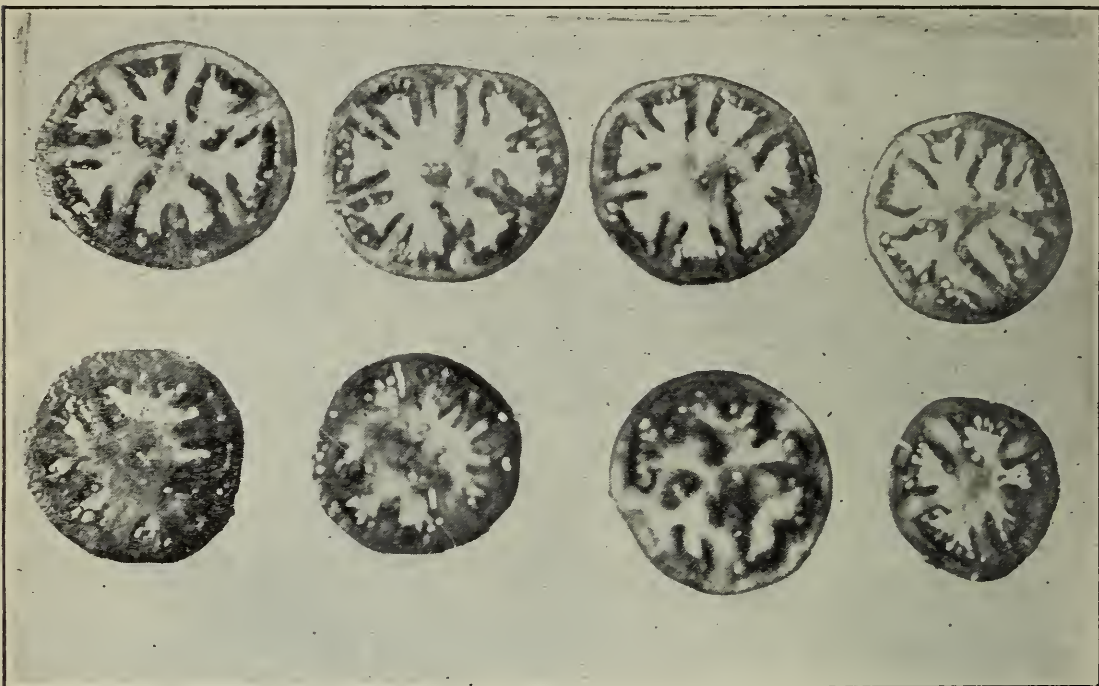
The Seed, its Source, Control and Selection.

Source: The bulk of the seed comes from the United States. A number of growers select their own seed in a more or less indifferent way. Only two men growing tomatoes for the seed value of the crop were met, Mr. G. H. Clark, at Leamington, and Mr. Maginnis, at London.

The price paid for the imported seed runs from $1 to as high as $10 per pound, the general price being about $3, the duty being 25c. per pound. From two and a half to four dollars per pound should secure good, reliable stock tomato seed. The higher prices are as a rule paid only for the extensive use of printer's ink in vividly portraying their imaginary qualities. Beyond keeping the varieties pure by growing them in separate blocks after a certain standard is reached, no special effort appears to be made by the seed firms with a view to improving and perpetuating their desirable points by selection. A rough estimate places the amount of tomato seed used annually in Ontario at from eight to twelve hundred pounds; thus the market for seed here is very small, and accounts for the importation. J. Bolgiano & Son, of Baltimore, The Livingstone Seed Co., of Columbus, Ohio, The Burpee Company, the Wm. Henry Maule, Henry A. Dreer, and W. P. Stokes Companies, of Philadelphia, are some of the bigger firms from whom the seed is imported.

CONTROL OF THE SUPPLY: The majority of the factories retain the control of the seed, supplying the farmers at cost price. A few factories, however, leave the farmers to obtain their seed from whatever source they see fit, whilst still a few others grow their own plants and sell these to the contracting party. Some growers select their own seed.

SEED SELECTION: The advisability of the grower selecting his own seed is perhaps questionable. A. W. Livingstone and W. J. Green are decidedly against this practice, their chief reason being, that while the grower may be able to select as good seed as the professional seed grower, yet the amount of seed which he uses is so small that the expense he would incur in producing it himself would be much greater than if



Greater Baltimore. Success. Stone. B.B.
Jack Roe. Earlianna. Hummer. Coreless.
Cross Sections.

he were to buy the very best selected seed from reputed seed firms. Notwithstanding this opinion, I believe that more of the seed used in this country should be grown here, and that a standard and well carried out system of straight seed selection among farmers is highly desirable, and would materially increase the average yield and profit. The seed selection which is at present carried on to some extent is with very few exceptions far from what it should be. Some few growers will drive up to the canning factory and select for seed purposes individual tomatoes from the crates standing on the platform, without ever seeing the plants they were grown on. Others will select the smoothest, most uniform, and best ripened fruits in their fields without regard to the plants they grow on. Some go a step further and take the plant, its vitality, amount and uniformity of yield into consideration. But not one grower have I met who has reserved a piece of ground exclusively for seed breeding and attempted to conduct rigid straight seed selection. The best seed selected one year is lost track of the next year. While considerable improvement in the yield, uniformity of size and smoothness of the fruits may confidently be looked forward to from proper selection, yet the greatest return which we may look for is a decided gain in early maturity, a very important factor in view of the shortness of the season. Some growers have already hastened the maturity of their crop some ten days in four or five years by a system of seed selection still open to improvement. Below will be found an outline of a system of seed selection

Greater Baltimore. Success. Stone. B.B.
Jack Roe. Earlianna. Hummer. Coreless.
Longitudinal Section.

aiming at improving the qualities spoken of, and which should be applicable to the case of the ordinary grower.

From the standpoints of soil, climate and market ascertain the type of plant and fruit best suited to your requirements, and keep the type clearly and constantly before you. Presuming that you have a field of tomatoes the seed of which is true to variety and reliable, go through that field and select one or more plants which in every respect approach nearest to the ideal in your mind. Mark these by staking them. Select healthy, productive vines of which the fruit is most uniformly of the desired type, for it must be remembered that the character of the seed is determined by the plant and not by the individual fruit. Thus the selection of an almost perfect tomato from a plant varying considerably in size and perfection is not advisable. The fruits selected should be large, but not abnormally so, the earliest to mature, smooth and well shaped. When the fruit is thoroughly ripe, but not till then, it should be picked and the seed extracted as follows:—

Cut the tomatoes in two crosswise; slip out the seed-pulp into a pail or tub; let the pulp stand twenty-four hours, then put in plenty of clean water; stir and break up the sour pulp until all the good seed will settle to the bottom, when left to stand a minute; pour off the top, then put in more water, going through the same operation again and again until the seeds settle in nearly clean water. Now drain off all the water you can; place the seed in a towel, and press out the surplus water; they are then ready to spread out in the sun or some warm place to dry. Stir them up occasionally until they are thoroughly dried. In putting them away see that they are in a place safe from mice. Label the seed plainly, recording the day of the month and the year when it was saved, and moreover, keep the seed from each plant entirely separate.

Supposing that five plants were selected. The following spring the young plants raised from the seed thus saved should be set out on a well prepared piece of ground, kept entirely separate from the main crop, taking care to keep the progeny of each plant separate and to set it in separate blocks. Label these blocks plainly, and as the plants grow compare them with the original plant from which they come and with the type in view. Select that block in which all the plants come nearest to the desired type, and which show the least variation. From that block the best plants are selected, discarding for further selection purposes all the other plants in the whole breeding patch. Such a course of selection should not be hard to carry out, and if judiciously and carefully done should in from three to five years result in strains of seed greatly superior and better adapted to one's own conditions than any which it is possible to purchase. The seed from the discarded plants may be used for the main crop, as it will be of a superior nature to that purchased.

Producing the Young Plants.

This is where one of the biggest causes of failure lies. When the plants are grown by professional growers they are often held back or suddenly forced to meet the grower's requirements, and through rush of business and lack of space are not properly hardened off. Where one grower is raising two hundred thousand or two hundred and fifty thousand plants, the space and appliances at his disposal are too often inadequate, and the attention which would be given to a smaller number is not applied, with the result that the plants are not as hardy or stocky as they should be. Many farmers are starting their own plants successfully, but in too many cases there is great room for improvement in the construction and make up of the hot beds and cold beds, and also in the management of the growing plants. I should like to be able to give more definite knowledge on this important phase of the business, but as the summer was already well advanced when the investigation commenced I was not accorded the chance to study the question. It is an essential of profitable production that good hardy, stocky plants be procured for setting. By the last week in May they should be from six to eight inches high, the stalk about the thickness of a lead pencil, and of a dark purple color and the root system well developed. It is essential that these plants be kept growing, that is, transferred to the field with the minimum amount of check, for any check that the tomato plant receives will always result in a reduction of the fruit, although the check may not be apparent in the foliage. Those spindly, light colored plants that are all stem, and seem, so to speak, up in the air, should be shunned. It is a sheer waste of time and money to endeavor to raise a crop from them. Below will be found a description of the hotbeds and cold frames, together with other apparatus necessary for growing the plants required for a five acre patch. I have endeavored to describe those most suitable for the farmer growing from one to five acres of tomatoes for the canning factory. General directions are given for growing the young plants, and these, of course, must be modified to suit the conditions and requirements of the individual.

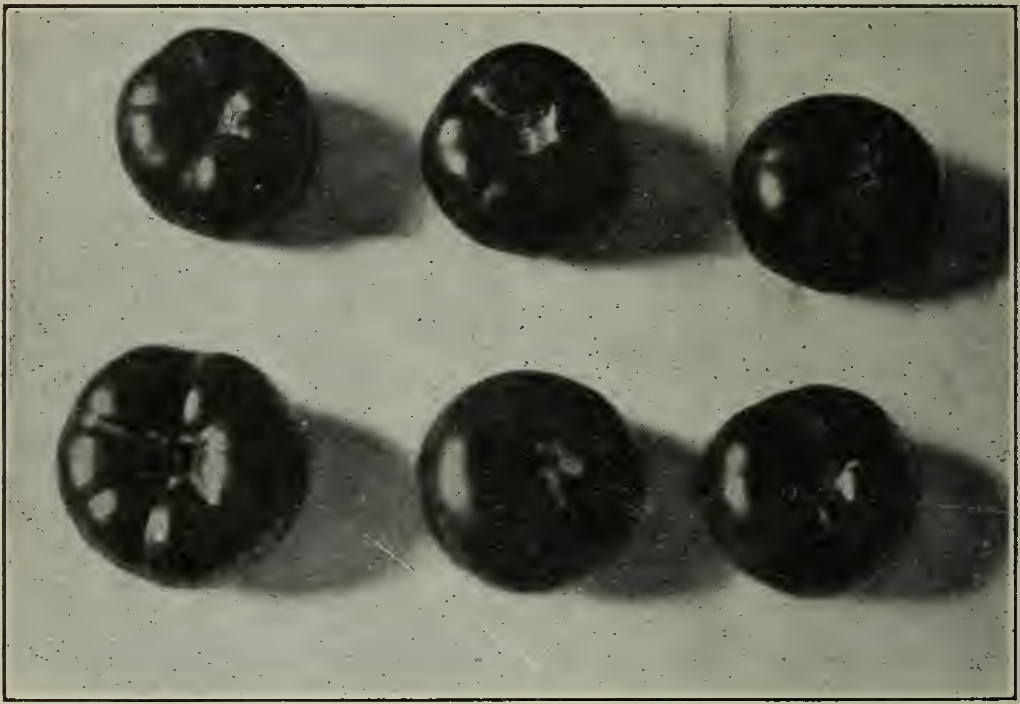
The Hotbed.

In locating hotbeds choose a warm sunny spot, dry and well drained, with as great a protection as possible from the north or northwest winds, a southerly slope being desirable. Let the land selected be some 30 yards long and 10 or 12 feet wide, and running east and west.

A hotbed frame of sufficient size to carry three 3 x 6 foot sash, that is, 9 x 6 feet, will enclose space enough in which to start the plants necessary for a five acre field of tomatoes. In the middle of the strip of land selected, remove the soil to a depth of one foot for a space of two feet larger each way than the size of the frames, that is, 11 x 8 feet. Now build up this space squarely with manure to a height of two feet. Fresh horse manure from grain fed horses without too much litter should be used. Uniformity of composition and in heating must be had if uniformity in growth is to be secured. This may be accomplished by shaking out and evenly spreading each forkful of manure and repeatedly and evenly tramping it down as the bed is being built up. The frame can now be placed on the bed of manure. It should be 10 inches high in front and 16 inches high at the back. If the back be made of two boards, let one of them be narrow and placed at the bottom so that the crack between them can be covered by banking up with manure or earth. Set the frame on the bed, first placing four short pieces of board under the corners to ensure even setting in the manure. Now complete the hotbed by placing on a top layer, six inches deep of light, rich friable soil. A soil composed of about three parts of garden loam, two parts well rotted stable manure, and part of an equal mixture of sand and leaf mould, is desirable.

The Cold Frames.

The young plants started in the hotbeds are to be pricked out into these. They may be of the same dimensions as the hotbed frames, and for convenience should be placed on either side of the hotbed, and adjoining it for a distance of 36 feet, giving space enough to hold, pricked out to four inches apart, all the plants which can be started in the central hotbed. The soil underneath the cold frames for a depth of eight inches should be removed and a five inch layer of well rotted stable manure placed in. This manure should be dry enough so that it will not become pasty when tramped into a firm level layer, and sufficiently rotted that it will not heat. On this place a four

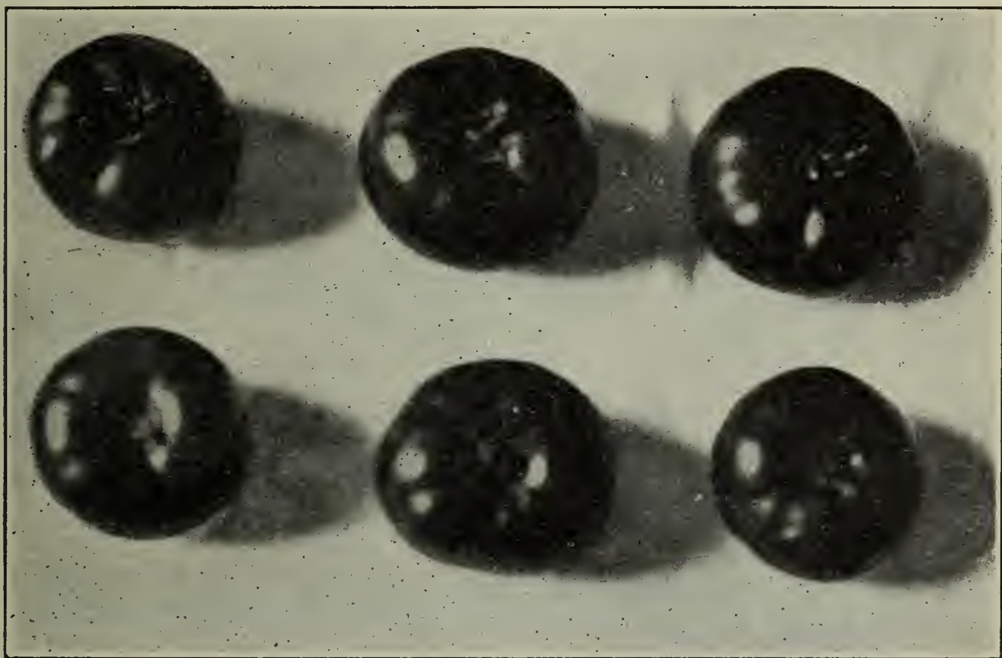


Stone.
Bolgiano's Best.

inch layer of the soil described above. Although cloth curtains often replace sash as a covering for these cold frames in more southerly climates, yet for this Province the sash had better be used.

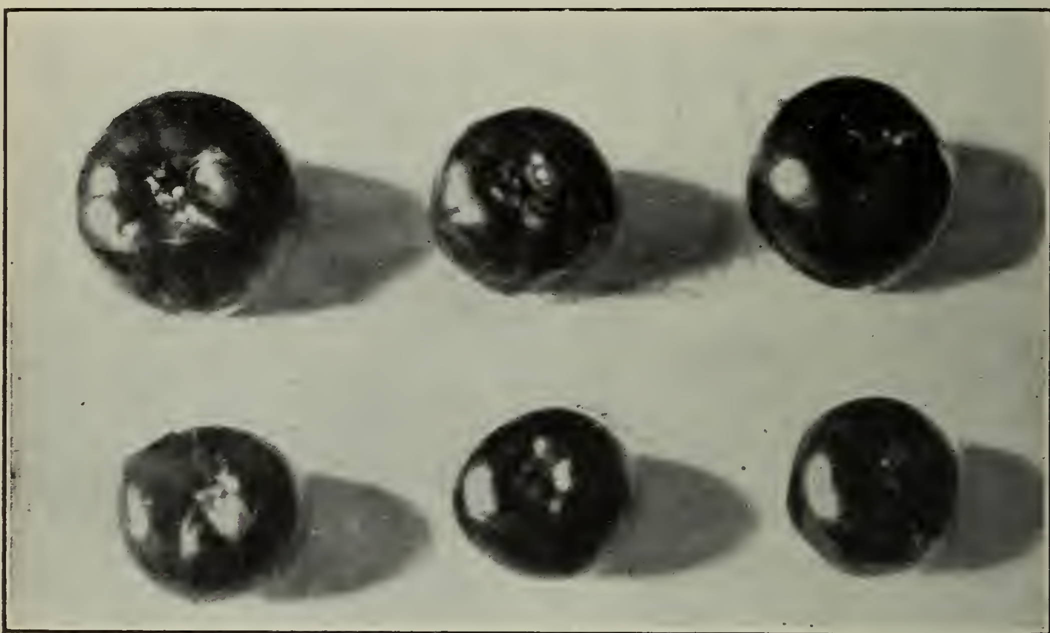
Directions for Growing the Plants.

We now have a hotbed located centrally in the middle of the cold frames and containing some 54 square feet, upon which we are to start plants enough to set five acres. First, thoroughly level off the soil upon which the seed is to be sown. About the first week in April sow the seed in drills ½ inch deep and 3 inches apart; seven or eight seeds to the inch. Now scatter over the surface an equal mixture of leaf-mould and lake sand and press firmly and evenly over the seeds. This covering will not bake or crust, and the tender shoots of the germinating seeds can much more readily break through. If the soil is dry, sprinkle lightly with tepid water and replace sash, partially shading the same. We now have some 36 rows 70 inches long and sown eight seeds to the inch, or a total sowing of over 20,000 seeds, which should give us enough plants for our purpose. It will take from three to six days for the plants to break soil, and the temperature during this period should be from 75 to 85°F. in the day time, and from 55 to 65°F. at night. When the plants have practically all broken through remove the covering from the sash and reduce



Success.
Greater Baltimore.

the temperature to from 70° to 80°F. The temperature can be regulated by dropping open the sash. After about ten days reduce the temperature to from 65° to 70°F. and give more air. Dull, cloudy weather, too high a temperature, crowding of the plants and insufficient ventilation, causes damping off. Great care must be taken not to over supply the young plants with water, as this will also cause damping off. Endeavor to keep them growing thriftily, with as little watering as possible. Some authorities favor two transplantings, and others only one. The system here recommended is a combination of the two. As soon as the central bud is well started prick out the plants to the cold frames, setting two inches apart. Remove the plants as carefully as possible, preserving the root system intact, and set them a little deeper than they were in the hotbed, pressing the soil tightly around them, so that they cannot be easily pulled out. To prevent excessive wilting, shade the young plants for the next few days. Don't apply any more water than necessary, and be sure that it is tepid. As soon as the plants are well established in their new positions admit as much light as possible, being careful that the temperature does not fall below 45°F., and that the plants are not subjected to cold winds. As soon as the plants begin to crowd one another transplant every other plant, setting them four inches apart; this will leave the whole lot four inches apart, half of them transplanted twice and the other half only once. When set in the field those transplanted twice will probably bear the first ripened fruits, and those transplanted once will follow shortly. Be careful not to over-water the plants or expose them



Jack Roe.
Earlianna.

to unfavorable winds, and maintain a uniform temperature throughout the day of from 60° to 75°F. Observe these precautions, and by the time that it is safe to set in the open field you should have good, hardy, stocky plants, which, with subsequent favorable attention and conditions, will produce a heavy crop.

A very convenient article to have when transplanting is a spotting board. This may be about 5 feet 10 inches long, one foot wide, with round tapering fingers, about one inch in diameter at the base, and 2½ inches long. These should be fastened into the board the distance apart the plants are to be set, in this case 4 inches. It should also have narrow projections carrying a single peg nailed to the top of the board at each end, so that when these pegs are placed in the end holes of the last row, the first row of pegs in the spotting board will be the right distance from the last row of holes or plants. By standing on the spotting board while setting plants in one set of holes, holes for another set are formed. The cost of the frames and sash recommended need not exceed $75, and might be considerably less, and they may be turned to advantage in many ways when not occupied by the young tomato plants.

The Use of Barnyard Manure and Commercial Fertilizers.

The nature and amount of fertilizing elements to be applied to the soil is dependent upon such a number of local conditions that no one individual can recommend a certain practice and guarantee success to all those who follow it. The more growers one sees the greater the variety of practices and the differences of opinions that one meets with. In general, the application of barnyard manure is not heavy, from 8 to 10 tons of well rotted stuff to the acre. In southern Ontario, to a lesser extent in western Ontario, and to a still less extent in eastern Ontario and Prince Edward County, this is supplemented with from 200 to 500 lbs. of commercial fertilizer, 2-8-10 generally, worked in around the plants at the time of setting. A relatively large per cent. of potash and small per cent. of nitrogen is desirable, since a large proportion of nitrogen will cause the plants to run to vine and lessen the yield, while potash tends to produce smaller vines and a better all round quality of fruit. The grower must strive to ascertain what his soil needs and aim to supply that need. The results with fertilizers have been so variable that I cannot make any general recommendation as to their use. Many growers in southern Ontario, however, would not think of doing without them, and they are more or less used in the other districts, yet many growers have no use for them. The grower must determine the actual value of these fertilizers to his soil by experiment. It can never be done by theory. Suffice it to say, that many growers would get heavier crops if they prepared their ground better, paid more attention to cultivation and used less fertilizer.

Fungous Diseases.

In this respect the tomato crop is very well favored, for compared to the potato and other crops, the yield is very little affected by the ravages of insect pests or fungous diseases. Of all the poor yields and backward fields of tomatoes seen, not one was due in the main to either of these two causes. Leaf Spot (*Septoria lycopersica*), commonly called blight, produces small, roundish, dark brown spots on the leaves and stems, and occasionally on the fruits. The lower portion of the plant is attacked first. Leaf spot was met with occasionally, but always very light, and never spread to any extent until the plants were well advanced and well loaded with fruit. Sometimes towards the end of the season it spreads rather rapidly, but as the plant by that time has set all the fruits the remaining length of the season will ripen, the effect is hardly detrimental, often helpful, by decreasing the foliage, thus exposing the fruit to sun and ripening it up more quickly.

BLIGHT (Bacillus Solanacearum), a bacterial disease, turning the stems and leaves brown and black. Less prevalent than the leaf spot. Both these diseases are referred to by the bulk of the growers as blight, no distinction being drawn between the two.

REMEDIES. As already stated these diseases have not been prevalent enough in the province to cause any alarm. Thorough cultivation inducing vigorous, healthy growing plants with frequent changes of the land will probably eliminate trouble from this source. Spraying with Bordeaux mixture is recommended by plant pathologists, but is generally considered impracticable, owing to the labor necessary to do the work well. If resorted to it should be conducted as follows:—

1st. Spraying while the young plants are still in the seed bed a few days before transplanting.

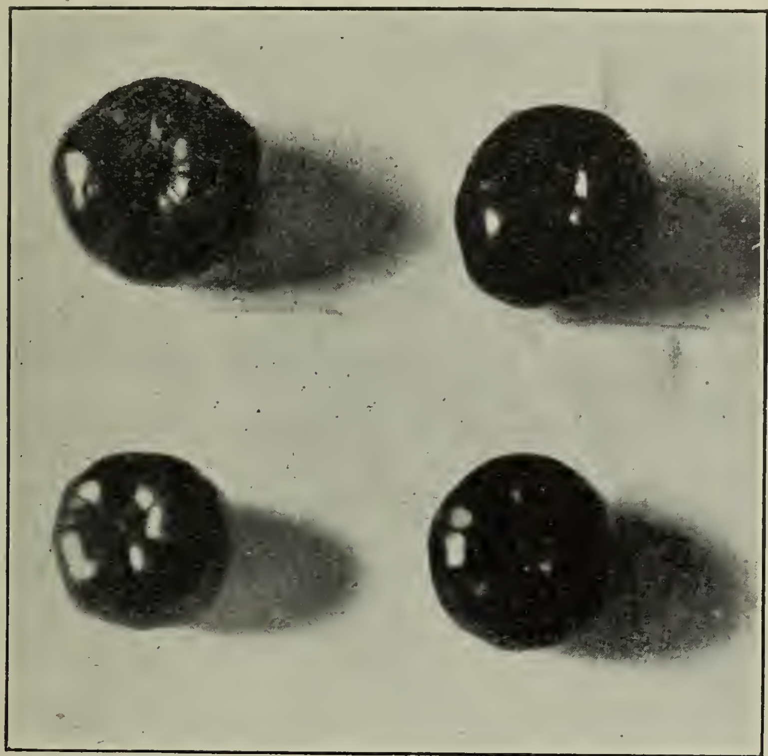
2nd. Spraying, a week after the plants are set in the field.

3rd and 4th. Spraying at intervals of two weeks. If needed a fifth spraying two weeks later. The work should be done thoroughly, every leaf being covered with a fine mist. Spray while the plants are still healthy.

POINT ROT OR BLACK ROT OF TOMATO. It occurs on the green fruit at various stages of its development. The germs causing the disease often lodge at the blossom end of the fruit when it is very small. . It begins as a sunken brown spot and gradually enlarges until the fruit is rendered worthless. The decayed spots are often roundish and covered with a dense black velvety growth (*Macrosporium tomato*) which was formerly thought to be the cause of the rot, which has since been proved to be only a saphrophyte. This disease is met with in small quantities over the Province, is not serious, but is often confounded with anthracnose or the ripe rot of tomatoes. Dry weather and light soils with insufficient moisture supply favor the prevalence of Black Rot. Spraying will not control it. Thorough cultivation and change of land will help. Gather up all the diseased fruit and burn it.

ANTHRACNOSE—RIPE ROT (*Colletotrichum phomoides*). This disease is distinguished from black rot by the fact that it occurs on ripe or nearly ripe fruits, and produces a soft, rapid decay. It is greatly favored by damp, rainy weather. It is commonly met with, in a few cases causing considerable loss. It is more prevalent in varieties that grow a heavy, close vine and will be found among the crown fruits and those resting on the ground, the exclusion of light and air tending to conditions favoring its growth. The remedies suggested for black rot should be used in this case. When gathering the first pickings instead of leaving these anthracnose infested fruits where they lie they should be placed in a separate basket and destroyed. Avoid as far as possible varieties that grow excessively heavy and dense vines.

CUTWORMS. A considerable amount of trouble and loss has been caused to tomato growers in the province, more particularly in the eastern Ontario and Prince Edward County districts, by the ravages of various species of cutworms. In the two districts just mentioned often 25, 50 and even 75 per cent. of the plants have had to be reset, so great have been the depredations of the pest. No description of these insects and their methods of attack is necessary as growers are as a rule quite familiar with both of them. Strange to say, with a few exceptions, the growers have made no effort to fight this pest, beyond



Coreless.
Hummer.

continual resetting which involves considerable additional labor and expense, and the reset plants are always behind. Those who have given a fair trial to the poisoned bait remedy have done so with much success. In the whole list of remedies for insect pests the poisoned bran mash has been one of the most effective, and it is to be regretted that such a cheap, easily applied and successful treatment as it has proved to be is not more generally used. In order to get the best results from the use of this bait the following precautions in preparing and applying it should be observed.

Procure a bushel box or large soap box and place 25 lbs. of bran in it. Moisten with half a pail of water thoroughly diffusing the moisture throughout the bran. It is better to have the bran under moistened rather than over moistened. Dissolve 3 lbs. of sugar in half a pail of water and add this in the same way. The right amount of water has been added when the bran is moist enough to cause the fine particles of Paris green to adhere to it and when it crumbles easily and runs through the fingers without adhering. Now take ½ lb. of Paris green and dust a portion of it over the surface of the bran. Stir the bran up thoroughly. Repeat this process until the whole ½ lb. of Paris green is thoroughly disseminated through the 25 lbs. of bran. If the Paris green is added to perfectly dry bran, owing to its weight it will sink at once to the bottom when stirred, in the same way that it does in water. Until ready to use place the mixture in a cool shaded spot. The land upon which the crop is to be grown should be kept free from all vegetation for two or three weeks previous to planting. This renders the cutworms hungry, and they will eagerly attack the poisoned bait when it is applied. The bait should not be applied till after the sun has gone down. If applied in the day time the heat of the sun dries out the mixture, and it loses some of its sweetness and is less attractive. The first application should be made in the evening of the day the plants are set out and subsequent applications during the next few days at the grower's judgment. When applying, sprinkle just a little close to the stock of each plant. Fifty lbs. of bran with one pound of Paris green, thoroughly sweetened and prepared as above described will cover one acre and can be applied in two hours, so that this remedy is much cheaper and more satisfactory than resetting. Wherever a plant is cut off, the worm is sure to be quite near the root and should be dug out and destroyed. Clean farming will also help by destroying many eggs and preventing the deposition of others.

Flea Beetles and Colorado Potato Beetle. A number of complaints were received of these insects, more particularly the Colorado Potato Beetle, feeding on the foliage of the young plants soon after they were set out. Spraying with Paris green 1 lb. to 100 gallons of water, or with 1 lb. of Paris green to 100 gallons of Bordeaux mixture whilst still in the cold frames and another spraying three or four days after planting is effective.

The Tomato Worm. A large green colored worm about three inches long feeding on the foliage seldom met in numbers large enough to do serious damage. On account of their color being almost identical with that of the plant, they are somewhat hard to see, but a little experience will readily help one to detect their presence, and they can be held in check by hand picking.

Varieties.

There are a great number of varieties of tomatoes grown throughout the province and I make no attempt to recommend particular ones for each district. There are, however, certain varieties commonly grown in each district which have given general satisfaction both to the canner and grower, and one is fairly safe in choosing any one of these. Ignotum Matchless, Worden, Greater Baltimore, Perfection, Success, and for a fairly early tomato Chalk's Jewel and selected strains of Earlianna. Stone, although a good yielder and an admirable variety from the canner's standpoint, is apt to be a little late and often a portion of the crop is caught by frost. Selection with a view to early maturity would produce a very valuable strain of this variety. Chalk's Jewel is apt to run off in size, and Earlianna after the first picking falls off in quality of yield, the fruits not ripening up well at the stem end, thus causing a waste to the canners. Both these varieties may be rendered still more valuable by judicious seed selection.

Tomato Catsup.

I failed to obtain any reliable estimate of the amount of whole tomatoes and tomato pulp manufactured into catsup; comparatively few factories put up pulp for this purpose. There is much concerning the produce from which this catsup is made, and the way that it is handled that is open to criticism and improvement. In some canning factories the tomato slop and peelings lies for some time in open receptacles, and in some cases sours and almost decomposes before being boiled down into pulp and finally converted into catsup. In too many cases the same cleanliness is not observed in handling the material that is converted into pulp as is observed in packing the tomatoes. The bulk of the canning factory tomatoes are of the solid meaty varieties and do not contain over-much juice and acid. On the other hand the finest tomatoes for catsup are those containing the greatest amount of acid and juice and less meat, which three qualities go together. Such tomatoes are not often produced in canning factory districts, and the rough product from which the catsup is made consists of refuse from all sorts and conglomerations of tomatoes, and hence the poor quality of the final product. The Earlianna is a variety of superior flavor and valuable for good catsup making.

Probable Extension of the Business.

There were packed this year in the Province of Ontario in the neighborhood of 21,000,000 cans of tomatoes, or about 3½ cans to each head of the population in the Dominion. This fact would seem to indicate room for extension of the business, but this extension largely depends on the quality of the goods put before the consumer. There never has been a time when strictly first class canned tomatoes were packed in excess of the demand. There may have been a time when the market was overloaded and injured by second class goods. The condemnation or approval of the masses who purchase these goods directly affects the supply and demand. If the consumers had implicit confidence in all canned goods, and those canned goods were strictly first-class, then the demand would be much greater than it is at present, and the possibilities of the canning industry would increase very materially. However, in this respect it would be well to remember that the canning factories in Ontario are by no means run to their full capacity, and that if there were, without increasing their number they would be able to supply a much greater demand than they do at present.

Tomato Refuse.

As already stated many factories do not put up pulp at all, and those that do still have a certain amount of refuse on their hands, so that all the factories have tomato refuse to dispose of. In a number of cases it is drawn away by growers to be used for pig feed. If not fed in too concentrated a state it proves of value. Used in large quantities and without mixing any other foodstuff with it, it is decidedly dangerous on account of its acidity. In other cases it is drawn away and spread on the land for its fertilizing value, on which there is considerable difference of opinion, some claiming to have used it with a fair amount of success, while others do not consider it worth the time it takes to draw it to the field. The majority of it is disposed of in these two ways. However, in a few cases it is drawn away to some dump nearby—a most objectionable practice. Where factories are situated on the banks of a creek or river, the refuse is dumped straight into the stream and is carried away by the current, and many bitter complaints of such a practice have been made by nearby farmers who depend upon the water thus contaminated as a drinking supply for their cattle. There is room for investigation and experimental work as to the feeding and fertilizing value of this and other canning factory refuse, and certainly room for improvement in the legislation controling its disposal or in the enforcement of that legislation.

Other Species.

Cherry, pear and plum tomatoes are grown to a very limited extent to be used in making preserves and sauces. They will be found on the markets from August 1st to October 15th, at prices from 60 to 75 cents per 11 quart basket.

EARLY TOMATOES.

Extent of the Industry in Ontario.

The production of early tomatoes to supply the demand before the first of the main crop matures has assumed considerable proportions in the more favored districts, namely, the Niagara peninsula, the Leamington district in Essex County, and the neighborhood of Toronto, and is carried on to a lesser extent throughout the tomato growing sections of the Province.

The summer was already well advanced when the investigation commenced, and this fact, coupled with the great extent of the area to be covered, and the large number of canning factory districts to be visited, rendered it almost impossible to pay any attention to this portion of the industry. In this respect another deterring element was that the investigation commenced in the eastern portion of the Province and the really early sections were not reached until the close of August, when the early crop was well over and the main crop coming in.

In the United States it is claimed that the amount of tomatoes annually put on the market in the fresh state is equal to the amount put up in cans. There is, however, no definite reliable information on this point, but certainly the amount sold in the fresh state in Ontario and the North-West is far below the amount taken by the canning factories. In the States the tomato is produced out of doors almost the whole year round, and doubtless the production of the great truck growing regions of the South considerably helps to swell the amount marketed in the raw state, in that country.

While in this country a large number of tomatoes are consumed in the fresh state, all the time the main crop is maturing, yet these cannot be classed as early tomatoes, the season for which may be said to extend only from July 1st to August 15th.

In the Leamington district, including Kingsville, Ruthven, Essex Centre, and Windsor, the total shipment during the above mentioned period, exclusive of those consigned to Winnipeg would approximate to 40,000 eleven-quart baskets. Of the extent of the shipments in the Niagara and other districts, I have no information at all reliable. The task of collecting information on this point is complicated, and necessitates the thorough co-operation of the express companies and wholesale fruit and vegetable produce handlers. An examination of the express companies' shipping bills at the individual stations is not altogether satisfactory, as the consignments are often mixed and merely recorded on the bill as so many baskets of fruit, the actual amount of each product not being specified. Also between July 1st, and August 15th, a considerable quantity of tomatoes are placed directly in the hands of the retailers throughout the Province by the growers themselves.

Markets.

The majority of these early tomatoes are marketed throughout Ontario, the bulk going to the principal cities and towns. The amount shipped to Winnipeg is not known, the consignments being mixed. The Essex growers claim that the Western trade has not proved satisfactory, as the first shipments by express are expensive and compete with the American grown product. Later on in the season when they are shipped in bulk much cheaper by freight, for some 60 cents per 100 pounds, they come into competition with the St. Catharines tomatoes, and the prices do not hold up well. Also they are not handled in Winnipeg to the best advantage of the grower, the jobbers taking too large a share of the profits. It seems that in this respect there is room for improvement in the selling organization for the Western markets.

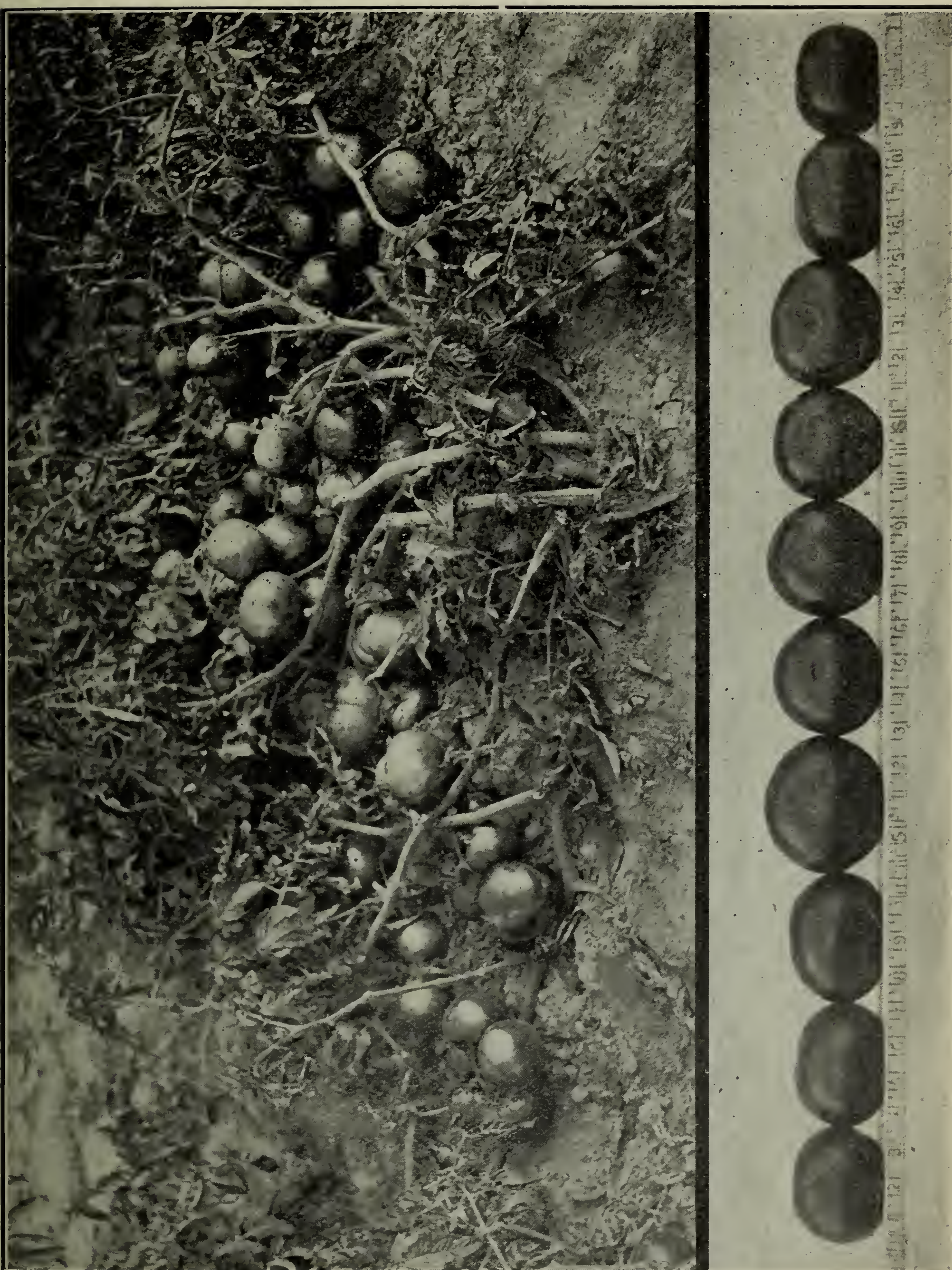
Culture.

The culture of early tomatoes is in the main, the same as for the canning crop, the greatest difference being in the growing of the young plants.

The seed is sown from February 20th to March 1st. The number of transplantings is more than in the case of the main crop, often as many as four, the last two transplantings into cold frames, the final transplanting being to six and even seven inches apart. At the time the plants are set in the field they will be some fifteen inches tall, with a spread of an equal distance, and bearing small tomtaoes. The time for setting out varies with the districts, from the 4th to the 10th of May in the Essex district, somewhat later in the Niagara peninsula and points further east. The plants are generally set 5 x 4 feet in the field. The first picking will be about July 1st and the bulk of the crop will be matured by the middle of August.

Cost of Production.

The great difference between the cost of producing the main crop tomatoes and early tomatoes lies in the increased expenditure incurred in the growing of the young plants and in the marketing of the final product. None of the early tomato growers with whom I came into contact had kept any record of the cost of production, chiefly because the young plants are grown in greenhouses along with other produce and the task of apportioning the various items of expenditure to each crop was a difficult one. They were, however, unanimous in placing the cost at from thirty-five to forty-five dollars per 1,000. The land suitable to the production of these early tomatoes in these more favored sections of the Province is considerably higher priced than that used for producing the main crop, and the rent item is therefore increased from seven to ten dollars per acre. The tomatoes being marketed in



Chalk's Jewel Tomato.

eleven-quart baskets also renders the cost of production higher. Taking these facts into consideration the total cost of production per acre will probably range from $175 to $200. The expense of picking, cleaning and packing the tomatoes into eleven-quart baskets is as mentioned heavy and therefore a light or heavy crop would make a considerable difference to the total cost of production.

Prices.

The prices for the first picked fruit will run from $1.50 to as high as $2.00 and $2.25, dropping to $1.00 per basket by the middle of July. By the end of that month they will be down to 70 cents and by the middle of August, will be selling as low as 30 cents per basket.

Varieties.

The Earlianna and Chalk's Jewel were the only two varieties I met with being used for this trade. Of these the Earlianna is earliest and more generally used.

T. Delworth: I would like to know what a man pays for his labor, if he gets the work done for $60 an acre?

A. G. Turney: That is a question upon which there is a great deal of dispute, because a lot of men do not want to count in their own labor. If they estimate the labor of a man and team, they do not figure it out at the price they would have to pay if hired.

T. Delworth: That is where a great many vegetable growers fail in not estimating the proper price of their own and hired labor. If you should use twenty tons of manure an acre; it will cost you at the car $20, and it has to be hauled from the car and spread on the field ready for plowing under. If the field is three miles from a station, how many tons will an ordinary man with a team of horses spread on the field? It is worth an additional dollar to haul it.

A. W. Peart: It is worth $4 for six tons.

T. Delworth: That is seventy cents a ton to deliver or $34.00 an acre for the manure to start with.

A Member: You should not charge that whole cost to a single crop.

A Member: The market gardener would not be satisfied unless he applied that each year.

A. G. Turney: Take twenty tons to the acre; the gardener who takes that from his barnyard would not estimate it at more than 50 cents a load.

E. E. Adams: Does Mr. Delworth put on twenty-five two horse loads per acre, every year.

T. Delworth: I do not make a practice of planting tomatoes year after year on the same land.

E. E. Adams: I am told by a gentleman that he has raised eighteen crops from the same soil year after year and the last crop was the best.

Mr. McCalla: I might make this statement, with regard to the cost of producing, that it depends upon one's local conditions and upon the way in which things are estimated. I want to say that I heartily approve of what Mr. Delworth said with regard to the estimated cost to the farmer of teams and labor. We have to feed our teams in winter and on rainy days and on Sunday, and unless we can get a pretty good price for our teams when actually working, we shall go behind, and we could not afford to keep teams for very much less than the man in town. We must not expect to work ourselves for less than the hired man gets, so that we ought to charge up the full cost of labor in every case. We figure it out in St. Catharines that a 400 bushel crop of tomatoes would cost to grow and deliver between $70 and $75 per acre.

As far as the manure is concerned, I would not if I could, put 25 tons of manure on any soil in ordinary good condition, and then plant tomatoes in it, as I would get too much top. Fertilizers have received such hard treatment here that I want to give you a statement of actual facts. I had a piece of land that was in peaches for five years. It received some commercial fertilizer and wood ashes and no stable manure. Two crops of clover were plowed under. We pulled out the trees and put on twelve spreader loads of fresh manure to the acre, that would be twelve tons. I planted it to corn and followed the corn with potatoes, using no manure but applying 600 pounds to the acre of high grade home mixed fertilizer. After the potatoes I had a good crop of wheat; sowed clover with the wheat and when the clover was seven or eight inches high, I turned it under and planted peaches again, and between the peach trees I planted tomatoes. That land had no manure since 1905, and I grew this year, if we count the actual land occupied by the tomatoes and not allow anything for head lands and drive ways, on four acres, 695 bushels to the acre, and if we allow for head lands and driveways, I had 600 bushels. It is all right to say twenty tons to the acre on certain land, but I think commercial fertilizers are a good deal better and safer. Manure costs us about $2 a ton put on the field.

A Member: What do the farmers in your neighborhood value their land at?

W. J. McCalla: $150 an acre.

T. Delworth: Our land is so valuable that we cannot plow under clover. A great deal of the land used around here for market gardening is worth double what Mr. McCalla estimates his land at.

W. J. McCalla: What will suit one locality will not do in another. The land on which I am growing tomatoes is worth from $200 to $250 an acre, and I would not have manure put on, if you drew it and put it on free. We plant tomatoes where we have grown musk-melons the previous season, and we have put on seven or eight tons to the acre for musk-melons.

T. DELWORTH: My crop for last year was slightly over ¾ of an acre, and we harvested over 600 bushels, and one-half of them was the Earlianna.

A. G. TURNEY: If we take Mr. McCalla's estimate of the cost as $75, that would leave only a profit of $15 if you only produced 300 bushels, but most men produce at least 400. Would you consider a profit of $50 an acre a fair return where it is almost a farm crop?

T. DELWORTH: A very small return to a market gardener who has to make a living off of five acres of land.

F. G. FULLER, LONDON: Some people have said that they can get land too rich for tomatoes. I admit that may be so for a late crop, but for an early crop I think it is absurd. If you don't have your plants well grown when you put them out then your ground can be too rich, but if your plants are early and you have some fruit on them when you set them in the ground you cannot have it too rich, even if it is one-half manure. Last year we put some out and forced these plants to the first of June, 3,000 plants to the acre, and from one acre we received between $500 and $600. The Dwarf Champion is not a large cropper, but we cannot get our land too rich for it.

A MEMBER: In my opinion we are running on two lines. I look upon the question of growing tomatoes for the factory a separate question altogether from growing them for the market.

JAMES GUTHRIE: Don't you think it is necessary for the market gardener to know what he is getting? I am one of the oldest gardeners in the room, and I have had a good deal of experience. I grow for the Toronto trade. I pay my taxes to the City of Toronto and they amount to about $300 an acre, and I have made a good living on 10 acres and raised a family of eleven. How could I make a living growing tomatoes, if I only realized $50 or $60 an acre of profit? It cannot be done. I grow an immense crop. I have greenhouses and grow flowers and vegetables, and a man has to work carefully in the City of Toronto to make a good living, even if he did not have to pay taxes. Some men have advocated manuring very highly for tomatoes. I have grown them for thirty-six years. I do not put on one ounce of manure for them, but I manure highly the previous year for another crop. Where I grow potatoes this year, I plant my tomatoes next year, and I have sold them on the market for 25 cents a quart. If I manure my tomatoes the same as some have suggested, I would have them all tops. I do not manure the Dwarf Champion, because it does not grow too quick. You can plant Dwarf Champions a foot apart every way and walk between them.

BULLETIN 197.] FEBRUARY, 1912.

Ontario Department of Agriculture

FRUIT BRANCH

Bee Diseases in Ontario

BY MORLEY PETTIT, PROVINCIAL APIARIST.

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

Bee-moths are often blamed for the ravages due to disease; but moths never destroy a healthy, normal colony, as they only feed on the deserted combs after the bees are nearly all gone. Heavy winter losses can often be attributed to disease. In fact, whenever a colony is not doing well the exact cause of its failure should be carefully sought to make sure there is no bacterial disease.

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

The inspectors of apiaries can do a great deal for the health of bees in Ontario; but to be of real value their work must be supplemented by the earnest efforts of the individual beekeepers. Every one should be his own inspector, carefully *examining every comb of every colony in the apiary at least once a year,* remembering that it is far better to detect it on the start in strong colonies than to wait until they are practically ruined and the disease has spread through the whole neighborhood. Only one cell of infectious disease makes it necessary to treat even the best colony in the apiary. And because one has kept bees for a number of years without seeing a case of disease is no reason why it should not make its appearance this year. Plenty of people have died of smallpox after having escaped it for fifty years.

When a case of infectious disease is suspected the beekeeper must first notify the Minister of Agriculture, Toronto, Ont., who will see that the case is attended to as soon as possible. It often means a loss of time for the beekeeper to correspond with the local inspector, because that official has no authority to make extra trips without instructions from headquarters. If the case cannot have immediate attention the beekeeper should go ahead and treat the diseased colonies according to directions given in this bulletin.

Examining an Apiary for Disease.

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

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

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

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

There are three brood diseases prevalent in the apiaries of Ontario; American Foul Brood, European Foul Brood, and Starved or Pickled Brood. The first two are known to be infectious; the last is not so considered, although its cause is not well understood.

Distribution.

American Foul Brood is pretty evenly distributed over that portion of Ontario lying south and west of the Trent Valley. European Foul Brood is spreading rapidly from three main centres of infection, so that the following counties are now diseased: Carleton, Russell, Renfrew, Northumberland, Hastings, Prince Edward and Welland. A slight outbreak was reported in 1911 in York.

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

Much, however, is being done by the Department of Agriculture towards restoring a well-grounded confidence in beekeeping as a business by various methods of instruction. To be effectual this government work must be supplemented by an earnest effort on the part of beekeepers themselves to keep their bees in a healthy condition. American Foul Brood must be reported and treated whenever discovered. So far as is known the race of bees does not affect the virulence of this disease. It is different with European Foul Brood, which simply cannot be cured in common black bees. Those who introduce Italian queens to their colonies

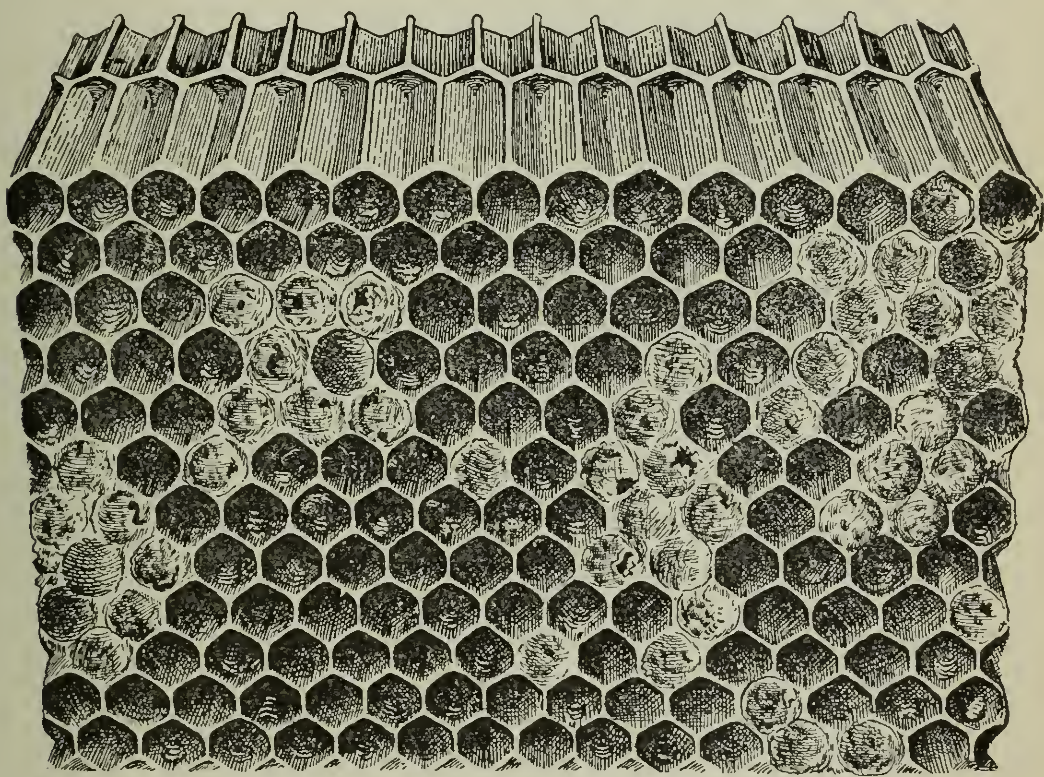


Fig. 1.—American Foul-Brood comb, showing irregular patches of sunken cappings and scales. The position of the comb indicates the best way to view the scales. (U.S. Dept. of Ag. Far. Bul. 442.)

ahead of the disease, or even at the time of treating, are saved heavy loss and are able to build up a good business. It is no more possible to check the spread of European Foul Brood among black bees than it is to stop a fire that is sweeping over a town of dry wooden buildings. But as in a fire-swept town progressive men will rebuild better than before, so in the disease-swept counties progressive beekeepers are now making more money than ever by the use of the well-bred Italian bees which they were compelled to adopt.

AMERICAN FOUL BROOD.

This disease is caused by bacteria known to scientists as *Bacillus Larvae* (not *B. Alvei*, as was formerly supposed). It reaches the healthy young larvae by means of infected food unsuspectingly fed to them by the nurse bees. In most cases the larva dies when nearly ready to seal up, and most of the cells containing infected larvae are capped. The dead larva softens, settles to the lower side of the cell in a shapeless mass, at first white or yellow, changing to coffee-color and brown. At this stage it becomes glutinous, so that if it is picked with a toothpick the contents will rope out half an inch or so when the pick is slowly withdrawn. It adheres to the cell so it cannot be lifted out entire. It has the odor of a poor quality of glue. When the larva dries it forms a tightly adhesive scale, of very dark brown color, which cannot be removed without tearing the cell wall.

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

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

The Treatment.

Now, to be cured of this disease a colony must be freed from all this infected brood, comb and honey. To do this we simply take it away. But in the operation some precautions are necessary. We must see that the colony will get healthy food as soon as the unhealthy food is taken away, and have means for building new comb at once. So the operation should be performed during a honey flow, and to make it perfectly sure it is a good plan to insert a division board feeder of sugar syrup.

We must take precautions against starting robbing, or causing the treated colony to scatter to other hives or swarm out, be lost, and carry infection to other places. So the operation should be performed in the evening, when the bees are settling down for the night, and the entrance should be covered with queen-excluding metal to hold the queen in case of swarming out the next morning. A regular queen-excluder laid on the bottom board under the brood chamber will answer the latter purpose. They should also be given a clustering space to occupy, as in the case of a natural swarm. Whenever bees are disturbed in their hives they will fill their honey sacs with honey from the comb. As this will happen when the hive is being treated, and some of this diseased honey might be

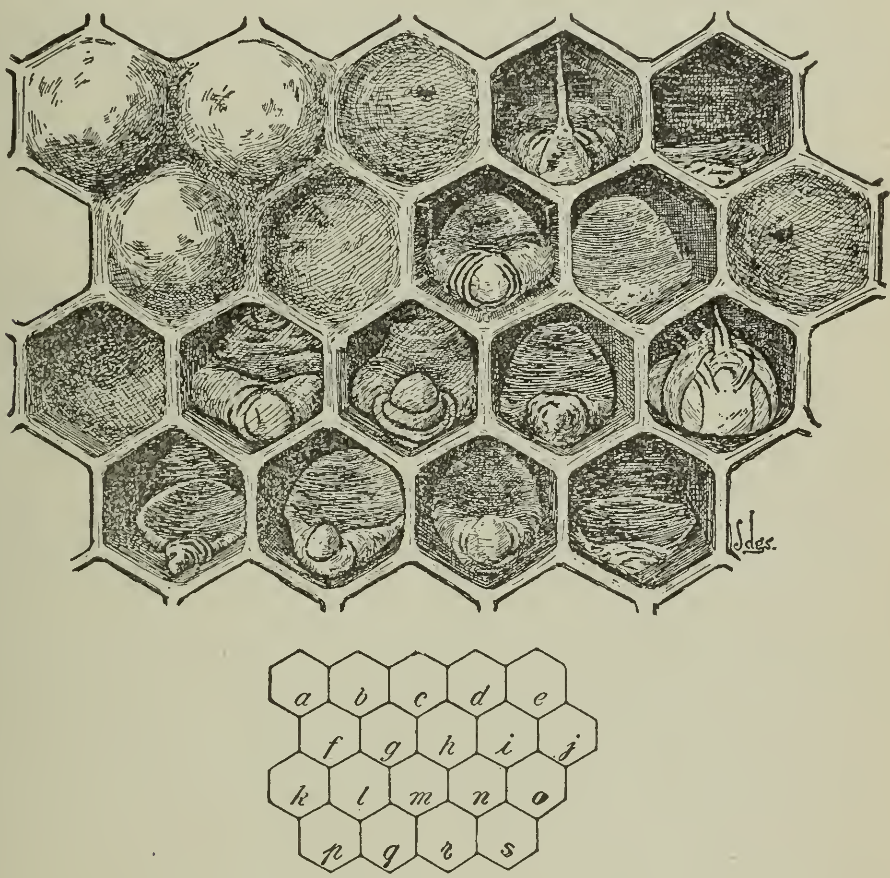


Fig. 2.—American Foul Brood: *a*, *b*, *f*, normal sealed cells; *c*, *j*, sunken cappings, showing perforations; *g*, sunken capping not perforated; *h*, *l*, *m*, *n*, *q*, *r*, larvae affected by disease; *e*, *i*, *p*, *s*, scales formed from dried-down larvae; *d*, *o*, pupae affected by disease.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

stored in the new combs, it is necessary to make them eat it before they can find a place to put it. To make sure of this, not one bit of comb of any kind can be left in the hive. Even sheets of foundation are unsafe, as some cells can be so quickly drawn out, enough to deposit a little infected honey. The hive must be quite empty so far as comb or foundation is concerned, except that very narrow starters of foundation may be placed in the frames to indicate where the combs are to be built. Thus the diseased honey will be consumed in wax secretion before any of it can be deposited in the hive.

Method of Treatment.

When there is a good honey flow on, go to the colony in the evening, remove it from its stand, and set in its place a clean, disinfected hive containing clean frames with small foundation starters, and, if convenient, a division board feeder with thin sugar syrup. The entrance of this hive must be covered with queen-excluding metal. Now shake the bees from the combs of the old hive into the new; but if any fresh nectar flies out in shaking it will be necessary to brush instead of shaking. Get these combs immediately under cover, and clean up very carefully any honey that may be around, so that robbers from healthy colonies cannot carry home disease.

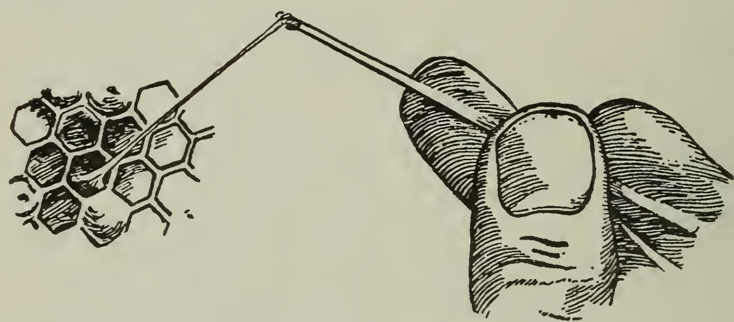


Fig. 3.—The ropiness of American Foul Brood. (U.S. Dept. Ag. Far. Bul. 442.)

When the diseased colonies are weak in bees, the bees of two or three should be put together into one clean hive, so as to get a good-sized colony with which to start the cure.

But in doing this diseased colonies must be united with their next-door neighbor, and not carried to another part of the apiary, as flying bees will be sure to return and may enter adjoining healthy colonies, carrying disease.

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

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

If directions have been followed carefully and thoroughly, the treatment should be successful. To make sure, however, the brood must be examined again in about three weeks and again the following season. If the disease reappears in any colonies they can be treated again. If the brood is perfectly healthy on the second examination combs containing too much drone can be replaced by frames of foundation or clean worker combs.

Saving Brood.

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

Saving Combs.

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

Disinfecting.

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

Fall Treatment.

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

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

EUROPEAN FOUL BROOD.

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

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

In the part of Ontario where it was first discovered apiaries were wiped out at first something like this:

112 colonies reduced to 23 in two years.

180 reduced to 21 in one year.

60 colonies reduced to 44 in one year, and the balance all diseased the second year.

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

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

The best description of this disease which has been published is found in U. S. Department of Agriculture Farmers' Bulletin 442, "The Treatment of Bee Diseases," by E. F. Phillips, Ph.D. It is as follows: "European foul brood was formerly called 'black brood,' or 'New York bee disease.' The name 'black brood' was a poor one, for the color of the dead brood is rarely black, or even very dark brown. European foul brood usually attacks the larva at an earlier stage of its development than

American foul brood, and while it is still curled up at the base of the cell (Fig. 4, *r*). A small percentage of larvae dies after capping, but sometimes quite young larvae are attacked (Fig. 4, *e, m*). Sunken and perforated cappings are sometimes observed, just as in American foul brood (Fig. 2, *c, g, j*). The earliest indication of the disease is a slight yellow or gray discoloration and uneasy movement of the larva in the cell. The larva loses its well-rounded, opaque appearance and becomes slightly translucent, so that the tracheae may become prominent (Fig. 4, *b*), giving the larva a clearly segmented appearance. The larva is usually flattened against the base of the cell, but may turn so that the ends of the larva are to the rear of the cell (Fig. 4 *p.*), or may fall away from the base (Fig. 4, *e, g, l*). Later the color changes to a decided yellow or gray and the translucency is lost (Fig. 4, *q, h*). The yellow color may be taken as the chief characteristic of this disease. The dead larva appears as a moist, somewhat collapsed mass, giving the appearance of being melted. When the remains have become almost dry (Fig. 4, *c*), the tracheae sometimes become conspicuous again, this time by retaining their shape, while the rest of the body content dries around them. Finally, all that is left of the larva is a grayish-brown scale against the base of the cell (Fig. 4, *f, h*), or a shapeless mass on the lower side wall if the larva did not retain its normal position (Fig. 4, *n, o*). Very few scales are black. The scales are not adhesive, but are easily removed, and the bees carry out a great many in their efforts to clean house.

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

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

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

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

Use Same Treatment and Italianize.

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

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

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

STARVED OR PICKLED BROOD.

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

The cause of Pickled Brood is not definitely known. It is not considered to be infectious. McEvoy asserts that it is caused by an insufficient feeding of the larvae, due to a sudden check of the honey flow, or a constitutional weakness of workers. The latter he charges to in-breeding of the queens. Re-queening with vigorous queens from other apiaries will often effect a cure, and it often disappears of its own accord.

Some Precautions.

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

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

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

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

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

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

INSPECTION OF APIARIES.

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

The following is a copy of the Act:

AN ACT FOR THE SUPPRESSION OF FOUL BROOD AMONG BEES.

His Majesty, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows:

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

2. The Lieutenant-Governor in Council, upon the recommendation of the Minister of Agriculture, may from time to time appoint one or more Inspectors of Apiaries to enforce this Act, and the Inspector shall, if so required, produce the certificate of his appointment on entering upon any premises in the discharge of his duties. And the Minister shall instruct and control each Inspector in the carrying out of the provisions of this Act. The remuneration to be paid to any Inspector under this Act shall be determined by order of the Lieutenant-Governor in Council.

3. The Inspector shall, whenever so directed by the Minister of Agriculture, visit without unnecessary delay any locality in the Province of Ontario and there examine any apiary or apiaries to which the said Minister may direct him, and ascertain whether or not the disease known as "foul brood" exists in such apiary or apiaries, and wherever the said Inspector is satisfied of the existence of foul brood in its virulent or malignant type, it shall be the duty of the Inspector to order all colonies so affected, together with the hives occupied by them, and the contents of such hives, and all tainted appurtenances that cannot be disinfected, to be immediately destroyed by fire under the personal direction and

superintendence of the said inspector; but where the inspector, who shall be the sole judge thereof, is satisfied that the disease exists, but only in milder types and in its incipient stages, and is being or may be treated successfully, and the inspector has reason to believe that it may be entirely cured, then the inspector may, in his discretion, omit to destroy or order the destruction of the colonies and hives in which the disease exists.

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

5. Any owner or possessor of diseased colonies of bees, or of any infected appliances for beekeeping, who knowingly sells or barters or gives away such diseased colonies or infected appliances, shall, on conviction thereof, before any Justice of the Peace, be liable to a fine of not less than $50 or more than $100, or to imprisonment for any term not exceeding two months.

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

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

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

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

10. Every beekeeper or other person who is aware of the existence of foul brood, either in his own apiary or elsewhere, shall immediately notify the Minister of the existence of such disease, and in default of so doing shall, on summary conviction before a Justice of the Peace, be liable to a fine of $5 and costs.

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

12. Chapter 283 of the Revised Statutes of Ontario, 1897, intituled "An Act for the Suppression of Foul Brood Among Bees." is repealed.

Inspectors' Duties.

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

Transferring Bees.

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

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

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

Disposing of Bees or Appliances.

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

Information Concerning Location of Disease.

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

EDUCATIONAL METHODS.

In this war against foul brood the most powerful weapon is Education, for it will never be mastered until the majority of beekeepers learn to know and treat it for themselves. Various methods of instruction are employed by the Department of Agriculture. First, a letter is written in the early spring to each beekeeper in districts where disease is suspected, warning him or her against the danger of the spread of disease by robbing; also advising all owners of bees dwelling in box hives to make preparations for transferring into modern hives during the swarming season. Next, the present Disease Bulletin, revised from year to year, is mailed in the spring to the complete mailing list of beekeepers in Ontario, now about 7,000. Next the inspectors visit beekeepers where disease is suspected, pointing out symptoms and explaining instructions given in the bulletin.

A new feature of the campaign of 1911 was a series of Apiary Demonstrations conducted by the Provincial Apiarist, the Apiary Inspectors and others under the auspices of the Apiculture Department of the Ontario Agricultural College, and with the assistance of the local Beekeepers' Associations. The value of such demonstrations is apparent. The average person learns how to do things far more quickly by seeing them done than by being told how. The inspector cannot afford to show everyone individually how foul brood is treated; he must simply give an explanation, leave printed instructions, and go on. But if a score or more people gather by appointment in an apiary he can meet with them and show them all at one time exactly what the disease looks like, how it should be treated to cure, and how the wax can be saved from the diseased combs. During May and June, 1911, twenty-seven demonstration meetings were held in apiaries in seventeen counties. They were remarkably well received by the local beekeepers, the highest attendance being seventy-five and the average about thirty.

In addition to these methods considerable information is given by speakers provided for the regular meetings of county Beekeepers' Associations, also by special bee institutes held in the worst infected districts during the winter.

Fuller information can be had on any of the points mentioned in this bulletin by applying to the Provincial Apiarist, Ontario Agricultural College, Guelph, Ontario.

AMERICAN FOUL BROOD.

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

BRANT: Brantford, Dumfries South.
BRUCE: Arran, Brant, Bruce, Culross, Elderslie, Greenock, Kinloss, Saugeen.
CARLETON: Goulbourn, Osgoode.
DUFFERIN: Garafraxa East, Luther East, Mono.
DUNDAS: Winchester.
DURHAM: Darlington.
ELGIN: Dorchester South, Malahide, Yarmouth.
ESSEX: Gosfield North, Maidstone, Rochester, Sandwich East, Sandwich West.
FRONTENAC: Kingston Township.
GREY: Artemesia, Collingwood, Euphrasia, Glenelg, Keppel, Osprey, Proton, St. Vincent, Sarawak, Sydenham.
HALDIMAND: Cayuga, Walpole.
HALTON: Esquesing, Nelson, Trafalgar.
HURON: Grey, Morris, Turnberry, Wawanosh West.
KENT: Harwich, Howard, Romney, Tilbury East.
LAMBTON: Bosanquet, Moore, Warwick.
LANARK: Lanark.
LEEDS: Bastard, Elizabethtown, Kitley, Yonge.
LINCOLN: Louth.
MANITOULIN: Bidwell, Gordon.
MIDDLESEX: Adelaide, Biddulph, Delaware, Lobo, London, McGillivray, Metcalfe, Westminster, Williams East, Williams West.
MUSKOKA: Draper, Macaulay, Muskoka.
NORFOLK: Charlotteville, Townsend, Walsingham, Windham, Woodhouse.
ONTARIO: Brock, Pickering, Reach, Scott, Thorah, Uxbridge, Whitby East.
OXFORD: Blandford, Blenheim, Dereham, Norwich North, Norwich South, Oxford East, Zorra East.
PEEL: Albion, Caledon, Chinguacousy, Toronto.
PERTH: Blanshard, Downie, Easthope North, Easthope South, Ellice, Elma, Fullarton, Hibbert, Mornington, Wallace.
SIMCOE: Adjala, Essa, Gwillimbury West, Innisfil, Medonte, Nottawasaga, Orillia, Sunnidale, Tay, Tecumseh, Tiny, Vespra.
STORMONT: Cornwall.
VICTORIA: Bexley, Eldon, Mariposa.
WATERLOO: Dumfries North, Waterloo, Wellesley, Wilmot.
WELLINGTON: Garafraxa West, Guelph, Luther West, Nichol, Puslinch.
WENTWORTH: Ancaster, Barton, Beverly, Binbrook, Glanford.
YORK: Etobicoke, Gwillimbury East, King, Markham, Scarborough, Vaughan, Whitchurch, York.

EUROPEAN FOUL BROOD.

From the reports of the inspectors of Apiaries we find that European Foul Brood is prevalent in the following townships. As this disease is spreading rapidly, it is very likely to appear in the townships adjoining these during the season of 1912. All beekeepers should be very much on the alert and examine their bees carefully for the symptoms of this disease.

CARLETON: Fitzroy, Gloucester, Huntley, Nepean.
HASTINGS: Huntingdon, Rawdon, Sidney.
NORTHUMBERLAND: Brighton, Cramahe, Haldimand, Murray, Percy, Seymour.
PRESCOTT: Plantagenet North.
PRINCE EDWARD: Ameliasburg, Hallowell, Hillier.
RENFREW: McNab.
RUSSELL: Cumberland.
WELLAND: Bertie.

The names of cities and towns located in these townships are omitted for brevity, but, as a matter of fact, bees in cities and towns are more often diseased than in the country.

NO DISEASE FOUND.

In the following townships some inspection work has been done, and so far no disease has been found:

BRANT: Burford.
BRUCE: Albemarle, Amabel, Carrick, Kincardine.
CARLETON: Gower North, March.
DUNDAS: Mountain.
ELGIN: Southwold.
ESSEX: Colchester South, Malden, Mersea, Tilbury West.
FRONTENAC: Palmerston, Storrington.
GLENGARRY: Charlottenburg, Kenyon, Lancaster, Lochiel.
GREY: Bentinck, Normanby, Sullivan.
HALDIMAND: Oneida, Rainham, Seneca.
HASTINGS: Hungerford, Thurlow.
HURON: Ashfield, Colborne, Goderich, Hay, Howick, McKillop, Stephen.
KENT: Raleigh.
LAMBTON: Enniskillen, Plympton, Sarnia.
LANARK: Bathurst, Beckwith, Burgess North, Dalhousie, Drummond, Elmsley North, Montague, Ramsay.
LEEDS: Crosby South, Crosby North, Rear of Escott, Leeds, Lansdowne.
LENNOX: Ernesttown.
LINCOLN: Caistor, Clinton, Gainsborough, Grantham, Grimsby South, Grimsby North.
MANITOULIN: Billings, Campbell, Carnarvon, Gore Bay, Howland, Mills, Sheguindah.
MIDDLESEX: Caradoc, Ekfrid, Nissouri West.
MUSKOKA DISTRICT: Monck.
NORFOLK: Middleton.
NORTHUMBERLAND: Hamilton.
ONTARIO: Whitby West.
OXFORD: Nissouri East, Oxford West, Zorra West.
PERTH: Logan.
PETERBORO: Asphodel, Smith.
PRESCOTT: Caledonia, Hawkesbury East, Hawkesbury West, Longueuil, Plantagenet South.
PRINCE EDWARD: Athol.
RENFREW: Admaston, Bagot, Bromley, Grattan, Horton, Pembroke, Stafford, Wilberforce.
RUSSELL: Clarence, Russell.
SIMCOE: Flos, Oro.
STORMONT: Finch, Osnabruck, Roxborough.
VICTORIA: Fenelon.
WELLAND: Crowland, Thorold, Wainfleet, Willoughby.
WELLINGTON: Arthur, Erin, Marlborough, Minto.
WENTWORTH: Flamboro East, Flamboro West, Saltfleet.

BULLETIN 198.] [FEBRUARY, 1912.

Ontario Department of Agriculture

ONTARIO AGRICULTURAL COLLEGE.

Lime-Sulphur Wash

BY L. CAESAR.

In this bulletin an attempt is made to give the results of the latest investigations and experiments on the making of the lime-sulphur wash and the various uses to which it can be applied.

DIFFERENT FORMS OF THE WASH.

1. Concentrated lime-sulphur:
    (*a*) Commercial or factory-made.
    (*b*) Home-made.
2. The old home-boiled lime-sulphur, 20.15.40 formula.
3. Self-boiled lime-sulphur.

Of these different forms No. 1 is by far the most used to-day. A few years ago No. 2 was popular, but the concentrated form is now rapidly superseding it. The reasons for this are as follows: The old home-boiled is intended for use only before or as the buds are bursting and has to be applied warm, otherwise crystals soon form and clog the spray pump and nozzles, whereas the concentrated wash can be used not only for this early spraying, but also for the later sprayings after the foliage has appeared. It does not require to be applied warm, can be kept for months without deterioration, and, therefore, can be made in spare time in the spring and stored away until required. Moreover, being much more highly concentrated and, therefore, requiring a great deal of dilution, it is more economical to manufacture. Numerous tests have shown that when diluted to the proper extent it is just as effective against San José Scale or other pests as the old home-boiled form.

No. 3 is not much used yet in Ontario. It is intended chiefly for use on peach trees after the foliage is out to control Brown Rot and Peach Scab. The other forms of the wash are not satisfactory for this purpose because peach trees are very tender and these mixtures would have to be diluted so much to prevent burning that they would not be effective in controlling these peach diseases.

Concentrated Lime-Sulphur.

As indicated above there are two kinds of the concentrated lime-sulphur, namely, the commercial or factory-made and the home-made. These are identical in character, the only difference being that the commercial form is considerably stronger than the home-made and therefore will permit of a greater degree of dilution, and, as sold by most of the companies, contains little or no sediment. This is removed before barreling because it has not nearly so much value as the clear liquid and therefore many purchasers object to its presence.

There are several companies, situated in different parts of the province, that are manufacturing lime-sulphur. The writer has used considerable of the product of two of these and found them quite satisfactory. He believes that all the companies make good washes and that it is quite safe to purchase from any of them. The only objection to purchasing the commercial lime-sulphur is the cost. Home-made concentrated can easily be made and the rules for diluting it quickly learned, and as it is much cheaper fruit growers should learn to make their own unless they live near a company's factory and can purchase on very favourable terms. The comparative cost of the two kinds of the wash will be discussed below.

Home-made Concentrated Lime-Sulphur.

Formula:—50 lbs. fresh stone lime, grading high in calcium.
100 lbs. sulphur, either flowers or a fine grade of flour of sulphur.
40 to 50 gallons of water, either hard or soft.

The amount of lime given in this formula can be modified profitably as mentioned below under the heading: "Best limes in order of merit."

When sulphur is purchased in bags containing 112 lbs., it is convenient to use the whole of this amount at a time instead of weighing out 100 lbs. In such cases 56 lbs. of lime would of course be required to keep the above proportions and 50 gallons of water are always preferable to 40.

Limes Suitable for Making the Concentrated Wash.

During the last season an attempt was made to obtain samples of lime from all the different limestone formations of the province. These were all tested and, whenever it seemed desirable, were chemically analyzed through the kindness of the staff of the Chemical Department. A number of these limes were found to contain too high a percentage of impurities, chiefly magnesium, to make a good wash without too much sediment. *Prof. Van Slyke has shown that the presence of large quantities of

* Bulletin 319, Geneva.

magnesium injures the wash in other respects also. Of the remainder some were much superior to others.

BEST LIMES ARRANGED IN WHAT SEEMS TO BE THE ORDER OF MERIT.

Name of Lime.	Address.
Beachville	The Standard Lime Co., Beachville.
St. Marys	Standard White Lime Co., St. Marys.
Renfrew (two grades; get the purer)	The Jamieson Lime Co., Renfrew, Ont.
Ottawa	Gloucester Stone & Lime Works, H. Robillard & Son, 236 Chapel St., Ottawa.
Selkirk	F. Helka, Selkirk, Ont.
Coboconk	Canada Lime Co., 34 Yonge St., Toronto.
Port Colborne	John A. Reeb, Port Colborne, Ont.
Trenton	W. H. Miron, Trenton, Ont.

Note.—Fruit-growers along the St. Lawrence can secure an excellent grade of lime from The Hackett Co., Ogdensburg, New York.

Fig. 1. Shows the comparative amount of sediment produced by each of nine kinds of lime boiled under the same conditions. The white line near the bottom of each vessel marks the height of the sediment.

As these limes are not all of the same strength the amount to be used with each 100 lbs. of sulphur may, with considerable advantage, be varied from the 50 lbs. given above in the formula as follows: About 48 lbs. seem best for Beachville; 50 for St. Mary's, Renfrew, Ottawa and Selkirk; 54 for Coboconk and Port Colborne, and 60 for Trenton.

It is very probable that there are a few more districts where suitable lime can be procured; hence fruit growers wishing to know whether the lime of their locality may be used should send to the writer samples of not less than one pound in weight.

Devices for Boiling.

Many different devices are used for boiling the mixture. It is not at all necessary to have an expensive outfit. A cheap one will give as good results. A kettle holding from 25 to 40 gals. water will serve the purpose, but it is rather slow, as only part of the amount indicated in the formula can be boiled at a time.

Fig. 2. Kettle used for boiling the lime-sulphur wash.

Fig. 2 shows such a kettle. A more economical device is shown in Fig. 3.

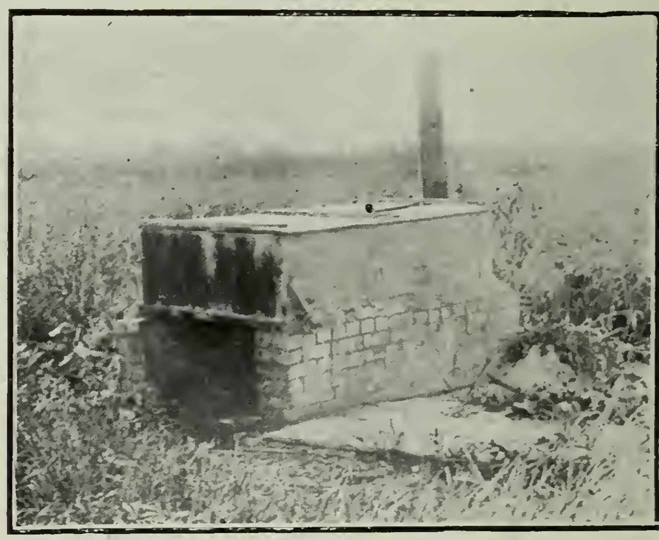

Fig. 3. Box with galvanized-iron bottom; a good outfit for boiling the wash.

This consists of a stout, close-fitting box with wooden sides and ends and galvanized-iron bottom. This box should be large enough to boil 50 gals. of the mixture at a time. Each box is about 6 feet long, 3 feet wide and from 14 to 18 inches deep. The sides and ends are made of 2 inch planks closely fitted together at the corners. The galvanized-iron bottom should extend slightly beyond the planks to protect them from the fire. It is nailed to them by ordinary wire nails. The box thus constructed is placed on a brick, stone or concrete foundation from 18 to 20 inches high with one end open for throwing in the fuel, and the other provided with a couple of lengths of stovepipe to create a draught and carry off the smoke. It is found very convenient to place a "molasses gate" or faucet with a good sized aperture near one corner to enable the operator to draw off

Fig. 4. Small steam generator, boils two barrels at a time; scarcely so good as the box.

the wash when ready. Before using the box it should be filled with water, and let soak a few hours. It is found that the mixture can be made very rapidly in these boxes because of the large amount of surface exposed to the flames. To prevent unnecessary loss of heat there should be a wooden covering made of three or four boards running lengthwise and fastened together by crosspieces near the ends. An opening must be left between the two middle boards wide enough for a hoe handle to run through easily to permit the necessary stirring.

Instead of boiling by direct heat from the fire many prefer to use steam. This is the most pleasant method and the most convenient, especially where a large quantity has to be prepared each day.

If it is desired to boil only two barrels at a time Fig. 4 shows a very convenient little steam generator costing about sixty-five dollars.

Fig. 5. Threshing engine used for boiling the wash.

Fig 5 shows an ordinary steam engine of about 15 horse-power which may be used to boil from eight to ten barrels at a time.

Fig 6. An outfit for boiling the lime-sulphur in larger quantities.

Fig. 6 shows a still larger outfit where the mixture is boiled in large tanks, each having a capacity of several barrels. The tanks, it will be observed, are placed on a platform, which is a few feet higher than the spray tank, so that the wash, when ready, can flow through a tap and large hose into the screen and be strained directly into barrels or other storage receptacles.

It is perhaps necessary to mention that, although boiling by steam is a very convenient and satisfactory way, it makes no better wash than can be made in the kettle or box or some other cheap device.

HOW TO MAKE THE WASH.

We shall first discuss the method of boiling in a kettle or box by direct heat and then the method of boiling by steam.

Put enough water in the boiling outfit to make a moderately thick paste with the sulphur, usually about 10 gals. Then light the fire and, while the water is heating up, throw in the sulphur and stir well with a hoe to make a paste and break any lumps there may be. Next add the remainder of the 40 or 50 gals. of water and, when it is nearly ready to boil, add the lime. When this has begun to slake, stir well with the hoe to prevent caking on the bottom and to keep the lime and the sulphur in suspension, as this hastens the chemical process of combination. The stirring should be frequent for about 20 or 25 minutes until all the lime and sulphur is in solution, after which it need be done only occasionally. Boiling should be continued for one hour or at least 50 minutes and water added in small quantities from time to time to keep the total always up to at least 40 gals., but preferably to 50 wherever the outfit is large enough to boil this amount. In order to keep track of this a measuring stick should be used to mark how high the total amount of water reaches when it is heated up. If a small crosspiece is nailed on the stick at this height it will be easier than a notch to see in the steam.

This method may be considerably varied to suit the convenience of the individual. If the boiling outfit is so small that the liquid will boil over if the lime is added after all the water has been put in, this difficulty can be overcome by throwing the lime on top of the sulphur paste and adding sufficient water to slake it thoroughly and then, when the slaking is over, adding the rest of the water and boiling as before for 50 minutes or one hour. The lime must of course be stirred when it is slaking. Some prefer to place sufficient water in the oufit to slake the lime, heat it to near boiling, then add the lime and, as soon as it is well slaked, add the sulphur and the rest of the water and boil for 50 minutes or one hour. The writer has found the first way the most convenient, but it is not necessarily the best; in fact one way in his tests gave just as good results as another.

When boiling by steam practically the same mode of procedure should be followed. If the boiling is done in barrels these should be only about half full, otherwise they will boil over. No water has to be added here to allow for evaporation, but care must of course be taken to see that the proportions given above in the formula are adhered to closely. There is sometimes a danger that the noise caused by the passing of the steam into the mixture may be mistaken for boiling, hence we must see that there is plenty of steam. If the pipe conveying the steam into the barrel reaches to about 10 inches from the bottom, this helps to keep the ingredients stirred up.

Points of Special Importance in the Boiling of the Home-made Concentrated.

1. The amounts of lime and of sulphur should be carefully weighed out and never guessed at.

2. Air-slaked lime should never be used as it does not combine well with the sulphur; hence always use fresh lime. If the lime, on its arrival, is placed in a dry room in well-covered vessels, it will not slake nearly so rapidly as if left exposed to the air, especially if the air is damp.

3. If possible, use 50 gals. instead of 40 gals. of water. In the writer's tests it was seen that where the same proportions of lime and sulphur were used, but the water varied from 30 to 50 gals., there was considerably more sediment from 30 gals. than from 40, and slightly more from 40 than from 50. When each lot was made up to 50 gals. at the end of the boiling and the strengths compared, the one boiled with 50 gals. was considerably stronger than that with 40 and much stronger than that with 30 gals. This shows clearly that we must be careful, when boiling, never to allow the liquid to get below the 40 gal. mark and preferably not below the 50 one. The only objection to keeping it always at 50 gals. instead of 40 is the need of a larger outfit for boiling than some have, and of extra receptacles for storing. Where this can easily be overcome, the 50 gal. should be used instead of 40. This shows that for the fruit grower it does not pay to attempt to make so highly concentrated a wash as the commercial companies do. It is easy, of course, to make it just as strong.

4. The process of bringing the sulphur and lime into solution and lessening the amount of sediment is aided by frequent stirring, especially during the first 20 or 25 minutes.

5. The boiling should be at a moderate but not furious rate.

6. Sometimes excellent mixtures are made by boiling only 45 minutes, but it will be found safer on the whole to boil one hour. The boiling should not be unnecessarily checked by adding large quantities of water at a time; it is better to add small amounts at frequent intervals.

7. If lumps of sulphur are found in the sediment that do not go through the screen, these may be crushed and thrown back into the boiler. This small addition of sulphur will not injure the next lot.

8. The colour of the sediment varies with different kinds of lime. This does not affect the value of the wash.

9 The amount of sediment from one kind of lime compared with another, while a fairly good test of the purity, is not an accurate one because the sediment of some kinds is much lighter and more flocculent than of others and does not settle so low. The hydrometer reading of the clear liquid is much more reliable.

Storing the Wash.

As soon as the boiling has lasted for one hour, the mixture can be strained through a fine screen of from 30 to 40 meshes to the inch into

Fig. 7. (*a*) Shows the comparative amounts of sediment from boiling the same proportions of lime and sulphur in 40 and 30 gals. respectively. Note the larger amount of sediment in the latter case, thus showing the importance of keeping the water up to at least the 40 gal. mark. (*b*) Hydrometer in glass cylinder of the liquid.

a barrel or other receptacle and covered well to keep the air out, as this slowly but gradually causes the wash to deteriorate. If the liquid is going to be used in a week or less, it is not necessary to be particular about excluding the air very carefully. Empty kerosene or other good barrels may be used for storage. If the bung is removed, the liquid can be strained through the hole and the bung replaced when the barrel is full. If vinegar barrels or barrels that have held any kind of acid are used, they should first be filled with water and allowed to soak so that all the acid may be removed. Acid decomposes lime-sulphur. Open barrels or tanks may be protected from the air by pouring about one-eighth of an inch of any kind of oil over them. This can be skimmed off before using the wash.

If the weather is very cold, the barrels must be protected against frost. They do not freeze nearly so easily as water. The writer found that a strength of 1.200 specific gravity left uncovered did not begin to freeze until the thermometer stood at 15° above zero Fahrenheit. Denser washes will stand more frost.

A wash properly protected from air and from freezing will keep a year or more without deteriorating to any appreciable extent.

Amount of Home-Made Concentrated Lime-Sulphur Required for Ond Acre of Orchard.

If the orchard is composed of fairly well developed apple trees from thirty-five to forty-five years of age, one barrel per acre of the home-made concentrated lime-sulphur, made according to the directions given above and properly diluted for each application, will usually be sufficient for the three regular sprayings that every orchard should receive. Roughly speaking, one may reckon that each tree on an average will be found to have required a little more than one gallon of the concentrated wash. Smaller trees will require a proportionately small amount; for instance, one barrel of the concentrated would ordinarily suffice for at least two acres of apple trees twenty years of age. A little thought will enable anyone to estimate fairly accurately how much of the mixture he will need to make for the season's spraying.

The Best Time to Make the Wash.

Except where one is making large quantities to sell or for a co-operative association and finds it impossible to get the work done unless he begins very early, it would be wise to leave the making of the wash until some time in March or April. This will avoid the necessity of so much care in protecting it against frost.

How to Test the Strength of Concentrated Lime-Sulphur and Determine the Proper Amount of Dilution for each Spraying.

Every fruit grower should learn to test the strength of the concentrated lime-sulphur, whether it be home-made or commercial, and how to determine the proper amount of dilution for each spraying. In this way alone he knows just what strength he is using on his trees, and therefore is acting in a more business-like manner. To test the strength of the wash a small glass instrument, about a foot long, known as an hydrometer, is used. (See Figs. 7 and 8.) These hydrometers are of two kinds, one with specific gravity readings and the other with Baumé. The writer prefers the specific gravity one, because the proper amount of dilution can always be worked out with it from a simple rule given below, while, with the Baumé scale, one has to consult the table which is also given below. It is convenient to have an hydrometer with both readings, and such are manufactured. Some of the commercial lime-sulphur companies sell hydrometers specially made for the purpose, the price varying from 75 cents to $1.00. Most wholesale druggists keep at least one kind of hydrometer for sale.

The specific gravity readings on the most convenient hydrometers run from 1.000 to about 1.350 or 1.400 and on the Baumé from 0 to 40 or 42. When an hydrometer is placed in a vessel of water it sinks to 1.000 on the specific gravity scale and to 0 on the Baumé. If the liquid is denser

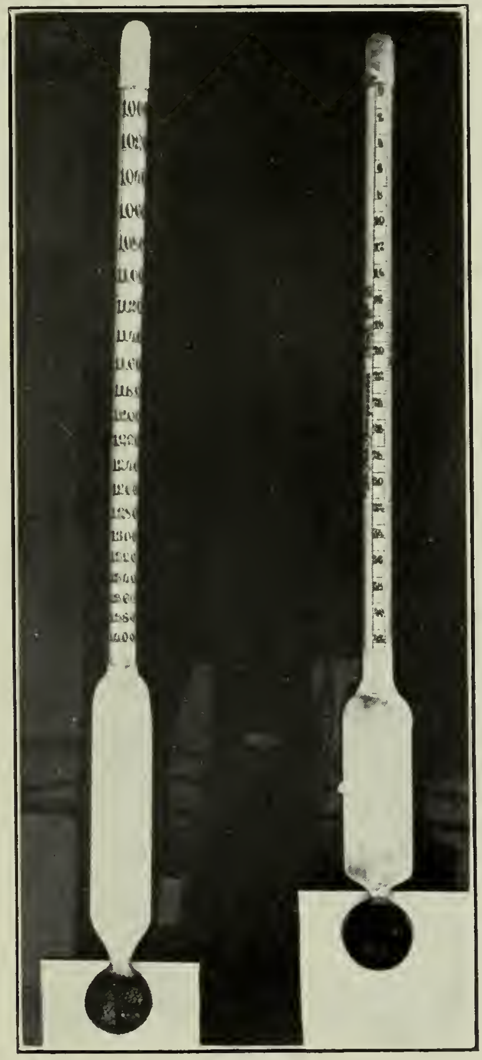

Fig. 8. Hydrometers (about ½ size). The one on the left has specific gravity, the other Baumé, readings.

than water it will not sink so deeply. In home-made concentrated, it usually sinks to somewhere between 1.200 and 1.240 specific gravity, or 24 to 28 Baumé, where 40 gals. are used in boiling, and from about 1.175 to 1.210, or 21 to 25 Baumé, where 50 gals. are used. In commercial lime-sulphur it sinks to about 1.300 specific gravity or 34 Baumé. Whatever point it sinks to is spoken of as the *reading* or strength of the wash, and the greater the number the more the wash will stand to be diluted before using it on the trees.

Precautions to be taken in Using the Hydrometer.

1. All the sediment must first have settled to the bottom and only the strength of the clear liquid be tested. If this is not done the reading will be much too high; for instance, the writer tested a wash before the sediment was settled and it read 1.240, and after it was settled only 1.200, the latter, of course, being the correct reading.

2. The wash should be left long enough to have cooled down to the temperature of the surrounding atmosphere. In a number of tests it was found that a more accurate reading was obtained by waiting until the second or third day after the wash was made. The reason for this is not clear.

3. The hydrometer should be washed each time after the reading and not allowed to get dirty. If it is found difficult to clean, rub it with a little vinegar on a cloth and then wash this off.

It is convenient when storing the wash to keep out sufficient in a vessel about a foot deep to test when necessary. The strength can then be marked on the barrel for reference.

Rules for Diluting Before Spraying if a Specific Gravity Hydrometer is Used.

Put the hydrometer in the clear liquid when it is cool and the sediment has settled. Note the reading. Suppose this is 1.240 sp. gr. The proper strength for use before the buds burst is 1.030, but if San José Scale has to be combated it is better to make it 1.032. To determine how much to dilute a wash reading 1.240 to get a strength of 1.030, divide the first three figures to the right of the 1 by 30, that is 240 divided by 30=8. This means that each gallon of the wash may be diluted with water to make 8 gals. of the strength of 1.030. For San José Scale divide by 32 instead of 30, that is 240 divided by 32=7½; so that in this case each gallon may be diluted to only 7½ gals.

For use on apples and pears just before the blossoms burst the proper strength is about 1.009. To get this strength from a wash reading 1.240, divide in the same way the first three figures to the right of the 1 by 9, that is 240 divided by 9=26 ⅔ This means that each gallon of such a wash for this application may be diluted with water to 26 ⅔ or 27 gals.

For the application just after the blossoms have fallen and for subsequent applications, if any are given, a strength of about 1.008 is satisfactory. To get this we proceed in the same way as above and divide the 240 by 8, which gives us 30, thus indicating that for this application each gallon may be diluted to 30. *In brief the rule is: Take the reading of the wash and divide the three figures to the right by 30 (or 32 if for San José Scale) for the first application; by 9 for the second and by 8 for the third, and dilute each gallon with water to the number thus obtained in each case.*

For the convenience of those who may happen to have an hydrometer with only the Baumé scale on it or for anyone who prefers to use a table instead of the above rule even with the specific gravity scale, the following table is given:

NOTE.—In this table the number of gallons of water to be added to each gallon of the concentrated wash is given, whereas in the rules just given above it is only the total number of gallons of spray mixture that each gallon of the concentrated wash will make that is given, and the number of gallons of water to be added is therefore one less than that total in each case.

TABLE FOR DILUTION OF CONCENTRATED LIME-SULPHUR.

Reading on Hydrometer.		First Application.		Second Application.		Third Application.	
Specific Gravity Scale.	Baumé Scale.	Lime-sulphur. Gallons.	Water. Gallons.	Lime-Sulphur. Gallons.	Water. Gallons.	Lime-Sulphur. Gallons.	Water. Gallons.
1.320 =	35¼*....	1 with	9† or 9⅔....	1 with	34½......	1 with	39.
1.310 =	34½.....	1 "	8⅔ or 9⅓....	1 "	33½......	1 "	38.
1.300 =	33½.....	1 "	8⅓ or 9......	1 "	32⅓......	1 "	36½.
1.290 =	32¾.....	1 "	8 or 8⅔....	1 "	31........	1 "	35.
1.280 =	31¾.....	1 "	7¾ or 8⅓....	1 "	30........	1 "	34.
1.270 =	31.......	1 "	7⅓ or 8......	1 "	29........	1 "	33.
1.260 =	30.......	1 "	7 or 7⅔....	1 "	28........	1 "	31½.
1.250 =	29.......	1 "	6¾ or 7⅓....	1 "	27........	1 "	30.
1.240 =	28.......	1 "	6½ or 7......	1 "	25⅔......	1 "	29.
1.230 =	27.......	1 "	6 or 6⅔....	1 "	24½......	1 "	28.
1.220 =	26.......	1 "	5¾ or 6⅓....	1 "	23½......	1 "	26½.
1.210 =	25¼.....	1 "	5½ or 6......	1 "	22⅓......	1 "	25.
1.200 =	24¼.....	1 "	5¼ or 5⅔....	1 "	21........	1 "	24.
1.190 =	23¼.....	1 "	5 or 5⅓....	1 "	20........	1 "	23.
1.180 =	22¼.....	1 "	4⅔ or 5......	1 "	19........	1 "	21½.
1.170 =	21¼.....	1 "	4⅓ or 4⅔....	1 "	18........	1 "	20.
1.160 =	20¼.....	1 "	4 or 4⅓....	1 "	17........	1 "	19.
1.150 =	19.......	1 "	3⅔ or 4......	1 "	15⅔......	1 "	18.
1.140 =	18.......	1 "	3⅓ or 3⅔....	1 "	14½......	1 "	16½.
1.130 =	16¾.....	1 "	3 or 3⅓....	1 "	13½......	1 "	15.
1.120 =	15½.....	1 "	2¾ or 3......	1 "	12⅓......	1 "	14.

* The fraction need not be taken into account unless the user wishes to do so.

† The smaller number is for use against San José Scale, the larger for use where there is no scale.

NOTE 1.—One should not test the strength of the diluted spray. All that is necessary is to dilute according to the rules given.

NOTE 2.—After determining the strength of a barrel of the home-made concentrated wash, it should always be well shaken before spraying, to distribute the sediment so that the mixture each time may be uniform in strength.

Comparative Cost of Commercial and Home-made Concentrated Lime-Sulphur.

Each barrel of commercial lime-sulphur costs on an average $8.00 f.o.b., and when the freight charges are added to this many of our growers have to pay at least $9.00 per barrel. but we shall, however, speak of the commercial wash as costing $8.00.

Those who make their own concentrated can nearly always secure their sulphur from the companies which are dealing in lime-sulphur for about 1½ cts. per lb., but as there is freight to pay on this, we shall suppose the sulphur costs 2 cts. a lb. Lime ordinarily costs not more than 25 cts. per bushel, but as some will have to obtain it by freight from a distance, we shall suppose it costs them in all 42 cts. per bushel. There is in addition to these the cost of barrels for storing, though usually there are several on hand; the cost of fuel and labour, and the interest on the original cost and maintenance of the boiling outfit. Taking all these into consideration we have the following:

Sulphur, 100 lbs. at 2 cts.	$2 00
Lime, 50 lbs. at 42 cts. a bus	30
Labor, at $2.00 per day	50
Fuel	10
Interest on outfit	10
Barrel	1 00
Total cost	$4 00

This wash is about two-thirds commercial strength, so the cost of an amount of it equivalent to one barrel commercial strength would be $6.00. This leaves a balance of $2.00 per barrel in favour of the home-made.

Whenever it is made in large quantities the cost is less, and therefore the gain per barrel greater than $2.00.

THE OLD HOME-BOILED LIME SULPHUR.

As mentioned at the beginning of the bulletin this form of lime-sulphur was until the last few years very popular and in fact about the only kind used. The most common formula is 20 lbs. good fresh lime, 15 lbs. sulphur and 40 gals. water. The lime and the sulphur are usually boiled in about 15 gals. of water for one hour, and then are diluted to 40 gals. The mixture must be applied while still hot, or at least warm. The same kinds of outfits and the same methods of adding the ingredients as in the case of the home-made concentrated wash should be used. The water should be kept up to about 15 gals. during the boiling and the same care taken to stir frequently. The wash, before using, must be strained through a screen of 20 to 30 meshes to the inch. This form of lime-sulphur, as mentioned above, cannot be stored, but must be used the same day as it is made, otherwise it will crystallize and clog the nozzles and spray pump. It is only used for the spraying before or as the buds burst. It is not, of course, so economical to make or convenient to use as the home-made concentrated, but is just as effective and is much liked not only for the good results it gives but also for the way in which it leaves the trees very white, thus showing clearly whether the work was well done.

SELF-BOILED LIME-SULPHUR.

The following are the directions given by Prof. Scott of Washington, D.C., for making this wash.*

"This mixture is composed of 8 lbs. of fresh stone lime and 8 lbs. of sulphur (either flowers or flour may be used) to 40 gals. of water. This appears to be about the correct strength, although in mild cases of scab and brown-rot a weaker mixture, containing 6 lbs. of each ingredient to 40 gals. of water, may be used with satisfactory results. The mixture can best be prepared in rather large quantities, say, enough for 160 gallons at a time, making the formula 32 lbs. of lime and 32 lbs. of sulphur to be cooked with a small quantity of water (7 or 8 gallons) and then diluted to 160 gallons.

"The lime should be placed in a barrel and enough water poured on to almost cover it. As soon as the lime begins to slake the sulphur should be added after first running it through a sieve to break up the lumps. The mixture should be constantly stirred and more water added as needed to form a thick paste at first and then gradually a thin paste. The lime will supply enough heat to boil the mixture several minutes. As soon as it is well slaked, water should be added to cool the mixture and prevent further cooking. It is then ready to be strained into the spray tank, diluted and applied.

"The stage at which cold water should be poured on to stop the cooking varies with different limes. Some limes are so sluggish in slaking that it is difficult to obtain enough heat from them to cook the mixture at all, while other limes become intensely hot on slaking and care must be taken not to allow the boiling to proceed too far. If the mixture is allowed to remain hot fifteen or twenty minutes after the slaking is completed, the sulphur gradually goes into solution, combining with the lime to form sulphides, which are injurious to peach foliage. It is, therefore, very important, especially with hot lime, to cool the mixture quickly by adding a few buckets of water as soon as the lumps of lime have slaked down. The intense heat, violent boiling, and constant stirring result in a uniform

* Circular 120, Bureau of Entomology, Washington, D.C.

mixture of finely divided sulphur and lime, with only a very small percentage of the sulphur in solution. It should be strained to take out the coarse particles of lime, but the sulphur should be carefully worked through the strainer."

The writer has used a good many barrels of this wash and found it very easy to prepare. To stir the mixture while boiling, a hoe was found satisfactory. With it the lime should be raised merely a little way from the bottom to let the water down and so prevent caking. It should not be brought to the top as that tends to check the boiling. The stirring must not begin until slaking has got well started.

As there is a great deal of sediment in this wash it can be strained much more easily if first diluted to about half the total amount. A screen of about 20 meshes to the inch may be used.

When applying the wash to the trees extra precautions should be taken to see that it is kept well agitated.

The cost per barrel at the prices of the materials given above is very low: Lime 5 cents, sulphur 16 cents, total 21 cents.

THE USE OF POISONS WITH LIME-SULPHUR.

Lime-sulphur itself is not an internal poison. It kills scale insects and some other very small but very troublesome pests, but does so by coming in contact with their bodies or by acting upon the waxy covering that protects them or by depriving them of the oxygen they need to breathe.* It does not kill the Codling Moth, Plum Curculio or any of the larger insects except in rare cases when, in their very early stage, the little worms may happen to get covered by the wash. For all these insects we need a poison which we can put on the leaves or fruit so that, when these are eaten, the insect will be killed. There is only one poison at present that we can safely recommend to be used with lime-sulphur for this purpose, namely, arsenate of lead. Other arsenical poisons, such as Paris green and arsenite of lime, when combined with lime-sulphur very frequently burn the foliage severely, especially in the later sprayings, although some years they do not do so. It is never safe to rely on them, and for that reason they cannot be recommended. It is very probable that new poisons equally as good as arsenate of lead and that can safely be combined with lime-sulphur will be discovered before long, but attention will then be called to them through the press, or in other ways.

Arsenate of lead is a white paste, costing from 8 to 14 cts. a lb., and from 2 to 4 lbs. are used with every 40 gals. of the diluted lime-sulphur. Before adding it to the lime-sulphur, it must always be stirred up in a gallon or two of water until it is all in suspension and is just like milk. When it is added to the lime-sulphur, it changes the colour of the latter,

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* See Technical Bulletin No. 11, Michigan Agricultural College, Lansing, Mich.

a chemical change being brought about by the combination of the two substances. This chemical change results in the formation of a blackish precipitate which settles to the bottom rather quickly unless kept well agitated while spraying.

Does the Addition of Arsenate of Lead to Lime-Sulphur Lessen the Value of Either Substance?

This is a very important question, but as the result of several seasons' careful experiments conducted by himself and by others, the writer has no hesitation in saying that the value of neither the lime-sulphur nor of the arsenate of lead is lessened, in fact it is believed that arsenate of lead itself has considerable fungicidal value; and careful tests by Wallace, of Cornell University, have shown that lime-sulphur and arsenate of lead combined is a better fungicide than lime-sulphur alone.*

LIME-SULPHUR *VERSUS* BORDEAUX MIXTURE.

Numerous questions are asked as to the comparative merits of lime-sulphur and Bordeaux mixture. There can be no doubt whatever that for the first application, which should be made before or as the buds are bursting, lime-sulphur is very much the better spray for fruit trees and shrubs because it not only controls diseases that may be spreading at this time of the year as well as Bordeaux does, but it also at the same time kills several of our worst insect pests, such as San José Scale, Oyster-shell Scale and Blister Mite, which Bordeaux will not do.

For the other applications on apples and pears one mixture seems just about as good a fungicide as the other, as either of them will control the fungus diseases that are found on these trees in Ontario in a very satisfactory way if properly applied. It is just possible that the foliage is a little larger when Bordeaux is used, but this is not fully proven yet and whether it be so or not the foliage on trees sprayed with lime-sulphur is very healthy and quite as large as normal. The great objection to Bordeaux mixture is that it undoubtedly russets some varieties of apples very badly, making them look far from attractive. Lime-sulphur on the other hand leaves the skin of the apple smooth and as beautiful as in nature when not attacked by any disease. Furthermore lime-sulphur is a good deal more convenient to use because all one has to do is to go to the barrel of the concentrated wash, take out what is wanted, strain it into the tank and then add the necessary amount of water and the arsenate of lead; whereas Bordeaux mixture has to be made up fresh each day and this requires considerable time and work. Moreover, if the orchard is infested with scale insects, the later applications of lime-sulphur help

* Bulletin 289, Cornell University, Ithaca, N.Y.

to supplement the spring wash in controlling these. Neither mixture, if properly diluted and if applied thoroughly at the times indicated on the spray calendar, will cause any appreciable injury to the foliage. The cost of lime-sulphur for these later sprayings is about the same as or slightly less than that of Bordeaux mixture. In the writer's opinion it is wise to use lime-sulphur in preference to Bordeaux for all the sprayings of apple and pear trees.

For plums and cherries Bordeaux is probably quite as good, if not better, than lime-sulphur, though there is need of further tests to determine the matter absolutely. On gooseberries lime-sulphur is preferable and probably on currants also.

For *potatoes* and *grapes, Bordeaux* is almost unquestionably superior. The writer had the opportunity this fall of seeing Prof. Stewart's experiments with Bordeaux and lime-sulphur on potatoes at Geneva. These tests were repeated five times and in every case the Bordeaux sprayed rows, as seen in October, were decidedly superior to the lime-sulphur sprayed and to the unsprayed rows. As for grapes the experiments of Hartzell, of Geneva, and Reddick, of Cornell, have proven clearly that it is not safe to use commercial or home-made concentrated lime-sulphur on grape foliage as it frequently burns it severely if used strong enough to combat the Black Rot disease. The self-boiled lime-sulphur could, of course, be used without danger against Powdery Mildew if this begins to appear in the vineyard.

INSECTS THAT CAN BE CONTROLLED BY LIME-SULPHUR.

San José Scale.

(*Aspidiotus perniciosus,* Comst.)

Although the San José Scale is a very tiny insect (see Fig. 9), not nearly so large as the head of a pin, it is capable, if not kept under control, of completely destroying whole orchards in a very few years. Fortunately many of our best fruit growers in districts where this scale has been for years have learned how to keep it so thoroughly in check that they do not fear it at all, and even think it a blessing in disguise, because it has forced them to use a wash which has greatly helped their trees in other ways than merely by destroying the scale. Of the many spray mixtures which have been tried against the scale none has given so uniformly good results as lime-sulphur, so that it is to-day almost the only wash used to any great extent for combating this pest.

Treatment.—Spray very thoroughly in spring, preferably as late as time permits, before the buds burst, using either the old home-boiled lime-sulphur (20-15-40 formula) or the concentrated wash of the strength of about 1.032 specific gravity. Very badly infested trees should receive two applications. These may both be made in the spring with an interval of a couple of days or more between them, or one may be made in autumn, as soon as the leaves have nearly all fallen, and the other in spring. Very large apple trees are hard to free from the scale, much harder than smaller or medium-sized ones. To make it easier to treat them thoroughly fruitgrowers in infested districts are heading the trees back severely. In doing this care should be taken to cut close to a side branch, sawing a little on the slope, so that the rain will run off, and to see that the wound is thoroughly painted over to prevent disease getting in and destroying the trees. It need scarcely be said that the pruning of infested trees

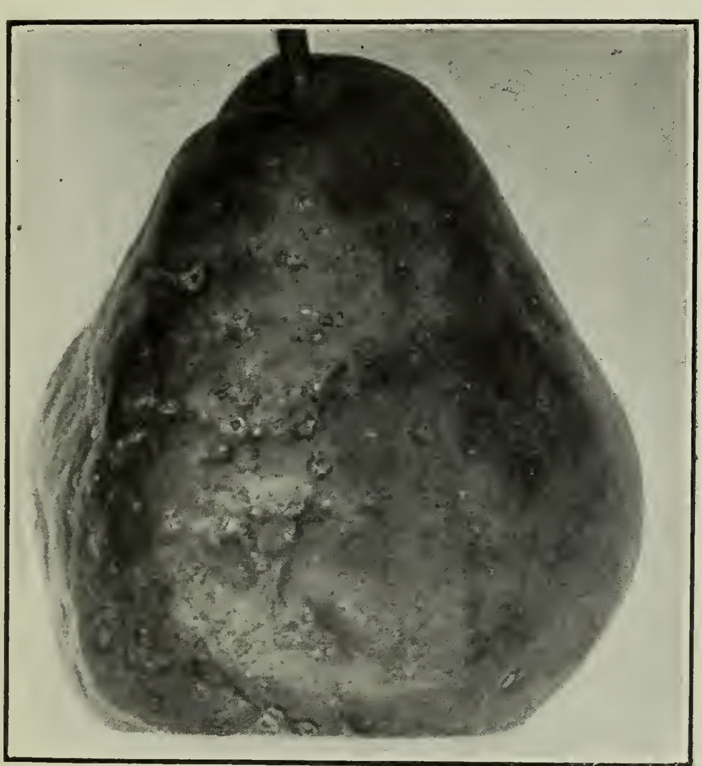


Fig. 9.—San José Scale on pear.

should be done before spraying, and that all prunings should be burned, not thrown into brush-heaps and allowed to remain there. If the loose bark be scraped off with a hoe early in the season it will allow the spray to reach scales that otherwise might escape. Careful cultivation and a liberal use of manure will assist the spray in giving renewed vigor to badly infested trees.

There is no insect, in Ontario at least, that requires more careful and thorough work on the part of the sprayer if he is to get good results, because, if even a few infested twigs are left unsprayed, there will frequently be enough scale on them to produce great numbers by autumn. From a single fertile female in spring at least 1,000,000 offspring may be produced before the end of the season. Hence trunks, branches and twigs—in short, every part of the tree—must be very carefully sprayed.

Oyster-Shell Scale or Apple Bark-Louse.

(*Lepidosaphes ulmi*, L.)

Though not nearly so destructive an insect as the San José, the Oyster-shell scale (see Fig. 10) is doing nearly as much damage to the province as a whole, because it is found in almost every orchard, whereas the San José scale is still almost entirely confined to the few south-western counties.

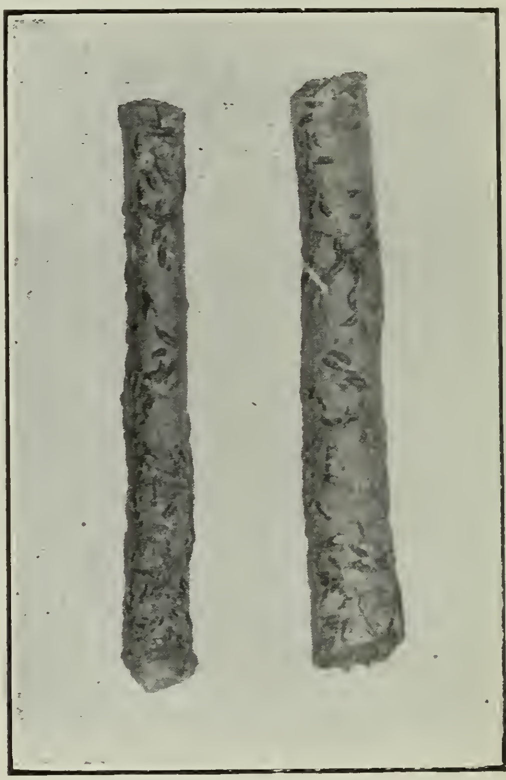


Fig. 10.—Oyster-shell Scale.

Treatment: Spray in spring at the same time as for San José scale, using the same mixture, at either the same strength or a little weaker, but not less than a specific gravity reading of about 1.030. A second spraying with the lime-sulphur diluted to 1.008 sp. gr. just after the blossoms fall (the regular time to spray for Codling Moth) helps to destroy the tiny young scales which have just finished hatching by this date. Scrape the rough bark off the trunk and large branches so that the spray may reach every scale. Cover every part of the tree with the wash. Cultivation of the soil in the early part of the season to give vigor to the trees helps against this scale, as it thrives best on trees that are not strong. It is seldom that all the scales are killed in one season, but at the end of two or three seasons, if the orchard has been carefully sprayed, the trees will be found to be free from the pest. Old empty scales hang on for a year or two, but their presence is not a proof that the spray was inefficient. These scales in winter will have no eggs under them, while the healthy scales will be found to contain from about 20 to 120 tiny white eggs. These can easily be seen with a small magnifying-glass, especially if worked out upon any black surface. During the last four years numerous orchards in the province have been almost totally freed from the Oyster-shell Scale by the above treatment.

Leaf-Blister Mite.

(*Eriophyes pyri*, Scht.)

The Leaf-blister Mite (see Fig. 11) is a very tiny creature, so small that unless a number are clustered together they are invisible to the naked eye. In spite of their diminutive size they make their presence very noticeable on both apple and pear trees by causing numerous blisters on the lower side of the leaves. These spots are often confused with fungus diseases, but can easily be distinguished by their being slightly raised beyond the surface of the leaf. As the name indicates, they are blisters or swellings in which the mites live and reproduce. Affected leaves are quite conspicuous in the later half of the season. On the apple leaves at this time the blisters become reddish brown in colour and visible on both the upper and lower surface. On the pear leaves they are usually more clustered along the mid-rib than on the apple, and become nearly black, often disfiguring the foliage very greatly and being visible several rods away.

The Blister Mite has gradually been spreading all through the province, and is now found in numerous orchards. It does not, so far as we know, cause the tree to die, but weakens it greatly by interfering with the power of the leaves to perform their proper function of manufacturing food for the rest of the tree, and by causing them to turn yellow and drop early, especially in a dry season when the tree needs them most.

Treatment: Many tests on a large scale throughout the province have shown that even very badly infested orchards can be almost completely freed from this pest in two years by a single application of lime-sulphur each spring just before or as the buds are bursting. The strength may be 1.030 sp. gr., or even weaker. Fairly good results may be obtained by an earlier spray. It must not be left off too long, for the mites enter the leaves when these are just nicely opened and still very small. Once under the surface of the leaf the mite cannot be reached. Every twig and bud should be covered carefully, as the mites winter under the protection of the bud scales.

Pear Psylla.

(*Psylla pyricola*, Forsh.)

The Pear Psylla (see Fig. 12) is another very small insect, being not more than about one-tenth of an inch in length. Its wings are clear, large and much longer than the body, which, as seen by the naked eye, is blackish to brown in colour. When one approaches near an adult, it will usually fly off to another leaf or part of the tree. The presence of the Psyllas on a pear tree can easily be determined by looking to see whether there is any clear, sticky liquid anywhere on the leaves. This substance is known as honey-dew and is secreted in great abundance if the insects

Fig. 11.—Blister Mite on leaf of apple and pear.

are present in large numbers. The young Psyllas are tiny, pale-colored, curious-looking creatures, with conspicuous red eyes, and with scarcely any resemblance to the adults. A hand lens will enable one to see them in these drops of honey-dew. A fungus grows in the honey-dew after a time and causes the parts where it is to turn black and very unsightly. The Psyllas pass the winter in the adult stage in any good hiding place on or near the tree, and come out with the warm spring weather and lay their little yellowish eggs on the twigs before the buds have burst. The eggs begin to hatch about the time the leaf buds are bursting, and soon after the leaves are out the adult insects die. There is more than one brood in a year. Every few years we have a severe outbreak of the Pear Psylla, and much damage is done, but Ontario is seldom so severely troubled by this pest as New York or some of the neighbouring states. Natural forces seem to keep it well under control most years.

Treatment: Ordinarily the Psyllas can be kept in check by a very thorough spraying of lime-sulphur of about the strength of 1.030 sp. gr. This spraying should be done just after the leaf buds have burst in spring, but before the blossom buds have done so or the leaves have unfolded. Prof. Parrott, of Geneva, and his assistant, Mr. Hodgkiss, have proven that this wash, if thoroughly applied, will not only kill the young insects that have already hatched out, but also most of the eggs, which are by this time nearly ready to hatch. Freshly laid eggs are not destroyed by the wash, nor are the adult Psyllas. It would, therefore, seem wise for fruitgrowers to leave their pears to the last to be sprayed. If necessary

Fig. 12.—Pear Psylla, adult, greatly enlarged. The small cross beneath shows natural size. (After Marlatt.)

the lime-sulphur spray may be supplemented by an application of Black Leaf 40 as soon as the leaves have unfolded. This is a tobacco wash and can be secured in small packages from the Kentucky Tobacco Product Co., Louisville, Ky. Half a pound of it is sufficient for 40 gals. of water. It is seldom, however, that it is needed in Ontario for the Psylla.

Aphids.

Most kinds of fruit trees are attacked in the early part of the season and again towards the end of it by aphids. These are very destructive some years, causing the leaves to curl and turn yellow, and dwarfing the fruit, which often, in the case of apples, hangs in small clusters that ripen prematurely and are worthless. The winter is passed in the egg stage, the eggs of most kinds being small, black and glistening, and laid on the smaller branches and twigs. They usually hatch about a week before the buds open.

Treatment: It is claimed by many that lime-sulphur will kill these eggs. The writer has several times tried to destroy them with it, but never with much success. He has also tested the wash on the freshly-hatched aphids, but has not been able to kill more than 50 per cent. of them by the most careful work. During the last spring many of the most enthusiastic advocates of lime-sulphur as a remedy for aphids were forced to change their opinion as to its merits against this pest. Fortunately for our fruitgrowers, weather conditions and natural enemies usually prevent very serious injury from aphids. Where it is necessary

Fig. 13.—*Chermes abietis*, Spruce Gall-louse, found chiefly on Norway spruce.

to spray for them. Black Leaf 40 applied as soon as the insects are noticed to be abundant is probably the best mixture we can use. Some experimenters claim that the Black Leaf 40 can be added to the lime-sulphur without injury to the tree or to the value of either wash. It was planned to test this mixture last spring, but unfortunately the Black Leaf did not arrive in time. Fruitgrowers should experiment with the combined mixture on a couple of badly infested trees, applying the spray just as the buds are ready to burst, as the eggs will be hatched by this time. It is the young insects and not the eggs that we should aim to kill.

Red Spider.

(*Tetranychus bimaculatus.*)

In dry seasons tiny, pale or reddish-coloured spiders, by working on the under side of the leaves and sucking the juices from them, cause the foliage to become blotched and reddish and the plants to be greatly weakened. The injury is often most conspicuous on currant and raspberry bushes.

Treatment: Spray the plants well from beneath with lime-sulphur, strength 1.008 or 1.009 sp. gr., whenever the spiders are noticed to be present. Repeat if necessary in about a week or ten days.

Fig. 14.—*Chermes similis*, Spruce Gall-louse, found chiefly on white spruce.

Spruce Gall Louse.

(*Chermes abietis*, Linn.)

We have two very destructive gall lice attacking spruce trees in Ontario: *Chermes abietis* and *Chermes similis*. The photographs show the difference between them. The former is found most commonly on Norway Spruce, and the latter is almost or possibly altogether confined to White Spruce.

Treatment: About three years ago Mr. J. W. Smith, of Winona, Ontario, discovered that lime-sulphur of the ordinary spring strength of

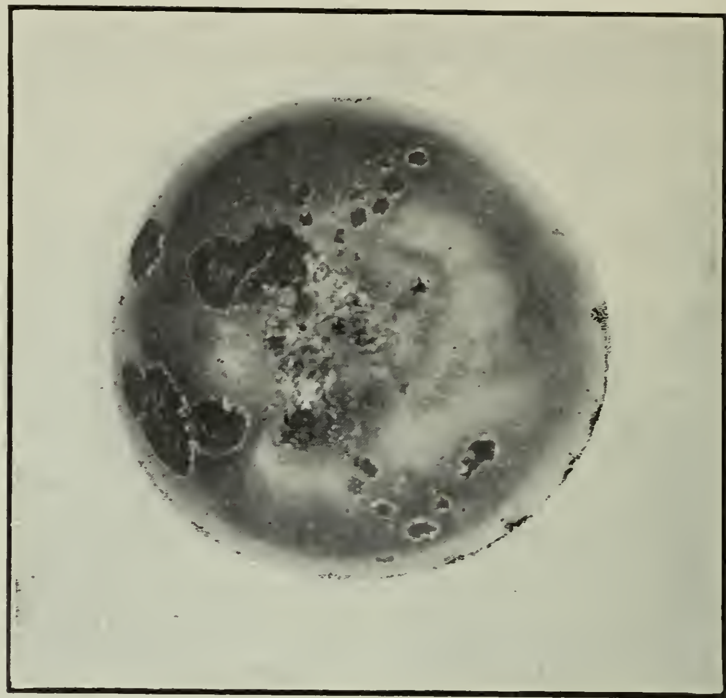


Fig. 15.—Apple Scab on fruit.

1030 sp. gr. would thoroughly control *Chermes abietis*. The spray must be applied before May, as the eggs are laid soon after this, and it will not kill these. Since Mr. Smith's discovery the writer and several others

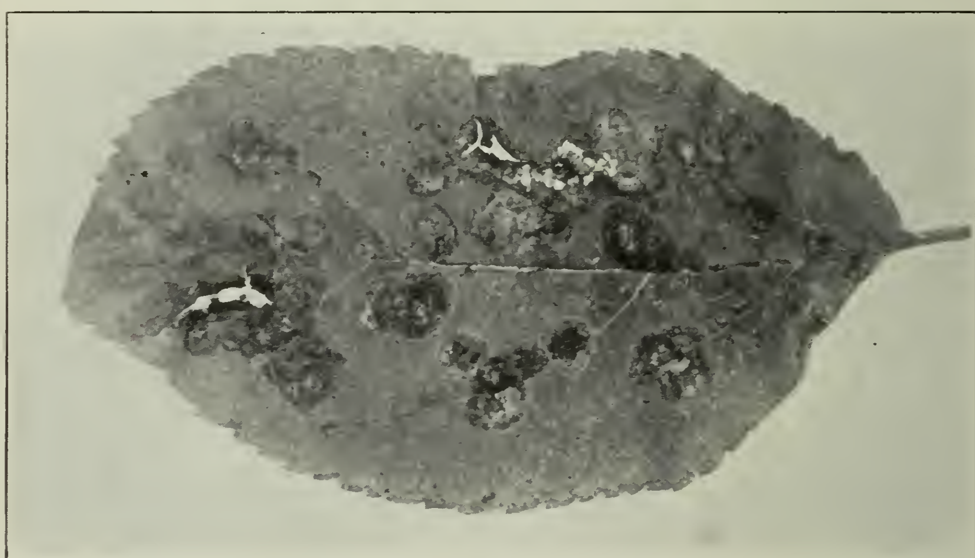


Fig. 16.—Apple Scab on leaf.

have tried the lime-sulphur and found it quite satisfactory for this species. It will not, however, control *Chermes similis*. For this species we have not yet been able to find a really satisfactory remedy.

DISEASES THAT CAN BE CONTROLLED BY THE LIME-SULPHUR WASH.

Apple Scab.

(*Venturia inaequalis* (Cke.) Aderh.)

Apple Scab or Black Spot of the apple is a disease that every grower is familiar with. It attacks the leaves as well as the fruit (see Figs. 15 and 16). In seasons that are wet or foggy at the time when the blossom buds are bursting and for a week or two later, it is much worse than in seasons that are dry and sunny at this time. It is also worse where wind-breaks or other causes prevent a good, free circulation of air through the orchard, or where the trees are so close together that the sunlight is shut out from the lower branches. Fameuse, McIntosh Red and a few other varieties are regularly much more subject to the disease than the rest of our apples. This disease, by getting on the stems of the young forming fruit, is often the cause of considerable dropping of apples.

Treatment: Usually in Ontario two thorough applications of lime-sulphur will completely control the disease. The first should be just as the buds are beginning to burst, as this is the time the scab is starting to spread rapidly through the orchard. Use lime-sulphur, strength 1.009, for this. The second must be at once after nearly all of the blossoms have fallen. This is the same time as the Codling Moth spray. For this use lime-sulphur, strength 1.008. In moist localities, such as along the St. Lawrence valley, another spraying with the same strength of lime-sulphur about two weeks after the second should be given.

Occasionally we have very moist weather conditions in August and a late attack of Scab. This, however, happens only very rarely. An extra spraying under such conditions would, of course, be very valuable.

Good pruning and the removal of unnecessary wind-breaks to allow plenty of sunlight and air help greatly. Apple Scab is not, however, very difficult to control if the spraying is thoroughly done.

Bordeaux mixture may be substituted for lime-sulphur in this case, but will russet the fruit, especially of some varieties. The russeting is much worse some years than others.

Black Rot Canker and Leaf-Spot.

(*Sphaeropsis malorum*, Pk.)

In many orchards of the Province, but especially in the part east of Toronto, numerous cankers or dead areas are to be seen on the branches

Fig. 17.—Black Rot Canker on apple branch.

and trunks of apple trees. These cankers, as shown in Fig. 17, become after a time charred and black. They are caused by the Black Rot fungus, which also attacks the leaves and fruit. On the leaves it causes small, round, dead areas, and on the fruit a firm, not a soft, rot. The diseased fruit at first becomes brown and later black. The disease on the leaves and fruit is seldom very destructive, but on the larger branches and on the trunks it is often serious. The cankers are usually found on varieties that are too tender for the district and so suffer from sun-scald and winter injury. These injured areas and also wounds of any kind make favourable places for the fungus to enter and grow. Having once got a foothold, it usually spreads slowly around the branch or trunk until it encircles it and kills the part above.

Treatment: (1) Plant only hardy varieties well suited to the district; for instance, such varieties as Fameuse and McIntosh Red will thrive in districts where Baldwin, Greening or King will die.

(2) Keep the trees thrifty by cultivation or by mulching in the early part of the season, but do not cultivate later than the middle or end of June in cold districts. Then sow a cover crop and harden up the wood in this way for winter.

(3) On trunks or large branches cut out with a draw-knife the bark over the cankered area, taking pains to be sure that all is removed up to the perfectly healthy bark. Then wash this cut with strong lime-sulphur, or with bluestone (1 lb. dissolved in 12 or 14 gals. water). The undiluted concentrated lime-sulphur will not do any harm, but may be diluted a few times if desired. After washing, cover the wound either

with coal-tar or with white lead free from turpentine. Do the cutting out before the spraying begins in the spring.

(4) Spray the trees at the regular times indicated in the Spray Calendar, page 40, using the strengths indicated there. When spraying, be careful to see that the trunk and main branches are covered.

Pear Scab.

(*Venturia pirina*, Aderh.)

Pear Scab (see Fig. 18) resembles Apple Scab very closely, and, like it, attacks the leaves as well as the fruit. It is often found also on the twigs. Some varieties, especially Flemish Beauty, are very subject to it.

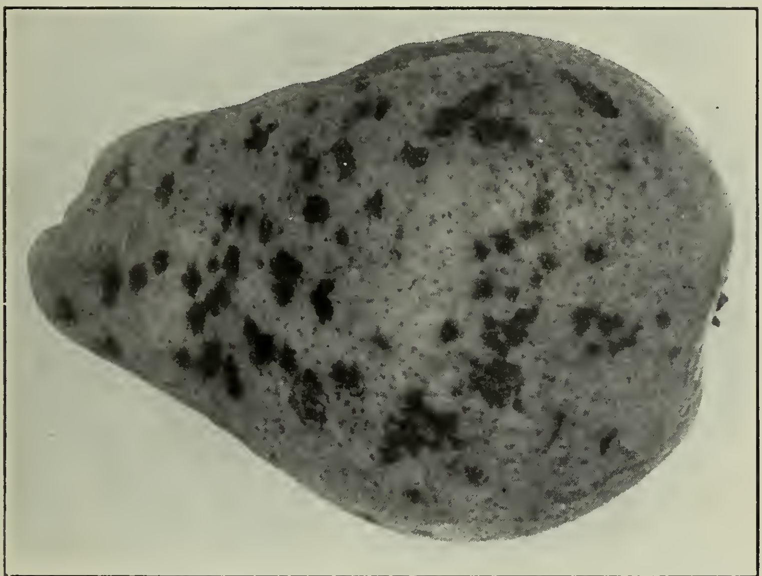


Fig. 18.—Pear Scab on fruit.

Its general habit of growth and the conditions that favour it are very similar to those mentioned under Apple Scab.

Treatment: The writer has controlled it completely on Flemish Beauty trees by four applications of lime-sulphur; the last of these might probably have been omitted. Spray at the times and with the strengths indicated in the Spray Calendar.

Peach Leaf Curl.

(*Exoascus deformans* (Beck) Fuckel.)

Every peach grower is familiar with this disease and knows that it attacks the leaves early in spring and causes them at first to become thickened, curled and distorted, and of a pale whitish or often reddish colour, and later on to become brown and dead and fall off. (See Figs. 19 and 20.) It is, next to Yellows and Little Peach, the most destructive disease that peach growers in Ontario have to combat. The loss takes the following forms: (1) In seasons of severe attack many young nursery trees are killed the first year they are set out before they have had a chance to get over the shock of transplanting. (2) There is a great drain on the vitality of the older trees from the loss often of a large part of their foliage early in the season and the necessity of producing a new

Fig. 19.—Peach Leaf Curl.

crop of leaves. Such trees are frequently not properly matured for winter and are sometimes killed by the cold. Trees severely attacked two or three years in succession not infrequently die, or at least lose a number of their branches. (3) The fruit is dwarfed, and often, in severe cases, drops off. This is to be expected from the fact that the food that makes the fruit is nearly all manufactured in the leaves, and that this source of supply is cut off for a considerable period by the disease. (4) The disease often attacks young shoots or twigs and kills these.

Leaf curl is well known to be not so severe some years as others. Experience has shown that it is favored by damp, late springs, while it is almost completely kept in check by dry, sunny weather around the time of blooming and while the leaves are still quite small. In the year 1910 the spring was very late, cold and wet, and so the disease was exceptionally severe. Last year, 1911, the spring was early and we had beautiful, hot, sunny, dry weather, with the result that there was no Leaf Curl, or almost none.

Fig. 20.—Peach Tree almost defoliated by Leaf Curl.

Treatment: Spray with lime-sulphur, either old home-boiled or concentrated, of the same strength as for San José scale. This application must be made *early in spring and before the buds have begun to swell.* The disease apparently begins with the growing bud, so to prevent its getting a start we must spray early before the spores around the buds can germinate. *Most of the failures to control the Leaf Curl are due to spraying too late and not taking sufficient pains to see that every bud is thoroughly covered.* Bordeaux would also control the disease, but is not recommended, because in most peach districts San José scale is either present or likely to be introduced, and the lime-sulphur will keep it in check, while Bordeaux will not.

Brown Rot of the Peach.

(*Sclerotinia fructigena* (Pers) Schroet.)

This is the same disease that is so common on plums and cherries. Fortunately it is not so destructive, as a rule, in our province to peaches as to cherries and plums, or as it is to peaches in some parts of the United States, where it has been known to destroy as high as 40 per cent. of the whole crop in a year. Nevertheless we sometimes lose a good many peaches from this rot. Triumphs and a few other varieties are much more subject to the disease than Elbertas and some of our other more profitable kinds.

Not only is the fruit attacked, but also the twigs and small branches on which diseased fruit is borne. The disease in such cases seems usually to work its way down from the infested fruit into the twig or branch and gradually girdle it. This, of course, causes the part above with all its leaves to die.

Fig. 21.—Mummied plums and peach due to the Brown Rot. About one-half natural size.

Like most diseases, there are certain conditions that favor the development of Brown Rot. The chief of these are damp, warm weather, lack of sunlight and of good air circulation, the presence of old mummied fruit on the trees, two or more fruits touching one another on the tree, and injuries from hail or biting insects, like the Plum Curculio.

Treatment: The above conditions favoring the disease give us hints as to how we may help to ward it off. (1) Give the trees plenty of sunlight and good air circulation by removing unnecessary windbreaks and by judicious pruning. (2) Knock all old mummied peaches and plums off the trees in the fall and either gather and burn them or plough them under early in spring. (3) Thin the peaches so that no two will be touching one another. (4) Spray with lime-sulphur for Leaf Curl and this will protect the blossoms from attack. (5) If the Curculio is troublesome, spray with 2 or 3 lbs. of arsenate of lead to 40 gals. of water soon after the fruit is set, and remove all rubbish and thickets from around the fence corners, as the beetles winter in such rubbish. (Two or three pounds of freshly slaked lime may be added to each barrel of the spray mixture as a safeguard against burning.) (6) Spray with self-boiled lime-sulphur about a month or five weeks before the fruit is ripe. Bordeaux or commercial lime-sulphur is often injurious to the foliage, even when used very weak.

Fig. 22.—Peach Scab. Note the small blackish spots and the cracks in the fruit.

Peach Scab or Black Spot.

(*Cladosporium carpophilum*, Thüm.)

This disease causes small blackish spots here and there over the surface of the fruit. Sometimes these are very abundant and disfigure the fruit greatly; occasionally a fruit is so badly attacked that it cracks open in the same way as a Flemish Beauty pear does when attacked by Pear Scab. (See Fig. 22). As a rule, this is not a very destructive disease in Ontario.

Treatment: Spraying with the self-boiled lime-sulphur about a month after the fruit is set will usually control this disease quite satisfactorily, as shown by the experiments of Professor Scott, of Washington, D.C.

Brown Rot of Plums and Cherries.

(*Schlerotinia fructigena* (Pers) Schroet.)

As mentioned above, this is the same disease as attacks the peach. It is frequently very destructive. The conditions that favour the disease on these fruits are the same as those mentioned under Brown Rot of the Peach.

Treatment: As in the case of the peach, the trees should receive plenty of sunlight and good air circulation. Old mummies should be knocked

Fig. 23.—Leaf Blight or Shot-hole Fungus of cherry and plum.

off in the fall and either gathered then or ploughed under early in spring. In addition the trees should be sprayed thoroughly at least three times and with the mixtures indicated in the spray calendar. It would be better to spray plums again as late before picking as it is safe to do so without discoloring the fruit.

Whether lime-sulphur is as good a fungicide for plums and cherries as Bordeaux mixture is still in doubt. Some who have used it advocate it very strongly; others say that Bordeaux is decidedly better. The writer has not had a chance to make a comparative test of the two mixtures, nor have any of the plant pathologists with whom he has talked. It is probable that for Japanese plums and possibly for sweet cherries Bordeaux will prove the better, except for the application before the buds have burst, when lime-sulphur, of the ordinary spring strength, should be used.

Leaf Blight, or Shot-Hole Fungus of Cherry and Plum.

(*Cylindrosporium padi,* Karsh.)

This disease causes small dead areas of varying size on the leaves of cherry and plum. Frequently these dead parts drop out, leaving little round holes as if the leaves had been riddled by shot. Some seasons cherry orchards in certain localities are almost defoliated. Plums are seldom so severely injured.

Fig. 24. Plum Pockets or Bladder Plums. The fruit on the left is healthy, that on the right diseased.

Treatment: The ordinary spraying of plums and cherries, as given in the spray calendar helps to control the disease, but sometimes it is necessary to spray again as soon as the cherries have been picked. Either lime-sulphur or Bordeaux may be used, as indicated in the calendar.

Plum Pockets, or Bladder Plums.

(*Exoascus pruni,* Fuckel.)

Frequently one finds plums, especially of the American variety, that are abnormally large compared with healthy plums, and that turn first whitish and then light brown or fawn. (See Fig. 24.) When these are squeezed they are soft, and, if opened, are seen to have no kernel. Such a condition is caused by a fungus disease. Damp, cold springs seem to favor its development.

Treatment: This spring the writer sprayed four trees in April before the buds had begun to swell, with the ordinary spring strength of lime-sulphur, and left a dozen or more as checks. On the sprayed trees all the fruit was sound, and on the unsprayed approximately 50 per cent. was diseased. The wind blew some spray over upon some branches of

Fig. 25.—Powdery Mildew of gooseberry. (After close.)

a few trees very close to the sprayed ones; these branches had very few diseased fruits. It seems clear, therefore, that Plum Pockets can, in the same way as Peach Leaf Curl, be controlled by an early spring application before the buds begin to swell.

Powdery Mildew of the Gooseberry.

(*Sphaerotheca mors-uvae* (Schw. B. & C.)

This mildew attacks the leaves, twigs and fruit of the gooseberry, and sometimes also of the currant. (See Fig. 25.) The parts affected are at first covered with a white, powdery substance, but later this becomes brown and tough or felty in appearance, causing much damage to the plants and ruining affected berries. It is especially destructive to European varieties.

Treatment: Spray with lime-sulphur, either the old home-boiled (20-15-40) formula) or the concentrated (strength 1.030 sp. gr.) before the buds burst in spring. Give a second application with the concentrated (strength about 1.009 sp. gr. or a little stronger) just before the blossoms open, and a third with the same strength as soon as the fruit is set. Some seasons it would be well to give a fourth application about ten or twelve days after the third.

Fig. 26.—Currant Leaf-spot.

Currant Leaf-Spot.

(*Septoria ribis,* Desm.)

This disease will easily be recognized from the photograph. It is very common in most currant plantations and does considerable damage to the bushes.

Treatment: Spray in the same way as just indicated for gooseberries, but giving only the first three applications. After the fruit is picked a fourth application should at once be given. This treatment will also help to prevent injury from Red Spider.

CONCLUDING REMARKS.

The strength of lime-sulphur recommended for use on the various fruit trees and shrubs after the foliage has appeared is weaker than that recommended by most plant pathologists and entomologists. Most of these recommend for these applications a strength of 1.010 specific gravity, which is just one-third of the spring strength before or as the buds are bursting recommended by the writer. Any who wish to use this strength instead of 1.009 or 1.008 can determine the proper amount of dilution to obtain it by following the same rule as given above; namely, take the specific gravity reading of the concentrated wash and divide the last three figures of it by 10, and the number thus obtained will be the number of gallons to which each gallon of the concentrated must be diluted with water to give a strength of 1010. For instance, suppose the reading is 1.230 sp. gr.; divide 230 by 10 = 23; hence each gallon may be diluted to 23. If a Baumé hydrometer is used, consult the table on page 13, and see what specific gravity reading given there in the first column corresponds to your reading on the Baumé scale, and then, having found this, apply to it the rule just mentioned to get the proper dilution.

The writer has found in his experience, and knows that the experience of many others agrees with his, that the strengths he has recommended in this bulletin and in the spray calendar will give satisfactory results if the work is done thoroughly. He is strongly in favour of very thorough spraying, and the strengths recommended permit a tree even to be drenched without any appreciable injury to the foliage. There is more danger of damage from the stronger spray (1.010 sp. gr.). if heavy spraying is done. Pears are more subject to injury than apples.

Anyone who watches the average man spraying must admit that the work is seldom done thoroughly, either because the man is anxious to get it done quickly, or else because he wishes to be economical. Some are misled by the old rule to stop spraying as soon as the leaves begin to drip. This is not a safe rule to follow in most cases. *A tree should never be left till every leaf and fruit or part aimed at has been thoroughly covered, even though in doing so the mixture may be dripping upon the ground like rain.* There is a wonderful difference between thorough spraying and only half spraying; one pays many times over; it is doubtful whether the other pays at all.

Another matter likely to be overlooked in spraying is the necessity of keeping the mixture well agitated, so that it may all be of uniform strength. Lime-sulphur and arsenate of lead combined require very frequent agitation. Get good nozzles; large disk nozzles like those shown in the figures are very good. Renew the plates when the holes get worn too much. Keep the spray machine in good shape. Use as strong pressure as you can conveniently get. Spray at the times indicated in the spray calendar. Do thorough work. Every evening, after the spraying is over, pump a couple of pails of clean water through the nozzles to clean out all the mixture. This will save a lot of trouble from clogging.

Acknowledgments.

In his study of the lime-sulphur wash and the various uses to which it may be applied, the writer has received many very valuable suggestions

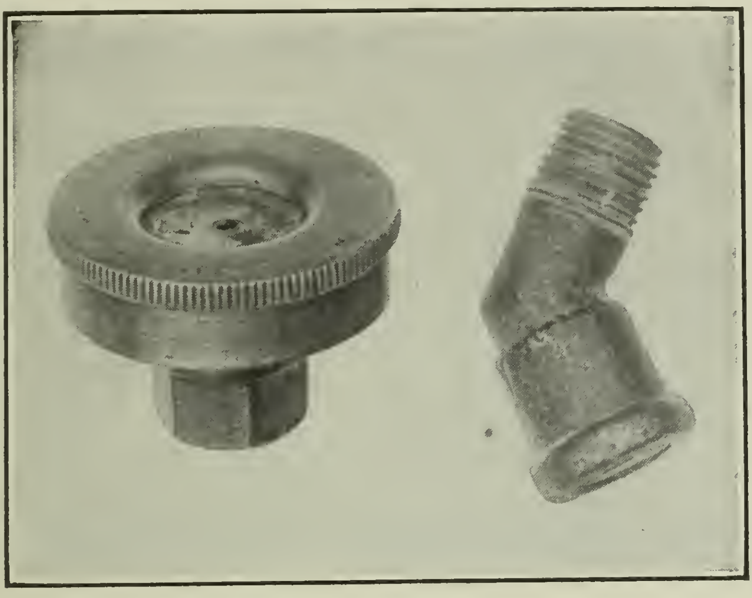


Fig. 27.—A good type of nozzle and an elbow to control the direction of the spray.

from the publications of several investigators in the United States. Those to whom he is specially indebted are Prof. John P. Stewart, of Centre County, Pennsylvania; Prof. L. L. Van Slyke and his assist-

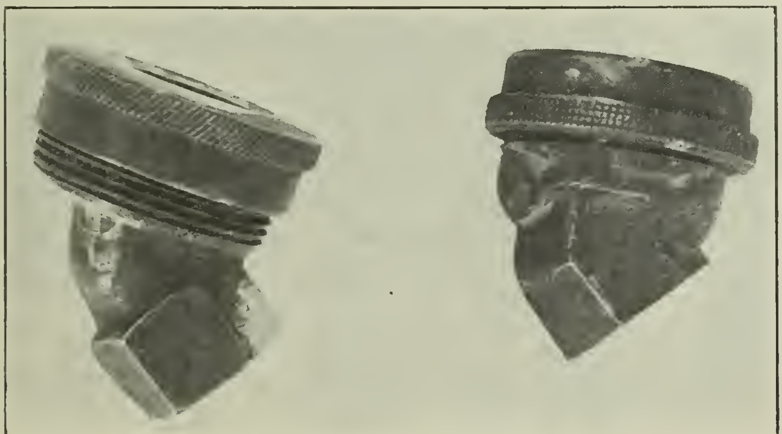


Fig. 28.—Angle nozzles, very convenient, especially in spraying for Codling Moth.

ants, Geneva, N.Y.; Prof. Erret Wallace, formerly of Cornell University, N.Y., but recently transferred to Washington, D.C., and Prof. W. M. Scott, of Washington, D.C.

SPRAY CALENDAR.

BY L. CAESAR, O. A. C., GUELPH.

PLANT & PEST.	1ST APPLICATION.	2ND APPLICATION.	3RD APPLICATION.	REMARKS.
APPLE Scab or black spot, canker, leaf spot, codling moth and other biting insects, scale insects, blister mite and aphids.	Shortly before the buds burst. Use A1 or B.	Just before the blossoms open. Use A2 or D with a poison.	Immediately after the blossoms have all, or nearly all, fallen, and before the calyces close. Use A3 or D with a poison. This is the application for codling moth.	Cut out, disinfect and paint or cover with coal tar cankered areas on trunks and large branches. In moist climates, or if the weather is wet or foggy, give a 4th application with A3 or D for Scab about two weeks after 3rd. See if aphids are present just before leaf buds burst; if so, spray at once with Black Leaf 40, or kerosene emulsion, or whale oil soap.
PEAR Scab or cracking, blight, codling moth, other biting insects, scale insects, blister mite, psylla and slugs.	Shortly before the buds burst. Use A1 or B.	Just before the blossoms open. Use A2 or D with a poison.	Just after blossoms have all fallen. Use A3 or D with a poison.	Cut out and burn blight as soon as seen, cutting always one foot or more blow diseased areas. Disinfect tools after each cut. In moist or in foggy or wet weather give a 4th application of A3 or D about two weeks after 3rd. For Psylla, spray thoroughly with A1 or B just after buds burst, or with Black Leaf 40 just after the leaves open. For slugs spray with arsenate of lead or dust fresh air-slaked lime over the leaves.
PLUM & CHERRY Black knot, brown rot, leaf blight or shot-hole fungus, curculio, slug and aphids.	Just before the buds burst. Use A1 or B.	Just after fruit is set. Use A2 or D with a poison.	About two weeks later. Use A3 or D with a poison.	Watch for black knot, and whenever seen cut out well below diseased area and burn. If leaf blight is troublesome, give a 4th application with A3 or D as soon as fruit of cherry is picked. Destroy mummied plums in autumn. Look for aphids just before buds burst, and if present spray at once with Black Leaf 40 or kerosene emulsion or whale oil soap. Treat slug as on pear.

SPRAY CALENDAR—*Continued.*

PEACH Leaf-curl, scab or black spot, brown rot, yellows, little peach, curculio, borer, San José scale, shot-hole borer.	Before the buds begin to swell. (All must be done before any sign of bursting of buds). Use A1 or B.	Just after fruit is set. Use arsenate of lead alone with water for curculio.	About one month after fruit is set. Use C.	If Brown rot is likely to be troublesome use C again about one month before fruit ripens. Destroy mummied fruit in autumn. Remove at once and burn any tree attacked by yellows or little peach, and also all suspected trees. Dig out borers at base of tree with knife in May, and again in October. For shot-hole borer cut down and burn before April all dead or dying trees or branches, and leave no brush heaps near orchard.
GRAPES Black rot, powdery mildew, downy mildew, anthracnose, flea-beetle, thrip or leaf hopper.	When 3rd leaf is appearing use D.	Just before the blossoms open use D.	Just after fruit sets, use D.	Spray again whenever wet weather threatens. It should always be done *before*, not after rain. At first sign of powdery mildew dust with sulphur or spray with C. For flea-beetles use poison whenever they appear. For leaf-hoppers or "thrips" use Black Leaf 40 or kerosene emulsion or whale oil soap in July, to destroy nymphs. Clean cultivation is very important, and destruction of all old mummied grapes and prunings.
CURRANT & GOOSEBERRY Mildew, leaf-spot, currant worm and aphids.	Shortly before buds burst use A1 or B.	Just before blossoms appear, use A2 with poison.	Just after fruit is formed, use A2 with poison.	For worms, when fruit is ripening, use hellebore. Look for aphids just before buds burst; if present, spray with Black Leaf 40 or kerosene emulsion or whale oil soap. Of little use to spray, for these after leaves curl.
RASPBERRY & BLACKBERRY Anthracnose, red rust, crown gall.	Before growth begins use A1 or B.	When shoots are 6 or 8 inches high. Use D and add poison if caterpillars are present.		If anthracnose is very severe, set out now plantation of healthy shoots. If disease begins, cut out old canes as soon as fruit is picked, also badly attacked new ones, and burn. For red rust remove and burn plants at once. No other remedy. For crown gall set out plants in fresh soil, rejecting any plant with a gall on root or crown.

STRAWBERRY Leaf-spot and white grub.	For leaf spot set out only healthy plants with no sign of disease. First season spray with D before blossoms open and keep plants covered with mixture throughout the season. Second year spray before blossoming with D, and again soon after picking; or mow and burn over after picking. Don't take more than two crops off. Plow down at once after second crop. For white grubs dig out as soon as injury is noticed. Do not plant on land broken up from old meadow or pasture for three years after breaking.
BEAN Anthracnose and bacteriosis.	Get seeds from pods showing no signs of disease. Do not work among the plants if they are wet with rain or dew. Spraying scarcely pays as a rule.
CABBAGE & TURNIP Flea-beetles, caterpillars, root maggots, aphids.	For flea-beetle on turnip sow after June 21st, or dust plants as soon as they appear above ground with Paris Green, or spray with Bordeaux and a poison. Repeat in two or three days. For caterpillars dust with Paris Green until heads begin to form on cabbage and cauliflower, then spray with pyrethrum, 1 ounce to 2 gallons water. For root maggots use medium thick tarred felt paper discs, putting on as soon as plants are set out, or set out plants after July 1st. For aphids use kerosene emulsion as soon as they appear.
POTATO Tip burn, early blight, late blight, scab, Colorado beetle, flea-beetle.	Keep foliage covered with D from time plants are about 5 inches high. Take special precautions to see this is well done if weather is at all damp after about 15th July, as late blight begins about this time. Add a poison to each application when necessary. For scab, soak tubers before cutting 2 hours in formalin solution, 1 pint of formalin to 30 gallons of water. Spread out on grass to dry. Wash all boxes, bags or other vessels to be used in same liquid. Plant none but perfectly healthy tubers.
TOMATO Leaf blight, black rot, flea-beetle.	Spray plants in seed bed with D. Keep foliage in field covered with D until danger of staining fruit. Add a poison if necessary for flea-beetles.
ASPARAGUS. Rust, beetles.	For rust, let no plants, not even wild ones, mature during cutting season. Late in fall, when growth is about over, cut and burn old plants. For beetles let poultry run in the plantation. After cutting season is over spray with arsenate of lead; repeat in two weeks. May add sticker and a little lime.

NOTE.—A1—Concentrated lime-sulphur, strength 1.030 specific gravity (1.032 for San José scale).
A2—Concentrated lime-sulphur, strength 1.009 specific gravity.
A3—Concentrated lime-sulphur, strength 1.008 specific gravity.
B —The old home-boiled lime-sulphur, 20.15.40 formula.
C —Self-boiled lime-sulphur.
D —Bordeaux mixture, 4.4.40 formula.

FORMULAE FOR INSECTICIDES

I.—POISONS (for biting insects only).

1.—ARSENATE OF LEAD—Two lbs. to 40 gallons liquid spray; 3 lbs. for potato beetles.

2.—PARIS GREEN—(*a*) ¼ to ½ lb. to 40 gals.; 1 lb. for potato beetles. If used with water alone, add 1 or 2 lbs. fresh lime. (*b*) 1 lb. mixed with 50 lbs land plaster, air-slaked lime or some similar substance, for dusting on plants. (*c*) Poisoned bran, mix 1 lb. Paris Green with 50 lbs. bran moistened with sweetened water. Scatter in evening on soil by plants for cutworms.

3.—ARSENITE OF LIME—Boil 1 lb. white arsenic and 1 lb. sal soda (crystals) with stirring for about 15 minutes in 1 gal. water till all the arsenic is dissolved, then add 2 lbs. stone lime and let slake in boiling liquid. Add water to make up for what has evaporated. One quart of this when well stirred is sufficient for 40 gals. spray liquid. Arsenite of lime can be made in large quantities and stored. Label barrel "poison," and be careful to keep white arsenic itself labelled "poison." Keep barrel covered to prevention evaporation. Stir well before using. N.B.—With Bordeaux, 1, 2 or 3 may be used; with commercial lime-sulphur, 1; the others cause burning.

4.—WHITE HELLEBORE—One oz. to 2 gals. water, or dust undiluted over the plants. For root maggot dust close to plants, or pour around roots.

II.—CONTACT POISONS (chiefly for sucking insects).

1.—KEROSENE EMULSION.

Kerosene (Coal Oil)	2 gals.
Rain Water	1 gal.
Soap	½ lb.

Dissolve the soap in water by slicing and boiling; take from fire, and while hot pour in kerosene and churn vigorously for five minutes. For use dilute with 9 parts of water, so that the above 3 gals. of stock emulsion will make 30 gals. of spray mixture.

2.—WHALE OIL SOAP—For brown or black aphids, 1 lb. in 4 gals. For green aphids, thrip and leaf-hopper, 1 lb. in 6 gals.

3.—TOBACCO WATER—Boil 1 lb. refuse tobacco in 2 gals of water for 1 hour, make up for water that evaporates.

4.—Black Leaf 40, made by Tobacco Product Co., Louisville, Kentucky.

5.—PYRETHRUM (or insect powder).

Pyrethrum Powder	1 oz
Water	2 to 3 gals.

Dry mixture, mix thoroughly 1 part by weight of pyrethrum with 4 of cheap flour, and keep in air-tight vessel for 24 hours before dusting over plants.
Note: Pyrethrum is useless if left exposed to the air.

6.—LIME SULPHUR WASH. (See under fungicides.)

FORMULAE FOR FUNGICIDES

I.—BORDEAUX MIXTURE.

Copper Sulphate (Bluestone)	4 lbs.
Unslaked Lime	4 lbs.
Water	40 gals.

Dissolve the copper sulphate in a wooden or brass vessel with hot water, pour into a barrel and add cold water to make 20 gals.; slake the lime, preferably with hot water; add cold water to make 20 gals. Stir both barrels well, and pour lime into the copper sulphate barrel. (Never mix concentrated milk of lime and copper sulphate solutions.)

A stock solution of each may be made and kept indefinitely if not mixed. Dissolve 40 lbs. copper sulphate in 40 gals. of water by suspending just below the surface of the water in a coarse sack. Each gallon of the liquid will now contain 1 lb. copper sulphate. Slake any desired quantity of lime and put into a box or barrel in shaded place, or sunk in the ground. Keep covered with small amount of water to exclude the air. Calculate how much is required for 4 lbs. lime if well stirred.

To test Bordeaux mixture, let a drop of ferro-cyanide of potassium solution fall into a little of the mixture in a saucer when ready. If this causes it to turn reddish brown, add more lime until no change takes place.

II.—LIME SULPHUR WASH. Consult Index to find any heading desired.

III.—DISINFECTANTS (for pruning tools and for wounds on trees).

1.—One pint formalin diluted to 2 gals. with water.

2.—Corrosive sublimate, 1 part to 1,000 by weight = 1 tablet to 1 pint of water. Apply with a swab on end of a stick.

Caution.—Corrosive sublimate is a deadly poison to man or beast if taken internally. It will also corrode iron or metal, so use in a glass or wooden vessel, and be sure to wash these out very thoroughly when through using them.

3.—Lime sulphur about twice spring strength, or Bluestone, 1 lb. dissolved in about 14 gals. water, may be used to disinfect wounds or cankers, but is not satisfactory in case of Pear Blight.

STICKER.

Resin	2 lbs.
Sal Soda (crystals)	1 lb.
Water	1 gal.

Boil together till a clear brown color which takes from 1 to 1½ hours. Cook in an iron kettle in an open place. Add the above to 40 gallons Bordeaux for use on smooth foliage like onions, cabbage or asparagus. If used with arsenate of lead, Paris Green, or arsenite of lime, add 1 or 2 lbs. of fresh lime to every 40 gallons of spray.

BULLETIN 199.] [FEBRUARY, 1912.

Ontario Department of Agriculture

[Reprinted from the Annual Report of the Ontario Vegetable Growers' Association, for 1908.]

Onions

By A. McMeans, O.A.C., Guelph.

Early in the year 1908, the Executive of the Ontario Vegetable Growers' Association requested the Department of Agriculture to have an investigation made into the extent and nature of onion growing in Ontario, and a report prepared upon the same.

I was instructed by the Minister to do this work, and was authorized to visit the principal onion-producing States, to enquire into the methods there pursued. During the months of August and September, I visited the onion-growing sections in the States of Michigan, Indiana, Illinois, and Ohio.

I beg to submit herewith my report, which I trust will be of some help to the onion growers of this Province, in helping them in some measure to produce larger and better crops, and which will assist in increasing their profits in this important business.

The American onion markets are supplied as follows:—In April, Egyptian onions make their appearance, an average of over 83,000 bushels having been imported annually during the past five years. These are followed by the Bermuda, and the Texas crop of Bermuda onions, which are marketed in crates. The crop in the State of Texas last year was over 2,000 cars. The Southern Texas Truck Growers' Association control over 90 per cent. of the shipments. The Bermuda onion does not last long nor keep well, and is out of the market before the northern grown crop is ready, so they are followed by the Louisville, Ky., onion. A large section in that locality is devoted to this line. They are all grown from sets, and supply the markets for two or three weeks, until the northern crop comes in. This is harvested in August and September and marketed during fall and winter. The Spanish onions, both the Denias and Valencias, compete against the domestic onion of the northern States during the fall and winter. During the year 1908, 214,430 crates of Denias were imported.

The following information was furnished me by the Bureau of Statistics of the United States Department of Agriculture. The latest federal statistics of onion production in the United States are those relating to the crop of 1908, and according to the census amounted to 11,790,974 bushels from an area of 47,983 acres, an average of about 266 bushels per acre. The principal producing states were as follows:—

State.	Acres.	Bushels.	State.	Acres.	Bushels.
New York..........	6,033	2,177,271	Connecticut..........	1,206	422,591
Ohio................	5,067	1,677,442	Pennsylvania........	1,506	347,806
Michigan............	2,611	783,948	Wisconsin..........	1,230	331,662
Massachusetts.......	1,670	748,309	Kentucky..........	1,705	305,113
Illinois............	2,563	546,681	Iowa................	1,195	292,097
California..........	2,207	514,859	Missouri............	1,383	259,272
Indiana.............	2,105	505,010			

The following also was furnished.

IMPORTS OF DOMESTIC ONIONS FROM, AND EXPORTS TO, CANADA.

Year ended June 30.	Imports.	Exports, domestic.
	Bushels.	Bushels.
1904....................................	2,103	78,886
1905....................................	2,137	118,920
1906....................................	520	39,600
1907....................................	641	81,585

SOIL. A profitable crop of onions can be grown on almost any soil provided that it is well drained and fertilized and has an abundance of humus in it. The land should be free from stones and rubbish, also from foul weeds and weed seeds, as any one of these will add heavily to the expense acount.

All of the onion-growing sections visited, with the exception of the Lake Ashtabula section in Ohio—which is one of the oldest, if not the oldest, onion-growing sections in the States—were on soil with muck varying from two to thirty feet in depth, depending on the locality, with subsoils ranging from sand to clay loam.

MANURE. Many of the commercial onion growers on muck soils do not use manure at all, depending on commercial fertilizers for their crop. applying it at the rate of from 800 to 1,200 pounds per acre. Their chief objection to stable manure is that it contains too many weed seeds. Other growers like to apply manure about once every three years at the rate of about twenty tons per acre, believing that the bacteria which are at work in the manure give life to the inert vegetable matter that is in the soil.

They also supplement the manure with a commercial fertilizer composed of potash and phosphoric acid, about eight to ten per cent. of each. Other growers like to get the crop of onions off the ground by the first of September, sowing oats, which are plowed under late in the fall, for the purpose of adding humus to the soil.

The onion growers situated on upland apply manure when it can be secured profitably, at the rate of forty or fifty-two horse loads per acre. The general tendency is not to use so much stable manure, fifteen to twenty tons per acre being deemed sufficient, to which is added five hundred pounds of fertilizer.

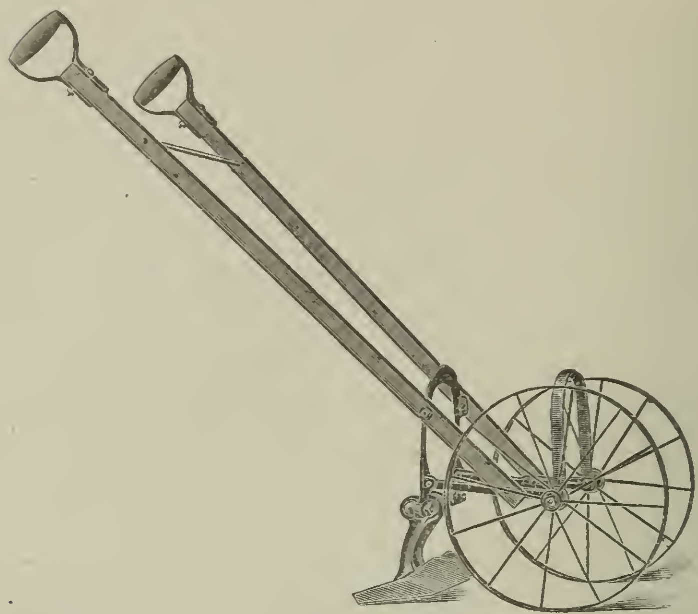
Where stable manure is used, it is generally applied in the fall and plowed in, although some prefer to plow the land in the fall and apply well rotted manure in the spring, working it in with a disc harrow.

Hand Cultivating.

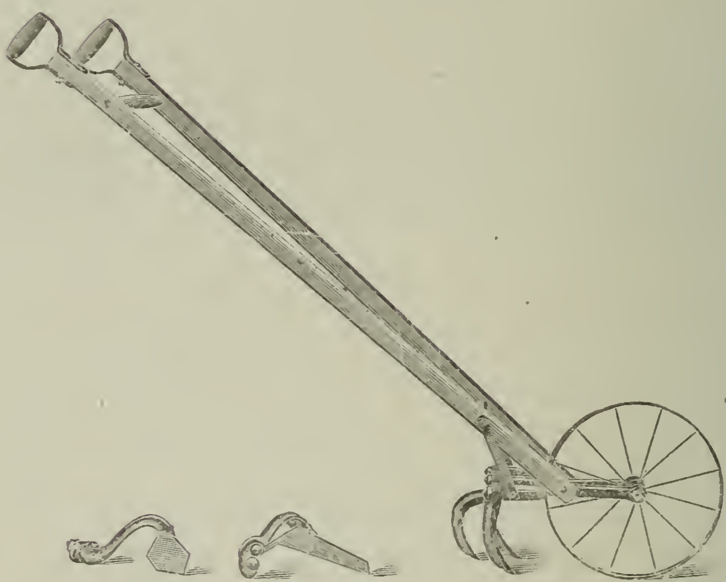
Where fall plowing is practised, the following is generally the rule: As early in the spring as the ground will carry a team, it is harrowed with a drag, which helps to dry the surface. A few days later it is disced and thoroughly pulverized. It is then harrowed. The fertilizer is then applied, usually with a drill, so as to get even distribution, after which the ground is again harrowed and planked, leaving a smooth, even surface, free from lumps and ready to receive the seed.

Seed. A goodly number of the growers test their seed for germination and sow their seed accordingly, generally using from four to four and one-half pounds per acre on muck soils, and on upland from four and one-half to five pounds of seed per acre. The exception to the above is in the case of white seed, which is generally sown at the rate of about six pounds per acre. The desired type of white onion is a little larger than a hen's egg, hence the heavier seeding of white.

The Iron King seed drill is used almost exclusively. Some large fields of twenty to thirty acres are sown with drills, one man easily sowing an acre per day, the rows being from twelve to thirteen inches apart.



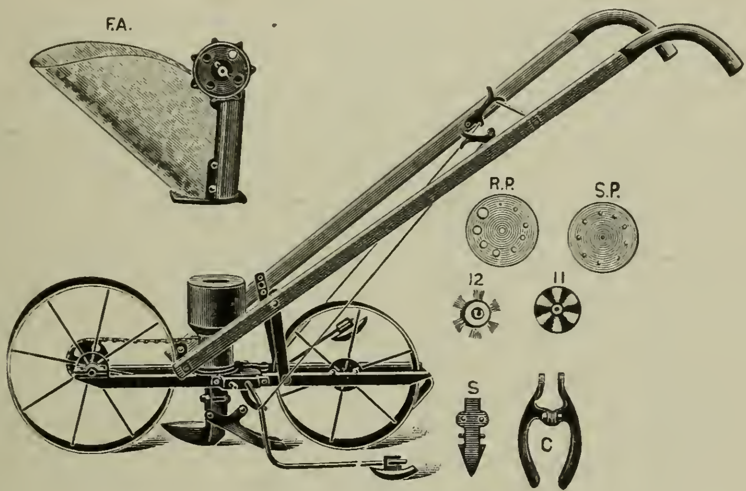
Cultivator.



Cultivator.

Some of the very large growers use an ingenious arrangement of their own, attaching from five to seven drills together, and using a horse for motive power, having a boy to lead the horse and a man to watch and guide the drills.

Weeding. The fight against weeds commences just as soon as the young onion plants appear above the ground. In fact, some of the growers do not wait for the plants to appear, but use a weeder about four feet in width built on the principle of the Breed or Hallock weeder. This weeder is attached to a wheel hoe and they go over the onion field across the rows just before the young plants appear. This tool serves a double purpose—it kills innumerable small weeds just starting and leaves a dust mulch on the soil, conserving moisture. This is followed by the wheel-hoe, which is generally used from five to eight times during the season, at a cost of about $1 per acre for each hoeing. Both single and double-wheel-hoes are used. Planet Jr., Iron King, Iron Age, and other makes of implements are used, some preferring one and some another. Some growers, not satisfied with any one of the machines on the market, use one of their own construction.



Seed Drill.

In growing red or white stock, at the time of the last wheel-hoeing, the hoes in the implement are changed or taken out altogether and teeth substituted, so as to throw up some soil on the onion bulb to protect it from the rays of the sun, and by so doing secure a better colored onion. The small weeds in the rows of plants that have been left by the wheel-hoes are removed by hand. For this purpose, boys and men are chiefly employed, and the field is generally gone over three times in a season, at a cost of from $10 to $25 per acre for hand weeding.

Harvesting. During the latter part of August or the early part of September, depending on the locality, the onion tops start to die down; as soon as tops are about half down and the root "lets go" of the soil, harvesting commences.

The methods employed, especially on red and white stock, is to pull six or eight rows and place in a windrow. Two men or boys take three or four rows each, pulling the onions by the tops in handfuls and placing them in the windrow between them, in such a manner that the bulb of the onion rests on the soil, while the half-green tops cover the bulbs of the preceding bunch, the object being to keep the onions from the sun to preserve colour. It also serves to produce a milder onion. With the Yellow Globes, the same particular care is not used. After lying in the windrow four or five days, they are topped by hand, slatted crates holding about a bushel apiece having been previously distributed throughout the field. The onion toppers mostly use a pair of sheep shears, although some prefer to use a knife. After the onion is topped it is dropped into one of the slatted crates. When full, these are piled one on top of the other about

Sowing the Seed.

four high, and a bunch of the onion tops placed on the top crate to protect the onions in that crate from the sun. They are then left in the field to cure, or are removed from the field without piling and taken to open sheds to cure. The hand toppers are paid from two or three cents per bushel for topping, and they leave slightly more top on the onion than is the custom in Ontario.

Where a machine is used for topping, the onions are left in the windrow a few days longer; they are then gathered up tops and all into crates, and these piled up in the field four high and in some cases ten or twelve in length, and covered with boards to protect them from the weather, and left until all the crop is ready. Teams are then used to draw the crates of onions to the topping machine, which is set up near the storage house. The latest improved topper is mounted on trucks and in many cases is taken to the field and used there, moving from one pile of onions to another, as no time is lost in setting up the machine. These topping machines pinch the top of the onion off by means of a square cutter bar, in such a manner that the length of the stem remaining on the onion is in proportion to the size of it, and never is an onion topped too short. After passing down the rolls of the machine, the onion drops on a travelling slatted screen to remove all small ones, dirt, etc., then the onion drops on an endless travelling belt, where the sorting takes place. All damaged, unsound, or "thick-neck" onions being removed by a man or boy stationed there for the purpose, the good onions dropping into crates at the end of the carriers.

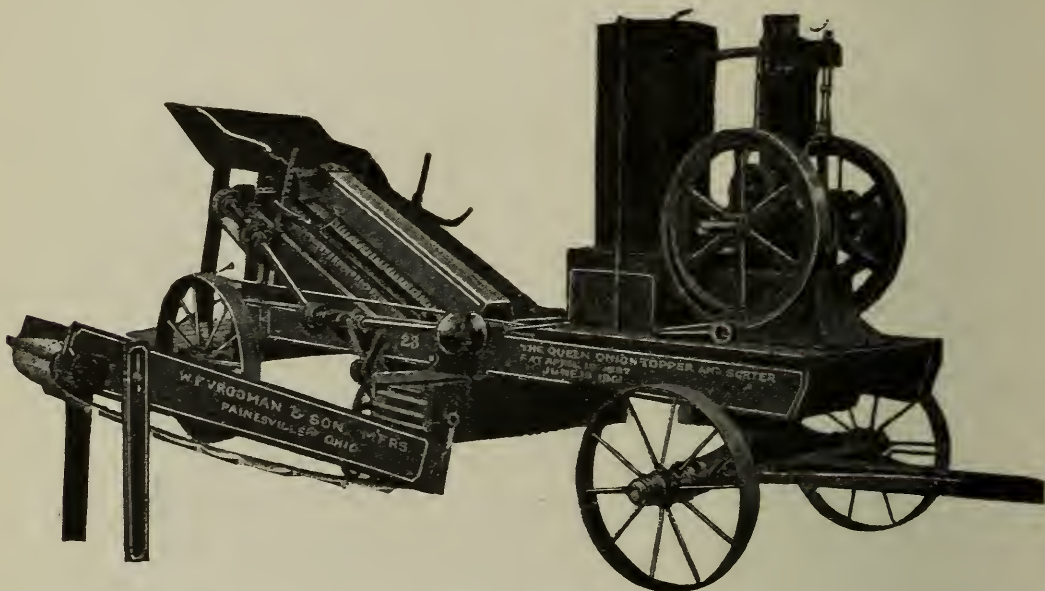
These machines are built in three sizes, one, two and four rolls, each roll being supposed to be capable of topping forty to fifty bushels of onions per hour.

Crates of Onions Curing in Field.

The onions that have been topped by hand, after they are thoroughly cured and are ready to be moved to market or storage, are run over screens to remove all small ones and loose skin on the onion. The ideal screen (the one in use in Hardin County, Ohio) is 36 inches wide, 10 feet long with an apron of 14 inches and narrowing in to a mouth of 15 inches in width, 44 inches high at the top or high end of the screen, 37 inches high at the low end or mouth of the screen, and the sides are six inches in height. The screen proper is made of hardwood slats spaced one and a quarter inches apart. These have rounded tops so as not to damage the onions when passing over them. They are one and one-half inches deep, 7-8 inch wide at the top and 5-8 inch wide at the bottom, so that once an onion starts to go through it has a clear passage. The screen proper is removable and can have other sizes used in the same frame, as some growers use one and one-eighth inch and others one and one-quarter inch screens. For white onions a one-inch screen is nearly always used. It takes six men to properly operate the above, one man to dump the onions on the screen, another to take them away, and two on each side to work the onions over the screen from one side to the other, always pushing them down towards the mouth of the screen, picking out all damaged and unsound ones. Six men will screen one thousand bushels in ten hours.

Some of the large growers have curing sheds and cribs, so that the onions can be cured under cover, away from the sun, rain and weather. These curing sheds are just open with a roof over them, and the crates are piled up in them in such a manner as to have a good circulation of air.

A description of a shed that was erected this summer will serve to show the type and cost of the same: Size of shed 48 feet wide, 96 feet



Onion Topper.

long, covered with Carey roofing, two 2 x 8 inch plank, bolted together used for posts, set in cement piers two feet square, four rows of posts used in width, the two outside rows being set four feet inside the eaves, the next row twelve feet from the outside row, leaving a sixteen foot space in the centre so that two teams can pass; the posts running lengthwise of this shed being spaced twelve feet apart. Cost of shed $700.

A description of the crib that is approved as best will suffice. The crib proper is 26 feet in width and with a two-foot eave projecting over, a five foot crib on each side, with a driveway down the centre between the two cribs 16 feet in width. Six-inch studding is used spaced two feet apart and tied together seven feet from the floor. 1 x 4 inch slats with an inch space between them are used for sides and ends. 1½ x 4 inch slats are used for flooring, with an inch space between them. Hinged doors, 22 x 30 inches for filling, are six feet apart along the sides of the crib, and the ones on the inside are five feet from the bottom and those on the outside seven feet from the bottom of the crib. The upper part of the crib is filled from the inside by emptying the onions over the top, as the cribs are ten feet in height. The crib is set up from the ground at least one foot. It has slides on the inside just at the bottom for the purpose of ease of emptying.

The crib which I have just described is 150 feet in length and is covered with Carey roofing, and cost $800 three years ago. It holds eight thousand bushels of onions in the cribs proper, leaving the sixteen foot driveway for the storing of onions in crates.

The big advantage of the crib is that it does away with a number of crates. The big growers who have cribs do not find it necessary to have a crate for every bushel of onions grown. Some of the large shippers have crates that they rent out to the small growers. Should the small

Curing Crib.

grower sell to them, no charge is made for the use of them. Should he sell to some other buyer, the grower pays two cents for their use.

Marketing. The red and yellow onions are marketed in different ways. Some are shipped in bulk, that is, loose in the car, some in one hundred pound, and some in one hundred and forty pound sacks, it all depending upon the markets to which they are consigned. Some are still shipped in barrels with fifteen inch heads holding about two bushels, but the barrels are going out of use on account of cost. The white onions are smaller than the red or yellow varieties, the size desired being slightly larger than hen's eggs. They are graded up as fancy stock and are shipped in Cummer crates. These are a slatted folding crate built on the same principle as the slatted egg crates used by the farmers of Ontario. They hold a bushel of onions, and cost laid down from $14 to $15 per hundred.

White onions are much harder to grow, cure, and store, and always command a higher price, especially in New York City, the price this year being from fifty to one hundred per cent. higher than red or yellow stock.

STORING. The warehouses used for storing onions are frost-proof buildings with provision made for ventilation. All persons who store onions agree that the buildings should be frost proof, but most of them hold different views regarding the means of ventilation and methods of piling the crates.

Folding Crate.

Neumann & Co., commission merchants, of Indianapolis, Ind., have an onion storage at Kimmel, Ind., 40 x 60 feet and 16 feet high inside, built on the following plan: Two thicknesses of inch lumber with building paper between them, then a 2 x 4 inch studding, then a board and paper lining, then 2 x 6 inch studding, another boarding, paper and matched sheeting on the inside, making altogether five thicknesses of boards, three of paper and two air spaces, one four inch and one six inches. The ceiling is of matched lumber, and has large trap doors which are opened in mild and closed in cold weather. The warm air finds an outlet through these traps, and then out through doors in the gable ends of the building. The building has a cement floor and six inch tiles through the walls just above the floor line. These are placed about eight feet apart, and are used for the admittance of fresh air. They are closed down during cold weather. This building cost $3,000, and will hold 14,000 bushels of onions. The method of storing last year was as follows: An eighteen inch space was left around the entire building for the purpose of looking after the tile ventilators. The onions were all in slatted crates, and three rows of crates were placed together, the rows running across the building. They were piled sixteen crates high, a space of four inches being left between every three rows. This method of storage proved entirely satisfactory, as the loss by shrinkage was only about three per cent.

At Kendalville, Ind., there is a storage house 40 x 143 feet, two storeys high, the ground or lower storey eleven feet high, the upper storey fourteen feet high. This house is built of cement blocks, with a lining of insulated paper inside, then a 2 x 4 inch studding, another lining of

A Method of Storing.

paper and finished on the inside with matched sheeting. It is built into the side of a gravel bank. On one side the upper storey only is exposed, while on the other side all of the building is visible. It has a side track running along the lower side, and the onions can be trucked right into the cars from the lower storey, as the floor of the car and the floor of the storage house are on a level. When loading a car from the upper storey, the onions in sacks slide down a chute into the car. This house was built in 1907 and cost $5,700, and has proved very satisfactory.

In Hardin County, Ohio, the storage house that is in general use differs somewhat in construction from most of those in other localities; a description of one will serve for all, as about the only difference to be found is in size. Forty feet wide, one hundred and ten feet long, sixteen feet from floor to ceiling, walls built as follows: four thicknesses of sheeting, four of felt paper and two air spaces, one of these being eight, the other being two inches. A basement six feet deep is under the entire building, the walls being built of stone, and two feet thick.

12 x 12 inch oak sills set on 2 x 6 foot stone piers, two rows of piers used and 3 x 12 inch joists spaced 18 inches apart from centre to centre, slatted flooring 1½ x 4 inches is used with an inch space between each piece of flooring. Eight ventilators on each side and two on each end, one foot square, are in the basement, a short distance below the floor line. Large trap-door ventilators in the ceiling, with doors in the gable ends over the ceiling, also a ventilator one foot deep and ten feet long just under the ceiling at each gable. The idea of ventilation in these houses is admittance of fresh air in the basement, finding its way through the slatted floor, up through the crates and onions, through the trap doors in the ceiling and out through the ventilators at the gable ends, and

Onion Storage House.

theoretically, at least, seems to be the ideal method of ventilation. The owner handles 150,000 bushels annually. This storage will hold about 40,000 bushels, not including the basement. The entire cost of operating, including storage, cribs, screening and loading, based on a six years' average, is about $2,000 per year. The shrinkage on stock in the above last year was, on yellow 5 per cent., on red 5½ per cent., and on white 12 per cent. Three years ago the shrinkage on red was 2 per cent., and on yellow 2½ per cent.

Horr-Warner Co., the largest growers of domestic onions in America, if not in the world, this year had five hundred and forty acres under cultivation. They have facilities for storing over 160,000 bushels of onions. The capacity of their different houses varies from 8,000 to 19,000 bushels each. They think that they get better results from a number of medium sized houses than from a few large ones.

In the ventilation of storage houses, one point was strongly fixed, and that is, not to have any of the ventilators go directly out through the roof. This has been tried and found unsatisfactory, as frost would gather on the sides of the ventilator. Should mild weather set in, the frost would melt and run down on the onions with damaging effect.

Should an order be received after the onions are in storage, say a month or so, the onions are again put over the screen to remove all loose peelings and to be sure that nothing is shipped but good, clean, bright stock. All the big shippers say that good market appearance helps to sell the goods.

Growing Seed: Many of the large growers of domestic onions grow their own seed. For this purpose the bulbs should be selected very carefully, both as regards shape, color and size. The best time to make the selection is when the onions are going over the screen. By having a crate at one side of it the extra choice bulbs can be picked out and dropped into it, and can be stored separately until spring. In Michigan and Ohio the seed is grown on upland, never on muck soil. Good rich clay or sandy loam is used, and the bulbs are planted in rows about three feet apart and about six inches apart in the row. This admits of horse cultivation and ease in working. About one hundred and twenty-five bushels of bulbs are used in planting an acre; the crop varies according to season, from one pound to upwards of four pounds of seed from each bushel of bulbs planted. Care is exercised in gathering the seed bulbs. The field is gone over sometimes four or five times, cutting off those that are ready, about two inches of the stock being removed with the seed ball. They are generally gathered in bags or sacks, and are taken to the seed drying house where they are spread out on shelves. These shelves are generally about one foot apart and the bottoms are made of one-half inch wire netting. Doors and windows are kept open on bright days to admit free circulation of air to aid in the drying of the seed. After the balls are thoroughly dry, the seed is beaten out with a stick while the balls are still on the shelves, the wire netting on the bottom of the shelves allowing the seed to fall on the floor. Others use a flail as a means of separating the seed. It is then gathered up and run through a mill to clean it and blow off the light stuff. After it is cleaned it is placed in barrels or tubs and water poured over it until all the good seed is entirely immersed, all the light and poor seed that floats being discarded. It is then thoroughly dried as quickly as possible. If it remains damp for any length of time it will mould or germinate, thus spoiling a large percentage. The big drawbacks to onion seed growing are hail, high winds, and danger of blight during the time the seed ball is filling.

Pickling Onions. Soil of same general nature as will grow a good crop of domestic onions can be used for growing pickling ones, with the possible exception of soil of a clayey nature. This kind should be avoided on account of the difficulty of harvesting. The soil need not be quite as rich as for a crop of market onions. In a field of four acres in Ohio, six to eight tons of manure were applied per acre, the land having been plowed in narrow strips in the fall at a cost of about $10 per acre. In the spring it was harrowed and one thousand pounds per acre of complete fertilizer 2-8-8, costing $26 per ton, was added. It was again harrowed and planked. Total cost of spring preparation and fertilizer, $15 per acre. Thirty-two pounds of seed, furnished by the pickling factory and costing $1.42 per pound, was sown per acre in rows ten inches apart. Cost of seed and seeding was $46.70. Wheel-hoed four times at an estimated cost of $8 per acre. Hand weeding was done three times, and part was gone over four times, at an estimated cost of $15 per acre. Pulled by hand into windrows, piled thin and in such a manner that the tops cover the bulbs as much as possible to prevent sunburn or scald. After drying some days they were crated by hand and hauled promptly to the topping machine at an estimated cost of $12 per acre.

It is said that twenty cents per bushel has been paid for topping and sorting by hand. Possibly fifteen cents per bushel will pay for topping and sorting by machine. Crop averaged five hundred and four bushels per acre, making cost of topping and sorting $75.60 per acre. Cost of delivery to salting station, $6. Total cost of growing, harvesting, and delivery, including value of land, estimated at $100 per acre, $198.30.

Total receipts per acre, $351.93, divided as follows—158 bushels 20 pounds of small, under ¾ of an inch in diameter, at $1.25 per bushel of 50 pounds, $198; 219 bushels 27 pounds medium, over ¾ of an inch and under 1¼ inch in diameter, at 50 cents per bushel, $109.77; 126 bushels 6 pounds large, over 1¼ inch in diameter, at 35 cents per bushel, $44.16. The cost is figured at what it was estimated it cost to grow the crop; an odd item may be a trifle low.

The growing of Dutch sets requires more skill and experience than the growing of either domestic or pickling onions. The soil and preparation is about the same as for a crop of the latter. The Planet Junior Drill with the set attachment is the machine I have seen used, sowing a row about two inches in width. Should you wish to grow only a small patch, you can open some drills about two inches in width and a foot apart. For sowing the seed a small tin can of a diameter of about two inches can be used. Punch a number of small holes in the bottom, slightly larger than the seed, but not large enough for two seeds to pass through the same hole at once. By filling the can with seed, and lightly shaking it along the open drill, it will sow quickly and evenly. Cover the seed in the drill with fine soil from one-half to one inch in depth, depending on your soil, the light covering for heavy soil and the deep covering for light soil. One ounce will sow about forty feet of a drill.

The varieties used for growing sets are Yellow Flat Danvers, Yellow Dutch or Strasburg, Australian Brown, White Portugal or Silverskin, Extra Early Red, and Red Wethersfield.

In the vicinity of Chicago, which is the largest set producing section in America, the rows are one foot apart, and from sixty to seventy-five pounds of seed are used per acre.

The cultivation and weeding are practically the same as for market onions. When the onions are ready to be harvested, some people use steel hooks to loosen the sets from the soil. Others use an attachment consisting of short steel blades about two inches in length. Two of these blades are used on a double wheel hoe, and the points of the blades are kept about an inch apart. The machine is pushed along by hand, with the blades deep enough in the soil so as not to hurt the onion. The onions are then picked up, with one hand grasping as many as it can conveniently hold, and as near the bulb as possible, and the other hand is then used to twist off the tops. They are then deposited in round half-bushel baskets, and when the basket is full it is taken and emptied into trays. These are three feet by four feet in size, with sides made from one inch lumber, and are three inches high, the ends of lumber of the same thickness and four inches high. They also have a four-inch piece across the bottom to give them stability. The bottoms are slatted and are made from four foot lath with a space of one-quarter to three-eights of an inch between. Each tray holds one and one-half bushels.

These trays, when filled with onions, are piled up one on top of another in the following manner—twenty-one at the high end, twenty in the centre, and nineteen at the low end. Some boards or strips of waterproof paper are placed over the tops of the piled crates to protect the sets from the weather, and it is then known as a house. The four inch end of the trays when piled leaves an inch space at the sides of the tray for the purpose of allowing the air to enter and dry the small bulbs.

After they are thoroughly dried, they are then taken to a Clipper cleaning machine and run through that, removing all the dried top remaining on the onion as well as any dried or loose peeling. It also sorts the sets as they pass over a screen, all over three-fourths of an inch in diameter being considered too large for sets and are used for pickling onions. The sets, after coming from the machine, are boxed or barreled for delivery, or are put in storage. If put in storage for winter or spring delivery, they are placed back on the same trays and these are piled up in the storage house, which is a frost-proof building. They should be kept as dry and cool as possible, but must not be allowed to freeze.

Some of the operators in sets in the Chicago district contract with small growers to grow sets for them. The contractor furnishes the seed and the trays for curing the sets, and pays the growers seventy to eighty-five cents per bushel for growing. This must be close to the cost of production, as the contractors have hard work to increase their acreage, and in some cases to induce the grower to continue to grow sets for them.

One large firm there grows about 250 acres of sets annually, using four Planet Junior drills attached together, and drawn by a horse, for sowing their seed. They also grow forty or fifty acres of seed to furnish their supply for the following year.

A good crop of sets yields from three hundred to four hundred bushels per acre.

In Ontario, and, in fact, Canada, the onion set district is practically confined to Huron County, with the village of Hensall the chief centre. The methods used here differ somewhat from those in the Chicago district. The contractors sell the seed to the grower of the sets and buy the sets from the growers in the fall, the price paid this year being four cents per pound. The contractor has his own seed drills and sows the seed for the grower. The method of harvesting is somewhat different also, three rows bing pulled and placed in a windrow (no tops removed from the bulb) and left to dry in the sun until such time as the top will rub off when going through the cleaning machine.

Harvesting Onion Sets.

For winter storage they are placed in trays and stored in much the same manner as previously described.

The standard weight for onion sets is forty pounds per bushel in the fall and thirty-two pounds per bushel in the spring, the shrinkage being about twenty per cent.

The estimated onion set production for Ontario is about 300,000 pounds, an increase of over fifty per cent. in the past five years. The Canadian market is from coast to coast, onion sets having been shipped from Hensall to the Yukon.

Onion Production in Ontario.

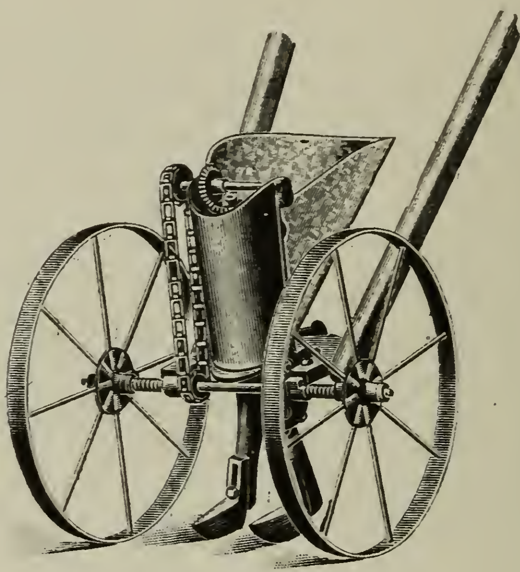
The onion markets of Canada are supplied as follows: In the month of April, Egyptian onions make their appearance and large quantities of them are sold, especially in the Maritime Provinces and Quebec; a few cars come into Ontario. These are followed by Bermudas, which are not good keepers, and are off the market by the time our own onions are ready. The strongest competitors we have in our markets are the Spanish onions. These come into direct competition with our onions, both in regard to season and price. There are two varieties which come from Spain, Denias, which are the very large Spanish onion, and which are shipped in crates holding about forty pounds; and Valencias, shipped in cases holding approximately one hundred and twenty-five pounds. The price of Valencias varies from four shillings a case upwards, with perhaps an average price of five to six shillings per case, f.o.b., Liverpool.

Owing to the high duty on onions coming into the United States, (forty cents per bushel, compared to the Canadian duty of thirty per cent. *ad valorem*) the consumption of foreign onions per capita is higher in Canada than it is in the United States, and the high American duty practically prohibits Canadian onions from going into that country.

If it were possible for the growers in the shipping districts to form an association to look after the proper distribution of the crop, so as to properly supply the different markets, it would be a step in the right direction. It would also be of material advantage and profit to themselves in the distribution of their crop. In some of the districts there seems to be a dread of over production. This should not be the case, and the sooner the growers get over that idea the better it will be for them. At present we are not supplying our own markets, but import American onions to the extent of over 78,000 bushels annually over our export trade, and these figures are based on a four years' average, as can be seen by referring to the table on page 2. When in Montreal last fall, in an interview with Mr. O'Shea, the Dominion appraiser of fruits and vegetables, regarding the importation of American onions into our markets, the question was asked, how many cars of American onions come into our markets, and to base his estimates on a five years' average? His reply was that he could not tell exactly, but a conservative estimate was an average of twenty-five cars annually.

In supplying the markets of the several Provinces with Ontario onions, the following was learned through correspondence with brokers and commission merchants in the large markets. The Nova Scotia markets will take about thirty-five car loads, containing 14,000 sacks of seventy-five pounds each. About twenty carloads go into St. John, N.B., and about fifteen into the Province outside of the city. The Province of Quebec will take about twenty-five cars annually; Prince Edward Island about six or seven cars of Ontario onions. In Newfoundland, Canadian onions are not a large factor, the market being divided between American and Spanish grown ones. The large firms there have an extensive trade with Portugal and Spain, sending out cargoes of fish, bringing back in their own vessels large quantities of Spanish onions at a trifling freight cost. Newfoundland imports about $10,000 worth of onions annually, of which Canada sends about $1,000 worth. Winnipeg and Manitoba import about twenty-five cars of onions annually. These are almost all brought from Minnesota, as, owing to cheaper freight rates, they can be imported from the United States, duty paid, cheaper than they can be brought in from Ontario, owing to the high freight rates from this Province, the freight rates on onions from Ontario points to Winnipeg being 49 cents per one hundred pounds all rail, and 44 cents per one hundred pounds rail and boat. If the growers in Ontario made proper representation of the situation to the railroads, this might be remedied and a good market for our onions developed in the West.

The variety of onions demanded in the different markets varies, and it would be well for our growers to give some study to it. The Provinces of New Brunswick and Nova Scotia demand a yellow onion. Quebec favors almost exclusively a red onion. Manitoba uses about sixty per cent. of red and the balance yellow. The markets of Ontario want the yellow. The Province of Ontario itself has a large market to supply.



Fertilizer Sower.

The large cities are mostly supplied by the local growers in the vicinity, but immense quantities are shipped to the North Shore of Lake Superior and Georgian Bay. It is estimated that this year it took twenty-five cars to supply these markets. The supply of onions to New Ontario will ever be on the increase.

The wholesale price of onions varies. The average price in Toronto markets per bag of 1½ bushels, 75 pounds, October 1st, was 98 cents; December 1st, $1.18; February 1st, $1.26; April 1st, $1.55. In Montreal markets on October 1st, $1.14; December 1st, $1.48; February 1st, $1.55; April 1st, $1.63. The above figures are based on the prices quoted for onions on the first of the respective months for the years 1903 to 1908 inclusive.

Using the same prices for the same months, we find that the average price for the crop of any one year, that is, the price onions were quoted at on October 1st and December 1st of the year the crop was grown in, and the price on February 1st and April 1st of the following years, was as follows:—Toronto market, crop of 1902, 75 cents; 1903, $1.40; 1904, $1.70; 1905, $1.20; 1906, $1.30; 1907, $1.11; 1908, 80 cents. Montreal market for the same years beginning with the crop of 1902, 90 cents, $1.80, $1.77, $1.32, $1.75, $1.25 and $1.40 respectively. Onions on Montreal market to-day (February 1st) are quoted at $4 per barrel.

The above figures cover the past six years from 1903 to 1908, inclusive, the lowest period being for the crop of 1902, when prices averaged seventy-five cents per bag in Toronto market, and ninety cents per bag in Montreal. Seventy-five cents per bag was also the average price the past fall in Toronto. The highest prices reached during the above term of years was in the month of April, 1905, when the price was from $2 to $2.25 per seventy-five pound bag, both in Montreal and Toronto markets.

As will be seen by the statistics of the onion industry of Ontario, found elsewhere in this report, the Scotland district in Brant County, the Leamington district in Essex County, and the Clarkson district in Peel County are the largest shipping districts. The Leamington district is the only one I know of where onions are grown on muck soil, the other districts growing them on soil that varies from sandy loam to clay loam.

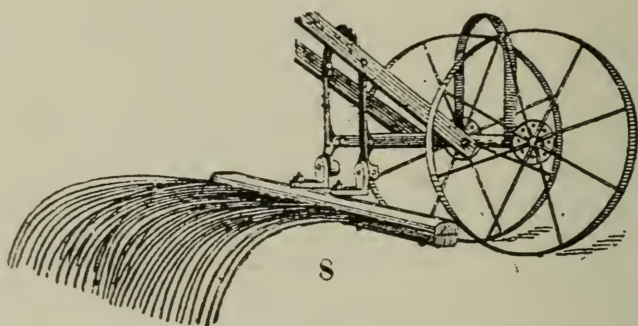
The methods used in the preparation of soil, seeding, and growing, do not vary much from those used in the United States, which are described in the early part of this bulletin. The main difference lies in the methods used in curing and harvesting. The Ontario method used is to wait until the tops die down thoroughly before pulling the crop. They are then pulled and put in windrows, being spread out thinly and exposed to the sun. After lying some days they are topped by hand, and two of the windrows are thrown into one during the act of topping, that is, when topping, the onion is picked up and topped and deposited on the other side of the topper on to the cleaned ground. They are then left there for some time, generally until ready to be sacked and delivered to the car.

In sacking, baskets are generally used in gathering, which are emptied directly into sacks and a number of sacks placed together. Scales with the weight set at seventy-six pounds are then brought along. These scales are usually placed on a piece of broad board with a piece of rope attached for drawing the scales along from one pile of sacks to another. The bags are placed on the scales separately and weighed, some sacks being found too heavy and some too light. They are all balanced up to weigh seventy-six pounds, one pound being allowed for the bag and seventy-five pounds for the onions. Sufficient care is not exercised by the majority of the growers in gathering the onions. This applies both in regards to having the onions clean and in sorting out the small ones, "thick necks," and injured onions. When it is left to the individual to sort out the onions and leave the small ones, no two individuals will select the same, whereas the screen treats every one alike.

This fall, upon my return from the American onion districts, I visited the Scotland and Leamington sections and advocated the use of the screen for sorting, with the result that a number of the growers made and used screens for sorting their onions. In conversation with them later in the season, they all claim superiority for the screen and are strong advocates for its use in the future.

In the growing sections of Ontario no provisions have been made for storage and sending the onions to market during the winter months, the storage being done by dealers and commission merchants, who hold them over in sacks, generally storing them in cellars, and it is not a desirable way of storing onions for future sales.

It will be seen from the foregoing table of average prices, that the price of onions rises about in proportion to the length of time they are held after harvesting and leaving the hands of the grower. In my experience and memory of onion prices, covering twenty-five years, we had two



Hallock Weeder.

crops (one of which was the crop of 1902) in which prices did not rise above the price set at harvesting; the balance of the time, it would have been a paying proposition to have stored at least a portion of the crop.

General Conclusions. From a study of the foregoing it will be seen that to place the growing of onions on a good sound basis, the following points are worthy of consideration:—

A study of the different markets, and the varieties demanded by them.

Good seed.

A study of soils and fertilizers, for the improvement of the crop, and increased yields.

A study of the insect pests and fungous diseases attacking the onion and the best means of combatting them.

The adoption of better methods in curing and harvesting, so as to place them on the market better in appearance, color, and condition.

The use of screens in the preparation of onions for market.

The formation of an association for the purpose of distributing the crop, so as to supply the different markets, and to avoid overloading or glutting any one market. This Association could also work for better freight rates, and the development of new markets, especially the Western Provinces.

Local associations in the growing sections will aid materially in the production of better crops, the gathering of statistics and information relating to the growing and disposal of the crop, and the distribution of that information through its members and otherwise.

Co-operative associations in the larger onion sections should be of material advantage to the growers. Under capable management they could buy their seeds, fertilizers, machinery, etc., and dispose of the same to their members cheaper than they could be secured individually, erect storage and shipping houses, and dispose of the entire crop of the growers in any one section through their manager, who could devote his time to the selling end of the business, advertise and extend their markets; in fact, do everything to help the sale and consumption of onions. Local experimental work could also be done to better advantage under an association than individually.

Experiment with growing onion seed in Ontario, with a view to producing our own needs in onion seed, if it can be done economically.

Fungous and Insect Pests.

Onion blight, or mildew, is a common disease of onions in Ontario. The fungus usually appears on one side of the leaf, about midway between its tip and base, from which it spreads rapidly through the entire leaf, causing it to wither and die. It usually makes its appearance after the bottoms have attained considerable size, and causes a premature dying, or ripening of the crop.

Treatment. Clean culture, the removal of all refuse or litter from the soil as soon as the crop is harvested. Spray with Bordeaux mixture, using a "sticker" made as follows: Resin, two pounds; sal soda crystals, one pound; water, one gallon. Boil till a clear brown color, usually taking one to one and one-half hours. Use an iron kettle. Dilute above amount with thirty gallons of Bordeaux mixture for use on cabbage or onions. Spray with Resin-Bordeaux made as follows: Melt five pounds of resin with one pint of fish oil over fire, cool slightly, add one pound soda lye with stirring; and five gallons of water and boil until the mixture will dissolve in cold water. Use two gallons of the mixture with forty gallons of Bordeaux.

Smut or Black Spore. This is most troublesome on white onions, and, when it becomes very bad, makes them almost unsaleable. Soak the seed for one hour in formalin solution: Formalin (40 per cent.) one ounce to two gallons of water.

THRIPS. These are very minute insects, about one twenty-fifth of an inch in length, of a pale yellow color. They generally occur in very large numbers, and the injury is visible in the form of small yellow spots on the leaf, increasing in size until the tips of the leaves become yellow or brown. This greatly reduces the vitality of the leaf, and hence its efficiency as a bulb-builder.

TREATMENT. A good heavy rain washes off and destroys considerable numbers of them. They can also be kept in check or destroyed by spraying with kerosene emulsion, used at the rate of one part of emulsion to ten parts of water.

ONION MAGGOT. The adult is a small fly, about half the size of the common house fly. The eggs are laid on the young plants early in the spring, and hatch in a few days, when the larvæ burrow into the bulbs. When full grown they pass into the soil and become pupæ, and the adult fly emerges some days later.

PREVENTIVE MEASURES AND REMEDIES. A quick acting fertilizer in conjunction with planting at the right time. Crude carbolic emulsion, sprinkled along the rows over the plants once a week. Making a furrow along the row of plants, in which is distributed a light dressing of nitrate of soda, and replacing the earth, helps on some soils. Some growers mix a small quantity of radish or turnip seed with their onion seed before sowing, and claim to get good results. Others sprinkle their onion seed slightly with kerosene or turpentine, believing that the smell of the same acts as a repellent to the fly from laying her eggs. Finely powdered tobacco dust sprinkled on the plants has been used as a preventive with some success.

CUT WORMS. The use of poisoned bait placed through the garden will be found effective, this can be made as follows: bran, 50 pounds; molasses, 2 quarts; Paris green, 1 pound; and enough water to make a thick mash.

VARIETIES OF ONIONS.

Yellow Danvers (1) also known as Flat and Round Danvers, a round onion of good size; thin yellow skin, flesh white, fine grained, firm and of excellent quality; it ripens early, usually a week or ten days earlier than yellow Globe Danvers; a good keeper, largely used for growing sets.

Yellow Globe Danvers (5) is a selected strain of the preceding variety; the bulbs are thicker through, but not perfectly globe shaped like the Southport Yellow Globe; flesh and quality the same as Yellow Danvers.

Southport Yellow Globe (7) is of large size, perfectly globe shaped, skin yellow, flesh white and of good quality; a good keeper. It matures about a week later than Globe Danvers; a very profitable onion to grow.

Prizetaker (9). The best of the large mild onions; usually used for transplanting; skin light yellow straw color, flesh white and very mild; not a good keeper.

Australian Brown (4). A round flat onion, matures early; skin dark brown, flesh white and very firm; a good keeper. Onions of this variety have been known to keep a year.

Golden Globe (6). A globe shaped onion with light straw colored skin, flesh white and mild; probably the earliest maturing globe shaped onion.

Early Flat Red (2) of flattened form, not so thick through as the Wethersfield; matures early and will often form bulbs on a cold soil where other varieties fail; a good keeper, used largely for growing sets.

Red Wethersfield (3). Grows to a large size, rather flat in shape, skin deep purplish red; flesh purplish white, moderate grain, flavor rather stronger than the yellow onion; a good keeper.

Southport Red Globe (8). A handsome onion of perfect globe shape, grows to a large size; skin deep red, flesh fine grained, mild and tender; a good keeper and deserving of general cultivation.

Southport White Globe. Resembles the Southport Red Globe in shape; both skin and flesh are pure white, fine grained; mild flavor, good keeper. This variety commands the highest market price, but requires more careful handling than the red or yellow varieties.

Barletta, used very largely for pickling, is a round white onion of handsome appearance.

The Extent of the Onion Industry in Ontario.

Below will be found acreage and yield of onions of 18 counties of this Province, as accurate as is possible to obtain by correspondence. There were shipped from Scotland station 94 cars of onions, from Leamington, 68 cars, from Brantford, 14 cars. These shipments cover the 1908 crop and are from the beginning of the shipping season to February 1st, 1909.

County.	Acreage	Average yield per acre. Bushels.	Total yield. Bushels.	Variety and percentage of each.
Brant	185	350	64,750	90 Y., 10 R.
Essex	100	400	40,000	55 Y., 45 R.
Carleton	90	400	36,000	50 Y., 25 R., 25 W.
York	60	375	22,500	95 Y., 5 W.
Peel	60	350	21,000	88 Y., 12 W.
Norfolk	35	375	13,125	85 Y., 15 R.
Simcoe	35	300	10.500	90 Y., 10 R.
Lambton	20	275	5,500	90 Y., 10 R.
Frontenac	20	150	3 000	75 Y., 25 R.
Haldimand	15	300	4,500	50 Y., 50 R.
Lennox	10	300	3,000	50 Y.. 50 R.
Wellington	9	250	2,250	90 Y., 10 R.
Huron	8	300	2,400	85 Y.. 15 R.
Oxford	7	400	2.800	80 Y., 20 R.
Grey	6	300	1,800	90 Y., 10 R.
Hastings	6	285	1,710	50 Y.. 50 R.
Elgin	4	315	1,260	85 Y., 10 R., 5 W.
Ontario	3	200	600	100 Y.
Total	673	312	236,695	Y. denotes yellow, R. red & W. white.

Of the average yield per acre, 77.7 per cent. were yellow, 19.7 per cent. red, and 2.6 per cent. white.

BULLETIN 200.] [APRIL, 1912.

Ontario Department of Agriculture

FRUIT BRANCH

Fruit Juices

By L. Meunier.

PREFACE.

Our experiments on fruit have a treble aim: First, to be useful to the fruit-grower by giving him divers ways of getting a big profit from his

Experimental Station at Jordan Harbor.

surplus crop or from cull fruit. Second, to put on the market natural non-alcoholic drinks made out of apples, grapes, etc., so supplying the people with beverages that will suit their taste without injuring their health. The hygienic properties of the unfermented apple-juice and grape juice are well known and generally recommended to the consumer. And lastly, we have considered the question of turning to profit the by-products of the juice industries (such as lees and pressed fruit, pomace, etc.) by making vinegar, food for cattle and hogs, etc. So, our work may be of interest not only to the fruit-grower, but to any farmer of this Province who has a surplus of inferior fruit.

PART I.—ON APPLE JUICE AND ITS FERMENTATIONS.

This will be devoted to Chemistry and Biology as connected with apple-juice, cider, and vinegar making.

We shall consider the composition of apples and their juice, and look into the causes and conditions of the alcoholic fermentation that turns the juice into cider. The acetous fermentation that makes the vinegar will also be explained.

The Apple.

What is an apple composed of from a chemical point of view?

The average composition of ripe apples is:

Water	82.70
Sugars	11.00
Protein	0.50
Pectin	2.00
Acids, Ash, etc.	0.80
Crude fibre	3.00
	100.00

The crude fibre is quite insoluble, and a great part of the protein, pectin, and ash is not very soluble. The remainder consists of water and very soluble compounds. So there is about 95 per cent. juice in the apple and 5 per cent. other materials that are practically insoluble.

The apple is an aggregate of very small cells, the walls of which are insoluble, and these cells are filled with juice.

By grating the fruit the walls are broken and the liquid is easily crushed out by pressing.

The percentage of juice that one obtains depends upon the variety of apple, and also on the way of grating, and especially on the method used for the pressing.

The composition of the juice which is crushed out is the same, no matter what process has been employed.

The Apple Juice.

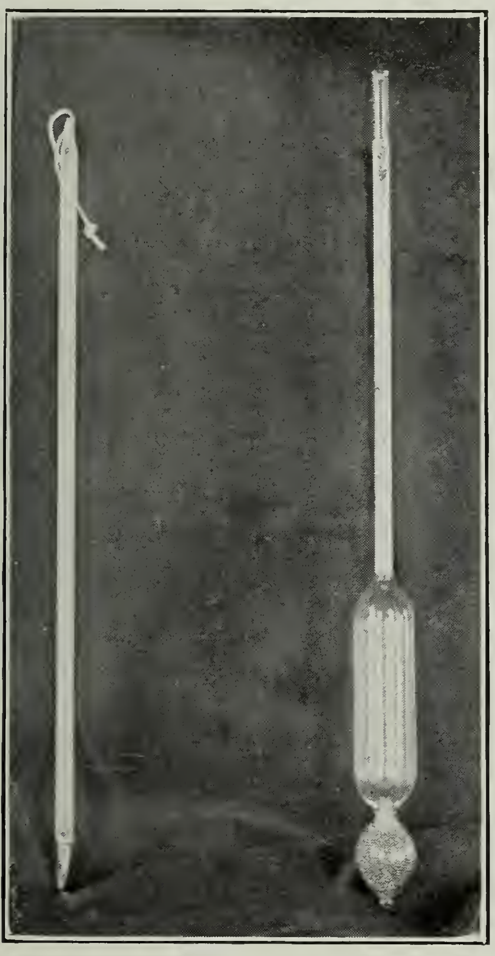
The average composition of the juice is:

Water	87.00
Sugars	11.60
Protein	0.10
Pectin	0.50
Acids and tannin	0.60
Ash	0.20
	100.00

The composition of the apple juice varies to a great extent according to the variety and state of ripeness of the fruit. For instance, the percentage of the total sugar may vary from 8 to 20, that of the pectin from 0.3 to 1.2.*

In any case the percentage of water is the highest, and that of the total sugar comes next. The sum of all the others (pectin, protein, acids, ash) is about one-tenth of the sugar.

So the sugar is, by far, the predominant substance that is dissolved in the juice. Consequently the specific gravity of the liquid depends chiefly



Thermometer and hydrometer.

Hydrometer and gauge.

Taking the Specific Gravity.

upon the amount of sugar, and it is possible to figure that amount roughly when the gravity is known.

The specific gravity is taken by the means of an hydrometer that is dipped into a gauge which is full of juice. The deeper the hydrometer

* The figures referring to the composition of apples and apple-juice are the results of analyses made in England and France, where a very extensive work has been undertaken to know something about the chemistry of the apple and its products (juice, cider, vinegar, etc.).

plunges the lighter the juice is and also the poorer in sugar. There is a scale on the rod of the hydrometer, and the figure that is on the scale and just above the level of the liquid indicates the specific gravity.

There are tables that give the percentage of sugar according to the gravity, and also the quantity of alcohol which may be obtained from a gallon of cider.

The specific gravity of a juice containing 11.6 per cent. sugar is about 1.054.

If the alcoholic fermentation takes place in a juice the sugar is turned into alcohol and carbonic gas little by little, and as the fermentation advances the specific gravity decreases until it reaches about 0.999. Then the sugar has been completely transformed.

This shows how to use the hydrometer in order to know the stage of the fermentation in a cider.

The Alcoholic Fermentation.

Why and in what conditions does a juice undergo the alcoholic fermentation?

Three conditions are necessary: the presence of yeast, a suitable temperature and a proper composition of the liquid.

Yeast. On the skin of the ripe fruit there are microscopic cells that have the shape either of eggs or lemons.

Their length is a little less than 1-100 of a millimeter; that is to say, 1-200 of a line.

As a rule, when the apple is grated and pressed many of these (yeast cells) are mixed up with the juice. Under favorable circumstances they multiply and, at the same time, turn the sugar into alcohol and carbonic gas. This is called "fermentation." If in the open air, the production of carbonic gas gives rise to a lot of small bubbles that rise to the surface of the liquid and burst there, making the liquid look as if it were boiling. Generally the fermentation goes on as long as there is sugar in the juice, and, when completed, the liquid is then undisturbed and settles quickly. The yeast cells sink to the bottom of the vessel that contains the cider and forms a granulated sediment called "yeast."

The yeast-cells are little plants and so have all the properties of vegetal protoplasm. So they are destroyed by high temperature, that of boiling water (212° F.), for instance.

They want air (or rather oxygen) to grow and multiply, and are killed by the use of preservatives, or at least become inactive under the influence of a certain proportion of an antiseptic.

Temperature. The fermentation cannot take place at any temperature. The yeast cells work only from 30° F. (—1° C.) to 95° F. (+35° C.). And between these extremes the intensity of the fermentation varies greatly. The quantity of sugar that is transformed during an hour is hardly detectable at 30° F. That quantity increases as the temperature becomes higher, and does so until it reaches about 75° F. At a still higher degree the intensity of the fermentation is less. That decreases quickly as the mercury goes up, and, above 95° F. there is no fermentation at all.

So it is at 75° F. that the sugar is turned most quickly into alcohol, and if the temperature becomes higher or lower the rapidity of the fermentation decreases, and the presence of yeast becomes void either under 30° F. or above 95° F.

Composition of the Liquid. Water, sugar, acids, combined nitrogen and various salts are necessary to the proper action of the yeast.

These principles are, as a rule, in the right proportions in the apple juice, so that it shall undergo fermentation if yeast cells are present there and the temperature suitable. And yet (even under these circumstances) the fermentation is sometimes very slow. This seems to be due to the poverty of the apple juice in nitrogen. When this is the case the addition of a very slight proportion of ammonium phosphate favors a quicker fermentation.

Some people put preservatives into the liquid in order to check the fermentation. That is a simple way to make "unfermented cider," but it is not to be commended. The preservatives kill the yeast cells, or, at least, render them unable to cause fermentation; but the action of preservatives on human protoplasm is about the same as on yeast protoplasm, so preservatives are "poisons" more or less dangerous to the human body.

Consequently the use of salicylic acid, benzoate of soda, etc., should be completely prohibited, the more so that it is possible to preserve the cider through other means.

Practical Conclusions. When the juice is intended for vinegar or brandy, the quicker the fermentation the better.

Consequently it is very important to know how to obtain the quickest fermentation available.

We have seen that the yeast is necessary to the fermentation. No fermentation can take place if there is no yeast cell in the juice. Besides, the rapidity of the fermentation increases as the number of yeast cells becomes larger. Therefore it is advisable to put a culture of yeast in the juice intended for quick fermentation. That culture may be obtained as follows:

Into a tub (or any other vessel of same shape) pour some apple juice and about 1 per thousand ammonium phosphate (neutral). The tub should be placed in a room of which the temperature is about 75° F.

Owing to the heat, combined nitrogen and oxygen of the air, the yeast cells multiply very quickly and a boisterous fermentation takes place. After a couple of days the liquid (yeast culture) is fit for use. Then the yeast culture is poured into the tanks or vats that contain the bulk of the juice. The addition of one per cent. of that culture is plenty as a rule.

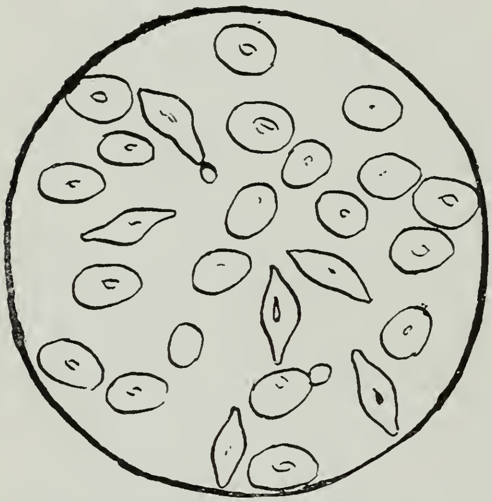
We remember that the yeast works best when the temperature is around 75° F, so if a quick fermentation is wanted one should try to maintain the juice at a temperature close to 75° F.

In the large factories the tanks should be provided with coils heated by steam; this is the cheapest way to control the temperature of the juice.

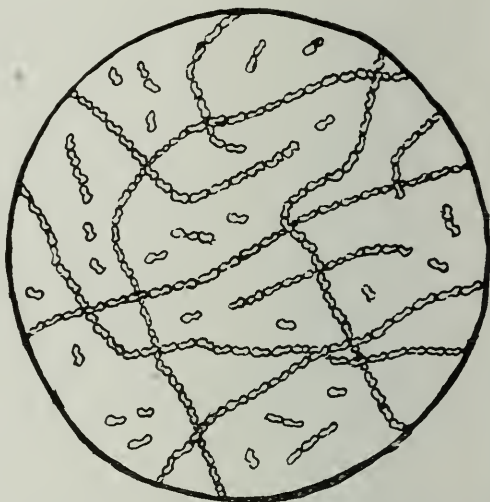
Let us now consider an opposite case: the making of sweet cider or unfermented apple juice. Then the aim of the maker is either to get a very slow fermentation or to check it completely.

As yeast cells and fit temperature are both needed for the fermentation there are two ways to make the action of the yeast void.

The yeast cells may be removed or killed by racking, filtering, heating, etc., or the juice may be cooled right off the press and put into cold storage at a temperature slightly under 30° F.



1. *Yeast.* Saccharomyces mali (egg-shaped cells) and Saccharomyces apiculatus (lemon shape).



2. *Bacteria.* Separate cells and chains of Mycoderma aceti.

To get a cider absolutely free from alcohol, but keeping its sweetness for months, allow a few yeast cells to remain in the liquid. And, instead of keeping the juice under 30° F., let the temperature go up to freezing point. So the keeping of sweet cider is possible in ordinary cold storages cooled by ice.

These various considerations show how useful scientific knowledge is to the cider maker. It gives him a complete control over the alcoholic fermentation and enables him either to check the work of the yeast or to obtain a slow or quick fermentation.

The Acetous Fermentation.

Let us now consider the vinegar question.

In many cases, the juice that has undergone the alcoholic fermentation becomes sour shortly after.

What is the reason for this?

Bacteria (called *Mycoderma aceti* by the scientist) grow on the surface of the cider, and there form a thin veil known as the "mother."

Thanks to these bacteria the oxygen of the air is combined with the alcohol, forming an acid, viz., acetic acid, which gives its peculiar flavor to the vinegar.

Four conditions are necessary to turn the cider into vinegar.

These are:

1st. The presence of acetous bacteria.

2nd. The contact of oxygen.

3rd. A favorable temperature.

4th. A fit composition of the cider,

The acetous ferment is a microscopic plant such as the alcoholic ferment (yeast).

That acetous bacterium is much smaller than a yeast cell. Its length is about 3-2000 of a line.

Every bacterium gives, by growing, a chain of cells of equal size. The chains spread in all directions on the surface of the cider, intermix, and make a sort of woven cloth, that is, "the mother."

The oxygen is absolutely necessary to transform the alcohol into acetic acid after the formula:

$$\underbrace{C^2H^5.OH}_{\text{alcohol}} + \underbrace{O^2}_{\text{oxygen}} = \underbrace{CH^3.COOH}_{\text{acetic acid}} + \underbrace{H^2O}_{\text{water}}$$

The oxygen used by the bacteria is that of the air. If contact between the air and liquid is avoided, acetous fermentation is not possible. That is the reason why one pours oil (olive oil or pure liquid vaseline) into the cider, in order to keep it from getting sour. In some large English and French factories the cider tanks are completely closed and there is in the vat no gas but carbonic anhydride. Therefore the acetous fermentation cannot set in and the cider does not become sour, no matter how long it is kept in these tanks.

There is no possible action of the acetous ferment either under 50° F. or above 110° F. From 50° F. to 82° F. the intensity of the acetous fermentation increases, but above the latter degree that intensity decreases. So the most suitable temperature for the acetous bacteria is 82° F., and the production of acetic acid is lessened as it becomes warmer or cooler.

As to the right composition, let us say that water, alcohol, nitrogen and salts are needed and must be in the liquid in suitable proportions. That is generally the case with cider. The presence of preservatives would check the acetous fermentation or lessen its activity.

The above scientific facts should guide the vinegar maker.

In order to turn the cider into vinegar as quickly as possible one should:

1st. Provide the cider with good mother.

2nd. Get a very large surface of contact of the cider and air, 3rd. Maintain the liquid at a temperature close to 82° F.

As the acetous fermentation is advancing the specific gravity of the liquid increases.

By the use of an hydrometer and a table it is possible to know the percentage of acetic acid.

When acetous fermentation is completed the percentage of acid is the same as that of the alcohol which was contained in the cider.

So, owing to the use of an hydrometer and two tables it is easy to know when all the alcohol has been turned into acetic acid. As the vinegar is sold according to its richness in acid this fact is of great interest to the manufacturer.

We shall give more details when considering vinegar making from a practical point of view.

As to the present, we have reached our aim; that is, to show how Chemistry and Biology will assist the cider and vinegar makers.

PART II.—HOW TO MAKE UNFERMENTED SPARKLING APPLE JUICE.

There are many ways to do so, but we only give a full description of the process that we have used at the Horticultural Experiment Station, Jordan Harbor.

The process we refer to is such that the use of heat or preservatives is not necessary to keep the juice unfermented. The sparkling does not come from natural fermentation but from artificial carbonation.

To understand the reason of every step in the making of that cider, we must remember some facts of paramount importance, i.e.:

1. The yeast (that is to say, the necessary agent of the fermentation) is *on* the skin of the fruit, and not inside the apples.

2. Practically, the yeast does not work at a temperature lower than 30° F. That yeast will give more and more alcohol as the temperature becomes higher, and so until the mercury has reached 80° F.

3. The intensity of the fermentation is in proportion to the quantity of yeast, or rather to the number of yeast cells contained in the liquid. So the fewer the cells, the less the fermentation.

4. When the juice deposits, nearly all the yeast cells are in the sediment or lees.

5. On any apparatus used in a cider factory there are yeast cells, bacteria or mould germs. They are dangerous to the cider as liable to set in the fermentation or to give a disagreeable taste to the liquid.

6. The contact of the juice with the air (or any gas containing oxygen) gives rise to a multiplication of the yeast cells, and besides, that contact may alter the color and flavor of the cider.

Now let us consider the various stages of the making. One can sum them up as follows:

1. Sterilizing the premises, apparatus, vats.
2. Washing the fruit.
3. Grinding the apples.
4. Pressing the pulp.
5. Putting the juice in tanks in a cold storage.
6. Racking to separate the sediment.
7. Filtering.
8. Carbonating.
9. Bottling.

There are two by-products: the pomace and the lees (sediment). Both can be used; we will show how later on.

Sterilizing the Factory.

Before the start, the ceilings, walls and floors should be "sprayed" with a solution of a strong antiseptic. Formalin at 1 per thousand will answer the purpose.

All the apparatus has to be sterilized in the same way, or, better, by the use of boiling water. If formalin is used it will be necessary to rinse carefully after.

The grinder and the press (including racks and cloths) should be rinsed and scalded every day as soon as the work is over.

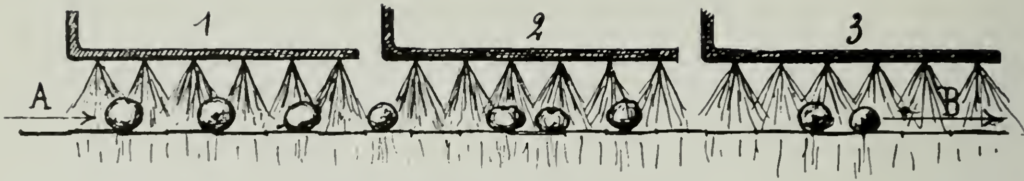
The floors must be washed also every day and kept in perfect cleanliness.

Washing the Fruit.

This operation is intended for getting rid of the yeast, bacteria and moulds which are on the skin of the apples. Just a dipping into water would do good; but a dip into an antiseptic solution will be much more effectual. In that case the antiseptic compound must be washed off afterwards, so that no preservative shall remain on the apples when the grinding takes place.

In our small factory at the Horticultural Experiment Station, we did the washing as follows: Three tubs were filled with water and one of them received 5 per thousand formalin. The fruit was put into large baskets and dipped successively into water, formalin solution, and water again. The liquid of the first and third tubs (which are filled with water only) must be changed very often, while the formalin solution can be used for several days. The apples were dipped into the solution for one minute.

This process, useful on a small scale, would not be practical in a large factory. There the apples could be washed as shown in the following figure.



The washing of the fruit.

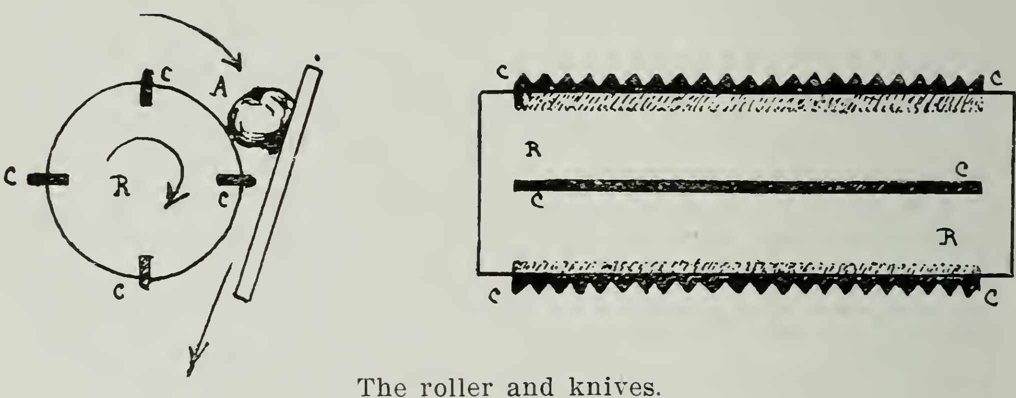
The apples are carried on a chain belt from A to B, and as they proceed they are washed by jets of water. The pipes 1 and 3 sprinkle the fruit with ordinary water, and from pipe 2 flows the formalin solution, that can be collected and used again many times.

The formalin water used in this case should be a 2 per cent. solution, and the fruit should remain a quarter of a minute under the formalin jets.

Grinding.

From the washer the apples are carried to the grinder, and there they are crushed or divided into small pieces. It is necessary to obtain as much juice as possible at the first pressing, so it is advisable to grind very finely when cloths are used for the pressing.

There are many kinds of grinders. As a rule they are made of two rollers between which the apples are crushed. But the finest pulp is obtained with only one roller provided with cutters. These are placed around the roller as shown in our drawing.



The roller and knives.

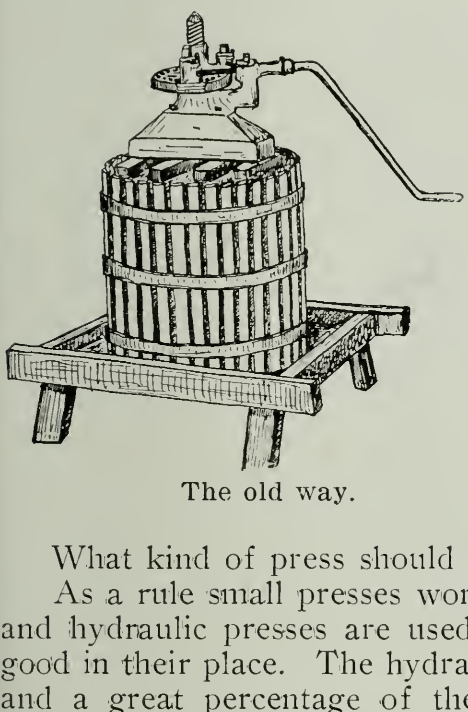
Each cutter (or knife) slightly protrudes, and, owing to its fine teeth, acts like a grater.

It must be remembered that the rollers of the grinder are generally made of cast iron, which is easily attacked by the juice. The iron gives to the liquid a slight but unpleasant taste. When the rollers become rusted the quantity of iron dissolved in the juice may be so great that it gives to the liquid a dark color. This must be avoided by a thorough daily cleansing of the grinder, after which the rollers should be oiled with "pure liquid vaseline."

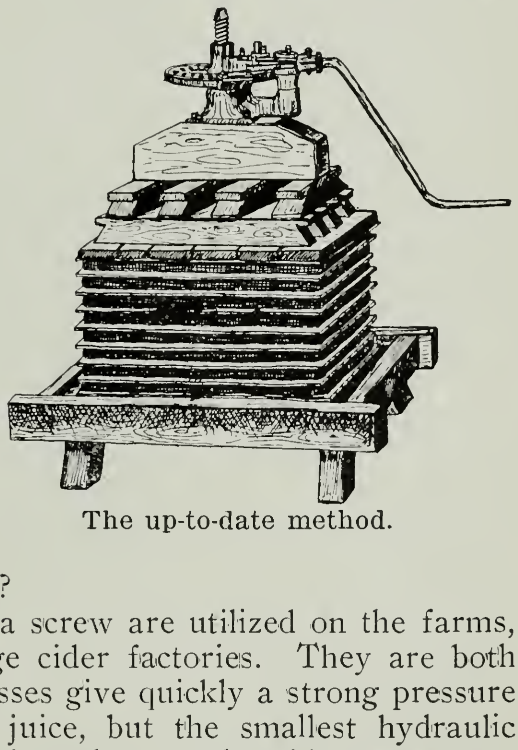
The grinding must differ according to the way of pressing. When the latter is done with the use of racks and cloths, the finer the pulp is, the better. But it would be nonsense to crush finely the apples when they are to be pressed into a cylinder of latticework. If one tried to do so all the pulp would pass between the laths, and any attempt to separate the juice from the crude fibre would be a failure. When the primitive process of the lattice cylinder is to be used for pressing it is necessary to grind the apple very coarsely.

Pressing.

The pressing of the pulp must be done after the grinding as soon as possible, so that the few yeast-cells, which may remain on the fruit-skins, shall have no time to multiply and cause the fermentation of the liquid.



The old way.



The up-to-date method.

What kind of press should be used?

As a rule small presses worked by a screw are utilized on the farms, and hydraulic presses are used in large cider factories. They are both good in their place. The hydraulic presses give quickly a strong pressure and a great percentage of the apple juice, but the smallest hydraulic press is too dear for the farmer who intends to make cider on a very small scale, for his own use, for instance.

In that case the cheap ordinary screw press costing about $20.00 is sufficient. But it will be necessary to replace the lattice cylinder by a set of racks and cloths as shown on the pictures.

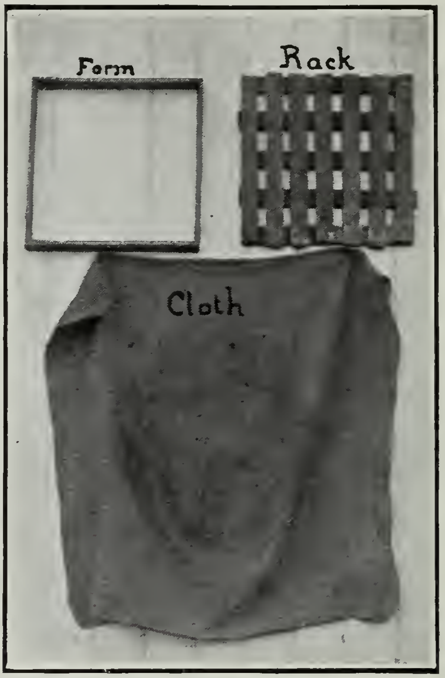
Our experiments at the Horticultural Experiment Station have proved that the lattice cylinder should be removed from the cider factory to some museum for tools of the past ages.

We have pressed the same quantity of apples in both ways, that is to say in the old way, and, on the other hand, with racks and cloths. The pressing was done by the same man with the same press and during the same time (half an hour). Through the lattice cylinder, we obtained 15 per cent of the juice, and with a set of racks and cloths, we have crushed out 55 per cent. of the juice.

As many farmers do not know the process of pressing by use of cloths, we will explain that method in a few words.

For an ordinary home press are wanted: A form, a dozen racks and half a dozen cloths.

We have made all that in the cheapest way. As cloths, we have used ordinary sack canvas cut in squares 30 inches wide. The racks and form have been made out of laths 1½ inches wide, and half an inch thick. A rack is a lattice work composed of laths crossing each other at right angles and nailed together. Our racks are square and 17 inches wide.



Form, rack and cloth.

There are 5 laths on one side and 7 on the other. A form is something like a square box without any top or bottom. It is made of four pieces of laths nailed together. Each side is 16 inches long.

We have taken a photograph that shows a form, a rack and a cloth used in our experiments.

Cloths, racks and form being so prepared we proceed as follows:

A rack is laid on the pressure platform and the form is placed on that rack, and covered with a cloth. The latter is carefully put in such a way that it closely lines the form.

And now the form is filled up with apple pulp. Then the cloth is folded upon the pulp and the form is pulled off. Another rack is put on the pulp and another layer of crushed apples is placed on the second rack just in the same way as on the first one. Three or four layers are put up in this way and on the last layer is placed the rack and beams. It is then pressed by working the screw in the way used to press the pulp in the lattice-tub.

In the making of unfermented apple juice it is very important to press quickly. The juice should be crushed out not later than two hours after the grinding. This is very easily done—either with ordinary or hydraulic press—when the press is properly fed by the grinder. Half an hour pressing is plenty when the hydraulic press is used and one hour is enough with the ordinary press fitted with racks and cloths.

Cold Storage of the Juice.

As soon as the juice is crushed out of the apples it should be put into a cold cellar, or better, into a regular cold storage. It is possible to check the fermentation for a few weeks at a temperature as high as 40° F., but it will be safer to run the cold storage at 30° F. That is a little under freezing point, but the apple juice freezes only at a still lower degree.

The apple juice is stored in vats or tanks. These tanks should be slightly tapering so that no sediment can stick to the walls. As a rule, the larger the tank is, the better. A big factory should use vats holding 10,000 gallons at least. In a very large tank, there is practically no loss through evaporation, no sensible change of temperature (even if that of the storage goes up for a while) and, besides, the cost of the storage of a gallon becomes smaller as the size of the tank increases.

The vats are made of oak, white pine or cypress. Oak tanks are dear. White pine vats are liable to give a nasty taste to the juice. Cypress should be preferred.

The outside of the tanks should be washed twice with linseed oil and the inside coated with shellac varnish.

Fill the tank up with water as long as it is not quite tight. After the drawing off of that water a scalding of the tank wall is required.

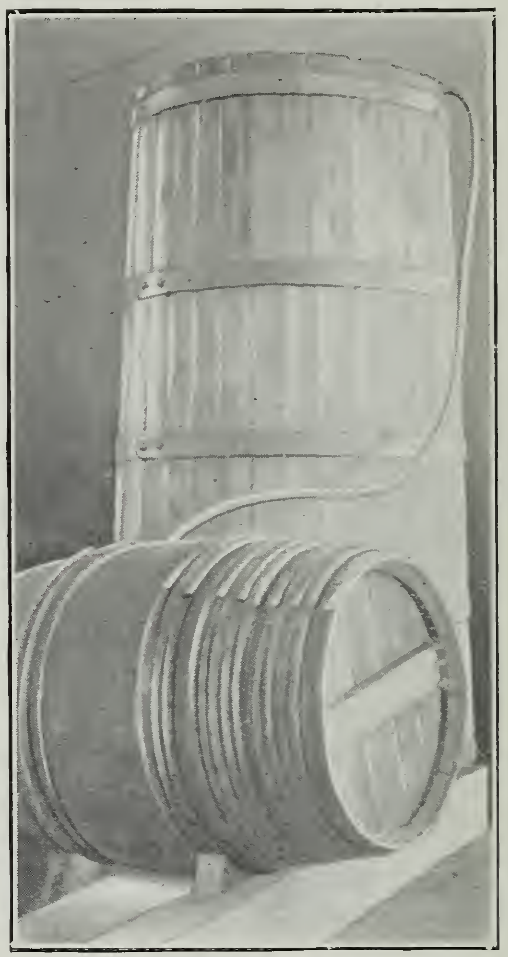
Then pour some pure liquid vaseline into the vat. That is intended to cover the apple juice later on. The liquid vaseline used must be refined so that there is no taste and no flavor in it. The right kind of oil must be secured as the cider would very easily take any bad taste or odor. The quantity of oil to pour into the tank should not be less than 5 ounces to the square foot of open surface. From the press to the vat the juice should be pumped or drawn through a rubber hose used as a siphon, the lower end of this being at the bottom of the tank.

When the tank is filled up, a cover should be put on the top in order to avoid the falling of any dirt or germs into the vat.

Racking.

Notwithstanding the precautions which have been taken, the juice would undergo fermentation after a month or two if the liquid was not carefully separated from the few yeast and bacteria cells which are still therein.

Fortunately the juice will *naturally* become clear within two or three weeks, and a sediment, a few inches thick, will sink to the bottom of the vat. That sediment is called "lees." The liquid above the lees will become very clear, and then practically all the germs (yeast and bacteria) are in the sediment. If we separate the lees from the clear liquid, the



Filling a barrel from a tank.

latter will not undergo fermentation as the yeast is necessary to do that work.

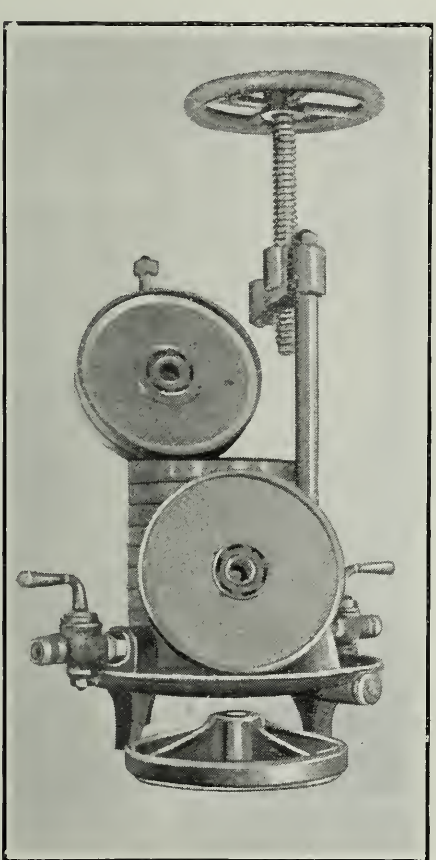
So, let us watch carefully the juice stored in the tanks and see how it settles by taking a little liquid every day. As soon as the lees have settled to the bottom of the tank the liquid juice must be drawn off (or racked).

Sterilize a pump and an empty tank and pour some liquid vaseline into the tank intended for the clear juice. This must be preserved all the time from contact with the air, when flowing from one tank to another under the oil.

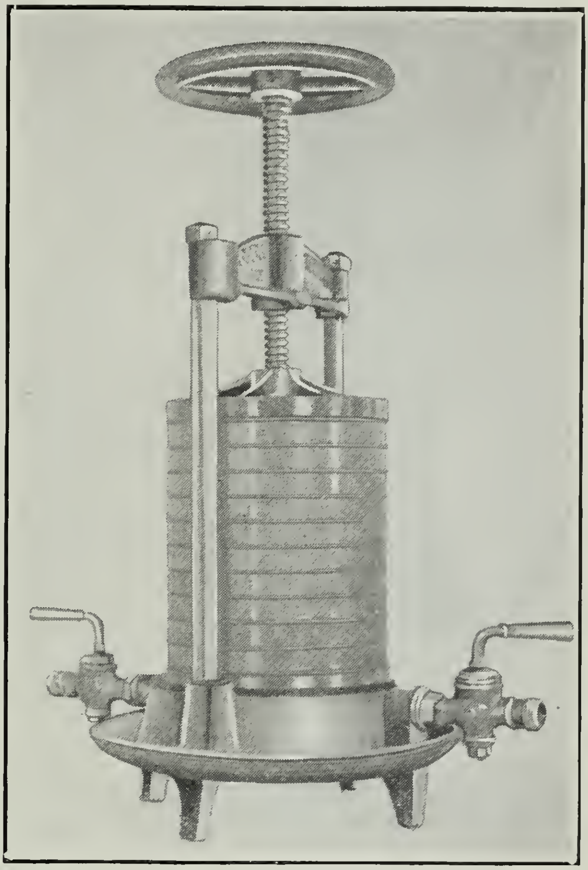
The liquid will very often deposit again and a second racking must take place within a month, after which the juice is very clear and contains so very few yeast cells that it cannot undergo any appreciable fermentation when kept undisturbed in the cold storage.

This apple-juice is ready for marketing, as unfermented sweet cider.

One can draw it from the tanks into sterilized barrels (see our picture), bung them down and ship them a short distance safely. And



The filter.
Showing the disc plates.



The filter.
Ready for work.

yet, after the opening of the barrel this cider will begin to ferment within a week or two if not kept in a cold place.

So, unfermented apple-juice intended for selling at any time of the year should be put into bottles instead of barrels, as it is the safest way to keep cider in good order.

To be a quite attractive drink, the juice sold in bottles must be of a bright color and sparkling. The brightness will be obtained by filtering, and the sparkling by means of carbonic gas.

Filtering.

Filtering is largely used to make wines and beers brighter.

We have filtered apple-juice in order to obtain the same result and also to complete the removal of any germ from the cider.

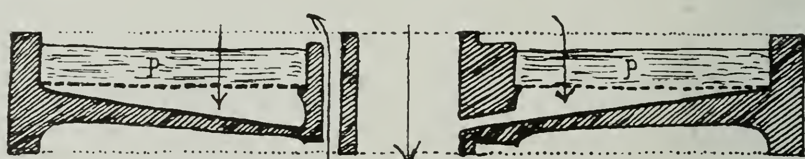
We used the Karl Kiefer filter which did good work. Other filters can be employed as long as the filtering is obtained by straining the juice through materials not liable to alter the quality of the cider and besides retaining any solid particle that may be in the liquid.

The pictures show the filter we have utilized at the Station. That filter is made of a frame and 10 round plates of same size and shape.

We have drawn the cut of a plate in order to make the filtering process comprehensible.

The liquid flows as the dashes show. It goes up through small holes and spreads on the layers of paper-pulp that are laid on a wire-screen. The pressure (given by a pump) forces the juice through the filtering paper. Then the liquid flows towards the centre of the plate and by the means of small openings enters the large central conduit.

Nearly all the common metals are attacked by the acids of the juice, so, all inside parts of the filter should be tin-lined or silver-plated.



The section of a plate of filter.

A good filter is expensive. That used in our experiments is worth $100.00 and the silver-plating cost $10.00. It cannot filter more than 200 gallons a day. So, the filter needed in a big factory should be much larger and more expensive. And yet the use of such a filter is to be commended as the best way to completely check the fermentation by removing all germs from the juice and to give an unrivalled brightness to the liquid.

Many people think that it is not possible to filter the cider when sweet. That is quite wrong. When the juice has settled, the clear liquid is very easily filtered, no matter how rich in sugar. It is not the sugar that makes the filtering difficult, but the pectinous matters and solid particles which are eliminated with the lees when the work is properly done.

Carbonating.

People are very fond of carbonated drinks. The beverages which have the largest consumption contain a certain amount of carbonic gas that is dissolved in the liquid. Such are most of the soft-drinks and beers.

When they are poured into the glass the carbonic gas gives rise to a multitude of bubbles which form a nice froth. The apple juice must be presented in the same way. So we have to carbonate it before the bottling.

I have been told many times that it is not possible to carbonate apple-juice properly.

That may be right in some cases, for instance, when the liquid is not clarified beforehand.

Carbonator. Gas drum and connections.

But our experiments have proved that the carbonating of apple-juice is not only possible, but very easily done. After it has been clarified and filtered the cider is easier to carbonate properly than water.

As the carbonating is quite unknown to most of the farmers and cider-makers, we shall describe that operation.

The necessary implements are: 1st, a cider pump; 2nd, a carbonator; 3rd, some gas drums. The picture shows them and how they are connected.

The juice, coming from the filter, is pumped into the carbonator; it flows in the pipe that is seen on the right. The liquid goes down the long cylinder of the carbonator, making a cascade on the balls that fill that cylinder. So the cider has a great surface of contact with the carbonic gas that is in the carbonator. When the juice reaches the lower part of the apparatus it is saturated with carbonic gas. (The height of the carbonated juice collected in the barrel is shown owing to a glass tube placed on the side of the carbonator.) A pipe goes up from the bottom to the tap that is seen on the right between the barrel and the long cylinder. The liquid flows up in that pipe, and, through a rubber hose, it goes from the tap to the bottling machine that is on the left.

The black cylinder is a gas drum which contains the carbonic anhydride. The drum is connected to the carbonator by a thin copper tube. The pressure and the flow of the gas entering the carbonator are regulated by the means of taps and a gauge showing the pressure to the square inch.

Like the filter, the carbonator is expensive, but necessary to obtain unfermented sparkling apple-juice of good quality.

The carbonator used at the Station is not a very large one and yet its cost is $250.00. This is convenient for a small plant, but a larger size would be needed in a big factory.

The carbonic gas is sold at 8c. a pound.

When the daily work is over water must be run through the filter and carbonator.

Tin and rubber are the only materials coming in contact with the juice during the carbonating process. The carbonator is thickly tin-lined, and all the connecting conduits intended for the cider are tin-pipes or rubber hose.

The pressure used in our experiments was 50 lbs. to the square inch. The result has been quite satisfactory.

Bottling.

The next operation is the bottling.

What kind of bottles and corks should be used?

As to the bottles, the size that seems to suit the trade best is the pint. Of course the glass must be transparent in order to show how clear and bright the juice is.

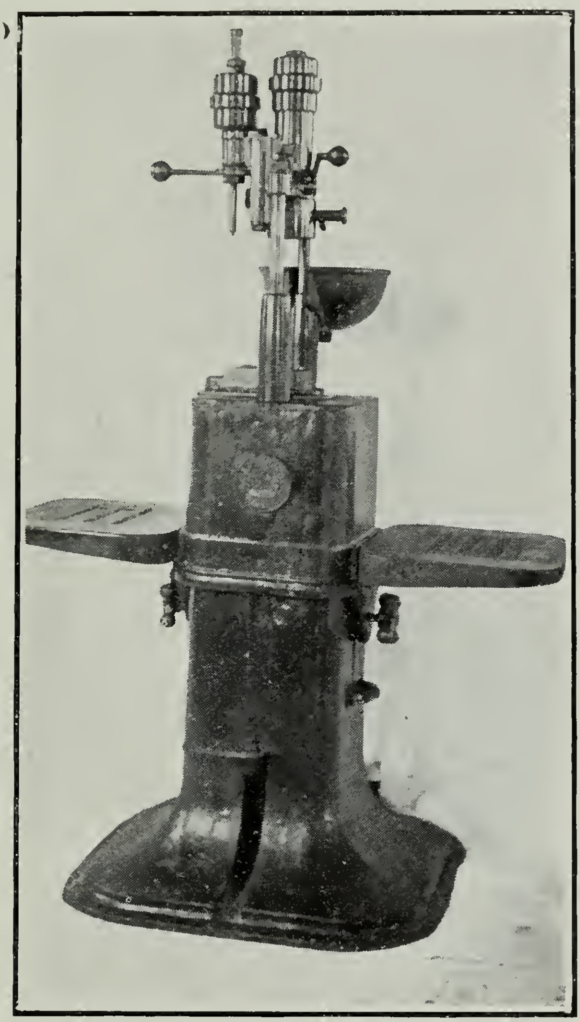
With regard to the corks, the crown is probably the best one.

The advantages of the crown cork are many. It is easy to put on and easy to take off. The crown makes a pretty fitting by itself and so it is not necessary to put any foil on the neck of the bottle. And, lastly, the crown cork is cheaper than any other cork.

The only drawback to the use of the crown is that special bottles (called crown-cork bottles) are required, and these are costly.

Nevertheless, crown-corking is used more and more and should be used for cider in most cases. And yet there will be a market for any high grade of apple juice presented in the same way as champagne. A drink of that kind could easily be sold at 15c. a pint, so giving a very good return to the maker. That will be considered later. For the present, let us explain how to use the crown corks.

The corking machine is seen in the photograph.



Bottling machine.
The crown-cork machine.

The carbonated juice arrives into the head of the machine through the rubber hose that is shown on the figure.

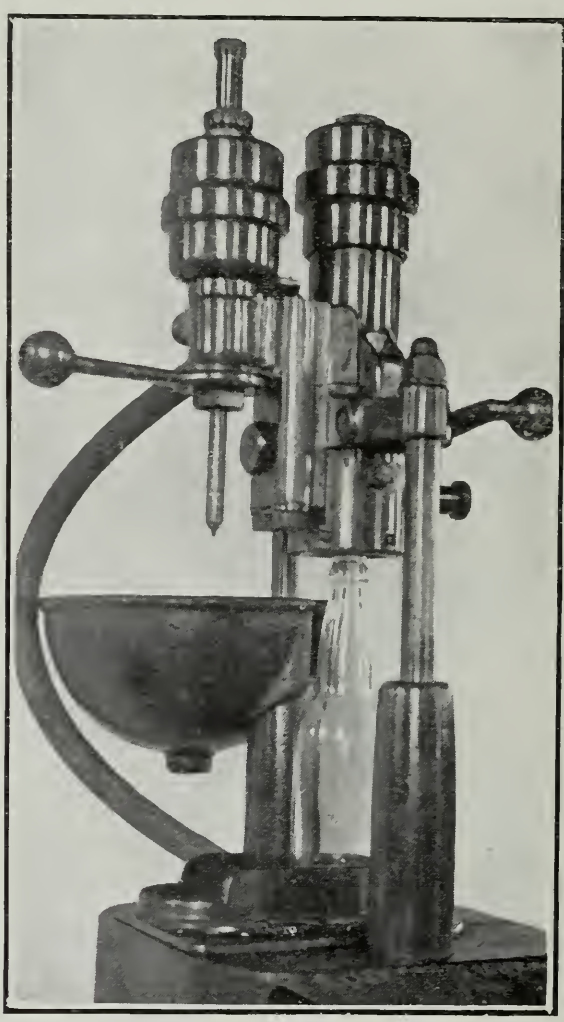
Let us also see how to fill and cork the bottles.

The machine, bottles and corks are first sterilized by the means of a formalin solution (5 per thousand). Of course the formalin must be removed by rinsing with pure water. The operator washes his hands carefully and sterilizes them by a dip into formalin water. One puts some bottles on the little table seen on the left of the machine and a lot of crown corks in the large cup.

A crown is taken and slipped up into a hole (throat) that is at the lower end of the head. The cork is held in the throat by means of four catches.

Then a bottle is placed as shown on the picture. The neck of the bottle is just under the throat, which is provided with a rubber ring.

The operator turns up the handle that is on the right, so narrowing the central hole of the rubber ring. By putting one's foot on the treadle—



Bottle in place for the filling.

that is in front of the machine—one draws the head down so that the rubber ring will make a joint on the top of the bottle.

Then the handle shown on the left is pushed forward until it opens a valve giving way to the flow of the carbonated juice into the bottle. When that is half full one pushes the left handle forward in order to open another valve that will let out the air contained in the bottle. Then by pulling the handle to him the operator reopens the first valve we spoke of, that allows the liquid to flow again and fill the bottle up. The handle is taken back to its first position and one gives a strong, firm pressure down on the treadle. That puts the crown on the top of the bottle. The right handle is then turned down and the operator takes his foot off the treadle so that the head goes up. The bottle is taken off (see the picture) and put on the table shown on the right.

It takes much longer to explain the work than to do it. After some days' practice just a few seconds will be required to fill and cork a bottle.

The crown-cork machine we have used is worth $100.00, and is made by the Aluminum & Crown Stopper Co, Limited, Toronto.

The top of the crown should be decorated with an apple or bear the words apple-cider. Attractive labels, adorned with fruit or apple blooms, should also be pasted on the bottles.

It pays to present the drink in an attractive form.

When labelled the bottles should be placed in a cold storage

Shipping and Selling.

"Cold is the friend of the cider," the Norman says. We must remember that and keep the drink in cold storage as much as possible.

One should use refrigerators for shipping, and every grocer dealing in cider should have an ice box to put the cider in.

Instructions should be given to the retailers asking them to put the cider in a cool place and not in the window as they too often do, so spoiling the beverage.

The bottles shown in the windows should be left there as an advertisement, but never sold.

PART III.—COST OF A PLANT AND PROFIT.

The cost of a cider plant will be very small on any farm provided with a cold storage.

The fruit should remain there until the winter. Then the grinding takes place and the juice can be stored in any room of which the temperature is about freezing point.

The bottling will be done early in the spring and the bottles taken back to the cold storage.

So, the only large expense will be the machinery.

The cost of that which I would use for a 5,000-gallon plant is:

Grater and press	$100
Tanks for 5,000 gallons	150
Filter and pump	150
Carbonator	250
Bottling machinery	100
Various implements	50
	$800
Building	400
	$1,200

By using this small plant it is possible to make a success of the business by the selling of 50,000 bottles a year at 7½c. a pint. bottle—that would be sold at 10c. a piece by the retailer.

50,000 pints can be obtained from 5,000 gallons crushed out of 500 barrels fruit.

If we figure the cost per bottle as follows:

Glass	2c.
Gas, cork, label	1c.
Interest and labor	1½c.
Total	4½c.

That gives a profit of 7½—4½=3c. a bottle, or $1,500 for 500 barrels fruit, that is to say $3.00 a barrel.

So, the culls could pay nearly as well as the No. 1 fruit.

It is needless to say that much larger profits should be obtained by putting up cider factories on a co-operative basis.

PART IV.—THE BY-PRODUCTS.

The return given by the cider-industry can be much increased if the by-products are properly utilized.

These by-products are the pomace and the lees.

What to do with the Pomace.

The pressed apples (pomace) are very often considered as a nuisance and thrown away.

And yet this pomace could be used in many ways.

It could be soaked in water and pressed again, so giving a certain amount of juice. That would not be so rich as the juice obtained from the first pressing, but still fit for making ordinary cider vinegar or brandy.

We do not advocate the use of the pomace in that way. We think that the pomace should be utilized for feeding purposes.

However rich in crude fibre, the pomace is a valuable food owing to its content of carbohydrates and protein.

The greatest part of the apple-protein is not soluble, so it remains in the pomace.

The percentage of protein contained in the apple is less than 0.50 on the average.

In the pomace that percentage is 1.37 according to Lechartier and 1.40 after Wolf.

Therefore, the pomace is about three times richer in protein than the apple. Hence, as a flesh builder, this pomace is about three times more valuable than the apple. Therefore, the pressed apples should never be thrown away, but should be utilized as a food for cows or hogs.

The pomace can be used when soft, but it must be dried for shipping or using after some months. This drying could be done easily and cheaply by the means of kilns.

If intended to obtain a food richer in carbohydrates, one could mix up molasses with the pomace. Besides beans might be used to increase the protein percentage.

At the Horticultural Experiment Station we have mixed up soft pomace and molasses (half and half) and moulded the mixture in "forms" of the same size as that used to make the cheese of apple pulp. (See Pressing.) The "cakes" so obtained were allowed to dry for some weeks. Then we fed some to a cow that took it greedily. A sample analyzed by Prof. R. Harcourt, O.A.C., contained:

Moisture	34.8
Protein	4.0
Fat	3.5
Ash	6.5
Crude fibre	10.6
Soluble carbohydrates	40.6
	100.0

Molasses for feeding purposes is worth about $20.00 a ton at the sugar factory.

How to use the Lees.

In Europe they make brandy out of the lees.

That is not to be commended; we think the lees should be turned into vinegar. Therefore, we shall explain how to make vinegar on a small scale, that being likely what most of the farmers will require.

The lees should first ferment completely, that is until the specific gravity is around 0.999.

If the fermentation is slow a yeast culture and also heat and ammonium phosphate might be used to get a dry cider quicker.

That cider will be turned into vinegar by the means of casks (or barrels) prepared as shown in the picture.

Every barrel is provided with a tap (T) and a funnel (F) fitted up with a rubber tube (R).

Two openings (O and O') are intended for circulation of air.

One starts preparing a culture of *Mycoderma aceti*. One pint of cider and one-third of a pint of ordinary vinegar are poured into some flat vessel which is then placed in a room at a temperature close to 80° F. After a few days a "mother" will grow on the surface of the liquid.

As soon as that mother is secured, the vinegar barrel is half-filled with cider mixed with one-tenth of vinegar. (That is to check the growth of any microbe but the right bacterium, *Mycoderma aceti.*)

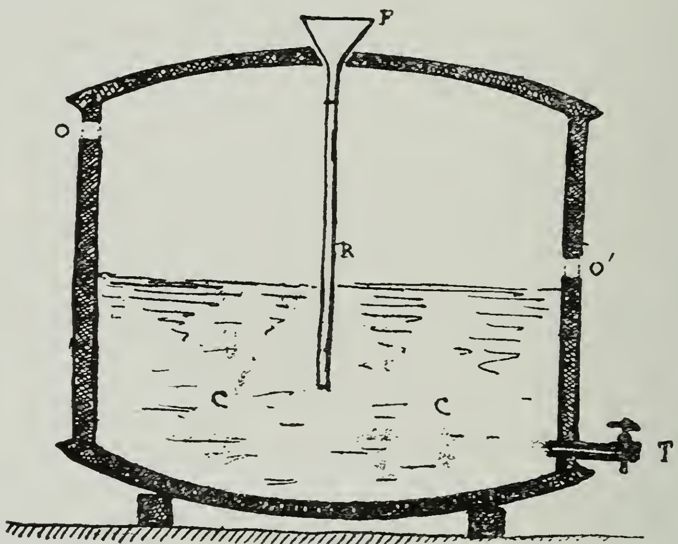
Pieces of "mother" are put on the liquid, through the holes.

At a proper temperature a quick acetous fermentation sets in. Within a fortnight the alcohol is transformed into acetic acid, and, then, one draws off one-third of the liquid by opening the tap (T). When that is done one pours slowly into the funnel the same quantity of cider as that of drawn-off vinegar. Owing to the rubber tube the cider flows under the mother without doing it any harm.

And now, from week to week, a third of the vinegar is taken out of the barrel and replaced by cider.

The vinegar so obtained should be filtered as soon as possible and stored either in barrels or in bottles.

By this process it is easy to make a high grade of vinegar.



Cask for vinegar making.

APPENDIX.

We shall give here the results of some experiments that we have carried on at the Horticultural Experiment Station.

They will illustrate what we have previously stated about the causes of, and conditions necessary to the fermentation.

The parts of the yeast, temperature and nitrogen will be clearly shown.

Our researches have also thrown into light the influence of the variety as to the quality of the cider.

The last part of this Appendix is devoted to the concentration of the juice by freezing it.

YEAST AND LEES.

The yeast-cells are the necessary agents of the alcoholic fermentation. The more numerous they are, the quicker the fermentation of the juice.

When the apple juice settles, most of the yeast-cells are in the sediment.

So, by separating the clear liquid from the lees, the latter will ferment much more quickly than the limpid juice.

The following results of our experiments show the accuracy of the above hypothesis.

Some juice of "Greening" was put in bottles and stored in a cold room. After some days the juice settled. Then the clear liquid was drawn off from some bottles and poured into clean ones, whereas the lees was gathered together.

That was on the 6th of March.

Thence, from time to time, the gravity has been taken with a Beaumé's hydrometer.

The following are the figures that represent the degrees Beaumé at various stages of the fermentation.

Date.	Clear Juice.	Juice.	Lees.
6, 3, '11	6°.3 B.	6°.3 B.	6°.3 B.
15, 3, '11	6°.3	6°.3	6°.2
22, 3, '11	6°.2	6°.0	4°.4
8, 4, '11	6°.1	4°.7	2°.3
12, 5, '11	2°.9	0°.4	0°.3

In the space of one month, the clear juice has only lost 0°.2, whereas the juice (not set apart from the lees) lost 1°.6 and the lees 4°.0, and, a month later, the juice and lees were nearly dry (completely fermented) when the clear juice was just half fermented.

That shows the importance of the "rackings" used in order to check the fermentation.

TEMPERATURE.

We have stated that the intensity of the alcoholic fermentation is closely connected with the temperature.

In order to prove this, we filled up some bottles with clear juice of Greening and divided the experimental bottles in three lots. One of them was placed in the cellar, the second on the first floor of the cider factory and the third in the greenhouse. The mean temperature of the cellar has been about + 5° C. and those of the first story and greenhouse + 10° C. and + 20° C. respectively.

The gravity was taken in each place the same day, from week to week.

Date.	Cellar (5°C.)	First Floor (10°C.)	Greenhouse (20°C.)
6, 3, '11	6°.3 B.	6°.3	6°.3
15, 3, '11	6°.3	6°.3	6°.0
22, 3, '11	6°.2	6°.0	4°.8
8, 4, '11	6°.1	5°.1	0°.4
12, 5, '11	2°.9	0°.2	0°.2

That table shows the great advantage of a low temperature to check the fermentation. Hence the use of cold storages for the making of unfermented apple juice.

As to the cold storage of apple juice, experiments have already been undertaken by Mr. H. C. Gore, of the United States Department of Agriculture. The cold storage was at 0° C. (freezing point). The juice of the varieties tried fermented at that low temperature; nevertheless, the rapidity of the fermentation was much less than under the ordinary circumstances.

So the use of a common cold storage is not enough to avoid any fermentation—at least with the juice of a great many varieties.

That is the reason why the yeast must be taken away by means of rackings, and filterings, if necessary.

NITROGEN.

The yeast cells need nitrogen to multiply.* If they do not find that in the juice, there is no multiplication, and they may be so very few that no fermentation takes place, no matter how favorable the temperature is.

Here are two examples of that influence of nitrogen.

In order to clarify a sample of apple juice a little casein was added to a part of the liquid. The casein, bringing nitrogen into the juice, quickened the fermentation.

* The cells cannot use nitrogen in every form. Soluble compounds of certain classes only are usable.

Date.	Without Casein.	With Casein.
14, 3, '11	7°.7 B.	7°.7 B.
13, 5, '11	4°.7 B.	7°.1 B.

The other instance was given by adding ammonium phosphate to some apple juice, which did not ferment, though at a proper temperature.

What was the reason of that? Want of yeast or poverty in some necessary principle?

The addition of ammonium phosphate determined a quick fermentation. As other phosphates did not cause the same result the role of the nitrogen is obvious.

There are two practical conclusions:

1. Nitrogen compounds should not be employed to refine the juice that is to be sold as unfermented. Therefore the use of casein, isinglass, gelatine, etc., should be rejected.

2. Nitrogenous substances could be added to the juice to quicken its fermentation, if wanted. That is generally the case when the cider is intended for vinegar or brandy. Then neutral ammonium phosphate should be used to prepare a yeast culture.

PROPERTIES OF EACH VARIETY.

The composition of the apple juice varies according to the variety.

Consequently the qualities of the cider vary accordingly, as well as the ways of its clarification and fermentation.

In Europe hundreds of varieties of apples have been analyzed, especially by Mr. A. Truelle in France and Mr. F. J. Lloyd in England. Both have done much for the " Chemistry of the Apple."

But, from a practical point of view, the most interesting feature is probably the work of Dr. B. T. Barker, Director of the National Fruit and Cider Institute (Long Ashton, England).

He completely gave up the old way of making cider with any variety, or rather with unknown varieties mixed up in unknown proportions. He treated separately each variety.

We have just begun to apply the same method to the Canadian apples, and already obtained some useful results.

Three varieties (Baldwin, Greening and Spy) have been compared with regard to their qualities as to the making of cider and unfermented apple juice.

Here are some notes referring to that subject:

Clarification. The apple juice, as we have previously stated, has the property to settle and form a sediment that contains the solid particles which were in the primitive juice. In other words, the juice becomes clear by giving a deposit of lees.

That takes place whenever the juice is placed in a very cold room. But the clarification becomes impossible as soon as the fermentation sets in; that is due to the disturbance caused by the rising of bubbles.

The juices of the three varieties were placed in a cellar, the mean temperature of which was about freezing point.

That was in March, and the fruit used had been kept in a cold storage.

The juices have been watched every day.

The natural clarification took place as follows:

Baldwin	after..............	4 days.
Greening	"	10 "
Spy	"	19 "

Clarification was perfect in every case.

Fermentation. Let us now compare the varieties as to their fermentation.

The table further on shows the results obtained by placing Greening and Spy juices under the same conditions:

Date.	Greening.	Spy.
6, 3, '11	6°.3 B.	7°.7 B.
15, 3, '11	6°.3	7°.7 B.
22, 3, '11	6°.0	7°.5.
8, 4, '11	4°.7	7°.2
12, 5, '11	0°.4	6°.0

(The Baldwin juice ferments as quickly as that of Greening.)

The very slow fermentation of the Spy juice is striking. It shows the possibility of making unfermented apple juice (or, at least, very sweet cider) just by the use of proper varieties.

Any farmer could make a success of that.

The Spy apples should be crushed when the mean temperature of the day keeps under freezing point. The juice—stored in tanks, in a cold room—would settle and give, within a month, a very clear liquid. That should be drawn off into another tank, and then, if possible, put in bottles. By so doing the juice could be sold as unfermented many months after the making. We have kept samples from March until June that did not ferment.

This remarkable property of the Spy juice seems to be due to the lack of nitrogen. The addition of ammonium phosphate (or albuminous substances) to the liquid gives rise to a quick fermentation.

We have mixed up Spy and Greening juices (half and half); the fermentation set in and became nearly as quick as that of pure Greening juice.

JUICE AND CIDER. The peculiarities of the clarified juices were:

Baldwin—

1. Pale yellow color.
2. Sweet and slightly astringent taste.
3. Nice flavor.

Greening—

1. Very pale greenish-yellow color.
2. Sweet and agreeably acid taste.
3. Pleasant, delicate flavor.

Spy—

1. Yellow, a little brownish.
2. Very sweet and slight, peculiar, rather unpleasant taste.
3. Very strong apple flavor.

We have made various kinds of cider with each variety, and we sum up here the results of our investigations.

Baldwin.—Makes good cider of any kind, but especially fit for "Champagne cider." Not suitable for unfermented apple juice if no cold storage can be used.

Greening.—Gives a delicious middle-sweet cider that reminds one of the famous "Devonshire cyders." Cold storage needed to prepare unfermented juice. Not very good when dry.

Spy.—Most suitable for "unfermented sparkling apple juice" and sweet "Norman cider." Not good when completely fermented.

That shows how important the choice of the varieties is, and the value of a careful study of Canadian apples with regard to cider making.

FROST AND CONCENTRATION.

The concentration of the apple juice seems to have a great future. So we shall relate an experiment that might be of great interest to the makers of concentrated juice.

First, what is concentration?

We have seen that the juice is (on the average) composed of

Water	87
Other substances	13
	100

One concentrates the juice whenever one takes a part of the water off.

That concentration may be obtained by evaporating the water.

In the evaporating plants the juice is heated and " boiled down " long enough to get a thick syrup.

This concentrate juice does not ferment. Moreover, its weight is less than one-fourth of that of the primitive apple juice.

The concentrate juice is stored in barrels and shipped safely and cheaply even to remote parts of the Old Country. There it is used in various ways: jellies, jams, syrups, cider and brandy making.

Let us now consider another method available to concentrate the apple juice.

If some juice is cooled down at a lower temperature than 30° F. (—1° C.) it partly freezes.

The icicles that appear at first are almost pure water. So, if one takes away these icicles as they are formed, the juice becomes more and more concentrated.

On March 3rd a pailful of juice was placed outside at a temperature of about 10 degrees Fahr. below freezing point.

After some hours the ice was separated from the juice and melted. It gave a liquid of which the gravity was 4°.7, Beaumé scale. The juice that remained in the pail showed a density of 14°.7 B., and the original juice 7°.7 B.

So it is possible to concentrate the juice in that way—to a certain extent, at least.

The peculiar properties of both liquids obtained by freezing are of interest.

The concentrate juice (14°.7 B.) *is very sweet, very acid, and deep in color. That means it is very rich in sugars, acids and tannins.*

On the other hand, the liquid from the icicles (4°.7 B.) *seems to lack anything but flavor, as if the icicles had included the flavoring essences of the fruit.*

Moreover this liquid of pleasing taste and flavor ferments very slowly. (That is probably because nearly all the yeast and nitrogenous principles are in the concentrate juice.)

Hence the idea of treating the liquid obtained from the icicles in the same way as apple juice in order to make a sparkling unfermented drink.

SOME PUBLICATIONS ON APPLE-JUICE AND CIDER.

1. F. J. Lloyd. *Results of Investigations into Cider-making.* 1903. (Board of Agriculture and Fisheries, London, England.)

2. Dr. B. T. Barker. *Bulletins of the National Fruit and Cider Institute.* (Long Ashton, near Bristol, England.)

3. From the U. S. Department of Agriculture. Bureau of Chemistry. *H. W.* Wiley, Chief.)

   A. Bulletin 71. *A Study of Cider Making.* By William B. Alwood. (1903).

   B. Bulletin 118. *Unfermented Apple Juice.* By H. C. Gore. (1908.)

   C. Bulletin 129. *Enological Studies.* By William B. Alwood. (1909.)

   D. Circular 48. *The Cold Storage of Apple Cider.* By H. C. Gore. (1910.)

4. A. McGill. Bulletin No. 169. *Cider.* (Laboratory of the Inland Revenue Department, Ottawa.)

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Ontario Department of Agriculture

FRUIT BRANCH

PEACH GROWING

F. M. Clement, B.S.A.

It is not my intention to attempt to write a long treatise on the peach, or discuss it from every point of view, but rather to put into readable form a few facts gained from experience and observation, in survey work in the Niagara Peninsula, together with the results of some experimental work in the different States of the Union. The study of the industry in relation to tariffs is the work of the trained economist and the leaders in the industry and will not be dwelt on here. The methods of production, planting, pruning, cultivating, fertilizing, thinning, picking, packing, marketing, etc., are more practical, and must be understood by all growers if good results are to be expected by them. As the supply or production increases, the quality of the fruit must advance if the present good prices are to be sustained. It is for this man, the man who is aiming at quality, that this treatise is written.

We believe that in a few years—perhaps not more than four or five—second and third class peaches will be a drug on the market; but good fruit must always sell at a profit. Growers, as a whole, are learning this very quickly, and as knowledge of the work becomes more general and growers become more expert, the man who refuses to keep up to the times must of necessity be forced out of business; quality must be the first consideration.

Classification.—The peach, in early botanical classification, was known as *Amygdalus Persica,* also as *Persica vulgaris,* but now it is classified with the other stone fruits and known as *Prunus Persica.*

There are five distinct races of peaches in America to-day, known as the Persian, the Chinese Cling, the Southern Chinese, the Spanish, and the Peen To. But we in Ontario are concerned only with the two hardier races, the Persian, to which belong such varieties as Oldmixon, Crawford and Salway, and the Chinese Cling, to which belong such varieties as Carman, Elberta, Greensboro' and Smock. These are well adapted to our northern climate. The other groups are all of a tropical nature.

HISTORY.—The first peaches are supposed to have been brought to America by the early settlers near the end of the seventeenth century, either as small trees or as pits. The pits reproduced true to type, and seemed to be adapted to a wide section of country. They were planted in garden and field, mostly at random, and to-day are found growing wild in the mountains of Virginia, the mother State of peach culture. It is from the crossing of these two groups, Chinese Cling and Persian, under varying conditions, that the most of our present varieties are derived. The first record we have of peaches grown for market in Ontario is from Mr. Dennis Woolverton, of Grimsby, who sold natural fruit in Hamilton market as early as 1820. In 1856, Mr. C. E. Woolverton, of Grimsby, planted five acres of commercial orchard, of such varieties as Barnard, Crawford, Oldmixon and Mountain Rose, and was, we understand, the first to ship by express to distant Ontario markets. From 1890 to 1898 the industry was boomed excessively and fell. Everybody got the "get-rich-quick" idea and planted peaches.. Very few knew how to produce good quality, with the result that large quantities of a low grade product were thrown on the market, which often did not pay the express charges. A severe winter freezing in 1897-98, coupled with the low prices, tended to check production and force out of business a large number of growers. The check was indeed severe, but it was not without its good results. The best of the growers came back slowly with improved methods and a better quality of fruit, until about 1904 and 1905 the supply again began to equal the home demand. This led to better methods of shipment and sale. The year 1904 saw the first shipment of peaches to the West by freight. Co-operative associations, especially the St. Catharines Cold Storage and Forwarding Co., and a number of independent buyers, began a systematic distribution which has greatly increased each year. The buyer deserves a great deal of credit for the market extension. He took the risk and shipped to distant points in quantity fruits that the individual grower must have otherwise cast on the nearby commission market.

The above applies to the Niagara district only. Lambton, Norfolk, and other counties have their history to make. The industry there is still in its infancy, centred around a few good men who are proving that peach culture is a profitable business, and sending the news broadcast to all who have "eyes to see and ears to hear." Watch the above counties grow; climate, markets and general conditions favor them a great deal.

Essex has grown peaches perhaps as long as the Niagara Peninsula, and is second in importance to-day. Repeated freezings have done much injury there, but as improved methods have become more generally understood the industry has become more firmly established, and it is believed that, now, the growers are in a much better position to fight the extremes of winter than formerly. The plantings are increasing very rapidly, and the quality of fruit that reaches the market is equal to the best in Ontario. As in the Niagara Peninsula the plantings during the last few years have increased extensively.

Extent of Industry.—As previously stated, the commercial peach areas of Ontario are comparatively small, except in Lincoln and Lambton, and the counties on Lake Erie. Throughout the Province trees may be found growing in the home garden, but these are not factors commercially. A careful study of the map of Ontario will show that in every case the area where extensive culture is practised is under the influence of a large body of water. In every case the slope is northern, or is so situated that there is a free circulation of air. In Lambton and Lincoln the north wind of winter must of necessity sweep for miles across the comparatively warm waters of the lakes before coming in contact with the buds. It is the regulating of the climate by these waters that makes tender fruit production possible at all. Essex and Elgin and Norfolk are tempered by elevation and by the waters of Lake Erie.

Ontario has within its area 90 per cent. of the peach trees grown in Canada, the 1911 census crediting this Province with 1,681,853 out of a total of 1,884,459 trees. The increase is given as 31.1 per cent, over the census of 1901. Of this number, approximately 95 per cent. are grown in the Niagara peninsula, largely in the townships of Niagara, Grantham, Louth, Clinton, Grimsby, Saltfleet and Barton, along Lake Ontario, and also in Stamford, Thorold and Pelham, in Welland County. The latter three townships are above the escarpment, and contain several square miles of excellent peach soil, but at present only a very limited area is planted.

Lambton County has approximately one hundred and seventy-five acres, or 18,000 trees, with about 50,000 trees ordered for planting in the spring. A large tract of land on the shore of Lake Huron, near Forest, much resembling the land on Lake Ontario in the Niagara district, gives promise of excellent results.

The acreage in Norfolk County is still less than that of Lambton, but the trees now growing are healthy and vigorous. The soil is, in many parts, excellently adapted to peaches, and some large orchards are being planted.

The Leamington district has several hundred acres of trees, the majority of which are well cared for and should prove a very important factor commercially within the next few years.

Some are also grown along the shores of Lake Erie in Kent and Elgin Counties, but the plantings are limited as yet. The possibilities of these districts are, however, greater than is generally supposed.

Nursery Stock.—The seedling trees are grown from the pits of the ripened fruits. It is not long since it was thought that pits from the natural fruit found growing in the Southern States were hardier and produced a stronger root system than the pits of cultivated varieties, but now the practice is, to some extent, discontinued, and the pits of our ordinary varieties are used. The pits are collected in the fall and stored in a cool, moist place, or buried in a broad, shallow hole, two or three inches deep. They must not be allowed to become dry. When thus stored the frost cracks a number of them, and in the spring the rest are cracked carefully so as not to injure the kernel, and at once planted in the field where it is intended the young seedlings shall grow. Care must be taken not to plant too deeply, from one to two inches of covering being sufficient. The rows should be left three and one-half feet apart, with at least eight inches between the pits in the row. Crowding tends to weaken the trees. The soil must be in good condition, both chemically and physically.

By August of the same year the seedlings are ready to bud. The buds are taken from a bearing tree or nursery row of known variety, and placed just under the bark of the seedling about four inches from the ground, and held in position by winding with raffia, the inner bark of the palm tree, in such a manner that it covers the wound but not the inserted bud. This is the ordinary budding operation. As soon as the buds take, or in the following spring, the seedling top is removed, and the new bud given every chance to develop. By the following fall it has grown into a fair sized tree, such as is usually obtained from the nursery. Thus in our climate two years are required to produce a tree from the pit. In the South, where the seasons are much longer, the seedlings are budded in June of the same year the pits are planted, and by fall have attained a size suitable for transplanting. The trees are dug in the fall, and are stored in cellars or storing sheds with the roots in moist sand or moss. This is done to facilitate packing for early shipment in the spring.

The trees are now ready for the grower, and it is here that his interest starts. But it should have started when the trees were seedlings in the nursery row. The budding operation, or rather the choice of bud inserted, should have excited his keenest interest. The cutting of buds from the nursery row or from non-bearing trees, is a practice that cannot be too strongly condemned. There are always many healthy bearing trees in the vicinity of the nursery of the required variety from which it is possible to obtain buds. These trees should be made use of, as it makes mistakes less liable and insures the growth of a tree that has not lost the "habit" of bearing. This applies more largely to apples than to peaches. Budding directly from the nursery row, where Yellows and Little Peach when present are not yet sufficiently developed to detect, is a means of spreading disease that is usually overlooked. Nevertheless, the spread of disease from this source—that is, from diseased nursery stock—is quite common; so common, indeed, that it is calling for special legislation in Virginia and possibly some other States. The Report of the State Entomologist, Virginia, 1908-1909, gives conclusive evidence of the spread of disease through nursery stock.

The practice of budding from the nursery row, besides spreading latent disease, gives no chance for selection. It is a well-known fact that no two trees yield the same average quantity of fruit, even under the same conditions. Some bear very heavy loads every year and some do not bear at all. Which are we going to propagate from, and how are we going to distinguish them until they have proved their usefulness by hard work? For this reason, it is recommended that one man grow the nursery stock for a group of men, each of whom might furnish buds for the new trees that had proved their value on his own farm.

SOILS.—Taking it for granted that the prospective grower is in a district adapted to peach culture, the first point that naturally arises is the choice of soil on which to plant. This is very difficult to answer unless all the conditions are known. There are many orchards on very light sand, giving excellent returns. Also there are some on clay soil doing equally well, which means that to a large extent the grower has matters much under his own control. But the natural soil of the peach is a deep rich gravelly loam or sand loam with the water table at least three feet below the surface. This is important. Surplus water means death to the roots. There is still much natural land available, and on this production is cheapest. Clay soil is not natural peach soil, but may be made so by the addition of humus, thorough cultivation, and under-drainage. Underdrainage, unless the natural drainage facilities are excellent, should come first. Trees on a deep moist—not wet—soil send a tap root as much as three or four feet into the soil and hold firmly, while those on a soil with an impervious or wet sub-soil, send their roots out laterally or horizontally, and are often much affected by the wind. It is common practice in these cases to ridge the trees very highly, so that all water or surplus moisture will find its way to the furrows between the rows. These soils are more adapted to grapes. Peaches on them are an expensive production.

SITE.—The choice of site is as important as choice of soil. It is not expected that every field on the farm is equally well situated, and even though they may all be very good, one must, in some respects, be better than the rest. The investment is of long duration, and when once the work is started a mistake is very hard to rectify. It is well, then, to take special care. Consult your neighbor and find out what the best men of the immediate neighborhood are doing. They can give the best advice for your special conditions. But though location may modify conditions, the principles remain the same.

(1) Use a northern slope, or at least a spot where there is a free circulation of air on the coldest nights. Avoid hollows: frost or cold air settles in them. A southern slope, almost without exception, should be last choice. This is warmest during the bright days of winter and early spring, and is sure to start the buds quicker than the colder northern slope. Wind, on nights we have frost, usually comes from the north. However slight the movement the north slope gets it, while on the south slope the air is perfectly still, and frost is sure to settle there.

(2) Use the dryest soil that will retain moisture. A peach tree must have a large quantity of water, but at the same time there must be no surplus moisture. The tree is very susceptible to it. Keep it dry. Drain the soil.

(3) Give sand or sand loam the preference. At the same time, do not forget the sub-soil. It is just as important as the surface soil, and must

be of a loose, porous texture. Sand is much more easily cultivated than clay, and though it may require a little more fertilizing than clay, the same quantity of humus that will put the clay in first-class condition will make sand first-class also.

(4) Do not plant on a wind-swept hill simply to get air drainage or air circulation, and at the same time do not plant too near a high windbreak. There must be air, but it must not be excessive, or almost entirely shut out. Use common sense.

Preparing the Field for Planting.—The best way to handle a field before planting admits of a great deal of discussion, and many methods are practised. But in a large majority of cases no regular plan is followed

The first year of the Peach Orchard, showing good growth from the whip.

at all. The trees are simply set when the grower gets the inspiration, regardless of what grew on the field the previous year. But this practice is not to be encouraged.

Occasionally the trees are planted in sod, but poor growth and a large percentage of loss is usually the result. Even when sod is fall plowed and well worked down the following spring, the trees do not make the best growth. The practice of planting in a stiff sod and then plowing up to the trees should not be encouraged. The soil requires as careful preparation for this crop as for any other. If early returns are to be looked for, preparation must begin at least one year before planting; longer preparation is better, but this depends much on the methods of cultivation to be followed later. The principle requisite is that the soil be rich and mellow when the trees are set. The trees have to form new root systems and become established. They must be nursed: so do not plant them in sod. It pays to wait a year and get the ground as loose and mellow as possible.

No method could be outlined that would suit the conditions of all, but below are given two extreme methods that have given good results. Each is represented by a good orchard in the Niagara Peninsula.

An 18-acre Peach Orchard of the Niagara District. Trees 2 years planted.

(1) A sand soil in fair condition was sowed to oats and seeded down with clover. The oats were harvested, and the following spring the trees were set. As soon as the clover had made a fair growth it was plowed up to the trees. The soil was cultivated again thoroughly till early fall, when rye was sown. The following spring this was plowed under as soon as it was from twenty to thirty inches high. Again the orchard was well cultivated all summer, and in the early fall seeded to vetch and plowed under the following spring. Besides this the orchard received on an average about two hundred and fifty pounds of bone meal and potash each year per acre in the ratio of two of the former to one of the latter. No crop has yet been taken from the field, therefore results cannot be given, but the trees are equal to the best.

(2) The soil was in excellent condition, both chemically and physically, rich, mellow, and full of life. The trees were carefully set and crops of vegetables, etc., grown for the first two years. Heavy applications of manure were applied each year for the intercrops to feed on. During the third and fourth years, heavy leguminous cover crops were grown and

returned to the soil. The grower hopes in this way to add such a quantity of humus and vegetable matter that it will not be necessary to apply barnyard manure or another cover crop for some years. Commercial fertilizers are to be added each year when the orchard begins to bear.

It will be noticed that in the first case the soil was poor when the trees were planted and the whole object of the owner was to build it up and get as much growth in the trees as possible before they began to bear. In the second case the soil was already highly fertile, and the owner grew an intercrop for two years, but took nothing from the soil that he did not replace. The next two years were intended to force growth on the trees, and fill the soil with humus before heavy crops of fruit were to be expected.

One orchard is as good as the other, and the principles involved will apply to almost any conditions. The above two methods differ from general practice only in that the grower fed the trees to get returns instead of waiting for the trees to produce a crop with which to buy manure to feed them to produce a second crop.

Varieties.—This selection of varieties is as important as the selection of the site. A few known varieties have established themselves in almost every district, and it is much better to follow the advice of the grower who has proved them, than the advice of the nursery agent. A few trees of the newer varieties may be worth trying experimentally, but it is not good practice to plant a large number of them until certain of their value.

How many different varieties to plant must, of course, depend on the size of the plantation, the market catered to, the ambitions of the grower, and the conditions under which he is working

Labor in the picking season is an important factor. A grower has often to depend on his own family, and in that case it is well to extend the ripening season over as long a period as possible. Or he may be growing for the factory, and wish to dispose of the crop before the apples are ready, when fewer varieties would be better. All varieties are not good canners. Or he may be catering to a special fancy trade, when the mid-season varieties would be best. But whatever the factors influencing the choice, *quality* should be the first consideration. There are plenty to choose from—sixty or more under cultivation in the Niagara Peninsula to-day—besides new ones coming in and poor ones being discarded yearly.

The following are recommended for the commercial plantation, for Canadian markets, covering the entire season. There may be some varieties equally as good, but the following ones have held their place and proven their value. They are given in the order of ripening, and though each is recommended it does not follow that they should be given an equal place in the plantation. Some are better than others.

(1) *Alexander,* first peach of any importance to reach the market; ripens in early August; poor quality, cling pit and inclined to be wormy; its only value is in its earliness; comes into competition with Southern fruit.

(2) *Triumph,* ripens about mid-August, largely planted, but not exceedingly popular on the market on account of its downy skin, dull color, and susceptibility to rot, has a small place following the Alexander, but is no advertisement of what is to follow.

(3) *Yellow St. John* is the first good yellow-fleshed peach to reach the market. Ripens from middle till last of August, good color, good quality, heavy bearer, good shipper; is one that everybody grows.

(4) *Early Crawford,* ripens in early September, good quality, good color, good shipper, and well known to the trade; many other varieties of the same type are sold under this name.

(5) *Garfield* or *Brigdon,* ripens the first of September, good peach of Crawford type, medium size, excellent color, good shipper; fills the space between St. John and Crawford.

(6) *Reeves Favorite,* ripens with New Prolific; good size and color, good shipper; is a favorite with a large number of growers.

(7) *Niagara,* ripens same time as Chair's Choice; inclined to bunch, good quality, good shipper, very large size, well recommended.

(8) *New Prolific,* ripens from mid to late September; very heavy bearer, medium size, good quality, good shipper, responds to manure, cultivation and thinning. This latter quality caused a prominent grower to remark: "If I could grow but one variety, it would be New Prolific."

(9) *Elberta,* ripens about ten days or two weeks after Early Crawford; large size, fair quality, best shipper; best commercial peach and more largely grown than any other variety.

(10) *Crosby,* medium sized, rich yellow-fleshed peach; a good canner and one of the best quality peaches grown.

(11) *Chair's Choice,* good peach, good quality, good shipper; is well recommended and planted very largely.

(12) *Smock,* best late peach we have; fair color, fair quality, excellent canner, ships well to distant markets.

Any five of the above varieties would make a good combination for the commercial orchard.

To show the difference of opinion regarding the varieties, the choices of five prominent growers are here quoted.

I. Triumph, St. John, Crawford (type), Elberta, Crosby, Chair's Choice, Niagara and Smock.

II. Triumph, St. John, Crawford, Fitzgerald, Elberta, Niagara.

III. St. John, Fitzgerald, Reeves Favorite, Jacques Rareripe, Elberta and Oceana.

IV. St. John, Fitzgerald, Crawford, Reeves Favorite, New Prolific, Elberta.

V. St. John, New Prolific, Elberta and Niagara.

It will be noticed that St. John and Elberta appear in every list.

The smaller varieties are gradually being discarded; size and color bring the price.

The four following are preferred by the factories for canning purposes: Hill's Chili, Elberta, Crosby and Smock.

Hill's Chili, not described above, is a medium-sized, firm peach of good quality, medium bearer, ripening just before Elberta.

It will also be noticed from the above lists that, excepting the early varieties, not a single white-fleshed fruit or cling-stone is recommended. This is not surprising, as far as cling-stones alone are concerned, but when we consider that some white-fleshed peaches are large and of excellent quality we have cause to wonder. But the Canadian market does not demand and will not pay as high a price for a white-fleshed peach as for a yellow. The English market likes the white flesh, and in the future there may be a large demand; but at present the planting of them is not recommended. Oldmixon, Mountain Rose, and Carman are our best white-fleshed varieties.

When making a selection of varieties, it is well to aim at prolificness, size, color and shipping quality, combined with texture and flavor. But it is size and color that bring the price under our present system of marketing, and no matter what the quality and flavor, unless it has these two qualities, it will be lost in the keen competition.

Are some varieties over-planted? It cannot be said that they are, unless it is such varieties as Greensboro, Rivers, Alexander, Smock, etc., which are lacking in size, color and quality. Elberta, St. John, New Prolific and Smock are perhaps planted heaviest, in the order named, but as yet no one has failed to get a fair price for good fruit of these varieties. Smocks would be over-planted if it was not for the fact that the factories take a large percentage of the production.

Selection of Stock, Time to Plant, Etc.—Because of a large demand for young stock, a large number of inferior trees, so-called, have been put out by the nurserymen in the last few years. The greatest demand is for the larger trees—four to six feet high. Trees with straight trunks, three or four feet high, are next in demand. These latter really have a decided advantage over the former because of less loss in transplanting, and because the grower can head as low as he chooses and expect to get fair results. The smaller and tenderer the bark is, the more likely are the chances of a well-distributed growth on the trunk. I do not mean to advocate the planting of second-class trees, but rather first-class trees of medium size, with good root systems. These can be headed as low as twenty inches or less. They should be one year old from the bud.

Instead of cutting back to a whip, if there are any side branches it may be advisable to prune them back to two or three buds and leave them for the framework of the tree. This is only good practice, however, when they are properly spaced, four to six inches apart, and arranged around the trunk. At least three branches should be saved; four is better.

It may sometimes be advisable to use both methods—cutting back to whips and leaving side branches—in the same row. Good judgment must be used and the choice made after the tree is set.

Spring planting is advised, as a tree not well rooted may dry out and die during the winter. But fall planting is being practised more and more every year, and where labor is scarce and time pressing in the spring it may be well to plant in the fall and risk loss by winter drying and freezing.

DISTANCE TO PLANT.—The distance apart to plant depends a great deal on the system of pruning to be followed later. Where severe heading-in is practised, 16 feet by 16 feet is a good distance, but that is the extreme advised. The greatest distance practised is 20 feet by 20 feet, but the orchards set at this distance are very limited; 20 feet by 20 feet is the best distance for the average grower, and is being gradually adopted, especially in the larger plantations; 18 feet by 18 feet is the distance most in favor in the townships of Louth, Clinton, Grantham and Niagara. Eighty-four orchards out of two hundred and forty-three visited in 1910 are planted this distance. In Saltfleet, Barton and North Grimsby, 16 feet by 16 feet is the favorite distance, 18.6 per cent. being planted this distance. Sixteen per cent of the orchards are planted 15 feet by 15 feet, but apparently are much too close. In Niagara Township, where land is cheaper than farther west, 20 feet by 20 feet is the favorite distance. The rule that on dearer land the trees are planted closer seems to hold good, but it is very doubtful if this is a profitable method of intensive culture.

Following are the distances apart the trees were planted in the orchards surveyed:—

18 x 18	129	orchards	20 x 20	57	orchards
16 x 16	111	"	16 x 18	45	"
15 x 15	89	"	16 x 20	19	"
18 x 20	62	"	Other distances	137	"

Besides the square and rectangular systems of planting, the diagonal and hexagonal systems are sometimes used. Neither is recommended for peaches, as the tendency is to plant too many trees to the acre, even on the square system. The diagonal and hexagonal systems allow a greater number of trees to the acre.

PRUNING.—The following observations regarding pruning should be carefully considered:—

(1) *The Principles.* The subject of pruning is one of wide discussion, and it is doubtful if any two agree exactly in their methods of operation. Simply cutting pieces from the root or limbs is not pruning. There are certain principles to be followed, and no matter how varied the methods these remain the same.

1. The habit of growth varies with the different fruits.
2. One branch lives at the expense of another.
3. Heavy winter pruning induces wood growth.

4. Plants grow from uppermost or outermost buds.
5. Cutting off terminal buds develops the lateral buds.
6. Pruning thins the fruit.
7. Heading-in in summer and checking wood growth induces fruitfulness.
8. Pruning depends on climate, moisture and general conditions.

Three-year planted Peach Tree unpruned.

(2) *Root-pruning*. How severe to cut back a root before planting admits of discussion, but it is agreed that all dead, injured or broken pieces should be removed so that a callous will have a chance to form on an even, healthy surface. Both methods, cutting back to a stub and leav-

ing all the roots, have their advocates, but the following experiment, taken from Delaware Bulletin XLV., would indicate that an intermediate method is better.

Fifty-four Crawford trees were used in each experiment, that is, three eighteens, and the roots were cut back to eight inches, three inches, and stubs or all roots removed.

In clay, cut to 8 inches, 17 lived, 17 were first class.
In clay, cut to 3 inches, 18 lived, 18 were first class.
In clay, cut to stubs, 10 lived, none were first class.
In sand, cut to 8 inches, 18 lived, 18 were first class.
In sand, cut to 3 inches, 18 lived, 17 were first class.
In sand, cut to stubs, 17 lived, 2 were first class.

Same tree pruned for high quality fruit.

The experiment was conducted with apples, pears and plums also. The following results were obtained:—

8-inch pruned, 91.0 per cent. lived, 91.0 per cent. first class.
3-inch pruned, 98.5 per cent. lived, 93.7 per cent. first class.
Stub pruned, 72.5 per cent. lived, 36.5 per cent. first class.

These results would indicate that it pays to cut back the roots to from three to eight inches.

HEADING.—Ten years ago, low-headed trees were very rare, but to-day, perhaps, one-half being planted are as low as twenty-four inches. The idea is gradually spreading, and now it is very seldom that we see a young orchard headed from three to four feet high. The idea in a low-headed tree is to get the fruit as near to the ground as possible, so that it can all be picked from the ground or, at most, from a two- or three-foot ladder.

FIRST PRUNING.—Do not start to prune unless you have a purpose in view. At the end of the first season, the trees should have made considerable growth. New Jersey Bulletin 219 puts it at from two hundred and seventy-five to three hundred inches linear growth on an average per tree. It may be necessary to prune away one-half or two-thirds of this, but the object is to form the framework of the tree and any unnecessary branch should be sacrificed to this end. Three or four branches well placed are much better than five or six poorly placed. The severe pruning will stimulate growth and give a large number of branches to choose from the following year. It will not increase the size of the trunk, but rather increase the number of laterals.

SECOND PRUNING.—The pruning at this time should be much the same as that of the previous year. The framework of the tree is started and it is simply necessary to thin out the new wood. Keep out the central limbs, as they develop at the expense of the laterals and tend to make the tree too upright. Heading-in a limb just above a bud on the outside tends to force outward growth and to widen the tree. Keeping the centre open encourages new growth from the centre. It is the wood produced this season that must produce the fruit the following year, that is the fruit when the tree is three years of age.

THIRD PRUNING.—Up to this time we have been pruning for wood growth and to direct the formation of the tree. Now it is time for the tree to produce. To thin out too severely or cut back very heavily may mean the loss of a large number of fruit buds. It is well then to wait till late spring, when the crop prospects are fairly definite before beginning pruning. A tree three years old should bear from one to two baskets; sometimes they bear much more, but usually a great deal less. And this quantity is given only as a guide to indicate what is possible at that age. The thinning out of the very thick parts of the tree and the removal of such branches as are drooping or are likely to be injured during cultivation may take place at any time. Whether to head-in or not is at the discretion of the grower. Too severe cutting back, one-half or two-thirds, is not recommended. Thinning out and cutting back about one-third would be much better. No one can tell how to prune. We must have the tree before us and do the work ourselves. Very severe cutting back or heading-in, in the colder districts is not practised because of the small tender growth thus produced.

Winter Pruning.—The general practice up to three years of age is to prune as previously indicated, but still there are some excellent growers who, up to that age, do not prune at all. They claim that just as strong growth can be obtained and that the trees fruit much better. And results do not prove that their contentions are wrong. But the great objection is that when the tree is allowed to grow at random so long it is very difficult to form a regular well-balanced head. No evil will result from directing the growth from the start.

Thinning out a little and cutting back the ends of the branches each year tends to keep all the bearing wood on the ends of the limbs and high up in the air. A good plan is to keep the centre open so that new growth is always coming on, which will take the place of the old wood when its day of usefulness is past or when the bearing wood has grown out of reach. Renew the tree gradually. Cutting down into the old wood to stimulate new growth is often very advisable. A tree cannot be kept low simply by cutting off the ends of the branches. The pruning must be from the bottom up. The amount of wood to leave in a tree varies a great deal, but it is always well to leave it sufficiently open to allow of a free circulation of air. The leaves are the food manufacturers and they must have sunlight in order to do their work. Leave the tree so that the sun can shine on each leaf at some time during the day.

Summer Pruning.—Summer pruning is practised systematically very little as yet. A number are experimenting, and the idea is spreading; but we have no definite results. Cutting and levelling the tops of the trees simply for appearance is not pruning.

The time to cut back is just when wood growth has almost or entirely ceased. The idea is to remove the terminal growing point and buds so as to throw the strength being used by it into the fruit buds. It may be cut back only an inch or two, or it may be as much as one-third of the total growth. A good example of how summer pruning acts is in the pinching out of the terminal growth of a rank-growing tomato plant in a greenhouse. It will cause the ripening fruit to burst. Similarly, the fruit buds are stimulated by the increased food supply. Care must be taken not to cut too early, or before the growth has almost ceased, because in that case small, weak growth will be forced out from the terminal and lateral buds and the strength of the tree will go into them rather than into the fruit buds.

Intercropping.—Many growers cannot afford to wait three or four years for the first returns from their land. Limited capital forces the growing of intercrops. The growing of such crops is not advised, but still, if the soil is properly cultivated and fertilized, no great evil can result. But it must not be continued when once the trees begin to bear. Potatoes, tomatoes, corn or any other hoe crop between the rows are recommended for the first and second year. Strawberries, set the year the trees are planted, may be used. Currants, raspberries, gooseberries, etc., are sometimes used, but then the tendency is to favor the bearing intercrop rather than the trees. They do not come into bearing sufficiently early to be recommended. The practice of growing another crop between the rows of bearing trees cannot be too strongly condemned. It is practised quite largely, but it is very difficult to see where there is any real gain.

Cultivation.—The cultivation of the orchard is a subject much discussed and opinions must always differ. But in every case the principles must be the same. Under the head of cultivation, fertilizing and cover crops might rightly be discussed also. The one operation overlaps the other.

When shall I plow my orchard, how often and how deep? is often asked. The soil itself, kind and condition, and your ideal of culture, must be the answer to the question. Some soils, especially the clays and clay loams, must be plowed to get a mellow surface. If a cover crop is sown and allowed to grow to a fair height, a plow must be used to turn it under. If the soil is a sand or sandy loam, and no cover crop is used, it is not necessary to plow, though some advocate it strongly. To twenty who are getting good returns, who plow in both spring and fall, fifteen plow in the spring only and seven in the fall only, while three do not plow at all and ten have no regular time. The three who do not plow do not leave their orchards because of carelessness, but because they feel that the same amount of work can be done cheaper with the disc and harrows and just as good or better results obtained. Ridging up for winter can begin in early summer and continue till it is time for cultivation to cease. An out-throw disc used with discretion will do this quite nicely. Many are doing it. Where the orchard is not ridged up in this way, it is necessary to fall plow, especially when there is a lack of underdrainage. The furrows between the rows will then carry off the surplus water. Also, it is preferred to have the orchard go into winter with the soil as firm as possible. A few weeds standing can do no further damage but really hold the leaves and snow.

Too early spring plowing is not recommended either. Allow the weeds to start. They will draw some surplus water from the soil and it will warm up quicker. The theory that plowing when the trees are in blossom causes the blossoms or young fruit to fall is not well founded if the work is carefully done. True, a great many plow just after the fruit is set, but that is because the soil happens to be in a fit condition just at that time. Also, by this time, if a cover crop has been used, it will have reached a fair height and will add considerable humus to the soil. From now till about the first or middle of July cultivation must be continuous. Harrowing once or twice a week is not too frequent; twice is better than once. This is the critical time for the tree. The young fruit is growing and the fruit buds are forming in embryo. Some continue the cultivation up till picking time or until the bending of the tree with fruit prevents; but this late cultivation is wasted unless the season is very dry, and besides there is danger of sending the wood and buds into winter in an immature condition. A shock to the tree, such as limiting the food supply or cutting down the moisture, will cause a storing-up of food in the tree and a development of the fruit buds. This is best obtained by the use of a cover crop or by ceasing cultivation and allowing the weeds to grow; a cover crop, not weeds, is recommended.

In the counties bordering on Lake Erie it is recommended that cultivation cease and the cover crop be sown by the first of July, as there is more danger here from winter injury than in Niagara and Lambton.

The depth of plowing and cultivation varies, but in no case is more than five inches recommended; four is better. The extension disc is the best implement for the low-headed trees, but at the same time extension harrows play an important part; a spring tooth is often of more value than a disc.

MANURES. (1) *Manure and Cover Crops.* Cultivation is the cheapest and most valuable fertilizer at the disposal of the fruit grower. Orchards on sandy loam soil have been known to produce good crops for six or seven years in succession without farmyard manure or commercial fertilizer, but they have always had a good supply of humus and thorough cultivation. The best cover crops are largely the same composition as farmyard manure, and with the exception of being unable to seed the soil with the organisms of decay, can take their place in every particular. The following is the chemical analysis of the three most prominent cover crops compared to farmyard manure. The figures show the percentage:

	Nitrogen.	Phosphorus.	Potash.	Water.
Vetch	.65	.146	.475	79.15
Red Clover	.41	.13	.45	80.
Rye (green)	.33	1.5	7.5	
Manure	.5 to .75	.5 to .75	.25 to .375	

Vetch and Red Clover are legumes, and consequently take a large supply of their nitrogen from the air, and when they decay give it to the soil. Rye is not a legume, but has the power of breaking up, absorbing and making available a large quantity of potash. It supplies a large quantity of the much needed humus. Rye when left too long before plowing becomes tough and fibrous, and does not decay readily, but if handled at the proper time is in no way objectionable.

As the table shows, any one of the three crops mentioned gives, when plowed under green, almost as much plant food ton for ton as the manure.

(2) *Commercial fertilizers.* Commercial fertilizers, without humus, have no place in orchard management, and therefore must be used in conjunction with a cover crop or farmyard manure. True, nitrate of soda is readily absorbed without humus, but it is the only fertilizer in common use that is absorbed by the plant in the state applied. The others, through the action of humus, must first undergo chemical change.

Potash is applied either as the muriate or sulphate, the former being in most general use, though the latter is equally available. Phosphorus is applied in a number of forms, such as kainite, ground bone, Carolina rock, superphosphate, etc. The ground bone and superphosphate are best known. For quick returns, use the very finely ground bone or the superphosphate. The latter acts the quicker, but for prolonged returns the coarsely ground bone is best. This must be broken up and well decayed before it becomes available.

The application of nitrogen in a leguminous crop is much cheaper than in nitrate of soda.

(3) *Combinations.* From data gathered this summer, 1910, the following methods of fertilizing are selected:

1.	10 tons farmyard manure @ $1.50	=	$15.00	
2.	6 tons farmyard manure @ $1.50	=	9.00	
	200 lbs. bone meal @ $1.50 per cwt.	=	3.00	
	100 lbs. muriate @ $2.15 per cwt.	=	2.15	
				$14.15
3.	30 lbs. vetch @ $6.00 per bus.	=	3.00	
	200 lbs. bone meal @ $1.50 per cwt.	=	3.00	
	100 lbs. muriate @ $2.15 per cwt.	=	2.15	
				$8.15
4.	20 lbs. red clover @ $9.00 per bus.	=	$3.00	
	200 lbs bone meal @ $1.50 per cwt.	=	3.00	
	100 lbs. muriate @ $2.15 per cwt.	=	2.15	
				$8.15
5.	1 bus. rye @ 95c. per bus.	=	$0.95	
	20 lbs. vetch @ $6.00 per bus.	=	2.00	
	200 lbs. bone meal @ $1.50 per cwt.	=	3.00	
	100 lbs. muriate @ $2.15 per cwt.	=	2.15	
				$8.10

Any one of the above methods is recommended. Choose the one that suits your conditions best.

(4) *Chemical Analysis.* The following is the analysis of the fruit, wood and leaves from nine-year-old Elberta trees, showing the comparative amounts of the fertilizer constituents removed by the different parts of the tree. Two other varieties, Champion and Hill's Chili, though not grown much with us, are given also. (Geneva Bulletin 265.)

	Total weight.	Water.	Nitrogen.	Phosphorus.	Potash.
Elberta	249.64	201.29	.473	.151	.424
Champion	190.03	150.04	.633	.130	.668
Hill's Chili	251.08	203.69	.757	.175	.714

Total weight includes fruit, leaves and new wood, and the results are in pounds.

The total dry matter removed on an average per tree was almost 46 pounds, distributed as follows:

In the pulp	17 lbs. or	38 per cent.
In the stones	6.5 lbs. or	14.5 per cent.
In the leaves	17 lbs. or	35.5 per cent.
In the new wood	5.5 lbs. or	12 per cent.
	45.0 lbs. or	100 per cent.

Each tree removed from the soil .6 lbs. of nitrogen, 19.3 per cent. of which was in the pulp, 4 per cent. in the stones, 67.7 per cent. in the leaves and 9 per cent. in the new wood. Also each tree removed .15 pounds of phosphorus, of which 42 per cent. was in the pulp, 5 per cent. in the stones, 44 per cent. in the leaves, and 9 per cent. in the new wood. In potash each tree removed .6 pound, of which 49 per cent. was in the pulp, 1 per cent. in the stones, 45 per cent. in the leaves and 5 per cent. in the new wood.

Any one of the five methods of fertilizing previously mentioned will replace in the soil the fertilizer removed by the crop.

Thinning. The average orchardist does not really know the meaning of thinning as applied to the production of first-class fruit. To many it is a fancy touch and means labor for which no returns are to be expected. A few recognize the real value of thinning. The general reply of the grower, when asked if he thins his fruit, is: "Yes, with the pruners." This means that an attempt is made while pruning to remove all surplus wood, leaving only enough new wood and buds to produce a moderate quantity of fruit, or just what the tree can grow to good size and ripen nicely. But this manner of thinning is not usually a success, as it tends to leave the fruit in bunches. Most growers have not sufficient moral courage to cut away half of the tree, and when the fruit is left in bunches it cannot be expected to attain as great a size and reach as high a color as when scattered well over the tree.

Hand thinning has been one of the most important factors in the production of high-class fruit in the West. The neglect to thin has been one of the reasons why trees in many sections bear only once in two years, and then flood the market with inferior fruit.

Besides the advantage of producing a higher quality of fruit, thinning has the advantage of preventing the over-working of the tree, so that fruit buds are produced for the following year, preventing damage from breaking down with excessive loads and developing regular bearing habits in the tree.

When to thin is a disputed point, but immediately after the "June drop," when the peaches are about the size of shelled walnuts seems a very satisfactory time. At this time the pits are forming and are just distinguishable from the rest of the peach. Less than a week later the shell has begun to harden.

What to remove is simpler to understand than when to remove it. Any grower knows that double fruits can never make first-class specimens. Shrivelled, stung, wormy, or otherwise defective fruit has no place on the well-cared-for tree. Leave the largest and as close to the main limb as possible, with plenty of leaves between the peach and the end of the branch.

Very few know how to thin. The grower hates to see thousands of good fruits thrown to the ground. He wants all, and in his eagerness is not willing to sacrifice quantity for quality. Most growers leave too much fruit on the tree.

The following is the result of an experiment concluded on fifteen St. John trees in the summer of 1910: The trees were healthy, of average size, nine years of age, and headed and pruned rather high. The previous year they had borne no fruit at all—the first time they had ever failed—and now they were very heavily loaded. These trees were chosen because they gave a chance to observe the greatest extremes. The thinning was done on June 25th and 27th. It required approximately two days to do the work. Distances in thinning can only be guessed at, and a statement of distances must necessarily convey widely different ideas to different persons.

Natural, means that the tree was left with what fruit, in the opinion of the experimenter, it could mature properly.

	Firsts.	Seconds.	Culls.
Unthinned	32½ lbs.	194¼ lbs.	328 lbs.
1 to 3	201½ lbs.	404½ lbs.	62¼ lbs.
3 to 5	245¾ lbs.	295½ lbs	9 lbs.
5 to 7	252 lbs.	183½ lbs.	5¼ lbs.
Natural	253¼ lbs.	219½ lbs.	30 lbs.

Unthinned	6.392 peaches.	weighing 555.25 lbs.,	worth	$7.75
1 to 3	4,503 peaches,	weighing 667.75 lbs.,	worth	22.01
3 to 5	3,466 peaches,	weighing 550.25 lbs..	worth	20.76
5 to 7	2,595 peaches,	weighing 446.25 lbs.,	worth	17.55
Natural	3,209 peaches,	weighing 502.75 lbs.,	worth	18.73

It will be noticed that the returns from the unthinned trees are very low. This is accounted for by the fact that the trees were extremely heavily loaded. The trees thinned from one to three inches, or just so two ripe peaches would not touch each other, as nearly as could be judged in the early part of the season, gave the highest gross returns. Thinned the greatest distance, or so not more than one peach was left on each twig unless it was exceptionally large, gave the lowest returns. This, however, would not have been the case if the fancy fruits had been graded as such and sold at the fancy price. Also, it was a year in which there was a good demand for almost any grade of fruit. The value is reckoned at seventy-five cents a basket for firsts and fifty cents for seconds. Some of the best sold for one dollar, but as the exact amount is not known no account is taken of it here.

Rather than thin to a set distance, it is much better to thin to the tree—that is, leave on the tree just what it can ripen nicely. This requires much judgment on the part of the grower. It is very seldom that two trees, even of the same age, are alike in growth and vigor. A tree at the end of the fourth summer should produce a basket of fruit. Some produce more, some less. At the end of the next summer it should produce two baskets; at the end of the next, four; and at the end of the eighth year, ten baskets, or an increase of two baskets a year up to eight years of age. This would be a maximum average, and is given only as a guide, not as an absolute rule, to follow when thinning. Small areas have been known to produce much heavier than this for one season, but the increase cannot be expected to be so great when the trees have once reached maturity. The idea is to remove when small all fruit that the tree is not likely to ripen properly. You know the health and vigor of the tree and how, what and how much you fed it. The tree can draw just a certain amount of food from the soil, and the question is how many fruits is this food to be divided up among. The pits always claim first attention, and it is only after they have been satisfied that the flesh and next year's fruit buds are developed. You have it within your power to say how much shall be left for flesh and buds. Ripen as few pits as possible consistent with quantity.

The Fourteenth Report of the Delaware College, 1902, gives the following percentage composition in the absolutely dry state of Elberta peach.

	Potash.	Phosphorus.	Nitrogen.
Buds	1.67	.85	2.77
Flesh only	2.32	.24	.63
Pit only	1.35	.72	.427

Taking the moisture into consideration, we have the following figures (New York Bulletin 265, Elberta peach):

	Moisture.	Potash.	Phosphorus.	Nitrogen.
Flesh	88.78	.150	.041	.059
Stones	32.67	.067	.081	.254
Leaves	63.78	.305	.141	.779
New wood	44.52	.222	.121	.431

Or, in other words, it takes in round numbers four times as much nitrogen, twice as much phosphorus and half as much potash to make a pound of pits as a pound of flesh. But we need potash for the leaves, which require more than twice as much as the flesh. Therefore, it naturally follows that the more fruits that are on the tree in numbers, the greater will be the nitrogen and phosphorus demand, while if the tree is healthy the leaves, new wood and buds will demand a large quantity of potash. Grow wood, buds, and flesh with as few pits as possible.

Picking. A peach is ready to pick for the home market as soon as it is springy to the touch. Taken between the thumb and finger and pressed gently, being careful not to bruise, it should give slightly and have a mellow feel. If it dents with this slight pressure, it is over mature and too soft to ship. If it feels hard, more than just firm, it is too green to pick. But the experienced picker goes more by the eye than by the touch. A red cheek with a yellow tinge, from which the green has entirely fled, denotes maturity. It needs no pressure test. Freeing readily from the stem without tearing is a good sign of maturity. All the fruit on a tree cannot be picked at one time. It must be gone over three, four or perhaps five times. The removal of the fruit nearest maturity gives the rest a chance to develop, when the larger and more mature are again removed, and so on until in about a week or ten days the last peach is removed.

The fruit is usually picked directly into eleven quart baskets, such as are used for shipping. These, as they are filled, are placed in the shade of the tree, from whence they are gathered and taken to the packing house. Here the fruit is graded and packed for shipment.

Peaches intended for export must be handled much more carefully, as the slightest bruise will cause decay when held for a long period. They are picked singly and placed directly in the boxes on wood fibre, in which they are carried to the packing house.

More careful handling and packing of the fruit for the home market is recommended.

When picking remember:

(1) That the fruit must be ready.
(2) That you are handling peaches not stones.
(3) That when once the fruit is picked shade is preferred to hot sun.
(4) That moisture hastens decay.
(5) That some one is expected to eat every peach put in the basket.

Packing. Packing at one time was considered of little importance. A basket filled to the top and covered with the ordinary patent cover was the only package the grower knew. But the public demanded something better, and the growers are gradually realizing it.

(1) Patent covers on eleven-quart baskets are still used today for all the poorer grades and for a large part of the better grades also, though for these latter it is gradually being discarded. The bulk of the

fruit, however, is still shipped in them, because the market has learned to know the brand. The West has learned it and now demands it. But each year sees the fruit graded and packed more carefully.

(2) Sometimes another layer of fruit is placed on the top of the above package and all covered with a muslin sewed on to or turned in under the framework of the basket. This makes a quite fancy package and commands a much increased price over the first. The fruit is shown to much better advantage.

The box package is increasing in favor for both local and long distance shipments. No pilfering or bruising of the fruit.

(3) Nine-quart baskets with bottoms the same size as the eleven-quarts, but with sides of just such a height that two layers of first-class fruit come even with the top, are gradually winning a place. This package is used in fancy trade only.

(4) Six quart or grape baskets are also used for fancy fruit and are in great demand among tourists who wish to carry a basket of fruit in the hand.

(5) The box 18.5 x 11 x 4 inches, inside measurements, holding about seventeen pounds, and which displays the fruit to the best advantage, is used for a certain fancy trade also. This is the package that pleases the retailer. The fruit here must be fancy.

(6) The Georgia peach carrier which holds six baskets of about four quarts each is used but little.

(7) A smaller box, 17 x 11.5 x 3.5 inches, holding from 20 to 27 peaches, is used for the British trade only. This is the special package for that trade.

It cannot be said that this great variety of packages has a very distinct advantage. In the opinion of the writer four packages well-known to the trade would be better than seven or eight.

Selling. The manners of sale are as varied as the packages in which the fruit is packed. In the western sections of the Province nearby cities and towns take a large quantity. The market is right at the door of the producer and hundreds of baskets are sold right at the orchard or delivered by wagon to the nearest town. In the Niagara Peninsula a large quantity is taken by St. Catharines and Hamilton, but hundreds of cars are shipped east and west.

There are five distinct ways of selling:

(1) Directly through the commission houses.
(2) To the buyer.
(3) To the canning factory
(4) Through the co-operative associations.
(5) By private order.

It must not be supposed that each individual grower adheres to one of these methods. The great majority of growers have no special method of sale, the method that appears best after the fruit is picked being often used.

The co-operative associations handled the fruit of more growers in 1910 than ever before. In the same areas the buyer claimed a larger portion. The factory handled the fruit of a less number. Where the co-operative associations are established, the number selling through the commission houses is greatly lessened. In Niagara township where no co-operative association has yet been established (1910), at least 65 per cent. of the growers sell through the commission houses. The factories claim nearly all the rest. No buyer has as yet secured a firm hold there. In Grantham, 55 per cent. sell through the co-operative associations. (The co-operative associations sometimes sell by commission, but that is not considered in the percentage). In Louth the buyers handled fully 50 per cent. of the peaches in 1909. In Clinton they handled 60 per cent. but this latter was cut down considerably in 1910, owing to the work of the Ontario and Western Co-operative Association. A few growers in all sections have a special trade, selling directly to consumer or retailer.

Commission. Under this system the wholesaler keeps the books. Suppose, for instance, six baskets are shipped from Queenston and sell for seventy-five cents each, or $4.50 in Toronto. The commission man keeps 10 per cent., or forty-five cents, gives the railway thirty cents, and returns the balance. $3.75, to the grower. Or the grower gives one basket for selling five. Also this method encourages the shipment of inferior goods, which are sold on the general markets and sometimes cause a glut.

It is, however, possible for good growers to build up good markets by commission. This has been done by at least three of the best growers in the Niagara Peninsula, but they sell only through one man, or two at the most. Their supply is large and of excellent quality and consequently has become known to the trade.

The most inexcusable practice is that of dividing up a small load of perhaps not more than fifty baskets between two or three different commission houses. The fruit then must be sold on a general market, which gives the brand no chance of gaining favor. One part of the load is also sold in competition with another part.

Buyer. The buyer has done a great deal to enlarge the peach market. It was his interest to do so. He has placed the fruit on many distant markets which have taken a large quantity from the general trade and tended to keep up the price. He has done a good work and in the majority of, but not all, cases, has been well paid for it. This manner of sale has its defects also, because:

(1) All are paid the same for what appears to be the same grade of fruit.
(2) It does not encourage careful grading and packing.
(3) It does not allow the grower to make a reputation.
(4) It puts the profits into the pocket of the capitalist, the man who takes the risk.

Canning Factory. Many claim that most money is made by selling directly to the factory. At any rate, there is little expense connected with it and the money is paid in a lump sum. The fruit is picked in baskets or crates, sorted into two grades, canning and pie peaches, and delivered at the factory at prices ranging from 1.5 to 5 cents a pound, depending on the quality and season. The baskets or crates are returned to the factory or grower.

All varieties, except the very early, are in demand, but Hill's Chili, Smock, Crosby and Elberta are favored most. The Smock in particular is an excellent canner, and large areas have been planted to it for this purpose, especially in Niagara township. The factory also takes care of a large quantity of cull fruit, that would otherwise go to waste, for the manufacture of jam.

Co-operative Associations.—The following advantages are claimed for these. They—

(1) Extend the markets;
(2) Encourage careful grading and packing;
(3) Save express and freight charges (car lots);
(4) Put the small growers on an equal footing with the large;
(5) Save the capitalist's profits;
(6) Are educational institutions.

A discussion of the work of the different associations is not necessary here, but the work being done by them indicates quite clearly that where growers in one locality are able to ship car lots at regular intervals it is the best method of selling for the reasons mentioned above

By Private Order. This is an exceptionally good method of sale and many growers have worked up good trades. The best city customers are anxious to buy this way, and where the growers have the right kind of goods it is exceptionally profitable. Many retail merchants are anxious to buy this way also. This method of sale also encourages careful packing, because a customer if once deceived is not likely to return. The writer this summer saw a shipment from a supposed responsible firm that was not up to the mark, and the retailer remarked to him, "I don't want any more from there." At the same time the demand for quality, packed as it is represented, is increasing.

A comparison of the returns from the different methods of sale is not possible with the data at hand. Each method has its advantages, and one may be better adapted to one section than another; but, generally speaking, the co-operative method is gaining fast, and the commission man and the buyer are losing ground. The factory will always have its place, because it handles large quantities of fruit that would otherwise go to waste. More factories would be a boon to the industry.

Markets.—The West, especially Manitoba and Saskatchewan, is the coming market for the surplus of Ontario peaches, under present conditions. At present the cities of our native Province take the largest quantity, but they are not developing or growing so rapidly as the Western cities are, and consequently the home demand is not increasing so rapidly; but the smaller towns and the towns of New Ontario are taking more each year.

The Western market is the field of greatest activity at present. Winnipeg and some other Western cities are familiar with the Ontario packages, and they look for fruit in quantity at a reasonable price. The fancy or box trade is limited and cannot yet consume a very large quantity.

A large undeveloped market is yet to be found in the small towns on the Transcontinental Railways. A large farming population is demanding fruit also, but the distribution is so limited that they seldom see a peach.

Montreal has no trade in fancy Ontario peaches, or at least the box fruit brings no more than the same quantity in baskets.

Toronto is the largest market and the poorest supplied with first-class fruit. It is the dumping ground of the careless grower, and is always well supplied with the poorer grades. Prices are usually low. Very little box fruit, comparatively speaking, is handled in the city. Some prominent growers are sending large quantities of their best fruit in baskets, and are receiving excellent returns, and there is room for more of this to help crowd out the trash.

The newest, and what promises to be an excellent market in the future, is that of Great Britain. Its value to us has not yet been fully demonstrated, but the Dominion and Provincial Departments together with a few growers are experimenting there. The first shipments of only a few cases were made in 1909. This year, 1910, 7,168 cases or boxes were forwarded under cold storage, and for the most part arrived in excellent condition. They were distributed throughout the leading cities of Britain, and some of the cities of the continent, and in no case was there an unfavorable report of the fruit. Prices per case varied a great deal, depending on their condition and the market, but gave an average return of 80.7 cents f.o.b. Jordan Station. They were sixteen days in transit, and cost 23.3 cents per case to put on the market.

Our fruit is yellow-fleshed mostly. The English market favors a white-fleshed peach, and consequently the white-fleshed peaches forwarded brought the highest prices. This does not mean that the planting of white-fleshed peaches is recommended. At this time it is unsafe to advise. The market is not yet established, and much experimental and educational work must be done before shipments can be taken up by the average grower.

The price, 80.7 cents f.o.b for six pounds of fruit, or about twenty-four peaches, may seem very high, but it really is not so when we consider the extra expense of careful handling, packing, etc., and that only the very highest quality fruit can be used.

The expense of delivery makes the price to the English consumer very high, which means that consumption must be limited. A lower price to the grower and less transportation expense would be more satisfactory to all who have a large quantity to sell.

Mr. Dobson, of Jordan Harbor, shipped sixty Georgia cases to friends in Britain in 1909.

In 1910 the following shipments were made:—

From St Catharines Cold Storage	3,743 cases
By the Dominion Department	1,284 cases
By Mr. Dobson	2,141 cases
Total	7,168 cases

Returns and Cost of Production.—Returns from orchards under apparently the same conditions are often very varied. So many factors enter into the case that it is impossible to quote a yield that is applicable to the conditions of all, but maximum and minimum returns, together with the average of a number of orchards, should give a fair idea of the possibilities.

The following are the best returns to hand at present: 1906, 20 acres, $4,263.53 gross; 1907, $4,193.93 gross; 1908, 26 acres, $6,193.87 gross; 1909, $9,011.06 gross. These trees ranged in age from 3 to 20 years.

In 1909, 475 trees gave 1,960 baskets; in 1910, 2,700 baskets. 76 acres, all ages, gave 28,000 baskets, worth $8,624, in 1909, and 13,000 baskets, worth $7,400, in 1910. All baskets, freight and commission are deducted, but not labor.

I do not doubt but that many are receiving better returns, but the above show fairly well what is possible, and are considered by many very exceptional.

In comparison to this we have many orchards that are not yielding a commercial quantity and are a yearly expense to their owners.

In thirty orchards, scattered from Beamsville to Niagara-on-the-Lake, which yielded well in 1908, and from which accurate returns were received in 1909, we have 32,460 trees, yielding 111,712 baskets, which sold for $50,280.33; or each tree yielded on an average 3.44 baskets, worth 44.92 cents a basket, f.o.b.

The average orchard has about 100 trees per acre, which on this basis would mean a f.o.b. return of $154.52 an acre.

Winter Killing and Winter Protection.—Winter killing may take place either in the root, trunk or branches. The killing of the root may be from excessive freezing under wet conditions, or from repeated freezings and thawings during the winter months.

The freezing of the branches is the commonest form of all. This is usually the result of going into winter quarters insufficiently matured or ripened to stand the frost. The freezing of the whole tree above ground is the result of excessively dry conditions usually. Even on the coldest day a certain amount of moisture is being sublimed from twigs. The soil must be sufficiently moist to allow the roots to make up this loss when a warm day comes. A moist soil frozen solidly below the roots has even the same effect. A warm day thaws the sap, but the ground being frozen to a great depth no water can rise and, as a result, the cell walls of the tree collapse.

Because of this winter loss various systems of protection have been advised and some adopted. In the very cold section where the fruit is not grown on a commercial scale, it is common practice to draw the limbs together and cover with straw or corn stalks, or to lay them flat upon the ground and cover similarly. The following methods are advised on a commercial scale:

(1) By use of windbreaks, etc., hold the snow as much as possible. It is Nature's method of protecting plants.

(2) Mulch with coarse straw or manure around the base of the tree as soon as the ground is slightly frozen in the fall. This prevents the frost from penetrating any great distance, and also holds the frost and delays growth in the spring.

(3) Grow a heavy cover-crop. This is the best and cheapest way of obtaining the desired results. Besides acting as a mulch it collects and prevents the leaves from blowing away in the fall, and it draws the surplus moisture from the soil and ripens the wood and buds. It has the advantage of being cheaper than a manure mulch.

INSECTS.

Black Peach Aphis (*Aphis Persicae-niger*) is not common in Ontario. It attacks the roots of the trees, especially when first planted, but a good application of farmyard manure seems to force their recovery or make the tree sufficiently thrifty to outgrow the attacks.

Peach Tree Fruit Bark Beetle (*Phleatribus luminaris*) and Fruit Bark Beetle (*Eccoptagaster rugulosus*) are located by green exudations on the trunk and main limbs; cut out and destroy injured parts of trees in winter or early spring; remove all dead and dying trees.

Peach Borer (*Sannina exitiosa*).—The adult is a clear-winged moth, but the larvæ do a great deal of damage by working under the bark in the sapwood of the trunk near the ground. These may be prevented from entering by wrapping the tree with two or three thicknesses of news paper up to about eighteen inches high, or painting with coal tar to the same height, about mid-summer. This hinders or prevents the egg laying. When once the larvæ have entered the tree they must be removed with a knife by digging them out in the months of October or the following May. It is well to go over the trees twice. Low headed trees are less attacked than high headed. Banking up with earth in mid-summer prevents their working to some extent.

Lesser Peach Borer (*Aegeria pictipes*) resembles very much the above, only it attacks anywhere on the trunk and large limbs. It must be treated the same as the above when once it has entered the tree. Keep trees in good health.

Plum Curculio (*Conotrachilus nenuphar*) does a great deal of damage by stinging the fruit, and allowing the admission of the Brown Rot spores. Spray with arsenate of lead, two pounds to forty gallons of water, when fruit is about the size of a pea. Repeat sprayings every two or four weeks if necessary, using self-boiled lime sulphur and poison.

Peach Saw Fly is not known in Ontario, but where common does damage by the larvæ eating the leaves of the tree. Spray with two pounds of arsenate of lead in forty gallons of self-boiled lime sulphur or water as soon as the pest is noticed.

San Jose Scale is the greatest enemy of the peach, but it requires no description here. When left untreated it makes the fruit unsaleable, and then kills the tree outright.

Control.—Spray thoroughly with winter strength lime sulphur before the buds burst.

DISEASES.

The diseases of the peach are discussed in the second part of this Bulletin, by L. Caesar, Lecturer of Fungus Diseases and Insects at the Ontario Agricultural College, Guelph, as Mr. Caesar has made a special study of these diseases.

Spraying.—One spraying only is all that the peach tree receives generally in Ontario. This is given, for best results, as late as possible, before the buds burst or just when they are beginning to swell. Two or three weeks earlier will give almost as good results. Home boiled, commercial, or home-boiled concentrated, lime sulphur is used. This cleans up the tree generally, destroys scale insects, and prevents the developing of Leaf Curl, previously mentioned. Without this spray no success can be looked for in peach culture. The spray should test at least .027, hydrometer reading, .03 is better. If left too late this spraying will not destroy the Leaf Curl. If the tree is infested with San Jose Scale, use the spray as strong as .032 hydrometer test.

The second spraying, if it is required, should be given with summer strength, commercial, or self-boiled lime sulphur, when the fruit is about the size of peas. This controls the rot and mildew to a large extent also. Poison, one pound of lead arsenate to forty gallons of solution, added to this destroys the curculio. Other sprayings may not be necessary, but at the first appearance of the Brown Rot or Mildew, it is well to repeat the spray recommended for the second application, leaving out the poison, that is for the third or fourth spray use self-boiled lime sulphur only.

Land Prices.—The price of unplanted peach land has been steadily rising for the last five or six years, till now, in the more favored sections, it has reached a maximum of $1,000 per acre. But this is abnormal and is more than the intending purchaser can afford to pay if he wishes to reap good interest on his money. In the eastern sections of the Niagara Peninsula, good peach soil may be had for from $150 to $300 per acre, but it is unimproved, some distance from the railroad and not in the co-operative districts. About $250 an acre would be a good, fair price for average peach land in the Niagara Peninsula. An orchard, three or four years of age, of good varieties, in the average locality, is worth about $600 an acre and will pay expenses and interest on that amount. Many sales are being made away above this figure.

In Lambton, Essex, Elgin, Kent and Norfolk counties, etc., first-class peach land may be had for from $50 to $125 an acre. This, from all appearance, is just as good as any in the Niagara Peninsula but has not yet been developed nor thoroughly tested.

Population.—It is very interesting to note that while so many sections of Ontario are decreasing in population the Niagara district has gained very rapidly. The following are the comparative figures for the fruit townships and the general farming townships of Lincoln County:—

Fruit Townships—	1907.	1910.	Gain.
Niagara	1,574	1,674	100
Grantham	1,976	2,193	217
Louth	1,685	1,860	175
Clinton	1,735	2,052	317
North Grimsby	1,365	1,505	140
	8,335	9,284	949
General Farming Townships—			Loss.
South Grimsby	1,287	1,222	65
Gainsborough	2,180	2,064	116
Caistor	1,524	1,379	145
	4,991	4,665	326

The population is decidedly mixed. The new-comers include many Englishmen with capital, city business men, commercial travellers and others who realize that peach land is a good investment. These, intermingling with the hard, practical pioneers, make first-class fruit farmers, and at the same time they lend some of their keen business ability to their neighbors, which is a great stimulus to the industry as a whole. Every man who handles fruit is fast becoming a business man, learning how to invest a dollar for the best returns and considering the cost as well as the selling price.

Factors of Success or Failure.—When a man is once properly located, success or failure in peach production depends more on his own ability than on any other single factor. Some men who were excellent stock and grain farmers have made miserable failures of peaches. The methods applicable to the one are valueless in the other. A man must know his soil and his varieties; he must know how to plant, prune, cultivate, fertilize and spray; and when to pick and how to pack. He must know good methods, good trees and good fruit. He must have high ideals and he must work; and he must have good business ability to fight for his place in the co-operative association or in the commission market.

Neglect to fertilize, cultivate, spray, thin or pick at the proper time means failure. One day late often means dollars of loss. The package and packing also often decide the success or failure of the business. Too great care and too much patience cannot be exercised. Knowledge of the minutest details is absolutely necessary. Where one man succeeds, two men fail, even in the same locality and on the same class of soil. If you do not know your business you will soon be forced out of it.

PEACH DISEASES

L. CAESAR, O. A. C., GUELPH.

In discussing the peach diseases of Ontario, I shall deal only with those that are likely to be familiar to the growers and that are of

Fig. 1. Peach Leaf-curl.

economic importance, omitting a number that are interesting, chiefly or almost solely to the plant pathologist. The following will be considered: Leaf Curl, Brown Rot, Scab or Black Spot, Gum Disease and Cankers, Powdery Mildew, Crown Gall, Yellows and Little Peach.

NOTE.—This was an address delivered before the Fruit Growers' Association of Ontario, November, 1911.

LEAF CURL, *Exoascus deformans*, (Berk) Fuckel,

Every peach grower is familiar with this disease and knows that it attacks the leaves early in spring and causes them at first to become thickened, curled and distorted and of a pale whitish, or often reddish color, and later on to become brown and dead and fall off. It is, next to Yellows and Little Peach, the most destructive disease that growers have to combat. The loss takes the following forms: (1), In seasons of severe attack many young nursery trees are killed the first year they are set out, and before they have had a chance to get over the shock of transplanting; (2), There is a great drain on the vitality of older

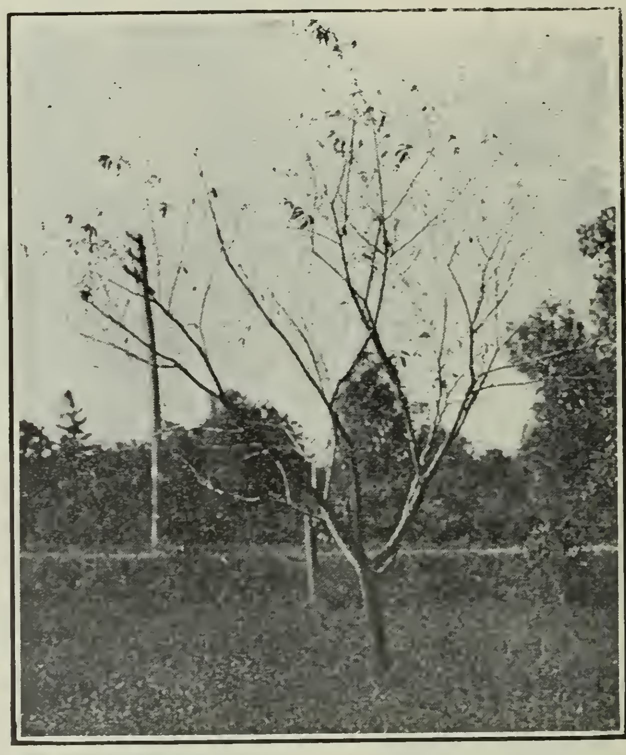

Fig. 2. Peach tree almost defoliated by the Leaf-curl disease.

s from the loss often of a large part of their foliage early in the season, and the necessity of producing a new crop of leaves. Such trees are frequently not properly matured for winter and are sometimes killed by the cold. Trees severely attacked, two or three years in succession, not infrequently die, or at least lose a number of their branches; (3), The fruit is dwarfed and often in bad cases drops off. This is to be expected from the fact that the substances that make the fruit are largely manufactured in the leaves, and that this source of supply is cut off for a considerable period by the disease; (4), The disease often attacks young shoots or twigs and kills these.

Leaf Curl is well known not to be so severe some years as others. Experience has shown that it is favored by damp, late springs, while it is almost completely kept in check by dry, sunny weather, around the time of blooming, and while the leaves are still quite small. Last year, 1910, the spring was very late, cold and wet, and so the disease was exceptionally severe. This year, 1911, the spring was early and we had beautiful, hot, sunny, dry weather, with the result that there was no Leaf Curl or almost none. This fact has led some to believe that Leaf Curl is not a disease, but is merely the result of unfavorable weather conditions. Such, however, is not the case, as anyone can easily prove who takes a glance through a microscope at one of the dead leaves from an affected tree and sees the millions of spores on the surface. These spores act like seeds, and are carried by the wind from tree to tree and orchard to orchard, but so far as we know do not germinate until the next year. For their germination then, and growth plenty of moisture is necessary, hence the wet seasons favor their development; moreover cold does not interfere with this, while it retards the vigor of the leaves.

A number of years ago we were told that spraying would not control the disease, because it was then believed that it passed the winter only in diseased twigs; but we now know from thousands of experimenters that even in the most favourable seasons for the disease we can keep it under thorough control by a single application.

Means of Control: Spray with lime-sulphur of the ordinary strength as for San José Scale (1 gall. commercial wash, diluted to about 10 with water). This application must be made *early in spring and before the buds have begun to swell.* The disease begins with the growing bud, so to prevent its getting a start we must spray early before the spores around the buds, can germinate. *Most of the failures to control the Leaf Curl are due to spraying too late, and not taking sufficient pains to see that every bud is thoroughly covered.* Bordeaux would also control the disease, but is not recommended, because in most peach districts San José Scale is either present or likely to be introduced, and the lime-sulphur will keep it in check while Bordeaux will not.

Brown Rot, (*Sclerotinia fructigena*) (Pers.) Schroet.

This is the same disease that is so common on plums and cherries, especially sweet cherries, and that frequently causes a large percentage of these fruits to rot. Fortunately, in our Province, it is not so destructive as a rule to peaches as to cherries and plums, or as it is to peaches in some parts of the United States, where it has been known to destroy as high as 40 per cent. of the whole crop in a year. Nevertheless, we sometimes lose a good many peaches from this rot. Triumphs and a few other varieties are much more subject to the disease than Elbertas and some of our other profitable kinds.

Not only is the fruit attacked, but also the twigs and small branches on which diseased fruit is borne. The disease in such cases seems usually to work its way down from the diseased fruit into the twig or branch and gradually girdle it. This, of course, causes the part above,

Fig. 3. Brown Rot on Plums (after Duggar).

with all its leaves, to die. Some seasons the blossoms are also attacked. I have noticed this to be quite common in the case of sweet cherries.

Like most diseases there are certain conditions that favour the development of Brown Rot. The chief of these are damp, warm weather, lack of sunlight and of good air circulation, the presence of old mummied fruit on the trees, two or more fruits touching one another on the tree, and injuries from hail or biting insects, like the Plum Curculio.

Means of Control: The above conditions favouring the disease give us hints as to how we may help to ward it off. (1), Give the trees plenty of sunlight and good air circulation by removing unnecessary windbreaks and by judicious pruning; (2), Knock all old mummied peaches and plums off the trees in the fall, and either gather and burn them or plow them under early in spring; (3), Thin the peaches so that no two will be touching one another; (4), Spray with lime-sulphur for Leaf Curl, and this will protect the blossoms from attack; (5), If the Curculio is troublesome, spray with 2 or 3 lbs. of Arsenate of Lead to 40 gallons of water soon after the fruit is set, and remove all rubbish and thickets from around the fence corners, as the beetles winter in such rubbish. (Two or three pounds of freshly slaked lime may be added to each barrel of the spray mixture as a safeguard against burning); (6), Spray with self-boiled lime-sulphur about a month or five

Fig. 4. Peach Scab. Note the small blackish spots and the cracks in the fruit.

weeks before the fruit is ripe. Bordeaux or commercial lime-sulphur is likely to injure the foilage. (For directions for making the self-boiled lime-sulphur see Spray Calendar or lime-sulphur bulletin.)

PEACH SCAB OR BLACK SPOT (*Cladosporium carpophilum, Thum*).

This disease causes small, blackish spots here and there over the surface of the fruit. Sometimes these are very abundant and disfigure the fruit greatly; occasionally a fruit is so badly attacked that it cracks open in the same way as a Flemish Beauty pear does when attacked by Pear Scab. As a rule this is not a very destructive disease in Ontario.

Means of Control: Spraying with the self-boiled lime-sulphur about a month after the fruit is set will usually control this disease quite satisfactorily, as shown by the experiments of Professor Scott, of Washington, D.C.

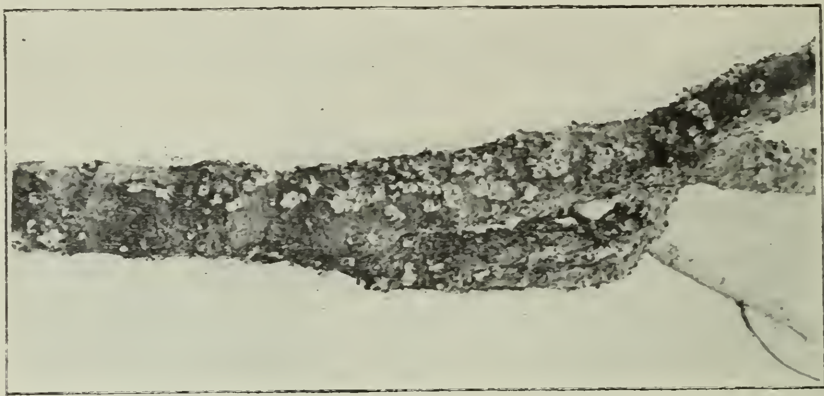

Fig. 6. Peach tree badly attacked by gum disease (original).

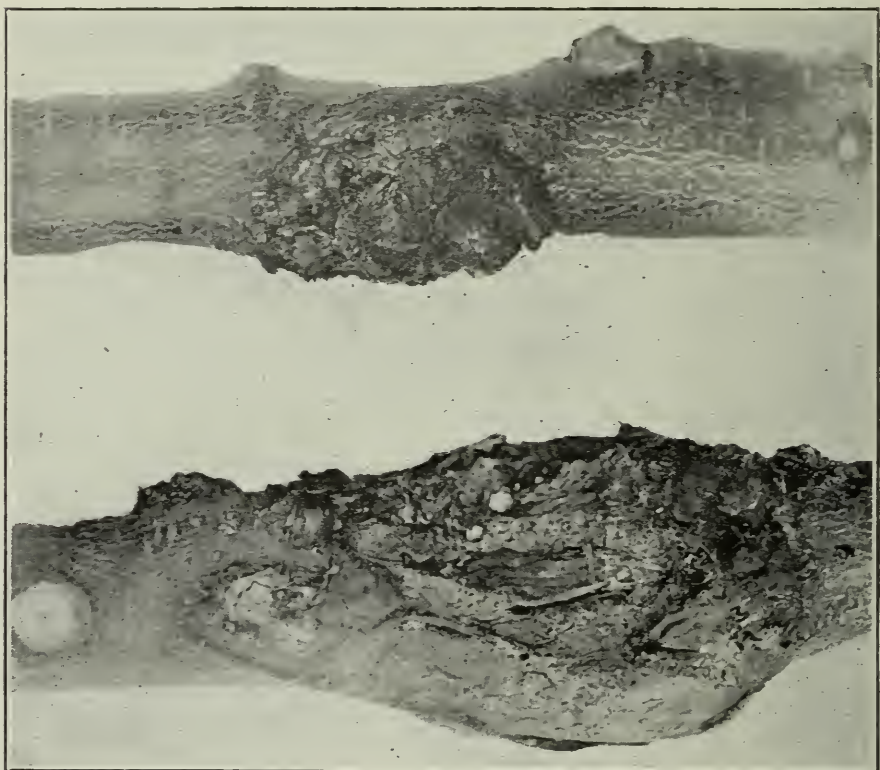

Fig. 5. Small cankers on peach branches, natural size (original).

Cankers and Gumming of Peach Trees.

In certain localities in the Niagara district, especially at Queenston, Niagara-on-the-Lake, St. Catharines, and in one or two orchards at Winona it is a common thing to find large, black, gum-covered cankers, chiefly on the upper side of large branches. These cankers do not heal over, but continue to widen out and enlarge until finally the whole branch dies. The disease is not confined to Ontario, but is quite common in Michigan and in parts of New York State, and probably in other states as well.

In Ontario, so far as I know, it was not very troublesome until the spring of 1908, and in that and the next year there was a regular epidemic of it in the above mentioned districts. Since then there seems to have been much fewer new cases, but the old ones are still active, and are causing the loss of many branches in otherwise vigorous orchards. The cause of these gummy areas is very doubtful. There is apparently no bacteria present. At first, as the result of a number of inoculations, it was shown that the Brown Rot fungus would, if inserted through the bark, produce very similar gum masses. I was inclined to think that it must be the cause of the disease, but further study and failure to get any fungus whatever in the wood beneath fresh gum masses, has made me believe that while Brown Rot may have something to do with preventing the healing of some of these cankers, it does not account for the origin of all of them. There is also the difficulty of explaining why some orchards, such as those at Grimsby, should be almost totally free from the disease, though Brown Rot is frequently quite as destructive, or even more so there, than in the diseased orchards. It is also hard to explain, why in many orchards, without any change in methods of spraying there have been almost no new cases. A good instance of this is the large orchard of A. Onslow, near Niagara-on-the-Lake. It is quite possible that very unfavourable and abnormal weather conditions, interfering with the cells of the plants performing their proper function may be the real cause. Much gumming of trees is, of course, frequently caused by small black beetles known as Shot-hole Borers, but it is easy to determine whether these are the offenders by removing the gum masses and seeing whether there is a small hole through the bark, made by the beetles. Sometimes the fungus Valsa leucostoma will produce gumming, but, so far as I can see it seems usually to be a secondary cause, and to enter at some dead area, and gradually kill the living tissues around this.

Means of Control: With our present lack of knowledge as to the cause of the gumming of peach trees, it is difficult to recommend any rational method of treatment. It would be wise, however, where a canker threatens to destroy a large and valuable limb to cut out all the dead tissues up to the perfectly healthy bark, disinfect the wound with formalin, 1 part, diluted to about 5 with water, or with corrosive sublimate, 1 part to 1,000 parts of water (this is a deadly poison), and cover it over well with white lead paint, free from turpentine. A second painting later in the season will usually be necessary.

POWDERY MILDEW (*Sphaerotheca pannosa*, Wallr. Lev.)

This disease is found chiefly on young trees, not yet in bearing, but occasionally it occurs on older trees. It attacks the leaves chiefly, especially those on the terminal twigs, and causes these to become somewhat folded, dwarfed, distorted, sickly, and covered with a powdery, white substance. The succulent twigs on which the affected leaves are

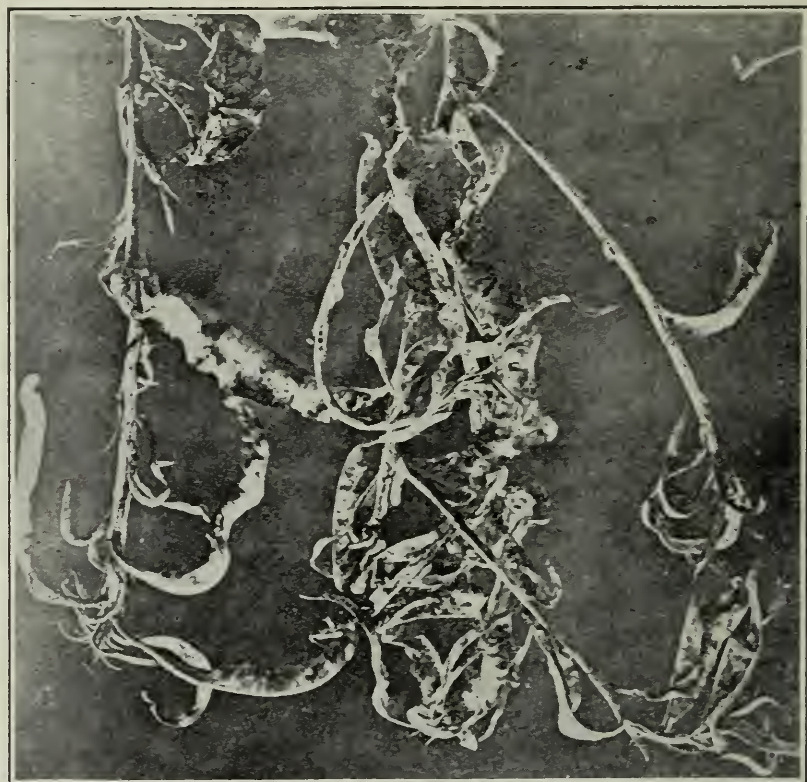

Fig. 7. Powdery Mildew on young peach twigs in nursery (after Duggar). Note the distorted slender leaves almost white with the fungus spore masses.

borne are also attacked. The disease is easily recognized by the white, powdery covering found in abundance on the affected leaves and shoots. This substance consists of countless masses of tiny spores.

This mildew is favoured by warm, moist condition and is worst in late summer and autumn.

It seldom does much harm, though young trees severely attacked are weakened greatly and stunted, and are liable to be winter killed. This is the same disease that attacks the rose bushes, on which, in fact, it is much more common and destructive than on the peach.

Means of Control: Spraying with the self-boiled lime-sulphur should be an excellent remedy. The spraying should be done as soon as the disease is noticed and repeated about every ten or twelve days. Dusting sulphur over the trees will also control it as has frequently been proven in the case of rose bushes.

Crown Gall, (*Bacterium tumefaciens, Smith*).

This disease has been shown by Dr. Smith to be caused by bacteria. It attacks numerous other trees and plants besides peach trees, and is

Fig. 8. Large Knot or Crown Gall on main root of 1-year tree (after Phillips).

easily identified by the woody knot-like growths it causes on the trunk and roots. Usually these swellings, when on the trunk, are just below or at the ground. In size the galls vary greatly, some being as large as a fair sized apple, while others may be less than half an inch in diameter. Just how much damage the disease does to a tree is a disputed question, but there seems little doubt that in some cases at least, it either kills it or greatly stunts its growth. Many trees, however, seem to thrive just as well as if they were not attacked.

Means of Control: I should not myself, plant any tree that had a gall anywhere on it, but would reject it and notify the nurseryman of the fact, requesting him to furnish a sound tree in its place. This seems

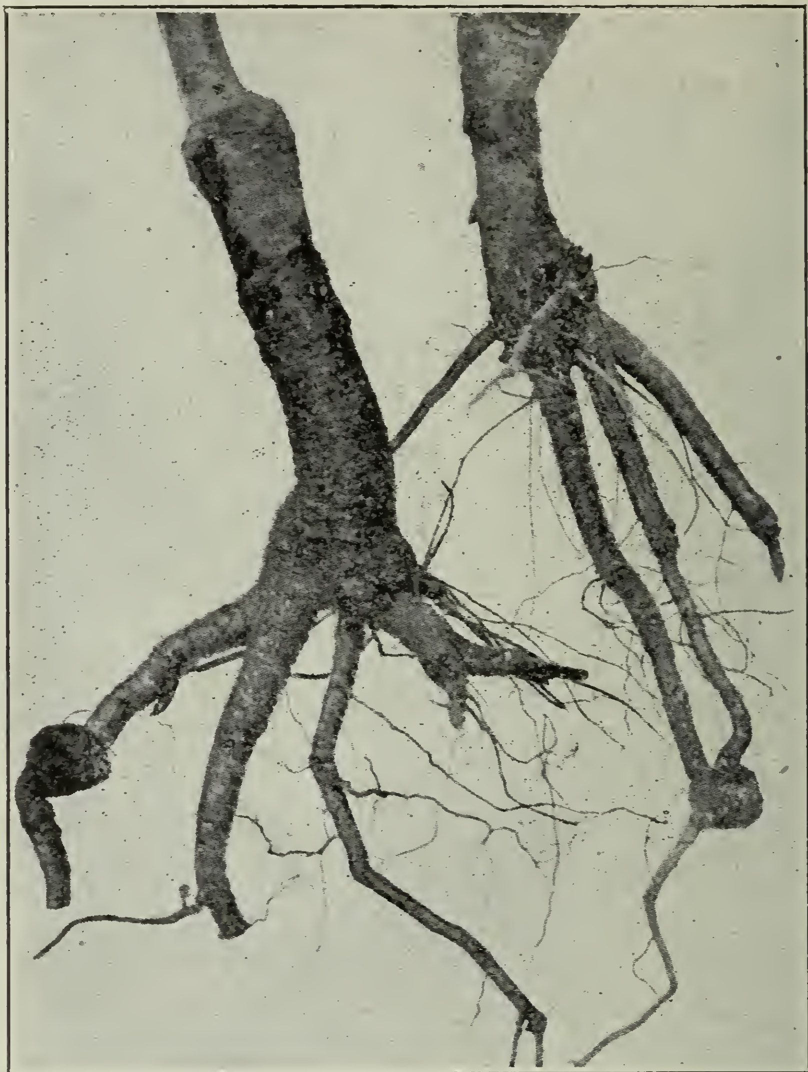

Fig. 9. Small galls due to the same disease on the smaller roots of 1-year peach trees (after Phillips).

to be the only safe way to avoid possible danger. It is much better than attempting to cure the tree by cutting off the galls, as in many cases they grow again. Peach trees should not be planted where raspberries have grown, as raspberries are very subject to this disease.

Peach Yellows and Little Peach.

As these two diseases are apparently very similar in their nature, and as the only known means of control are the same for both, it seems desirable to discuss them together, instead of taking each separately.

Symptoms of Yellows.—1. The fruit ripens prematurely, being from a few days to several weeks earlier than healthy peaches of the same variety. This premature fruit is usually highly colored and blotched with red on the outside, and on the inside is more or less streaked with red from the skin to the pit; the flesh around the pit is also much redder

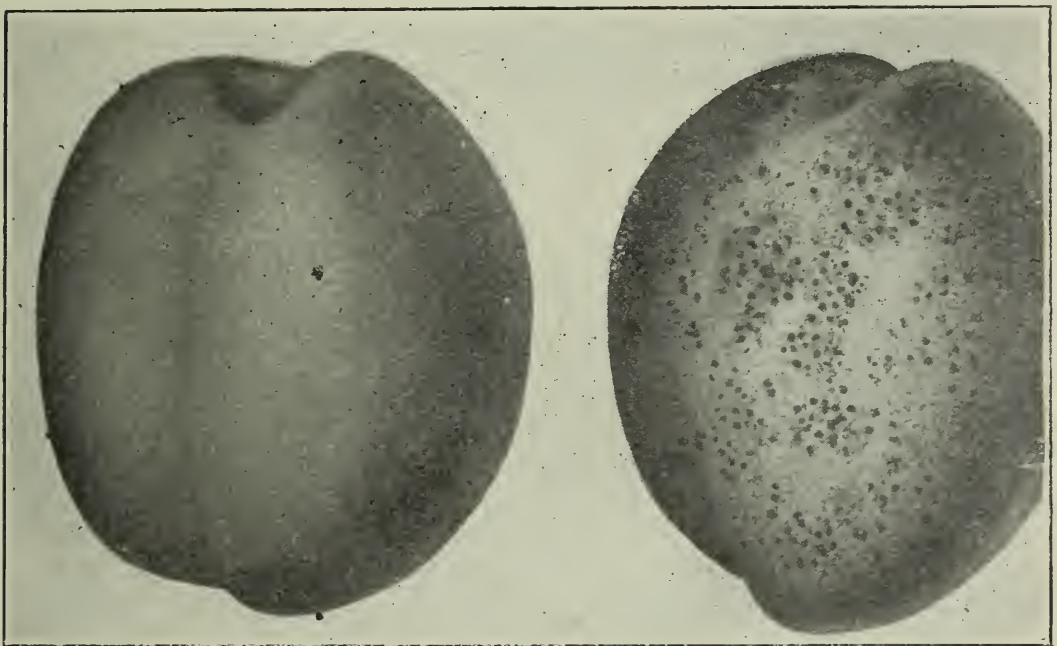

Fig. 10. Premature and healthy peaches from a tree attacked by Yellows (after Smith).

than normal. The flavor with a few exceptions is very poor, being usually insipid and sometimes bitter. Hence, if many such peaches with their fine red colour, but very poor flavour were put on the market they would soon lessen the demand, even for good peaches, because the consuming public would not be able to distinguish between a diseased and healthy peach. The first year the diseased fruit is usually larger than normal, but the second year it is smaller and the next smaller still. Not infrequently diseased peaches are very irregular or knobby on the surface.

2. On trees in which the disease is well advanced, dormant or concealed buds on the main branches very commonly burst

and form little slender shoots with small, narrow, pointed, sickly, yellowish leaves. Sometimes these shoots branch repeatedly as shown in figures 11 and 12. This is one of the easiest means of identifying the disease, but it is by no means always present. In addition to the burst-

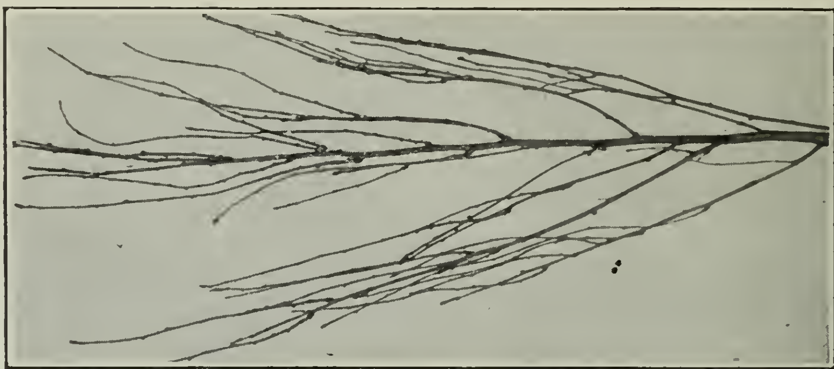

Fig. 11. Bushy, slender growth from main branch of Yellows tree (original).

Fig. 12. Similar bushy growth with narrow pointed leaves from main branch of Yellows tree (After Smith).

ing of these dormant or concealed buds we commonly find that the buds in the axils of the leaves that should remain dormant until the next spring burst the same year as they are formed.

3. When a tree is badly attacked we very often find the leaves turning yellow and becoming curled and clustered in the same way as in the case of Little Peach. In early stages, however, the foliage of the whole tree is usually quite green, and it is only by observing the premature

Fig. 14. Young tree diseased with Yellows; set six months. (After Smith).

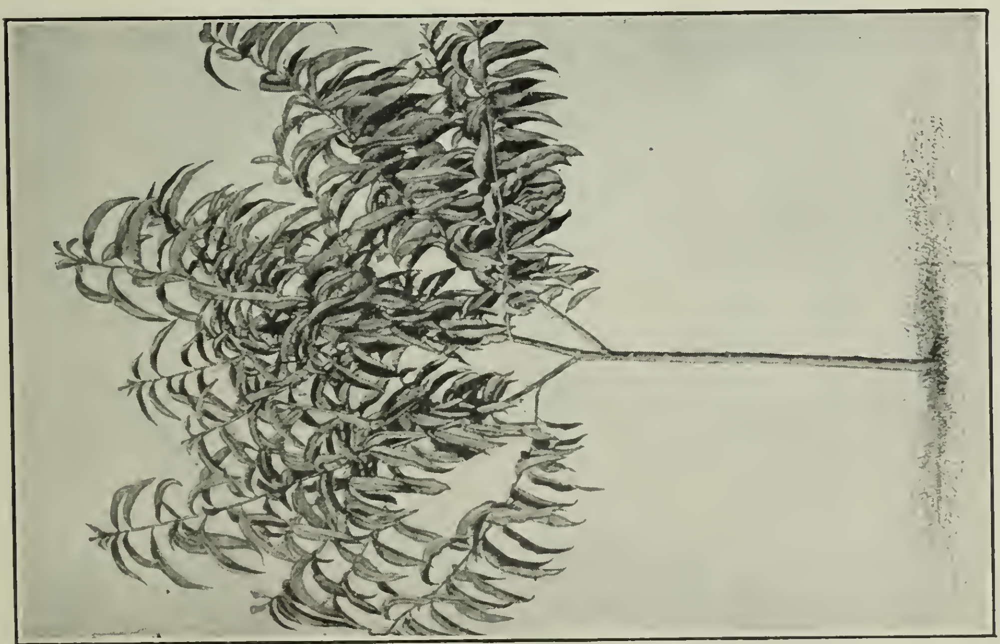

Fig. 13. Healthy young tree; set five months. (After Smith).

highly colored fruit on it that we can tell that the tree is diseased. Sometimes only one branch or even one twig will bear such fruit, while that on all the other branches and twigs will be quite normal. Next year more fruit will show the symptoms and the foliage will begin to grow yellow on at least part of the tree. The disease will sometimes kill a tree in two or three years, but usually it will linger on for four or five years. After the first season the crop is almost always poor and worth less, so that the sooner one gets rid of the tree the better even from a financial standpoint.

Symptoms of Little Peach.

Unlike the Yellows, the fruit ripens later than normal, and is usually somewhat smaller, as the name suggests. These symptoms, however, should

Fig. 15. Peach Yellows—result of budding from diseased tree. (After Smith). Bud was inserted at "*a*" in each case 15 months before photo was made. Diseased growth was headed back on 1 and 3. No. 2 is dead; b, b, b, are diseased growths from stock itself.

not be relied on too much, because we have very frequently in almost every diseased orchard found affected trees on which the fruit ripened about the usual time and was almost as large as the healthy fruit. The second year the fruit tends to be much smaller and probably is more uniformly late in ripening.

Fig. 16. A healthy branch. (After Smith).

Fig. 17. Branch of Little Peach tree just beginning to show the clustering and curling of leaves near the base. (Original).

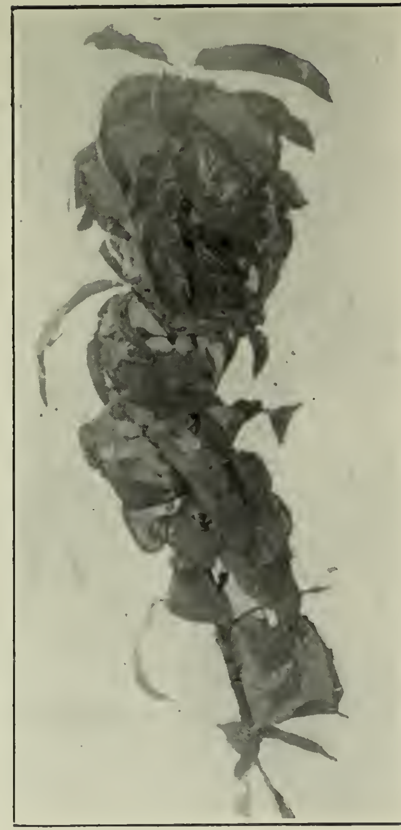

Fig. 18. Branch of Little Peach Tree, showing badly curled and clustered leaves. (Original.)

Again, in contrast with Yellows there is none of the high coloring and blotching of the fruit on the outside nor of the red streaking inside. As a rule both the outside and inside have the normal color. The flavor, however, is usually insipid, just as in the case of Yellows, though apparently there are more exceptions where the flavour is good or fairly good. Still no one would care to purchase such peaches if he knew they were diseased.

2. The most characteristic and reliable symptom of the disease is the peculiar way in which the leaves curl and cluster, and turn an un-

Fig. 19. Leaves from Little Peach Tree showing characteristic flattening and curling. (Original.)

healthy, yellowish or often reddish yellow color. Most of these curled leaves look to be somewhat shorter and flatter than usual, and by the bending of the midrib they curl down at the tip in a claw-like manner. This curling downward and inwards towards the twig helps to give them their characteristic clustered appearance. On some varieties these characteristics are much more conspicuous than on others, and in studying the disease one should first compare the foliage of various kinds of healthy trees and see how they differ. He will observe that the leaves on the Crawford and closely allied kinds, like Fitzgerald, are quite different in form from those of Smock, Longhurst, Lemon Free and several similar kinds, and again that Elberta is different from either of the above classes. St. John is a variety that frequently is inclined to have a yellow tint to the foliage that at first is somewhat misleading.

After studying the healthy foliage of these trees examine carefully the foliage of clearly and badly diseased trees of each kind, looking for the symptoms mentioned above. This will give one a picture in the mind to go by, and, having once got it there, is not a great deal of difficulty in passing on to the identification of the disease in its earlier stages. Attention should perhaps be called to the tendency of diseased Elberta leaves to droop as if the water supply had been cut off, but close examination will usually show, even here the characteristic curling and clustering and sickly color on at least some of the central twigs or shoots. Fortunately the disease can easily be identified in young trees from two to five or six year of age, if they are grown in well cultivated soil. In such cases it nearly always shows up in the centre or inner part of the tree, where the leaves turn yellowish or reddish yellow, curl and cluster, while those on the outer and upper parts are still quite green and normal in appearance. One can frequently recognize the disease in such trees fifty yards or more away. Sometimes one sees young trees with all the outer or terminal foliage reddish and sickly, but the central or inner foliage green, vigorous and normal. Such trees are not attacked by Little Peach or Yellows, but usually are somewhat lacking in vigor and often show little brown spots on the leaves, due to what is called the Shot-hole fungus, a disease which helps to produce the unhealthy appearance. Trees in sod and those attacked by San José Scale usually have a sickly appearnce and for a little while at first it is difficult to identify the disease on such trees.

3. Sometimes late in the season we find that, as in the case of Yellows, numerous buds have burst in the axils of the leaves and dormant buds on the main branches have pushed forth and produced small shoots. Unlike the Yellows, these shoots never develop into slender bushy twigs with narrow pointed yellowish leaves.

Varieties of Peaches Attacked by Yellows and Little Peach.— So far as my own observations go, and as I can discover from reading the literature on the subject, or from questioning growers, there is no known variety of peach that is exempt from either disease. Many claim that naturals are not attacked, but Erwin Smith states that they seem to be just as subject as the commercial varieties. It is often stated that Triumphs are more attacked by Yellows than any other variety, but I think this is very doubtful.

Other Kinds of Trees Attacked.—Both Yellows and Little Peach will attack Apricots and Japanese plums, and possibly in rare cases European plums also. This, last August, I was taken by one of the inspectors to see a European plum, that both in the foliage and fruit showed very strong symptoms of the disease. This is the only case I have seen myself, but inspectors Kelson and Hunter of Grimsby stated that they had seen four European plums that they felt certain were diseased. It is quite possible, of course, that something else may account for these cases, but one is strongly inclined to believe that they are exceptions to the general rule that European plums are immune.

Apricots are very little grown, but Japanese plums are very common in most districts and are apparently almost, if not, altogether, as subject to Little Peach as are peaches.

I have during the summer seen at least two small Japanese plum orchards completely destroyed by this disease and several others rather badly attacked. The symptoms of the Little Peach are not so clear on these trees as on peach trees, and often the first thing noticeable is the small size of the fruit. Frequently it is not more than half an inch in diameter on badly diseased trees. The leaves often cluster somewhat as on peach trees, and begin to get a sickly, reddish color and become quite dwarfed. I have only seen a few cases of Yellows on Japanese plums and on these the symptoms were much the same as those given above for Yellows on the peach. In the inspection for Yellows and Little Peach we have up to the present devoted less attention to Japanese plums than we should. They are certainly a source of danger to neighboring peach trees.

How Long the Disease has been in United States and Canada.---Dr. Erwin Smith, of Washington, has very carefully traced back the history of Peach Yellows, and states that it undoubtedly appeared in the vicinity of Philadelphia as early as 1791, that is 120 years ago. It gradually extended in all directions, but more quickly north-east, north and north-west than south. It has been in parts of New York State for nearly 100 years, in Michigan for about 45 years, and was reported at St. Catharines and Grimsby in 1875 or 1876, about 35 years ago. So that Yellows is by no means a recent disease even in Ontario.

There is not much literature that I could find on Little Peach, but the earliest records I know of would indicate that it has been present in Michigan for about 25 years, and in New York State for over ten years. It has been known in Ontario only for about six years, but has probably been present for about ten years in a few districts. It is only in the last two years that it has become known to many of the growers as a distinct disease, and of course, the majority do not even know it except by repute.

Present Distribution of Yellows and Little Peach.—Yellows is found to-day in every state north of Alabama. Large parts of Virginia, Carolina, and Tennessee, and almost, if not quite all of Georgia are free from the disease, but it is quite common in all the states, north of this, and west almost to the Mississippi. It does not occur in Alabama, Texas, Colorado, Utah, or any state west of the Rockies. Apparently it cannot exist under any conditions in Alabama, Texas or any of the warmer parts of the southern states. Prof. Waite tells me there is a line in the south, beyond which Yellows will not develop. The United States and Canada are the only known countries where Yellows is found.

I have not been able to discover just how far Little Peach has spread, but have learned from correspondence with investigators that it occurs in at least Virginia, New Jersey, New York and Michigan, as well as in Ontario, and is probably found in most of the other states also, in which Yellows have been mentioned as occurring. Prof. Waite assures me that he thinks that Little Peach will not exist farther south than Yellows. As to whether it occurs in Europe, Asia or other countries I have no information. In Ontario I believe it is at present limited to the Niagara district, though it may possibly be in some of the other districts.

Destructiveness of Yellows and Little Peach.—Any one who thinks that Peach Yellows is not a very destructive disease should read Dr. Smith's voluminous report on it. Time after time he tells of whole orchards being destroyed and sometimes almost all the peach trees in a large district. In several places the disease caused the price of land to decrease by one-half. Several of those present have seen orchards in the Niagara district destroyed by this disease. In October I was over in New York State, and saw there an orchard of about three acres in which there was scarcely a tree that was not attacked by Yellows. The orchard was an isolated one, and was nearly dead with the disease, though apparently not more than ten years of age. It is quite certain that Yellows is, and has been for years a very serious disease wherever it has been neglected.

When we come to Little Peach we find considerable difference of opinion as to its destructiveness. Peach growers and inspectors in Michigan told me that they consider it at least five times as destructive as Yellows. On the other hand some inspectors in New York State claim that it is not doing more than probably one-quarter as much damage there as Yellows. Mr. R. D. Van Buren, Assistant Chief of

Bureau of Horticulture and Nursery Inspection, informs me that he does not consider the disease any more serious or difficult to control than Yellows. My own observations in Michigan last fall and throughout the whole Niagara district this year, would make me think that if Little Peach is as serious a disease elsewhere as it is in Ontario and parts of Michigan, it is at least several times more destructive than Yellows. However, after we have once got it under control I am hopeful that we may find it not any more difficult to keep it so than Yellows. It may be that the present outbreak is more due to the failure in the past to remove diseased trees than to the virulence of the disease itself. I think I am safe in saying that at present nine out of every ten diseased trees show the symptoms of Little Peach, rather than of Yellows. I know of at least seven orchards that are almost totally destroyed by it, and several others in which over thirty per cent. of the trees are attacked. These trees vary in age from three to fourteen years. Some of these orchards contain over 1,000 trees.

My estimate of the total number of trees that showed symptoms of Yellows or Little Peach this year in the Niagara district, and that ought to be removed is over 50,000. We have, I think, about 1,200,000 peach trees in the whole district, so that this gives a little over four per cent. of diseased trees. Probably nine-tenths of these diseased trees will be found in about thirty-five orchards. These orchards are not all by any means confined to any one district, but are pretty well distributed, though three or four or more of the worst diseased orchards are usually found pretty close together.

Causes.—The cause of either disease is as yet unknown, having baffled some of the cleverest students of plant diseases of the age. At present a very clever botanist is working on the subject and thinks, I am told, that he has perhaps a clue. The discovery of the cause will be a great boon to all peach growers and will, I think, help greatly to simplify the matter of control.

The claim that the disease is due to our climate being too cold for normal conditions, for the peach seems not to have any force; for it thrives and is never attacked, at any rate by Yellows (we have no data on Little Peach), in China in regions quite as cold as, or colder than in Delaware or Maryland, where the disease is as severe as here in Ontario. Moreover, there are small orchards of old peach trees, over 27 years of age near Collingwood to-day that have no sign of Yellows, and before Yellows came into Maryland, Delaware, New Jersey, Michigan and many other states, whole orchards lived until they were 25 years old and upwards. The fact that the disease will not develop south of a certain parallel of latitude is no proof that climate is the cause, for the peach itself, does not thrive so well there as farther north. We might as well say, that climate was the cause of Black Rot of the Grape, because this disease thrives in New York State and is never, or almost never found in California; climate is apparently merely a favouring factor.

Again, it seems absurd to claim that lack of proper cultivation of the soil or absence of any of the necessary kinds of plant food is the cause; for we find the disease in sandy soil and in clay, in rich soil and in poor, in well cultivated land and in sod. Moreover Dr. Smith treated 111 plots with various substances, such as potash, sodium, magnesium, iron, sulphur, phosphoric acid, nitrogen, lime, etc. Some of these plots contained only diseased trees, and the object was to see if these could be cured, 645 diseased trees being treated. The rest of the plots contained in all 3,800 healthy trees, and the object here, was to ward off the disease. The result was that none of the 645 trees recovered, and 2,638 trees out of the 3,800 healthy ones contracted the disease from neighboring unhealthy trees. Hence none of these substances, though applied in a most intelligent manner, and in various forms and combinations, was of the least use.

There are many other theories as to the cause, but none of them seem to stand the test.

How the Diseases are Spread.—Unfortunately lack of knowledge of the causes of the diseases has made it extremely difficult to determine just in how many ways, or when either of them is spread. We do know, however, by numerous tests made by Smith and Waite of Washington, Welch of Michigan, and Phillips of Virginia, that they can be distributed by taking buds from diseased trees and using these in the nursery to bud seedlings See figure 15. In almost every case such buds, whether from the clearly diseased or the quite healthy looking part of an affected tree, produced the disease, though in the former case the symptoms appeared more quickly than in the latter. Out of 202 trees budded, from a badly diseased tree by Smith in August, 1887, all had become diseased and were dead in 1891, except three, and these were diseased. None of these trees showed the disease in less than nine months. Again, out of 210 trees budded from healthy looking shoots on a tree just getting the disease, 103 were diseased by the end of 23 months, and next year all showed symptoms. Sixteen of these did not show the disease until two years or more after budding.

Smith's experiments were with Yellows, but Waite and Welch have shown that Little Peach can also in the same way be spread by budding. Welch told me he had budded more than 200 trees with buds from Little Peach, and in every case the disease had shown up, but not until the second year after the budding. There seems, therefore, to be not the slightest doubt that budding in the nursery from diseased trees is one method of spreading the disease.

In reply to my question as to *how long it takes after a tree contracts the disease until we can see the symptoms of it.* Waite says: * " A bud inserted in August may develop the leaf symptoms the next August, either in a nursery tree or when top-worked into a bearing tree, when it has grown into a branch. In nursery trees or in strong, young trees the symptoms may be so obscure as to be scarcely noticeable. . . . . In older bearing trees the curling of the leaves is usually pretty pronounced by September. On some strong growing trees on rich soil at Washington, buds of some Little Peach and Yellows top-worked on some two-year trees scarcely showed the symptoms the first year after budding. The second year they showed up fairly well but were still vigorous and not conspicuous. In the third year the cases were well marked. Ordinarily, I think, however, that bearing trees show their symptoms the year after they are inoculated, though perhaps it may be obscure; and the second year after inoculation, I think, the symptoms come out strongly."

Many think that another method of spreading is that pits from diseased trees are often planted and grow, and such nursery trees develop the disease after they have been set out in the orchard. I have endeavored to get what information I could on this point.

Dr. Smith says that he has got an average of 1 pit out of 1,000 to grow, where he supervised the planting himself. Of 3,104 pits that he gathered from diseased trees and sent to different parties in various states to test, only 15 grew, or less than 5 out of 1,000.

Prof. Waite says he has never been able to get pits from either Little Peach or Yellows to grow. Philips of Virginia, got a small percentage to do so. All of these produced diseased trees by the end of three years. Prof. Blake, of New Jersey, says that nearly all the pits he tested failed to germinate, but one or two did so. These experiments tend to prove pretty thoroughly that pits from clearly diseased trees nearly always fail to grow.

If one will break the pits and examine the kernels of such fruits he will usually find them small and shrivelled, as shown in figure 20. One would not expect such kernels to grow.

We have this year gathered something over 1,000 pits from trees that were just beginning to show the disease and are testing them for germination.

In spite of this great mortality of pits, most of the men mentioned above, state that they are not at all sure that pits from trees that are

*Letter of August 14, 1911.

just taking the disease, but do not yet show the symptoms, would not grow and produce diseased trees. This does not seem to have been tested, and is naturally a hard thing to test, but I believe we can do so another season.

Whether the disease can be propagated from diseased pits or not, there seems to be not the least doubt that it is in some mysterious way spread through the orchard by allowing diseased trees to remain in it. There are many clear cases of this, both with Little Peach and Yellows, and all our experienced growers are satisfied it is a fact. In our inspection work this year, this was brought home very clearly to us in every district. In New York State, as I went around and saw where trees were pulled out for Yellows, and as I talked with growers, I was

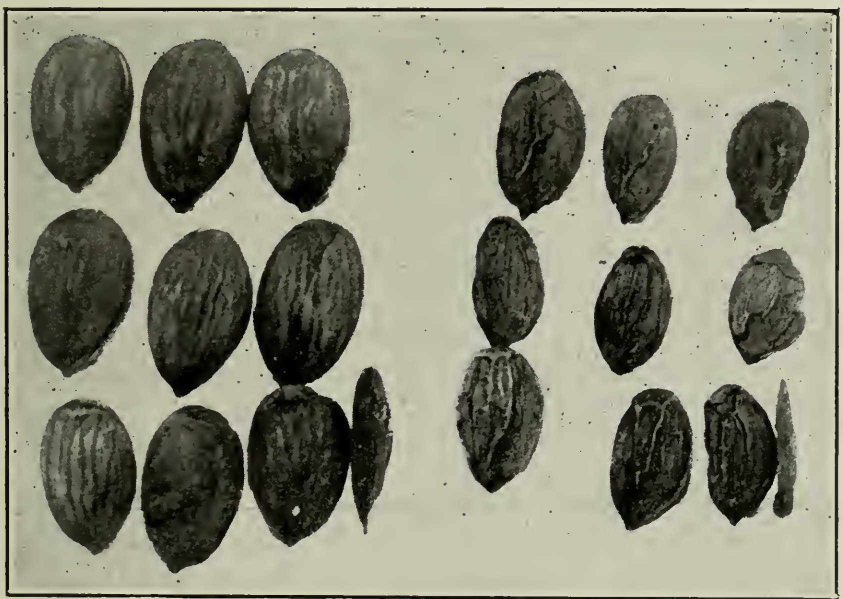

Fig. 20. Pits on right from diseased tree; on left from healthy trees. Note that diseased pits are much smaller and shrivelled. The pit at the lower right hand corner of each is on its edge and shows the difference in thickness between them. (Original).

still more convinced of the truth of this belief. It is my opinion that fully nine-tenths of all the diseased trees we saw this year contracted the disease, not in the nursery, but from diseased trees in the orchard itself, or nearby, which had been allowed to remain there, in some cases for two or three years after they had become affected. This is, I think, the view pretty generally held by students of these diseases.

If this view be right the nurseryman is not so much to blame as many fear. Nevertheless, there seems to be no question that our nurserymen cannot possibly be too careful to keep their peach and Japanese plum stock absolutely free from contagion; for it is clear that if buds should be taken from apparently healthy tree in an orchard, where either disease is present, the tree from which they were taken might have had the disease, but not yet have shown any symptoms of it. I have been told by a good authority of a case that happened some time ago, where buds were in some such way as this, obtained from diseased trees and the nursery stock, when set out, in the orchard, developed the disease. The nurseryman budded another series of seedlings from these young trees in the same way and those in turn developed the disease. He finally found out his mistake and destroyed all the infested stock. Nearly all the nurserymen of New York State and of Ontario get their pits from Tennessee, Alabama and North Carolina, where the bulk of the so-called natural fruit pits are grown. If there is any danger of the disease coming through the pit, a supposition that scarcely seems proven, then there is some risk in using these pits; for in the higher regions of both Tennessee and North Carolina, Yellows is to be found to-day. I do not know whether Little Peach is there yet. I doubt, however, whether any better pits than these can be got, unless from South Georgia, Alabama, Texas, or California, or some such states as these, but in this case most of the pits, I think, would have to be from commercial varieties: These pits are much larger and more costly per thousand. Furthermore there would have to be a guarantee that the pits were not fraudently shipped in from some cannery in a diseased area. It is probable that this sort of thing happens frequently when there is a shortage.

Where diseased trees come from the nursery it is often possible that the source was not the buds or pits, but the presence of older diseased trees nearby. In the past there have been several cases where badly diseased trees have been allowed to remain near nursery stock. This, I think, should be carefully guarded against, and nurserymen should demand the prompt destruction of such trees, and frequent thorough inspection of all neighboring orchards.

When the Disease Spreads in the Orchard.—This is a very important point, and one that deserves a great deal of study. At present no one seems to be at all sure about it. Many think that it is at blooming time and that possibly bees carry it; others think that it is spread by pruning; others believe that in digging out root borers at various times in the year we may get our knife contaminated and give the disease to perfectly healthy trees. The fact that it can be inoculated into a tree by budding, makes these last two theories worth careful study. It seems hardly probable that bees carry the disease, or otherwise no tree would be likely to escape. These are all matters that apparently can be determined pretty fully by careful experiments.

Can Young Trees be Planted in the Ground Where Old Diseased Trees Were Dug Out?—There seems to be no doubt that it is safe to do this, both in the case of Yellows and Little Peach, but in old orchards it is not desirable as a rule.

Means of Control.—1. The nurserymen should use the greatest care in the selection of buds. I am aware that most nurserymen take their buds from the nursery stock itself, but from time to time most, or all of them get a number of buds from bearing trees. In so doing great care is necessary. Again, it is very important if they are to take the buds from their own stock that they take every precaution against allowing diseased trees to be left in the neighborhood, lest young trees become diseased from these. There has not been sufficient care taken in this matter in the past. It would be an excellent thing if our nurseries could be a mile or two away from all bearing trees, but this hardly seems possible.

What has been said of peaches applies equally to Japanese plums.

2. Every orchard should be carefully inspected in August, and again in September and, until we know more about the time when the disease spreads, the marked trees should be taken out as soon as possible in each case. This is the practice of the men who are keeping their orchards healthy in spite of these diseases. This thorough double inspection each year would also be a means of detecting any diseased tree that might come from the nursery and of getting rid of it before any damage was done. Owners would act wisely in taking out suspicious trees as well as those clearly diseased.

The experience of Prof. Waite in his carefully conducted experiments in Michigan and New York, furnishes strong evidence that the careful inspection of orchards by competent men from about August 1st to October 1st, and the prompt removal and destruction of all diseased trees will rapidly bring either Little Peach or Yellows under thorough control. In addition to this, we have the experience of many good growers themselves, who have practised this method for years and are losing very few trees. But where orchards are close together, co-operation in the work is absolutely necessary, because the disease will spread from one orchard to another nearby and the negligence of the indifferent man may defeat the efforts of the careful one.

Suggestions.—1. A good biologist should be appointed to spend his summer studying the diseases, helping inspectors to recognize the earliest symptoms of them, encouraging them in their work and holding orchard demonstrations in each district, so that every grower might have a chance, not only to learn the symptoms, but also to discover the most up-to-date knowledge on the subject. This would be true education. Such an expert could spend his winters in institute work or might be added to the Biological staff of the Agricultural College.

2. There should be an almost entire remodelling of the present system of appointing, paying and overseeing inspectors. The need of this will be very clear when the following points are mentioned:

(*a*) There is no method to-day of training an inspector for his work or of seeing that he is efficient in it. As it is, any man may be appointed, even if he has never seen either disease. Such a man may make an excellent inspector, but, if so, no thanks are due to those who appointed him and for some time at least he is greatly hampered by his lack of experience, and is very likely at the outset to lose the confidence of the growers who may fear that he is marking trees that are not diseased or is overlooking many trees that are affected. Mistakes of this kind are costly and should not be necessary.

(*b*) Under our present system there is no means of seeing that an inspector will do his work loyally. He may inspect all the orchards in a haphazard way, or he may only work a few days here and there when it suits him and let the greater part of the orchards go. Again, he may inspect the orchards carefully and mark all trees, but to avoid making ill-feeling, may not take any steps to see that the trees are taken out if the owner does not wish to do so.

(*c*) The present rate of wages are not sufficient to keep the best men, as a rule, at the work and to induce them to do their best, especially as in many cases inspection is a thankless task. I never recognized until this season how trying a thing this work is, and how hard it is to go into a fine orchard and mark tree after tree, especially when the owner is very doubtful whether they are diseased or is openly hostile to their being marked.

(*d*) The township council may hamper the inspector greatly by urging him to hurry the work over, and thus keep down expenses or by advising him not to insist on marking trees or requiring their removal when the owners object strongly, especially if these owners have considerable public influence.

From these things, therefore, it is surely quite clear that our present system is not at all business-like, satisfactory or a credit to the province. I shall not attempt to outline fully a new system, but would propose the following:—

(1) The inspectors should be appointed by and be responsible to the Provincial Government, and should report bi-weekly the number of

trees inspected, the number marked and any other matters likely to be of special interest. These reports could, if so desired, be sent to the expert biologist, and at the end of the season could be worked up by him, and form part of his report on the work done on the diseases during the season.

(2) The salary should be increased so that a man begins on say, $3.00 per day of ten hours, with travelling expenses when his work takes him away from home, and at the end of the first month, if his work is satisfactory, should receive at least $4.00 per day for the rest of the season.

Part of the money necessary to pay these salaries and those of the biologist could be assessed on the townships interested and part paid by the Government.

(3) Inexperienced men should be assigned as companions to experienced men, until they have thoroughly learned the symptoms of the diseases and the methods of work.

(4) Whenever the expert reports favorably on the work of an inspector, he should be re-appointed year after year at the maximum salary.

In conclusion, I should say that in spite of the system the great majority of the inspectors are doing very loyal work, and are showing an excellent public spirit in their efforts, often in the face of much opposition, to stamp out these diseases. I believe that nearly all of them know the symptoms of the diseases well, and so far I have seen no mistakes have been made by any in marking trees. They are all, however, very anxious to see the present methods changed for a more permanent and business-like one.

BULLETIN 202.] [MAY, 1912.

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Ontario Department of Agriculture

THE GRAPE GROWING INDUSTRY IN THE NIAGARA PENINSULA.

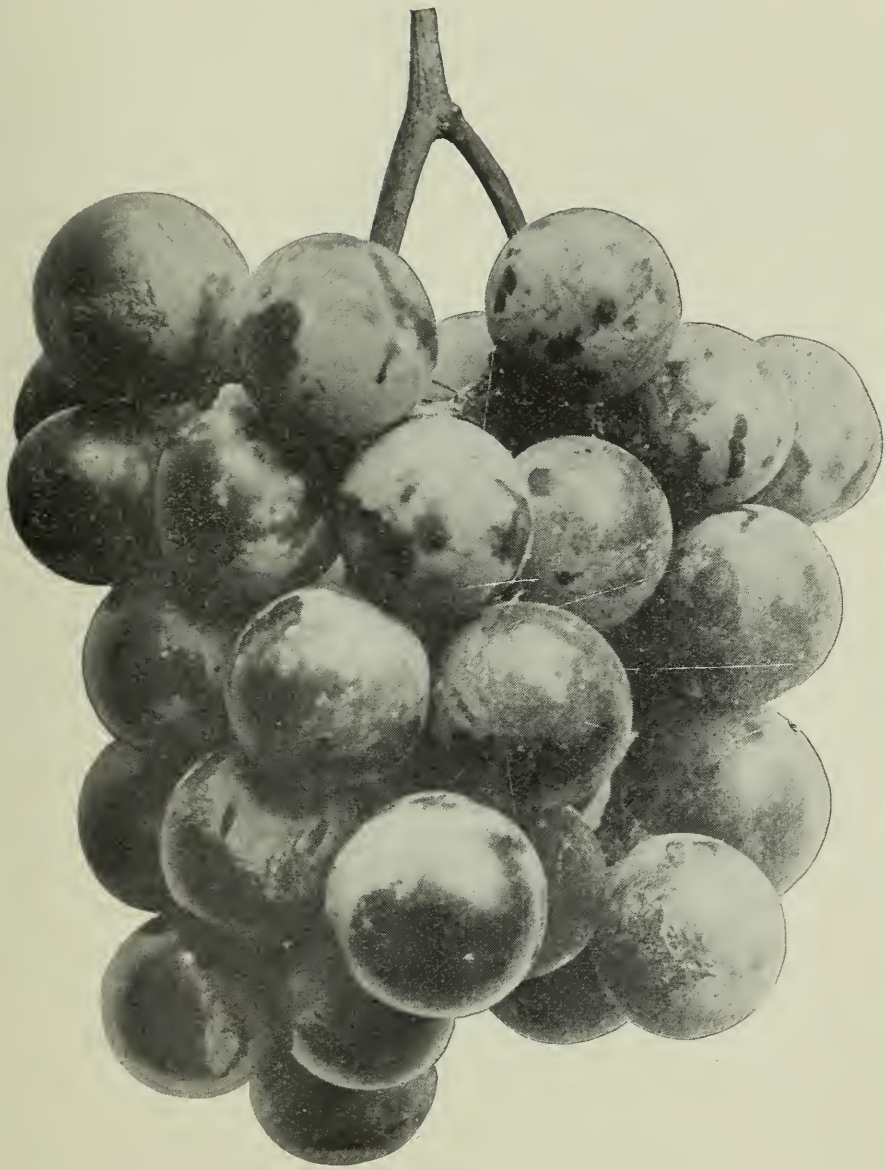
BY T. B. REVETT.

It is almost impossible to get any definite idea of the early days of the grape in the Niagara District. There seems to have been a few men who had planted two or three vines prior to 1860. In that year three plates of grapes were shown at an exhibition of native products held in Hamilton. These were supplied by Mr. Jonathan Pettit and Mr. W. D. Kitchen and a gentleman whose name could not be ascertained. These grapes attracted a great deal of attention, as they were probably the first Ontario-grown grapes ever shown at the exhibition. About 1857 some grapes were planted on a farm belonging to Mr. Porter Adams, situated in Niagara Township. In 1858 Mr. W. D. Kitchen and Mr. J. R. Pettit planted some grapes at Grimsby. In 1862 Wm. Read, of Port Dalhousie, planted three acres of Concord, Hartford, Prolific and Delaware. In the same year Peter Wright, of Stamford, planted three acres of Isabella grapes. In 1863 Messrs. Lusee, on the mountain near Winona, and J. M. Stewart, Henry Lottridge and Christopher Biggar, below the mountain, all planted small vineyards. In 1868 F. G. Stewart, of Stamford, planted 2½ acres of Concord and Delaware, and P. Prest, of the same place, planted an acre of Delaware, Concord and Hartford Prolific, and in 1869 Walter Kerr, of Drummondville, planted 2 acres of Concord and Delaware, and Mr. Lowin, of St. David's, planted 2 acres of Concord. For the next six or seven years, as far as could be ascertained, very few grapes were planted. About 1880, however, by the introduction of the Niagara grape, a strong stimulus was given to the grape industry. Vines of this variety were sold at $1.25 apiece, and the purchaser had to repay the company out of the first three crops, and was bound to sell all the wood from these vines to the company, and was not allowed to plant a single cutting, under a heavy penalty. In spite of these high prices and binding regulations, the vines yielded a profit of from $2 to $3 per vine for several years.

According to the late Mr. Murray Pettit, who was one of the earliest to grow grapes commercially, and who planted a Concord vineyard in 1872, and who was considered an authority on grapes, there were only about 400 acres of grapes in 1880. In 1890 it had increased to 2,400 acres, with a production of 3,318.27 tons. In 1901 the acreage had increased to 5,750 acres, with the crop valued at $20,000.00. From 1901 to 1909 the planting increased very rapidly, and after careful calculation the approximate acreage of grapes in the Northern District was found to be in the neighborhood of 10,000 acres. This tremendous increase was not due to any abnormal prices, but to the increase in number of fruit growers, and to the fact that it was found that grapes had proven to be a staple crop. The prices ranged from $20.00 to $22.00 per ton in 1909, as there was a tremendous crop, and as a result very few grapes are being planted this spring.

The Early Marketing of Grapes. It is interesting to note the gradual trend and development of the markets for grapes. Mr. F. G. Stewart, of Homer, told the writer that in the "seventies" he used to ship by boat from old Niagara-on-the-Lake to Toronto. Freight, wharfage and harbor dues at that time amounted to 18½c. per basket. These baskets had a capacity of twenty lbs., were made by Indians and sold at from 22c. to 25c. apiece, and used to be returned free from Toronto by the steamship company. Mr. Stewart said that in the "eighties" he netted as high as $210.00 per ton for Delawares and $140.00 to $150.00 a ton for Concords. Mr. E. D. Smith, of Winona, who has been a long time in the business and is perhaps the largest grower and shipper, recalls the time when a few baskets of grapes were enough to supply the market, and it was thought that a few acres would glut the market. In 1872 the express companies started to handle the grapes and the fruit growers began to ship to Toronto and Montreal, and the tendency was to find new markets. After the introduction of the Niagara grapes the price for these grapes was 10c. per lb., or $200.00 per ton. Since that time, as the acreages have been increased and distribution better handled, the consumption of grapes has been increased, yet the price has gradually been falling until it has reached the present low level, which varies from $16.00 to $22.00 per ton.

The gradual development of the markets, the better and more attractive baskets, the general keeping qualities of the grapes and the progressiveness of some of the shippers and co-operative associations have all lent themselves to developing the grape industry. In order to get some idea of the magnitude of the grape industry and its wonderful development in the last forty years one has only to consider that grapes are shipped by freight from the Niagara District to Vancouver in the west and Halifax in the east. The St. Catharines Cold Storage Company, which is a co-operative organization of growers in that section, shipped grapes to the West in 1904 under this Department's supervision; in 1905 Mr. R. Thompson, the manager, went West, and as a result of his trip 18 carloads were shipped; in 1906, 30 carloads were shipped West; in 1907, 45 cars; in 1908, 45 cars, none on consignment; in 1909, 90 cars were shipped to the western markets. With the development of the grape industry we also had a development of the wine industry. There



Agawam.

are five wineries in the Niagara Peninsula, which used 2,400 tons of grapes in the fall of 1909. There are also three or four factories situated in Toronto, Montreal and Sandwich, which are also supplied with grapes from this district. It has been found that under normal conditions about one-third of the crop of grapes is manufactured into wine. The buying for this purpose has usually been very brisk except during the last two years.

SOILS. The grape will thrive on a great variety of soils. In the State of Michigan the soil of the grape sections is a sandy one. In Southern Ontario and Pelee Island the grape soils are mostly sandy. In the Niagara district the grapes are grown on every variety of soil, from a light sandy soil to a very heavy, flat, red clay. In this district, however, the best grapes are grown on the mountain wash soils. This is of a loamy clay. It is a very deep, strong soil, and from year to year is kept fertile by the washing from the mountain. There is a strip of this mountain wash soil from Hamilton to Queenston, and its width varies from 100 to 500 feet. Toward St. David's, in the township of Niagara, we find the greatest width of this mountain wash soil, and with its advantage of earliness it must rank as the most ideal location for the growing of early grapes in the peninsula. The best soil for grapes, outside of special locations, etc., is a deep, rich clay or clay loam. When grapes are planted on these heavy soils they ripen their fruit better, and the flavor is much more pronounced and color better developed than grapes grown on sandy soils.

Grapes will also do well on a variety of the lighter soils, but it is hardly advisable to devote such lands to grapes, as these lands may be employed to a very much greater profit for production of other crops.

The soils for grapes in the Niagara district may be said to be the clay soils, as they are cheaper and better adapted to the most profitable production of grapes.

PREPARATION OF SOIL PREVIOUS TO PLANTING. The kind of treatment given to the cropping of land prior to the fall before planting is not very important. The chief factor to be kept in mind is the condition of the land to facilitate planting. A sod is not desirable because, in plowing out the furrows in spring, the result is that the sod is turned up. Grain or hoed crops are perhaps the best to use on land that is to be planted to grapes.

The land should be thoroughly plowed in the fall, and furrowed so as to insure good surface drainage. In the spring this land should be thoroughly worked down with disk and cultivator, and should be gone over twice. While the vines may do well on the land that has not been thoroughly worked, yet the grower should always endeavor to have the soil in the best shape possible.

TIME OF PLANTING. Vines should not be planted until the soil is dry enough to work without puddling. If the vines are planted when the soil is wet, the soil will become caked around the vines from planting, which is very undesirable. Planting may be done from the 1st of May

Vergennes.

to the 24th. Many of our best growers prefer to be late in planting and have good soil conditions, and they claim that the vines do just as well as early plantings.

Distances Apart in Planting. The distance apart in planting a vineyard, or the amount of feeding space to be allotted to each vine, depends almost wholly on the kind of soil, and to some extent on the method of pruning. In rich, deep clays—in fact, in all deep, heavy soils—the space required by vines is much less than in sandy or lighter soils. In light, sandy soils it is recommended to plant your vines 10 feet apart each way, *i.e,* the rows will be 10 feet apart and the vines 10 feet apart in the rows. This gives adequate room for the development of the vine.

In the heavier type of soils some of the growers recommend the rows to be 10 feet apart and the vines 9 feet apart in the row. This is a good conservative distance, and, for the average fruit grower, is perhaps more adaptable. In instances, however, where a grower has land which by some outstanding feature is peculiarly adapted to the production of grapes, such as would probably be situated at the foot of the mountain, and the grower has made up his mind to give some special attention to this vineyard, it might even be advisable to plant his rows 10 feet apart and have the vines 7 or 8 feet apart in the row. With this close planting it would be possible to get the most out of the vineyard, but at the same time a great deal more attention would have to be given to the pruning.

One of the best grape growers in the Winona section said that he thought it would be a very good plan to set out a vineyard closer and to remove the intermediate vines after a period of five to six years, thereby increasing the yield per acre up to the time of removal, which would considerably lessen the cost of establishing a vineyard.

This method, however, could be practised only where the vines were planted 9 to 10 feet apart in the row, and when vines could be purchased at 2½c. apiece. It is a question whether it would be advisable to recommend it, as the grower would find it very hard to remove the intermediate vines, and if they were left too long a lot of injury might be done to the vines which would eventually form the permanent vineyard.

Kind of Vine to Plant and Its Preparation. Nearly all the fruit growers buy their vines from the nurserymen, and very few, if any, grow their own. The nurserymen gather the wood from the vineyards as soon as they are pruned, and make the cuttings from the good, thrifty wood with sound buds. The base of the cutting is clipped off just below the bud, and the end just an inch or so above the third bud. This gives three buds to a cutting, and the cutting is about one foot long. These cuttings are tied in bundles of from 100 to 300 in a bundle and layered in the soil, standing on end with the buds turned upside down. This is done to stimulate the callousing and formation of roots. In the late spring, when the soil is in good shape, a deep furrow is made, and the cuttings are set in this furrow from three to five inches apart, in rows four to six feet apart These cuttings are cultivated and kept free of weeds, and make an excellent growth. Those cuttings that have made

Campbell.

a strong growth are sold the following spring as No. 1 one-year-old vines. Those vines that are not sold are replanted and are sold the following year as two-year-olds. There are perhaps some cases where the cuttings are allowed to grow two years and then sold as two-year-olds.

With the above knowledge the grower will be able to decide that the one-year-old vines are the proper ones to plant. This is the consensus of opinion amongst the best vineyardists, for they claim that a two-year-old is nothing but a one-year-old cull that has been replanted. However, there is one factor which has been suggested by one of the growers which would have some influence on the age of vines to be planted. He claims that some varieties are slow growers, and that better results are got from planting two-year-old Worden instead of one.

The usual precautions should be taken in ordering, *i.e.*, the varieties should be given, and you should request that no substitution should be made. The order should be mailed as early as possible, as the nurserymen fill their orders according to the date of receipt of same. The quality of stock required should be plainly stated and the age given. If these precautions are taken there should be no trouble in obtaining your stock. As soon as the vines are received the bundles should be cut open. and the vines heeled in and mounded up to three-quarters of their length. Care should be taken to keep varieties separated, and any simple device will do this. The place in which the vines are heeled should be protected. if possible. When the soil is ready for planting the vines may be trimmed up by cutting back the wood to three buds. There is some diversity of opinion in regard to the cutting back of the roots. Some growers believe in cutting them back two-thirds. This may be done with sharp spade or hatchet when the vines are received in bundles. In this way a lot of time is saved, and the slight difference in the evenness of the roots does not appear to make any difference. One very successful grower told me that he only removed the injured parts of the roots except in cases where they happened to be over twenty inches in length. and he claims that he could not desire better results. Another grower claims that he cuts back the roots liberally. but he finds that with the system of planting by a furrow the roots take a long time in getting hold of the middle of the row. and that most of the energies seem to be spent in the direction of the furrow. In order to obviate this he cuts two of the roots that are opposite to short spurs from one to three inches long. and in planting these roots should extend towards the centre of the rows or at right angles to the furrow. and he claims by so doing the roots develop in all directions.

Spring Preparation of Land for Planting. As soon as the land is dry enough to work, disk it thoroughly and go over it with a spring tooth cultivator and work it down until it is in good shape. It is almost necessary to go over it twice. When the land is in shape and the time has arrived for planting, the marking out has to be done. This is a very simple task, and requires a good plowman and a steady team. The rows are staked out at the proper distances apart at each end of the field, and by the use of two or three rods, depending on length of row, the plow-

Concord.

man strikes out a deep furrow of about six inches deep and returns in the same furrow. This plan has been found to be very successful by many growers, and all that is needed in planting. On the other hand, some of the growers prefer to strike out a furrow, and on the return strike out another, leaving a dead furrow between. This is plowed out on the third turn and deepened on the fourth turn. This method is longer, more expensive, but gives a somewhat better condition for planting. It is, however, a question which the grower must decide for himself, and will depend entirely on the amount of time at his disposal.

PLANTING. As soon as the furrow has been made the planting should be started, and should follow up the plow all the time. A rod cut to the desired length, which is the distance apart of the vines in the rows, is used to show the position of vines. A boy carries a bundle of vines which have been trimmed for planting, and one man does the planting. In planting, the root should be arranged carefully and the earth firmly tramped. The vine should be set so that the two or three buds are just above ground. One cannot be too careful in having the earth firmly packed around the roots, as perhaps more dead vines are due to this defect than anything else.

When a lot of vines are to be planted, two men are used, and a boy supplies them with the vines. By utilizing the second man the work may be more quickly and efficiently done. In some instances another man follows up the planting and fills in the earth to a distance of about eighteen inches on each side of the vine. Some growers have found that by applying a couple of handfuls of bone meal at the time of planting better results were obtained. The bone meal is not thrown on the roots, but is scattered about them before the earth has been completely filled in. When the field has been planted the furrows are filled in by using a disk. The disks are set at such an angle that each section will pass on the side of the row of new planted vines. This is by far the best machine to use, as it pulverizes the soil and fills in the furrow beautifully.

FIRST YEAR MANAGEMENT OF VINEYARD.

As soon as the vineyard is planted it should be kept cultivated, either with a disk or spring tooth cultivator, and the ground should never be allowed to bake or crust. Cultivation should continue until about the 1st of August, when the vines should be left to mature their wood. In the fall it is well to plow and furrow out the vineyard in order to afford good surface drainage. However, all that appears to be necessary in the way of fall plowing in so young an orchard is two or three furrows on each side of the row. By this I do not mean to imply that the fall plowing of the whole vineyard is not to be recommended. In hilly lands or any lands situated in such a manner that there is a considerable wash in the spring, I think it would be greatly advisable to abandon the plowing of the whole vineyard and only plow two or three furrows up to the vines, whether the vineyard be young or old.

Moore.

There is one vineyard I know of which is situated at the foot of the escarpment, and the water runs straight down the rows. In this vineyard the above practice is, and has been, followed for several years with excellent results.

Mulching of Young Vineyards. Mulching of young vineyards is practised by a great many growers, and seems to be a commendable practice, because, besides manuring the vines, it acts as a protection and mulch. Good, strawy manure is used, and two forkfuls are generally applied to each vine.

Cropping of One-Year-Old Vineyard. The question that naturally arises is, will a systematic cropping injure a young vineyard? It seems almost obvious that the plants do not require the whole of the feeding surface for their development during the first year, yet nearly every grower seems very skeptical on this point and almost invariably ends by giving his opinion, which is not very favorable to cropping, and his ideas must have been formed either by personal experience or observation. However, it stands to reason that if the land is needed it will in no way injure the grapes if the vineyard is cropped, but a distance of three feet should be left on each side of the row, and only those crops which will not shade the vines and are hoed crops should be used. I would not recommend the use of corn, as it does not permit free circulation and shades the vines too much. Tomatoes, potatoes and roots are probably the best to be used in cropping a young vineyard. I have always observed that the great drawback to inter-cropping was the lack of appreciation by the grower of the fact that if he inter-crops he must also fertilize and endeavor to carry on such a rotation that will improve rather than deteriorate the soil. If this factor were more faithfully observed there would not be so many discouraging opinions with regard to intercropping.

Spraying. It is not usually found to be necessary to spray a one-year-old vineyard, but should any insect attack it, poisoned Bordeaux mixture should be used. It is very little trouble to spray such a vineyard, and the expense is almost infinitesimal, and it would be a good precaution to spray the young vines after they had made their first growth.

Rubbing off of Buds. Two buds were left in the first instance, in order to insure a sprout, and in case one sprout was destroyed there would be another to take its place. As soon, however, as the growth has attained a length of from 10 to 15 inches, select the best shoot and remove all others. This will strengthen the growth.

Pruning.

Second Year Management. The method of cutting back in the second year varies greatly. Many growers desire to maintain their first year's straighter growth. However, taking all things into consideration, I would advise following out the method of cutting back to the second bud. By

Worden.

doing this the growth is greatly stimulated, and, as a general rule, the wood that is formed is of a strong, healthy texture.

CULTIVATION. A soon as the ground is dry enough it should be plowed about three inches deep. In many cases it may be noticed that some plowmen, while doing this work, will hold their plow at an angle. This is a very bad practice, because the work done is very uneven. The heel of the plow is up and the point down. This makes the furrow to a small degree V shaped—one part of the furrow being deeper than the other. The plow should be held squarely and an even furrow plowed, and the work will be more thorough and uniform. A gang plow is the best for this work. It does the work more evenly and with greater rapidity. After plowing it will be necessary to use the grape hoe, in order to get as near as possible to the trunk of the vine. While the young vines have not yet taken full hold of the ground allotted to them, it is not wise to plow very deeply, and thereby cut the surface roots. This is especially so in well-established vineyards, as in these the roots have extended very far and should not be ruthlessly destroyed by deep plowing. After the vineyard has been plowed it should be disked and cultivated, and the cultivation should be kept up until the 1st of August, and in the fall it should be plowed as in a one-year vineyard.

CROPPING. While it may prove successful if a proper method of cropping was carried on the first year, I think it is highly undesirable to crop during the second year, as I believe that full attention and every advantage should be given the vineyard from now on.

MULCHING. The system spoken of in the first year's management is a good one to follow and is giving good results.

TRELLISING. The work of putting in your posts and starting the trellis should be started.

POSTS. Good cedar posts should be used. For the end post the post should be longer than others, and not less than five inches in diameter, while the intermediate posts should be about three inches up. The posts should be well cured and not dead. If your posts are good they should last at least twenty years. If the butts of the posts are painted with tar they will keep very much better. The posts should be set about thirty feet apart and from 2 ft. 9 in. to 3 ft. in the ground.

SETTING END POSTS. The end posts have to be set more firmly, as they have to bear a greater strain. There are several methods of setting and guying the end posts. The usual method is to make the post hole deeper and larger, and to nail a cross bar on butt of post. This is done to keep post from heaving. Some heavy stones, if handy, are advantageously used as the first filling. Care must be taken that the filling is well rammed. The post is then guyed with strong wire (galvanized). The wire is secured to the post about a foot from the top; the other end is attached to a large stone, which is buried about three feet deep and as near to the post as possible without decreasing the relative ratio of the purchase. This distance is about four to five feet. The wire is tightened by using a stick and twisting the wire. The greatest objection to this method of guying the end post is the waste that is occasioned. The wire interferes with cultivation, wastes a lot of land and is conducive to slovenliness. However, this method is the best method of guying or giving the necessary strength to the end post by use of an outside support. Many of the new vineyards have been guyed on this principle, only the wires have been attached from the top of the end post to the base of the first post. In some cases a wooden brace between the end and first post is used, and is very effective.

Ends of grape trellis, showing method of bracing posts.

Another method of setting an end post which has been strongly recommended by one of our best growers, and which appears to be evidently acceptable as it does away with the guying, is "setting the post in cement," and is done in the following way A large hole is dug, the bottom of which is made very much larger than the top, and the ratio of increase of diameter of hole increases very rapidly at the bottom. This is done with the idea that if the soil is not disturbed the rigidity is greater, and by shaping out the bottom the cement foundation will be more rigid. In preparing the post for setting a cleft is cut on each side, in order to give the cement some hold on the post. It may even be beneficial to attach a cross bar to the bottom of the post. The post is then set in position, and the cement is filled in and well rammed, in order that it will thoroughly fill the hole. The filling is continued until you have a cement foundation about a foot thick. The cement is left exposed for a few hours, and then the hole is filled in usual method. This method of setting in cement is more expensive, but the headrow of the vineyard is easily kept clean, as there are no wires in the way, and again we invariably have the rusting and breaking of guy wires, which are tedious and expensive to replace.

Wire and Wiring. It is a good plan to get the best grade of galvanized grape wire. No. 9 staple wire is the usual size in use.

It may not be necessary to put on all the wires that are actually needed for the system of training that is to be followed, but a job that is half done is unsightly and detracts from the appearance of the young vineyard, and is likely to give a bad impression to casual observers, and if it is at all possible to complete the wiring it is strongly advisable to do so.

The wiring of the posts is a very simple thing. In wiring of end post one of the many plans for tightening the wires has to be followed. There are some simple devices which are attached to the post, and the wire is tightened by turning a crank. A very simple method in use is a piece of hardwood about an inch square and six to eight inches long. The wire passes through a hole in the post and is attached to the stick, and to tighten the stick is just turned round, and the tautness of the wire, together with the shape of the "tightener," keeps it in place. In stitching the wire the spool is placed on a spindle at one end, and a man takes the wire to the other, where it is tightened and fixed in the same method as the first post. The wire is then fastened to the post by staple.

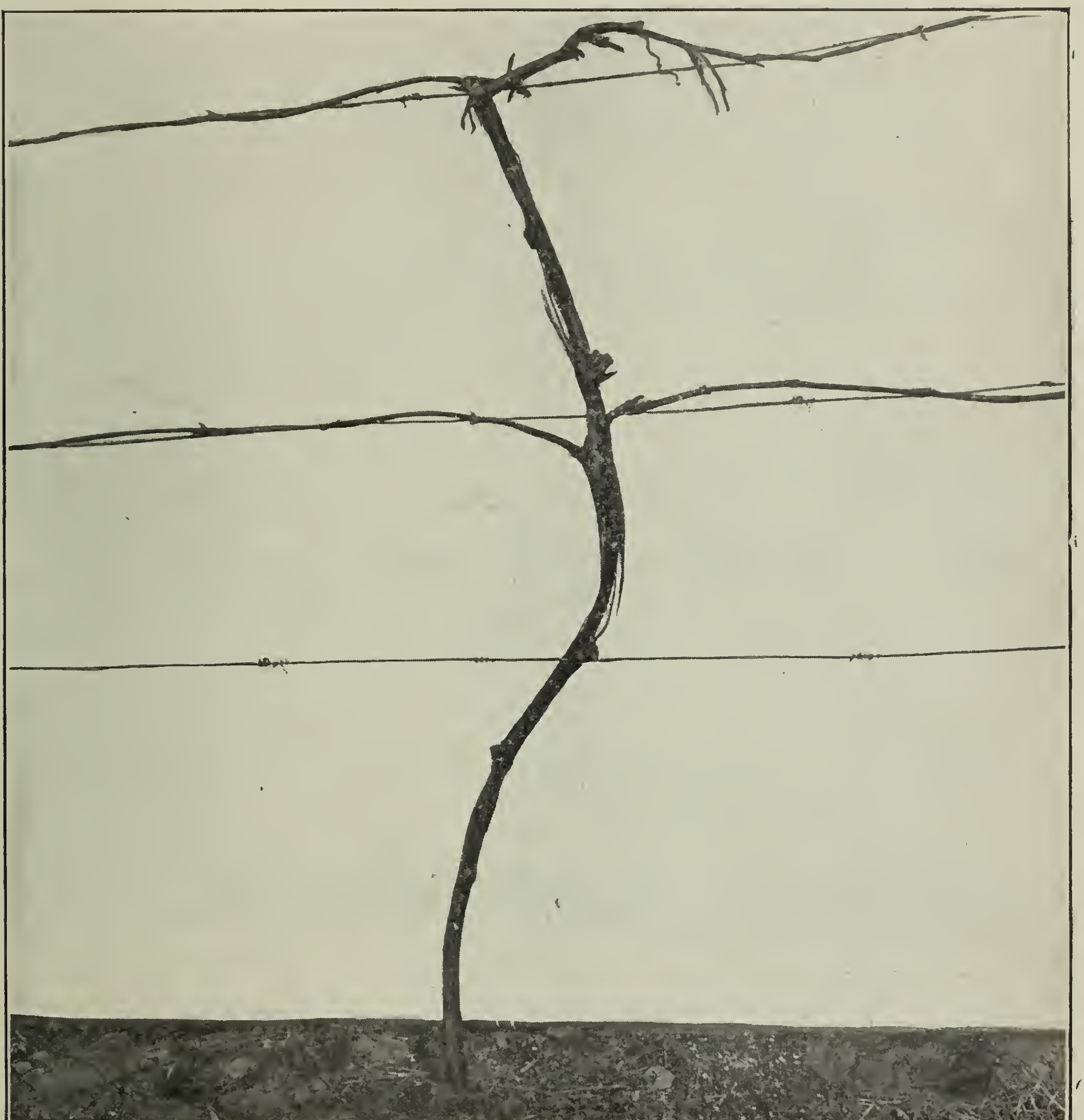
Distance Apart of Wires. The distance apart of wires depends entirely upon the system of pruning. When only two wires are required, the first wire should be 2½ ft. from the ground, and the second or top wire 2½ ft. from the first. Where three wires are used the first wire is generally 18 inches to 2 ft. from the ground, and the top wire 5 ft. from the ground, while the third wire is halfway between. In cases where four wires are used, the first wire is from 15 to 18 inches, and the other wires evenly spaced off, the top wire being 5 ft. from the ground.

Training of Two-Year-Old Vines. In many cases the training of these vines is neglected; but this is very wrong, as it is desirable to obtain as straight a trunk to the vine as possible, and this can only be done by training during the second season. The chief training to be done is that of the main shoot, which should be tied up to second wire as soon as its growth permits.

Summer Pruning of Vines. The only summer pruning to be done in a two-year vineyard is to rub off all the buds or shoots from the main stalk from the ground up twelve or fifteen inches of the trunk. This is done to strengthen the trunk and keep it clean and even.

Management of a Three-Year-Old Vineyard.

In the third year a vineyard commences to bear and the general routine of work is practically the same as all other years, the cultivation,



Old Kniffen System.

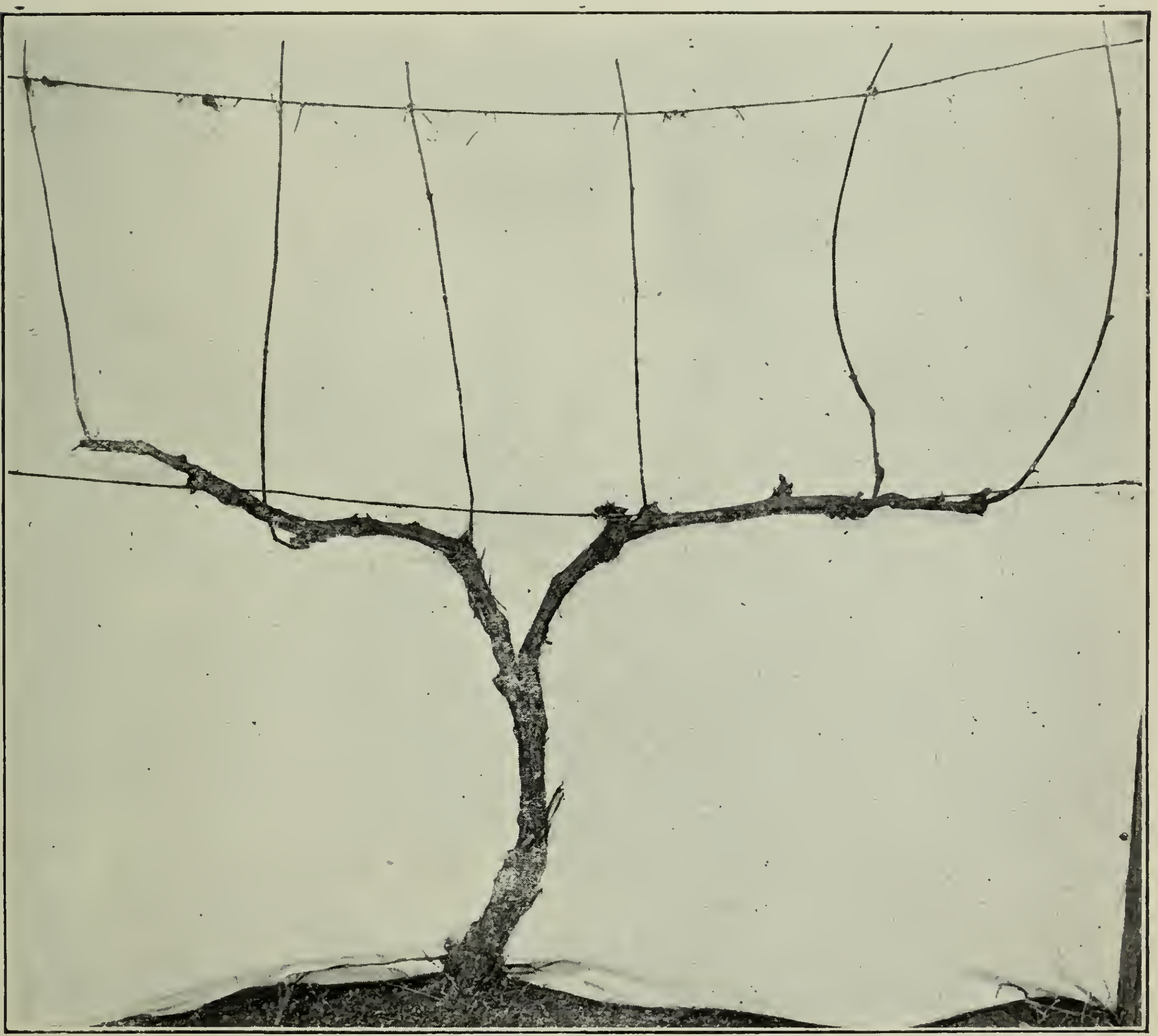
which consists of fall and spring plowing, and a thorough harrowing of the soil. The use of the grape hoe becomes more necessary, and some of the growers attach a small one-horse cultivator to the grape hoe, the cultivator taking the place of the shear of the grape hoe. This makes a very handy tool for working up to the vines. In the fall the soil is plowed up to the vines and in spring away from them. It, however, cannot be too fervently expressed that proper and frequent cultivation must be given the vineyard in order to get the best results, and the cultivation must stop about the latter part of July in order to induce the vines to ripen their fruit and mature their wood. The most important thing in the third year of a vineyard, and perhaps of all the preceding years, is the pruning and training, and this feature will be taken up after the discussion on the different methods of training grapes as the pruning closely hinges on the methods adopted.

Improved Kniffen System, showing the method of dividing trunk of vine.

METHOD OF TRAINING GRAPES. There are six methods of training and trellising grapes to be found in the Niagara Peninsula. They are as follows:—

1. The Kniffen system.
2. The Arm system.
3. The Fan system.
4. The High renewal system.
5. The Arbor system.
6. The conglomerate and do as you please system.

THE KNIFFEN SYSTEM. This system of training grapes is perhaps the most common, especially in the neighborhood of St. Catharines and towards St. Davids and Queenston. It consists of a central cane with four arms and is trained on two wires. This system is greatly recommended by some of the best growers, especially in cold sections and on sandy or light soils. Its chief advantage is that it permits of thorough ventilation. It is generally cut back to seven buds to each arm and four



Arm System.

arms to a vine, which gives fewer bunches than other systems, but these fill out and ripen better, and there is not as much tying up. The Kniffen system is admirably adapted to the production of market grapes of the best quality but the yield of bunches is not as great as in the other systems.

In pruning for the first and second year the vines are cut back to two or three buds as previously described. In the third year one arm is trained along the first wire, and if possible a second arm is trained on the same wire. The second arm is generally from the first. The probability of securing a second arm may be increased by leaving a spur at the proper point during the second year pruning. The main shoot is carried up to the second wire. The grower should endeavor not to crop his vineyard too heavily, and from twelve to fifteen buds are quite suffcient to be left, the others should be rubbed off. With this system there is virtually one central trunk with a side arm at the first vine from which the two arms are eventually taken. It is claimed that in this way the flow of sap is straight to the top of the wire, while the canes on the first wire do not get as much nourishment and they do not as a general rule give the best possible results. This argument may be substantiated if the size of the trunk is any criterion by which one may judge the ratio of the flow of sap, because it is invariably noticed that the size of the trunk from the first wire to the top of vines is a great deal larger.

In order to ameliorate or equalize conditions, Mr. F. G. Stewart, of Homer, devised the plan of dividing the main trunk below the first wire, carrying one trunk to the first wire and continuing the other up to the top wire, and he claims he has accomplished the act of more evenly distributing the flow of sap over the whole bearing surface of the vine. The division is got by allowing two canes to grow at about fifteen inches from the ground. In the fourth year the vine should have conformed itself to the Kniffen system, and in pruning in the spring there should be two arms on each of the wires and seven buds should be left to each arm. The Kniffen system is a very desirable form for training grapes and is highly recommended by a great many growers.

The Arm System. The system is best adapted to the production of a quantity of grapes and is used more for wine production, but in Ontario there is no specialization of growing grapes for wine, and the growers only adopt this system because it appeals to them. It consists in having two main trunks along the first wire, and from each of these trunks five canes with from seven to eight buds are left. These canes are tied up to the wires at almost right angles to the arm. Three wires are used, the top wire being about five feet from the ground and the middle wire evenly spaced. In the second year the vine is trained in two arms along the first wire and in the third year it is cut back two or three buds to the arm, and the fourth year four or five canes are left which are cut back to five or six buds.

Fan System. This system is admirably adapted for the production of a quantity of grapes. It is easily pruned and gives an even distribution of wood, and next to the Kniffen system is more generally used in the district than any other. It is not advisable, however, to adopt any system which has the tendency to induce over bearing, especially in late ripening varieties, as this might result disastrously in cases of early frosts. Besides, when over-production is prevalent we have an improper ripening of wood, and as a result winter killing of the canes. This system is very prevalent between Hamilton and Grimsby, especially in the Winona District.

HIGH RENEWAL SYSTEM. This system seems to be a moderated type of Fan and Arm systems. Its chief value is the evenness of distribution of wood, the apparent simplicity in pruning and the excellent results it has given around Winona, especially on the mountain wash lands. It is used by Mr. E. M. Smith, who recommends it very highly. In the

Fan System.

first year the vine is pruned to two buds. After they have grown about ten inches break off one cane. The second year cut back to two buds again (if vine is weak save only one cane) ; train to first wire. Third year train to first wire and tie vine so that it is taut (vine should be twenty to twenty-four inches from ground). Rub off all buds below one foot from ground. Fourth year run out two canes along first wire and centre cane to second wire and cut off all canes to six or eight buds.

Arbor System. In this system the vine is cut back in the first and second year to two or three buds, one shoot being retained each year. In the third year the vine is run up to the top of arbor, which is built about five to six feet high. The vine is then trained along the top of arbor, and every year the wood is renewed and about thirty buds left to bear. Outside of home vineyards, which are trained in this manner in order to lend an appearance of beauty to the garden, there is only one commercial vineyard trained in this manner and the grapes are grown for wine. This vineyard is situated at St. Catharines and is the property of one of the large wine-making companies.

The Conglomerate and do as you Please System. This system, I am sorry to say, appears quite frequently in the Niagara District and the adjacent country where grapes are grown. It may or may not be the result of carelessness, but the chief cause is the lack of definite knowledge of the methods of training, and also the employment of trimmers that are not conversant with any definite methods or reason for methods which they may practise, the chief idea being to remove a portion of last year's growth. In these cases we invariably find that too much bearing wood is left on the vine and the net result from such conditions is that the vineyard presents an uncared for appearance, the fruit is much harder to pick and the bearing wood recedes further each year from the main trunk. There is no special method of training these vines, as this system is liable to be found on any kind of trellis.

Pruning. Pruning is one of the most important factors in successful grape growing. On it depends the even distribution of wood, the limitation of the crops, the quality of fruit, the development of bunches and the ripening of same and the general appearance of vineyard. The majority of growers understand the importance of pruning. They realize that wood must be renewed but have not arrived at some specific ideal of training, which goes hand in hand with pruning. Too often men are hired to prune the vineyard, and probably a different man every year, with the result that the best results are not achieved, and in many cases the shape of vines destroyed. No definite plans can be laid down for pruning, and several things have to be taken into consideration which are local and call for personal observation and experience. The ultimate object of pruning is to produce the best fruit, to keep the vines in a desired shape, to control the factor of bearing and to facilitate all necessary operations in the production and harvesting of fruit. The vineyardist must bear in mind that it is within his control to limit the number of bunches to be produced by any vine in his vineyard. With this factor under his control he should use his judgment in pruning. He must study his varieties and their methods of bearing and ripening. For instance, those varieties that are late in ripening should not be allowed to bear too heavily, for this is conducive to late ripening, and very often we find late ripening and productiveness hand in hand. The amount of fruit which a vine can bring to maturity with the best results depends upon the fertility of the soil. This is another factor which receives too little attention by the growers of the Niagara District, and it too often happens that because somebody, who may have entirely different soil both in regard to physical character and fertility, leaves so much bearing wood on his vines it must be right for somebody else to do the same. The only way to determine the amount of bearing wood to be left on your vine is by observing the crops and their quality. A vine that is young and inclined to be small and lacking vigor will not improve by over-bearing and should be cut back more severely. It must be borne in mind that the proper number of bunches to a vine should be just what the plant will be able to fill out properly and mature. It is better to have fewer bunches and better ones. It is a general plan to allow from twenty-eight to thirty buds to a well-grown vigorous vine. One factor which must bear strongly on the number of buds to the vine is the distance. Vines that are planted closely should not be allowed so many, but the aggregate production to the acre will be more. The fundamental principle of pruning grapes is based upon the following fact that the fruit is borne in a few clusters near the base of the growing shoots of the season which spring from wood of last year's growth. The number of bunches that are borne on these growing shoots vary from two to five, according to the variety. This feature will be taken up in the discussion of varieties.

The feature next to the importance of the proper proportion of bearing wood to the vigor of the vine is securing the desirable growth for the following year and to obtain this growth in position desired. All successful vineyardists endeavor to have the bearing wood spring from as near the centre part of the vine as possible. In order to get this it is customary to leave a spur with two or three buds in the desired position, and the growth resulting from this is the bearing wood for next year. Sometimes it is not possible to do this and on the other hand shoots may start from the stem of the vine which may be more adaptable than those from the spurs.

THE KIND OF CANE TO SELECT FOR BEARING WOOD. It is not an uncommon thing to have extremely well developed canes which appear plump and most desirable. It will be noticed, however, that the joints of these canes are abnormally long and the buds are wedge-shaped instead of being round and plump. The best growers avoid the selection of these canes, which they call "Bull canes," and claim that they do not produce as good bunches. One grower, however, informed me that he tried an experiment with some of these bull canes and could find no difference in the productiveness and quality of fruit. It would be advisable, however, to retain those canes which are characteristic to the variety and well developed and have round, plump buds.

TIME OF PRUNING. In the Niagara District it does not seem to matter at what time during the dormant season that grapes are pruned. It has come to be an established fact that pruning of vineyards may be started in January and finished by March. It is best to have the same man do your pruning from year to year, and if more than one man is employed some responsible party is generally placed in charge of the work. After the vine has been pruned the trellises are cleared by cheap labor. Trimmings are thrown in the centre of the row and are gathered in the spring and burnt.

In gathering the trimmings a pole from 12 to 16 feet in length and 2½ to 3 inches in diameter at one end and slightly smaller at the other end is used. It is best to have the largest end, which is the one that draws along the ground, slightly curved at the end. A horse is used to drag the pole and the whippletree is attached by means of a chain or rope to a point about four or five feet from the ground end of the pole. The driver holds one end of the pole and proceeds down the row. The pole soon

Method of renewing old vineyard, showing a two-year-old cane which will take place of old trunk at next pruning.

collects the trimmings, which are heaped at the end of the rows and burned. Some of the growers use a spring tooth cultivator for this work with a great deal of success.

Summer Pruning. Summer pruning is not recommended as a general thing. Some of the growers shear back the vigorous growth if it is shading the fruit too much. In some varieties, such as Champion and Vergennes, sprouts will very often appear and fruit many small ill-shaped bunches. These should be removed. It is also a good practice to remove any vigorous growth which may sprout up from below the first wire. However, if one is about to renew his vine it is well to select one of these shoots sprouting from the collar of the vine and train it.

PRUNING TOOL. The ordinary clippers is all that is required for winter pruning. Unnecessary growths in early summer are best rubbed off with the hand, and the pruning back of vigorous growths is usually done with a pair of large hand shears.

RENEWING OLD VINEYARD.

A system of renewing is sometimes adopted in vineyards that are very old or in vineyards that have been disfigured by improper pruning. In order to renew a vine a shoot coming from the ground is protected and in pruning the first year it is cut back to the first wire. The second year it is pruned according to the system of training, and part of the old vine is removed. In the third year the pruning is carried out as the second year but your wood on this new vine would probably enable you to train it on the upper wires. This year some more or the whole of the old vine is removed according to the vigor of its successor. This plan is very good because no crop is lost in the renewing of the vine, and when the old vine is discarded the new one is in full bearing. It is sometimes hard to get a new shoot from the ground, and while the majority of growers wait for their opportunity to secure a sprout one of the growers claims that he gets good results by ringing half way round the base of the old cane. This ringing causes the formation of sprouts, from which one is selected.

TYING. In the spring the vines are tied up with strong grape twine. A woman will do this work very handily. The twine should be wrapped twice to three times around the wire, make one knot and then tie up cane. This method of tying does not cause slipping and allows room for expansion of cane.

FERTILIZATION. To get the best results from a vineyard the soil must be fertile. In rich wash soil situated at the foot of the mountain the grapes do well with practically no manure or fertilizer. This is evidently due to the fact that a good deal of fertility is washed off the mountain on to these lands every spring. The majority of the heavy clay soils and the loamy soils need manure, especially the clay soils, the physical texture of which is far from being ideal, and good applications of barnyard manure would be very beneficial.

Within the last two years a great many of the growers are applying barnyard manure. They, however, make the great mistake of applying it around the trunk of vine instead of spreading it over the row where the feeding roots can get at it. While a good application of barnyard manure will give excellent results, it must be remembered that it contains more of nitrogen than of the other constituents of plant food, and too heavy and frequent applications would be apt to stimulate too much growth. An application of from six to nine tons per acre every three years should give good results.

Commercial Fertilizer. The use of commercial fertilizer is becoming more common amongst the fruit growers. Many of them claim that by its moderate use good results are obtained, providing the soil is in good physical condition, especially on the lighter soils. Mr. F. G. Stewart, of Homer, recommends the following application: Rock phosphate 400 to 500 lbs., potash 100 lbs. per acre sown broadcast. In buying fertilizer the grower should never buy a mixed compound but should buy the ingredients and mix it himself, and in doing this he saves money and knows exactly what he gets. There is no definite rule in regard to the amount and kind of fertilizer to use. This depends entirely on the soil and its condition. The grower, therefore, should experiment for himself and he will be able to know definitely what is needed and the quantities that will give him the best possible results on a minimum expenditure.

Cover Crops. The use of cover crops is primarily to incorporate vegetable matter in the soil, and when nitrogenous crops are used they also incorporate nitrogen in the soil. The secondary function of the cover crops is to hold the snow. The greatest drawback in a cover crop is that it makes it very wet picking the fruit. Nitrogenous cover crops are not often used in vineyards. The chief crops used are rye, oats and barley. These are sown early in the summer and plowed under early in the fall to facilitate picking. In some cases rye is sown in the fall at the rate of one to one and a half bushels to the acre and plowed under in the following spring just when the grain starts to head.

Harvesting.

Never pick your grapes until they are ripe. During the past years there were growers who have been extremely eager to obtain the highest market price for their grapes, and to do this they pick their grapes without the slightest regard for the ripeness. Their whole endeavor is set on getting to the market with grapes before anyone else, and incidentally to palm off on the unsuspecting public an article not fit for hog feed, much less human consumption. If there were only individual cases of this fraud being practised it would not be so bad, but the neighbors see the grapes going to market and the temptation seems to be almost irresistible and we find growers all over shipping green grapes. Ask them their reason and they will reply that the other man is doing it and getting the high prices. What is the result of this marketing of green grapes, and who does it affect? The answer to the first question is very apparent. The consumer gets the green grapes and decides that either they are green and unfit to eat and that he has been cheated or that he has lost his taste for grapes, and what is the result? A falling off in consumption. The good prices that are obtained on an early market do not last long and the growers suffer. This regrettable feature should be eliminated and the growers should do everything in their power to stop themselves and their neighbors from selling green grapes. Grapes do not require to be picked before they are ripe in order that they carry well.

On the other hand they carry better and keep longer when they are picked ripe.

The question may then be asked, when is a grape ripe? A grape may be said to be ripe when it has received its full development of color and flavor.

Picking of Grapes. The picking of grapes is mostly done by women. The grapes are picked directly from the vine and put in the baskets, which are placed when full on the shady side of the vine to be picked up later by the wagon. The bunches should be handled as carefully and as little as possible, in order not to rub off any of the bloom. The bunches are severed from the vines by means of grape plyers. This little instrument is very much like a pair of scissors, but the blades are very small. A knife should not be used, as it necessitates holding the bunch more firmly, and the act of cutting the stem with a knife requires a forward pull which tends to bruise the bunch. The stem of the bunch should be cut short, about an inch to one inch and a quarter. Any dried or green berries must be picked out with the fingers. The bunches are then placed in the baskets so that they are not loose. Those bunches forming the top layer of the basket are placed stem downward which gives the basket an attractive and finished appearance. The baskets are usually covered in the field and taken to the packing shed, where they are hooked. The baskets used are either six or eight quart baskets, and cost about $34 per thousand. There are several other packages which are more or less fancy and could be used to advantage for high class trade, such as the crate which holds four three-quart baskets. These make a very attractive package, but the market for such packages is very limited at the present time, though there is no doube that it may be worked up.

Markets.

The markets for the grapes of the Niagara District include the whole Dominion of Canada. Our grapes are being sold from Vancouver to Halifax. The great drawback seems to be improper distribution and underselling. Like every other commodity the grapes have to be sold at a certain price in order to be profitable to the grower. It is the last crop the grower has to market, and the fruit comes in in great quantities and very rapidly, especially towards the end of the season. The result is that distribution has to be very perfect in order to market the crop without glutting any one market. The present state of marketing is far from perfect. There are six co-operative societies, three large buyers and many small buyers shipping independently, and the result is an unsteady market. The grapes have to be disposed of quickly in order to move the crop, and the buyers must sell at an advance of 1½ cents per basket in order to make a small margin. In the face of daily increase of grapes the buyers and associations have to find a market. For instance, last year's crop was marketed to the great dissatisfaction of the grower and in several cases to the loss of the buyer. The grape crop was a very heavy one. The wine manufacturers only bought about one-third of their usual purchase, and in spite of the fact that green grapes had been sold in large quantities, which discouraged the early markets, the consumers were taking a tremendous quantity of grapes. The price was falling rapidly and many of the growers had to be satisfied with 10c. per basket, while the average price was not above 12½c. per basket. Several reasons were given for this demoralizing state of affairs. The great cry was that the French Treaty had cause the wine manufacturers to curtail their purchases almost one-third, and that there was an over-production of grapes. These factors no doubt played a very important part in producing the crisis, and the effect will tend to stop the planting of grapes to a very great extent. Some growers justly claimed that the promiscuous selling of green grapes lowered the average price to a great extent and they were unquestionably right. However, these causes do not seem to answer sufficiently for the prices of grapes. The markets did not seem to be glutted in any case, and the consumer had to pay the usual price per basket even in Toronto. While grapes were being bought at from 10 to 12½c. per basket from the grower the consumer in Toronto was paying from 18 to 28c. for the same article, and yet we know that the buyers in the fruit district lost on their grapes. There seems only one explanation, namely, that the buyers have been underquoting their competitors, even below the margin of cost, and that this system was greatly intensified in view of the large crop and the rapidity with which it ripened. To the average onlooker who had no knowledge of the industry a simple remedy would be to amalgamate the interests or to have some working basis on which prices should be based. The first suggestion has received a great deal of thought, but would be an extremely hard plan to consummate. In this market there are individual buyers and co-operative associations consisting of the growers themselves, while the buyer buys the grower's produce and expects to make his profits, and it would hardly be acceptable to the buyer to have such close relations with the farmers through their associations. If such a proposition could be established it would greatly ameliorate the conditions of the grape market and would be the greatest boom to co-operation that Ontario has ever seen or even dreamed of and would mean a tremendous increase in the membership of the co-operative associations. To the average public such an organization would be greeted with a great deal of awe and disfavor and the cry would immediately arise that a monopoly existed and the price of grapes would immediately be raised and maintained. This, however, would not be the case. Grapes are perishable and have to be consumed within a short period, and the consumption decreases rapidly with the advent of cold weather. The main object of this amalgamation would be to fix a uniform price for grapes, starting from the early varieties down to the end of the season. Such an amalgamation would mean that the distribution would be more even, the grapes would be better packed and handled and the green grape nuisance would be more conveniently held in check.

The second suggestion, that the associations and buyers should get together and fix a ratio of prices which would be rigorously adhered to seems to be a very admirable one at first thought. This has been tried, with the result that the quotations were not adhered to and a merciless cutting of prices was instituted and the growers had to foot the bill, especially those who had not contracted their grapes beforehand.

The different parties who are interested in definitely doing away with the present unstable and unprofitable state of the grape industry have had several meetings already with but little result, but it is hoped that some definite plan will be formulated and upheld during the coming year.

Contracting Grapes. A large percentage of the grape growers contract their whole crop of grapes either to the buyer or wine manufacturer. The contracting is resorted to in order to insure a certain percentage of grapes before the market opens. The buyers usually contract at so much per basket for the different varieties or buy the whole vineyard at a flat rate per basket.

The wine manufacturers buy at so much per ton f.o.b. Grapes are picked and put in barrels, all fruit being taken. The different colored grapes are kept separate. In selling to the wine manufacturer the grower has very little trouble in the harvesting and shipping of his crop.

Cost of Production of One Acre of Grapes.

As a sequent to the prices realized by the growers last year great interest has been shown in regard to the actual cost of production. Mr. Murray Pettit, who is one of our largest grape growers, and is considered an eminent authority on grapes, not only in Canada but also in the States, gave an address at the Convention of the Fruit Growers' Association in November, on the cost of producing and maintaining an acre of grapes, and also endeavored to prove that grapes were an unprofitable crop at 12c. per basket, and while there was some diversity of opinion with regard to his figures on the actual cost of production yet the consensus of opinion throughout the whole district is that the margin of profit at that price is too small to cover risks of hail or frost or variability of crop, and they all agree that the prices should be from 14 to 18c. per basket according to variety.

It must be taken into consideration in computing the cost of producing and maintaining an acre vineyard that there are two years in which the vineyard does not yield any crop. It is true that a crop may be grown the first year, but the percentage of land that may be utilized is small. The three crops used are corn, potatoes or tomatoes, but corn is not very highly recommended, as it shades the vines. Potatoes and corn do not give the very best results on the majority of grape soils. The cost of grape land varies very much, but the average would be about $125 per acre.

First year.

Land	$125 00
Fall preparation of land	3 00
Spring cultivating and marking furrows	1 50

Cost of 435 Vines at 4c.	17 40	
Planting	3 00	
Cultivating	3 00	
Fall plowing	2 00	
Interest on money invested at 5% (practically)	7 50	
Allowance for cropping		10 00
Total expenditure for first year	$162 40	10 00
Net expenditure for first year	152 40	

Second year.

Working soil in spring	1 50
Cultivating	3 00
Pruning and tying	1 00
Interest on capital at 5%	7 50
Cost of trellising—	
435 Posts at 15c. per post	65 25
Planting 435 posts (including digging and setting posts) at 5c. per post	21 75
Staples and Wire	10 00
Wiring	2 00
Interest	13 00
Total	$125 00

Third year.

Pruning	1 50
Tying	50
Cultivating and plowing	5 50
Fertilizing	8 00
Spraying twice	1 00
Interest	14 70
	$31 20

Average crop for third year, 435 baskets per acre.

Cost of 435 baskets at $34 per thousand	14 79	
435 Baskets at 12c.		52 20
Picking 435 at ¾c. per basket	3 26	
Covering	1 00	
Delivery	75	
	19 80	
Total expenditure for third year	51 00	
Total revenue		52 20

Total expenditure for first three years—above receipts:

First year	152 40	
Second year	125 00	
Third year	8 50	
Third year	1 20	
Management for 3 years at 5%	16 92	
		$293 12

Fourth Year.

Pruning	$3 00	
Tying	2 25	
Gathering and burning brush	50	
Spraying	50	
Plowing and cultivating	5 50	
Fertilizing	8 00	
Interest	15 73	
850 Baskets at 12c.		$102 00
Cost of 850 baskets at $34 per thousand	28 90	
Picking 850 baskets at ¾c. per basket	6 37	
Covering	2 00	
Delivering	1 00	
	$74 65	
Management	5 00	
	$79 65	102 00
Profit	22 35	

Insects and Diseases.

The grape is perhaps freer from the devastation of insects and diseases than any other fruit grown in the Niagara district, and it is perhaps owing to this factor, together with the almost assured prospect of the production of an average crop every year, that the grape has been placed in the same relation to the fruit industry as grain may be said to hold in regard to general farming—namely, the staple crop.

While a good collection of insects may be gathered by a visit to all the vineyards in the Peninsula, yet I have not been able to locate any special insect which may be said to be the cause of any serious damage to the grape industry.

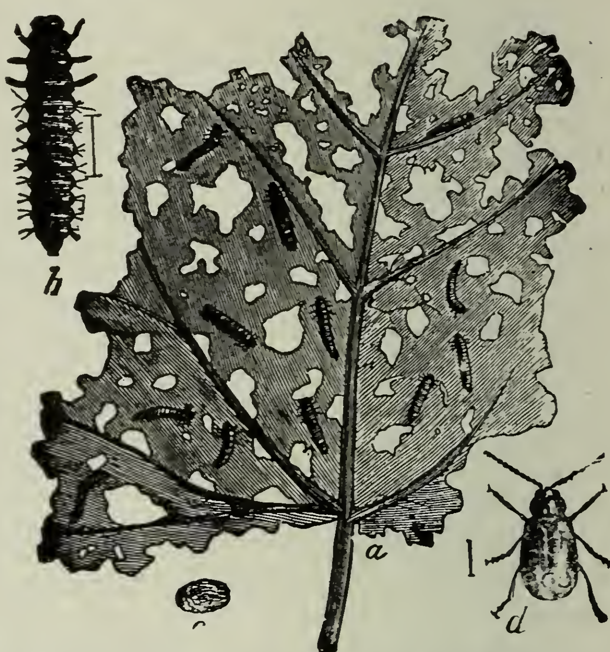
The Grape Vine Flea Bettle, *Haltica chalybea.*—This is a little, shiny steel blue beetle about one-sixth of an inch long and appears during the early period of growth, and while it does not do any considerable injury in the Peninsula it is perhaps the most prevalent but is easily controlled with poisoned Bordeaux. This insect winters over under rubbish or near the roots of stumps of trees. The grower should always keep it under control as it is capable of doing a considerable amount of damage.

The Rose Chaffer, *Macrodactylus subspinosus.*—This insect is a dull yellowish brown color, half an inch long, with long spiny legs. It is a very voracious feeder and will completely strip a vine or rose bush. It is not very common and seems to appear locally. I remember one case where this insect appeared on a farm near Burlington and did considerable damage to some of the vines. It is not easily controlled, as the poisons, especially Paris green, do not seem to have any effect on it. As soon as these insects appear they should be hand-picked and destroyed.

The Spotted Pelidnota, *Pelidnota punctata.*—This is a large brown beetle something like the June Beetle, but has three black spots on each wing cover. It appears during July and eats the foliage. It succumbs to the poison, but it is so conspicuous that it is easily detected and should be killed when seen. This insect is quite prevalent but does not do any serious damage.

Grape-vine Flea Beetle (Haltica chalybea).

Grape-vine Leaf-hopper (Erythroneura vitis)

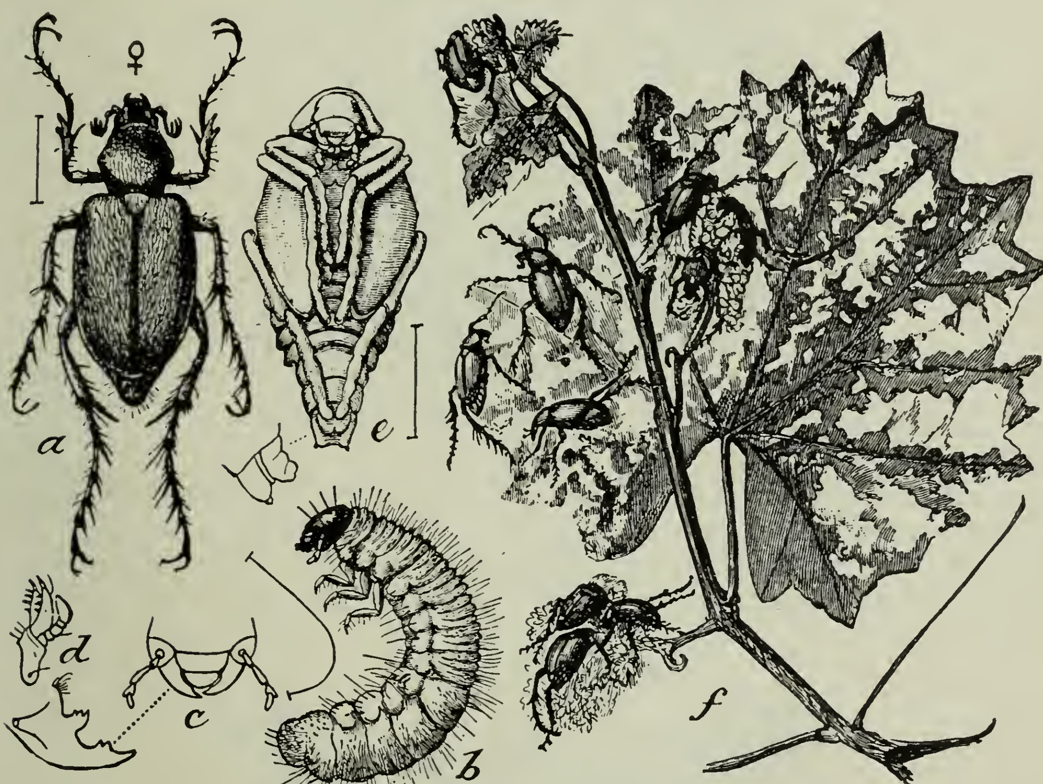


Grape-vine Flea Beetle (Haltica chalybea); *a*, Larvæ feeding; *b*, Larva; *c*, Pupa stage; *d*, *Beetle.*

The Grape Vine Sphinx. According to Mr. T. D. Jarvis there are five species of the insect to be found in the vineyards, the commonest being the Green Grape Vine Sphinx. When the caterpillars are full grown they are about two inches long and are very noticeable. They are found occasionally in almost all the vineyards and may be hand-picked. The adult is a beautiful large moth, the fore wings expand about two and one-half inches, of a velvety green color with dark bands. The hind wings are smaller and of a dusty red color.

There are several other caterpillars that appear in the vineyards, but have not been the cause of any serious loss. The following is a list of some: Grape-vine Leaf Roller, Grapevine Geometer, the Yellow Wooly Bear and species of cutworms.

THE GRAPEVINE LEAF HOPPER, *Typhlocyba vitifex*.—This insect is very prevalent in the vineyards of the Peninsula. It is very small, about one-eighth of an inch in length and may be found in great numbers on the under surface of the leaf, and when disturbed takes flight very



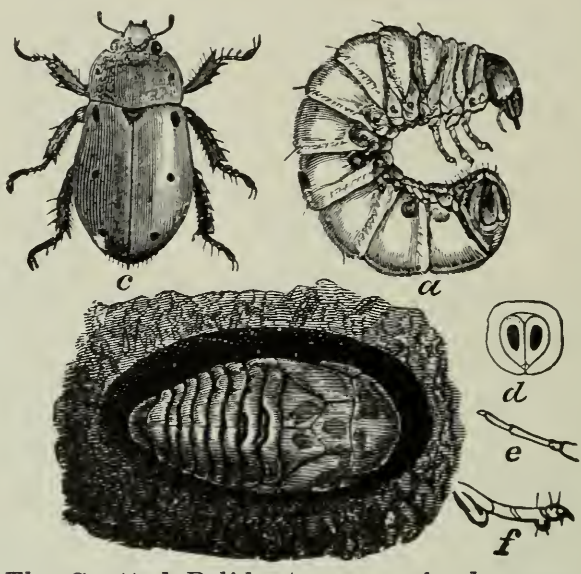
Rose Chafer (Macrodactylus subspinosus); *a*, beetle; *b*, larva; *c* and *d*, mouth parts of same; *e*, pupa; *f*, injury to leaves and blossoms with beetles, natural size, at work (after Marlatt, U.S. Dept. Agriculture).

quickly. The larvæ appear in June and moult several times. The moultage may be found on the under surface of leaf. The larvæ resemble the adult, only smaller and wingless. They are sucking insects and can only be destroyed by contact insecticides, such as tobacco water, whale oil soap and kerosene emulsion.

GRAPEVINE PHYLOXERA, Phyloxera vastatrix.—This insect is very uncommon in our vineyards and is only occasionally found. The insect has two forms, one attacking roots, causing rotting and death, the other attacking the leaves, producing innumerable galls.

Fungus Diseases.

Black Rot. This is perhaps the most dangerous enemy of the grape. It is prevalent and seems to appear locally and periodically throughout the district. This, however, may easily be explained as it seems only



The Spotted Pelidnota; *a*, grub; *b*, pupa; *c*, beetle.

to appear in those vineyards which are kept in sod, neglected or improperly sprayed. There are one or two exceptions to this, because I have found that in certain localities the disease seems to appear every year. One of these localities is on top of the first escarpment, near Vineland.

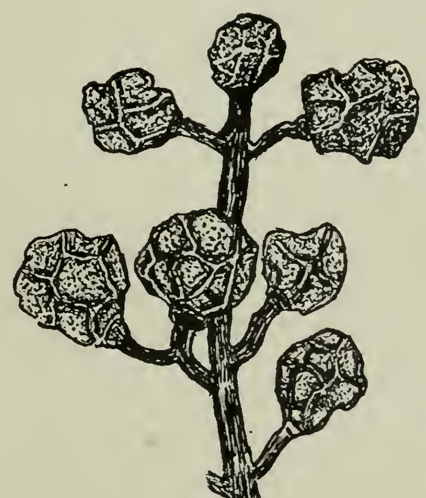
Green Grape-vine Sphinx Moth.

It is the opinion of some growers that it more frequently appears on dry, sandy elevations, but the factor which seems most favorable to its development is lack of atmospheric circulation, and I would strongly advise that vineyards should only be established on those positions of the farm which are not protected from the winds.

The growers as a general rule are aware of the tremendous damage that this disease will do in one night, but still many of them will not spray their grapes if they look clean. I have seen vineyards with very

Phylloxera Galls on Grape Leaf.

slight infections allowed to go unsprayed. This disease might quite easily be controlled by spraying with Bordeaux, but the spraying must be done before its appearance. When spraying after the disease appears, a minimum amount of lime should be used in neutralizing the bluestone,



Cluster of grapes affected with
Black Rot.

and I would strongly recommend the application of Bordeaux which has been made by neutralizing the bluestone with clear lime water rather than with the milk of lime.

The grower will probably first notice the disease in the fruit by one or two of the berries turning brown and gradually getting black. This will happen even when the berries are half grown. The berries will shrivel up and drop. When the disease has reached this stage it will make short work of the bunches. The first appearance is shown, however, in the leaves. Yellow spots appear near the vein of the leaves. It is often apparent, however, that the sun produces similar spots on the leaves, especially when they are tender. The yellow discoloration on leaves caused by the fungus is very noticeable in vineyards which are badly affected.

The fruit grower should destroy all diseased bunches and berries and not leave them to hang on vines, as is too often the case. He should also endeavor to keep the vineyard cleaner. If clean methods are adopted and the vineyard sprayed at least twice every year, little injury should result. The red varieties seem to be more susceptible and should be carefully sprayed.

Downy Mildew, *Plasmopara viticola.*—This fungus is quite common. It attacks the fruit, leaves and young shoots. The bunches and underside of leaves become mouldy, being covered with a delicate white film. The greatest damage is done to bunches. The berries do not develop so well and the appearance of the bunch is far from inviting. This disease is easily controlled by two sprayings of Bordeaux and if necessary an application of flour of sulphur, which is dusted on the vines in the morning.

Powdery Mildew, *Uncinula spiralis*—Attacks the grape in the same way as the downy mildew, but is more especially found on the canes. When berries are affected they show brownish or blackish spots. It is quite common in the Peninsula and the same treatment as for downy mildew is effective.

There has appeared quite frequently in our vineyards an undesirable condition of the vines, which has not been attributed to any particular cause. It appears mostly on sandy soils and attacks all bearing vines. Its first appearance is noted by a peculiar mottled yellow discoloration of the young leaves, and in the middle of the growing season the whole vine will turn yellow. The vine loses its thriftiness and the fruit does not develop so well as on other unaffected canes. This malady may or may not appear in succeeding years on each vine, but it will always be found in the locality of the vine in which it first appeared. I have noticed vines to regain their normal color the year after being affected, and the following year again will show almost an extenuated form of the malady. One vineyard which I have in mind is situated near St. Catharines. In the vineyard the vines seemed to get worse every year and this year they were removed. This peculiar malady does not seem to spread very rapidly, and its periodic appearance would tend to indicate that it might be caused by the lack of some constituent in the soil.

Spraying Grapes. Every vineyard should be sprayed at least twice every season, and the most successful vineyardist sprays three times.

There are, however, hundreds of vineyards that are not sprayed at all and a great many more that are only sprayed once. It is hard to explain the reason for this. The grape is considered one of the hardiest and most resistant of our fruits and the necessity of spraying depends to a great extent on the weather. Very often a grower will neglect spraying his vineyard one year and will reap a good clean crop, so he lets it go the next year without spraying. This is done even in cases where insects and diseases are found to a small degree. The grower does not seem to realize that this infection will gradually increase until the effect is strongly in evidence and considerable loss is sustained. After such an example the grower will spray for a few years and then again become lax. There is not a single vineyard in the whole district that has not been sprayed in which it is not possible to find the mildew or other diseases and there is no class of fruit which is so easily and cheaply sprayed as the grape, and perhaps no fruit which is more quickly destroyed by fungus diseases. The lack of spraying of grapes seems to be largely due to the lack of knowledge concerning diseases and insects affecting the grape, and to the extent of the damage done by such pests.

It must be fully understood, however, that only economical spraying is recommended, and not promiscuous spraying as previously mentioned. There are some seasons which require less spraying to protect vineyards, and an experienced grower will take advantage of this factor and perhaps save a few dollars, but this economizing should not be instituted until after the second spraying.

Sprays and Spraying. As grapes are not affected with the San Jose Scale it is not necessary to spray with lime and sulphur. The mixture universally used is " Poisoned Bordeaux Mixture," which is simply bluestone, lime, and water, poisoned with one of the arsenical poisons. The formula generally used is 4 lbs. bluestone, 4 lime and 40 gals. water. This is poisoned with 2-2½ lbs. arsenate of lead, or 4-6 oz. Paris green. The bluestone is dissolved and put in the tank, which is about half filled with water. The lime is then thoroughly slaked, diluted and poured into the mixture of bluestone and water through a fine strainer, which removes the coarse particles. The poison is then made into thin paste, diluted and added to the mixture and the whole made up to the desired amount. Too great an excess of lime should never be used and the proportion of lime and bluestone should be adhered to.

Another form of Bordeaux Mixture which is used by one or two growers and which, I think, is greatly superior, is made in the following way: Forty lbs. of good stone lime is slaked in a barrel and thoroughly stirred after it is properly slaked. Great care must be taken in slaking not to drown or burn the lime by use of too much or too little water during slaking. The formula adopted in this mixture is 2½ to 3 lbs bluestone to 4 gallons of the clear lime water, which is got by allowing the lime to settle. The same amount of poison and water is used as in the standard Bordeaux. The mixture should always be tested with ferro cyanide solution and if any red air colouration add more lime water.

The value of this mixture is deserving more attention. In its manufacture only enough lime water is used to neutralize the bluestone and no lime sediment is present to clog the nozzles. The mixture is finer and more easily applied, and as there is no excess of lime the fungicidal action of the copper sulphate or bluestone is immediate and constant until the application has lost its utility by virtue of the chemical action of the moisture of the atmosphere on the ingredients of the Bordeaux mixture. I consider the availability of the fungicidal action of the copper salts a very important factor, for we may be sure that should the spores of the disease be present there will also be active Bordeaux mixture to combat their development.

When to Spray. Grapes should be sprayed for the first time just before the blossoms appear, when the grapes are about the size of B.B. shot and about three weeks later and as many times after this as the grower feels it will be profitable. Under ordinary conditions, three sprayings are all that are necessary.

Spraying Machinery. There are at present several makes of grape sprayers. There are small two-wheel carts with a tank of 80-gallon capacity, wheel power with horizontal arms to which are attached nozzles which may be turned in any direction. This outfit at first looks very admirably adapted to the work. It does away with the handling of rods and all there is to be done is to drive up and down the rows. There are a lot of growers who like this machine and use it extensively, but I have never been able to convince myself that the work is done as thoroughly as when a man handles the nozzles. In the early sprayings before the foliage is fully out a great deal of spray is wasted and when the foliage is fully out the spray does not seem to reach the inner portions of the vines. I think the most thorough and effective method of spraying a vineyard is to apply the spray with a rod and nozzle cluster. In this way the man may walk behind the spray cart and can apply the mixture whenever it is most desired and the work is done with greater efficiency.

Varieties.

In no branch of the fruit industry in the Niagara Peninsula is there such uniformity in the varieties grown as in grape growing. There are a few standard varieties that every grower plants and they stick to these with the result that any quantity of these varieties may be had at almost any shipping point. The Concords are far ahead of any other variety in popularity, followed by the Worden, Niagara, Rogers 9 and 15, Delaware and Moore Early.

Early Grapes. A great difference of opinion prevails in regard to the advisability of planting early grapes. At one time Champions were destroyed because they were thought to be valueless, and yet on the top of all this our best growers have always made money from their early grapes.

Location is a great factor in deciding this question. Apart from the fact that every grower should have a few early grapes there are locations which, in my opinion, are better adapted for the production of early grapes than the late ones and will every year yield a greater profit. These special locations are found here and there in the western part of the Peninsula, and their presence is due to some special location, good drainage or physical condition of the soil, but in the eastern part of the peninsula, and especially in the township of Niagara, there is a large acreage of land situated on the first bench of the escarpment in the neighbourhood of St. David's, which offers every facility for the early production of grapes. The soil is admirably adapted and the fruit ripens from 5 to 10 days ahead of any other part of the peninsula. The result is that the early grapes command a high price. Mr. F. A. Goring goes in extensively for the production of early grapes; succeeds in putting his crop on the market ahead of the other sections and derives the benefit of a strong demand and high prices.

Of the early varieties of grapes there are three grown in the district—Champion, Moore Early and Campbell Early. The Champion is the earliest grape, is bluish black in colour, a medium sized round berry, thick skin and acid until very ripe. There is quite a diversity of opinion regarding the value of this variety. The flavor is poor, yet it is a good bearer and if left on vines until ripe, the quality is not bad.

Moore Early is the best early grape; berries are large, round, black and thin skin; flavor is slightly foxy and flesh juicy. The vine is hardy, healthy and vigorous. It does best on light soils. It does not make enough wood on heavy soils. The yield is about two tons per acre.

Campbell Early. The berry is large, black, blue bloom, tough, rich flavor, flesh sweet, tender, seeds small; bunches do not fill out; is preferred by some growers to any other early grape.

Grapes for Main Crop.

Worden.—Large compact bunch, large, black, thin-skinned berry with heavy bloom; flesh sweet; berry cracks easily and is not a good shipper or keeper. Good for home market. Its flavor is superior to Concord. It is hardy and a good grower. Yield 3¼ tons per acre.

Delaware.—The best table grape grown; bunch small, compact and shouldered; berry small, round, beautiful red, thin skin, whitish bloom, sweet delicious flavor. Vine is healthy and of fair vigor; does well on great variety of soil and is quite hardy. Too much wood should not be left as it is short jointed. Will overload if too much wood is left, with the result that the fruit will not ripen. Yield 2½ tons per acre.

Concord.—The most valuable commercial variety; very prolific; strong grower; heavy, thick foliage which seems to enable it to resist the frost in the spring; less susceptible to black rot; bunch is large, compact, five to six inches long; berry large, round, black with heavy bloom;

skin thick; flesh pulpy; flavor good when ripe; splendid shipper; yield 3½ tons per acre.

NIAGARA.—The best white grape; bunch very large, compact and shouldered; berry round, medium-sized with whitish bloom; skin tough; pulp soft, juicy and sweet; flavor good, possessing a delicate muskiness when fully ripe. Vine is very vigorous and hardy, does well on variety of soils, but more inclined to black rot on light soils. Color pale yellow and whiteish yellow on light soils; yield 3½ tons per acre.

LINDLEY OR ROGERS NO. 9.—Large red grape, splendid flavor, thin skin, splendid shipper; does best on mountain wash soils; strong, vigorous grower; should be trimmed to seven buds to the arm. This variety is a poor fertilizer, the bunches not filling out enough; it is one of the best varieties; yield 2½ tons per acre.

AGAWAM—ROGERS NO. 15. Vine strong grower, productive; wood long jointed, should have long pruning; bunch large and compact, shouldered; berry large, thick skinned, brownish red; flavor very good; good shipper; inclined to be subject to black rot and mildew.

VERGENNES.—The best grape for winter use, large red berry, tough skin, juicy, good flavor, medium sized bunch; like Champion it bears five to six bunches to a bud. therefore should be trimmed short to five or six buds to a cane. if not it will overload and not ripen fruit. The vine is vigorous, healthy and productive and does best on the heavier soils; yield about 3 tons per acre.

BRIGHTON.—This is a beautiful red grape with an excellent flavor and of medium size; the bunch is large, shouldered, fairly compact and attractive looking. It is very hardy, healthy and vigorous, but slightly subject to mildew, very productive, but should be planted near other varieties that are good pollinizers. The season is medium and the variety only a fair keeper, but it is valuable for home markets.

In writing this article my aim was to explain as explicitly as possible the conditions of the grape industry in the Niagara District, and to describe the methods which are now in vogue. The fruit growers gave me every assistance that was in their power, and I take this opportunity to thank them, especially those whose names I take much pleasure in mentioning: Messrs. F. G. Stewart, R. Thompson, J. E. Henry, E. J. Smith and F. G. H. Pattison. On the whole, the grape industry is in splendid condition, and more uniform excellence has been obtained in this branch of the fruit industry than any other. There are three outstanding features which seem to have been neglected. First, proper attention has not been paid to the physical condition of the soil. This is especially so in the clay lands. Second, spraying has been more or less neglected. Third, much carelessness is displayed in the handling of the fruit by the growers.

While these defects may appear to be very great and would give the impression that the growers are very lax, on the other hand, scores of growers are up to date and treat their vineyards with every care, recognizing that these produce a very valuable staple crop.

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Ontario Department of Agriculture

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Ontario Vegetable Growers' Association for 1909

CABBAGE AND CAULIFLOWER GROWING IN CANADA AND THE UNITED STATES

By A. McMeans, O.A.C., Guelph.

Late in the month of July, 1909, the Executive of the Ontario Vegetable Growers' Association requested the Department of Agriculture to have an investigation made of the cabbage and cauliflower industry.

I was entrusted to do this work and was authorized to visit some of the principal cabbage-producing States to gather information and enquire into the methods used by the leading growers. During the month of August, the States of Michigan, Wisconsin, Illinois and Ohio were visited, and early in the month of November some of the cabbage-storing sections of New York State and the cauliflower district of Long Island.

CABBAGE.

Origin and History.

On the sea coasts of England and other countries of Western Europe, from Norway down to the northern shores of the Mediterranean, may be found the wild cabbage, *Brassica oleracea*. The cabbage in its wild state is entirely destitute of a head but has a rather succulent stem and leaves. Botanists tell us that from this wild plant originated not only all our varieties of cultivated cabbage, but also all forms of Kale, Kohl-rabi, Brussels sprouts, Brocoli and Cauliflower. No more wonderful example than this exists of the changes in a plant by cultivation. The improvement of the wild cabbage began, probably, some three or four thousand years ago. The Jews and Egyptians cultivated it and it is interwoven with the mythology of the Greeks. There seems to be no doubt, however, that the greater part of the development of the cabbage as we at present know it, took place within the past two hundred years. The origin of it is, however, of minor importance compared with the knowledge of its cultivation.

Status of the Industry in Ontario.

There is no information available regarding the extent of the cabbage industry of this Province. In a Departmental Report for 1908, the statement is made that 4,900 crates or bushel baskets of cabbage were shipped from the Leamington district that season; of this amount fully one-half were express shipments.

In conversation with several leading commission merchants regarding shipments of storage cabbage into this Province, it was estimated that they ranged from forty to fifty cars yearly. In the past, storage cabbage have been brought in from New York State and the Province of New Brunswick, and, the present season, cabbage is being shipped in from the Province of Quebec, which cost laid down in Toronto a trifle less than $20.00 per ton.

A Standard Cabbage Crate.

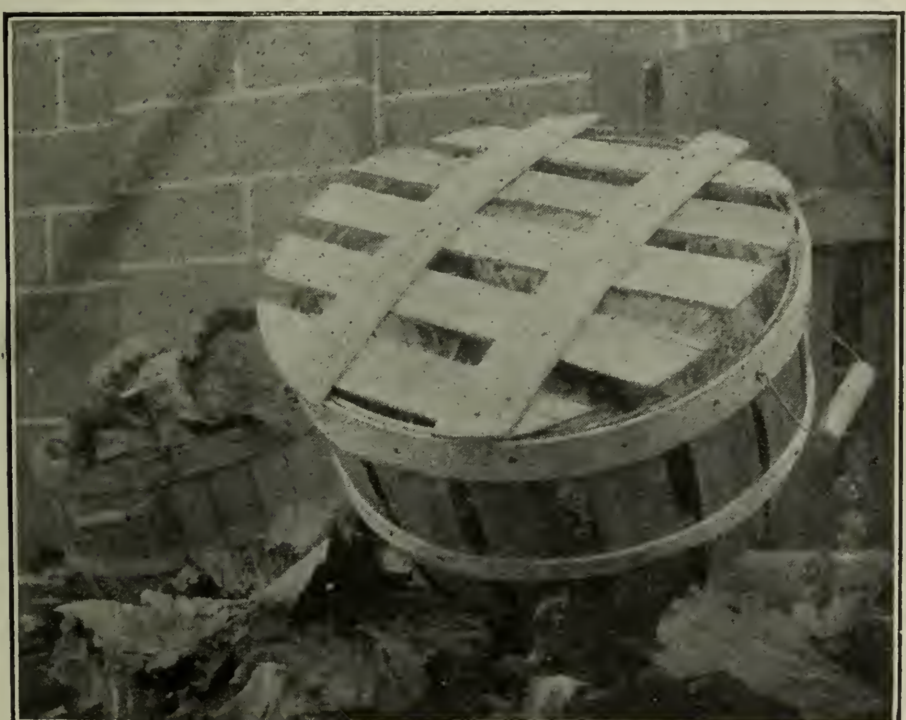
Markets and How Supplied.

Our early markets are supplied with cabbage grown in the Southern States; these are chiefly of the Wakefield type and are usually shipped in crates. The standard crate is of the following dimensions: Heads and centre piece 11 x 20 inches, the side slats and top and bottom pieces are 40 inches long. The crate holds from two to four dozen cabbage, depending upon the size of the same.

This southern-grown stock supplies the markets of this Province with new cabbage from February until about July the first, when shipments of domestic cabbage from the Leamington district make their appearance in the market. The cabbage from this section is usually shipped in ventilated bushel baskets and small slatted crates holding not over one and one-half bushels. The industry in this section is not yet of sufficient extent to warrant the shipment of car lots.

From July on, the home markets are supplied by the growers living in the vicinity of towns and cities, and this source can generally be depended upon to meet the demand until March or April. Should the price of storage stock in the United States be low, then can be seen the strange spectacle of American-grown cabbage of the Danish type competing against fresh Southern stock on the Ontario markets.

As yet in this Province the cabbage industry has not passed the stage when each grower either stores or pits his own crop.



Ventilated Basket used in Leamington District.

Types.

There are three distinct types of cabbage with reference to the shape of the head, oval or pointed, round and flat. There are also three distinct classes, white or domestic, savoy and red. Some varieties are distinct in type while others partake of two or more shapes due to crossing. There is variation also in the shape, character and texture of the leaf, from regular straight edges, to irregular almost fringed edges, and from smooth and tender to coarse and tough. There is also some variation in hardiness. Usually the purplish-green varieties with crinkled leaves are hardier than the whitish-green sorts with smooth leaves.

Ontario Methods.

Growing Early Cabbage.

The seed is sown either in hot beds or greenhouses during the month of February or very early in March, using Early Jersey Wakefield or a variety of that type. Shortly after the true leaf makes its appearance they are transplanted into flats; as soon as they begin to crown they are again transplanted into other flats, this time about three inches apart. Shortly after the second transplanting the flats are removed to cold frames or hot-beds. Where hot-beds are used, they are either "spent" beds, that is hot-beds which have exhausted most of the heat which was in the manure (by having had a previous crop), or else hot-beds in which manure to the depth of six to nine inches is used. By using this small amount of manure as heating material, the bed is kept much cooler and, as a consequence, the plant becomes gradually hardened and thus stands the check of transplanting to the field. This is also helped greatly by leaving the sash off the beds during the day, covering them only on cold nights. While there is no doubt that the above is one of the best methods, the one practised by most growers is as follows: The seed is sown in the hot-bed rather thinly and the plants left to grow along, gradually hardening them by removing the sash, or transplanting them directly from the seed bed to the cold frame. The varieties grown which are started in this manner are Early Jersey Wakefield as the earliest, followed by one of the Early Summer type as second early.

Soil.

Any good garden or farm soil that will grow a good crop of corn will produce a good crop of cabbage. For early cabbage a warm or well-drained sand or sandy loam is preferable, and as the cabbage plant is a gross feeder it is almost impossible to have too much plant food in the soil. Barnyard manure, from twenty to fifty tons per acre, is generally applied and quite often this is supplemented with commercial fertilizers. In growing early cabbage, it is necessary to bring the plant along to marketable condition quickly, so as to catch the high market price, and one of the chief aids in doing this is by having more plant food in an available condition in the soil than the plant can use. It is preferable to have the soil fall plowed, plowing again early in the spring and working it up to a nice tilth.

Planting.

The plants are transplanted to the field as early as possible, and at the same time it is desirable to secure as favourable weather conditions as possible, which is a soft, moist air from the south or east.

Wakefield varieties are usually planted in rows twenty-eight or thirty inches apart and the plants sixteen to eighteen inches apart in the row; Early Summer and All Head varieties in rows thirty to thirty-two inches apart and plants twenty to twenty-two inches apart. This admits of horse cultivation one way and at the same time gives the plant plenty of room to develop.

In planting, it is necessary that the work be done well, and for this purpose a "dibber" is used. The planter makes a hole in the soil with the dibber held in his right hand. With the left hand holding a cabbage plant, he thrusts the roots of the plant in the hole previously made. The soil is then firmly pressed against the roots of the plant by means of the "dibber." This work can be done very quickly by anyone who is experienced in the use of this tool.

Types of "Dibbers."

A good test as to whether the plant is properly set or not is to take hold of the edge of one of the leaves and if the leaf tears away the plant is properly set. If, however, the plant pulls out of the soil, it will be necessary for the planter to see that the soil is pressed more firmly against the root of the plant than he has been doing.

Cultivation.

This should start in almost at once, it being necessary to the life of the plant as it is to kill weeds. The general practice is to cultivate at least once a week and rather deeply at the start, gradually working shallower each time of cultivation. The hand hoe is generally used at least twice between the plants in the row, and cultivation is kept up until it is impossible to get either the horse or cultivator between the plants without damage to them.

In cutting early cabbage for market, a few more of the outside leaves are left on than is the case with later varieties.

Late Cabbage.

The late cabbage crop as grown by the vegetable grower of this Province is generally a second crop, spinach, peas or some other early crop having occupied the soil for a time previous to the plowing and fitting of the soil for the cabbage crop. The soil for late cabbage should be much the same as for early, but what is really preferred is a well-worked loam with a cool, retentive subsoil. Careful preparation of the soil for this or any other crop is generally well repaid by the resulting crop.

Seed and Growing the Plants.

The production of plants for the late crop is quite different from that of the early one. For this purpose, a strip of land is chosen in the spring, is put into good shape with the aid of a plow and harrow, then floated or rolled, and seed sown in rows which are spaced about one foot apart. Although one ounce of cabbage seed will contain close to eight thousand seeds, the average grower is satisfied if he gets two thousand good plants per ounce of seed used, thus taking about four ounces of seed to produce plants for an acre of cabbage. The seed can be sown by any of the seed drills on the market and should be sown rather thinly, say one ounce to four or five hundred feet of row. It is the practice of some growers to select a rather poor piece of soil for the seed bed, the idea being that plants grown on a poorer soil are usually more tough and wiry than those grown on richer soil, and thus bear the shock of transplanting better than the green, soft, succulent plant. The date of sowing seed for the late crop will vary from the first to the twentieth of May for the different parts of the Province. After the plants break through the soil they should be hoed or wheel-hoed to keep down weeds, help growth and conserve soil moisture.

In five or six weeks after sowing the seed, the plants should be ready for setting out in the field.

Planting.

If the field has been kept well cultivated or thoroughly worked and plowed freshly, the chances are that the soil will be moist enough for planting without going to the extra trouble of watering. A good rule to go by is to insert the " dibber " in the soil, withdraw it, and if it leaves the hole clean and open, without filling it with dry dirt, the soil is or should be sufficiently moist for setting plants without the use of water in weather that is favourable. The distance apart at which the plants are set will vary with the soil and condition of the same and land value. With most of our growers living close to towns and cities, where land values are high, the distance apart is generally rows thirty-two inches and plants twenty to twenty-two inches apart. This will vary up to rows three feet or more apart, and plants two feet and upwards apart.

It is the practice of a few growers in this Province to sow the seed where the plant is to mature. For this purpose a hill-dropping drill is used and three or four seeds dropped in a hill. After the seeds germinate and make nice-sized plants, the extra ones are thinned out. This method requires more seed per acre, and while it saves the labour incidental to transplanting, it also necessitates that the land on which the crop is to be grown by this method be what is known as clean land; otherwise, the extra labour required to keep the land clean would overbalance the cost of transplanting. As for the crop, when carefully tended to, in either case there is no marked difference.

Cultivation should be kept up the same as for early varieties.

Varieties Grown.

These are largely All Head, All Seasons and Flat Dutch for fall use and a short period of storage, say up to Christmas; Danish Ball Head and Hollander for storage and supplying the markets from the last of October until the supply is exhausted in the spring.

Storage.

The methods of storage in this Province are as yet in the hands of the grower and vary very much even in the same district. Some growers have small storage houses for their vegetables and store their supply of cabbages on shelves, others store in narrow bins, in barn basements. These bins are about two feet in width, with narrow air spaces between them, and the cabbages are piled some five or six feet deep. In the past, sufficient care has not been taken to get a good circulation of air through and around these deep but narrow bins, with the result that the loss by rot was of undue proportion. I was in a large barn basement this fall where upwards of fifty tons of cabbage were stored in long A-shaped piles. These were about three and a half feet wide at the bottom, about four feet high and twenty feet in length. The cabbage in these piles had the rough outside leaves trimmed off, but some six or eight inches of the stump were left on, the grower thinking that the shrinkage was not so heavy and that the head would draw some sustenance from this extra portion of the stump, also that the A-shaped pile of cabbage would allow of better circulation of air, the extra portion of stump not allowing the cabbage to lie so close together. Other growers resort to pitting their supply of late cabbage for storage. This involves an extra lot of labour, both in storing and again in taking them out of the pits to prepare them for market. At best it is but a makeshift and not to be recommended. In pitting cabbage two methods are chiefly used, so a brief description of each may be of use.

The A-Shaped Pit.

To pit cabbage by this method a piece of ground is chosen that is either well drained or slightly higher than the surrounding ground; this is for the purpose of getting dry location. It is levelled off some three or four feet in width and of a length sufficient to hold 150 or 200 heads of cabbage. The cabbages are placed on the portion of ground thus levelled off, starting at one end and placing three heads in width, folding their heavy outside leaves under them as much as possible. On top of these three cabbage are placed two others, folding the leaves of that part of the head that is placed on the inside of the pit under the head proper, allowing the outside half of the leaves to fall down over the outside of the lower head. On top of these two is placed another cabbage, the outside leaves of which are allowed to fall down over the two heads beneath it. This is continued until your pit is twenty-five or thirty heads in length, and when cabbage are placed properly the outside leaves form a sort of thatch roof which will shed rain or snow from this long A-shaped pile. These pits should run north and south in preference to east and west for the following reason: should we get a period of warm weather the long south side of the pit would warm up too much and, in all probability, rot and decay would take place. This is avoided when the pit runs north and south, as both sides of the pit get almost an equal amount of heat from the sun. It is preferable to make a number of these pits, holding from 100 to 200 cabbages, instead of one long one. These are usually covered lightly with straw and then with three or four inches of soil, beginning at the bottom and working up. Care should be exercised so as not to pack the soil when covering the pit, as by doing so the frost will enter more readily. When the weather gets sufficiently cold, coarse litter or manure can be added. To keep the cabbage cool without freezing is the desired aim.

The Long Trench Pit.

This is another method in general use which is as follows : Plow out a furrow and place the cabbage, head down, along it, folding the loose outside leaves under the head as much as possible. A light covering of straw is placed over this row. The plow is then run along both sides of the row, throwing the furrow on and over the cabbage. This is supplemented with a man and a shovel to see that every part is properly covered.

A big objection to pitting cabbage is that considerable loss is often found just at the junction of the root and head. The cause ascribed is that the root or stump protruding from the top of the ridge or pit allows winter rains and thaws to enter and settle around his point, thus leading to decay.

The method in general use in cutting cabbage for pitting, is to use a sharp spade and a quick, strong, swinging drive, aiming the blade of the spade at a point on the stump two or three inches above the soil, which causes a sliding, driving cut that will surprise the beginner how fast cabbage can be cut by using this method.

Analysis and Composition of the Cabbage.

This extract is taken from Bulletin No. 133, Maryland Agricultural Experiment Station, and is work done by H. J. Patterson in 1893. The samples represented a number of average mature plants, or plants with the heads in the best condition for market.

Dry Matter and Principal Mineral Constituents of Different Parts of the Mature Cabbage Plant.

Components.	Heads per cent.	Refuse, leaves and stalk. per cent.	Root per cent.
Water	98.50	91.02	83.29
Dry matter	1.50	8.98	16.71
Total	100.00	100.00	100.00
Organic matter	1.29	5.40	14.21
Mineral matter	0.21	3.58	2.50
Dry matter	1.50	9.90	16.71
Pure ash	0.20	1.58	1.53
Sand	0.01	2.00	0.97
Crude ash	0.21	3.58	2.50
Lime (CaO)	0.019	0.441	0.107
Magnesia (MgO)	0.005	0.060	0.057
Phosphoric acid	0.023	0.080	0.111
Potash (K_2O)	0.087	0.402	0.762
Soda (Na_2O)	0.001	0.052	0.082
Iron and Aluminum	0.031	0.021	0.025
Chlorine	0.010	0.018	0.075
Sulphur (SO_3)	0.056	0.035	0.030
Sand	0.010	2.000	0.97
Nitrogen	0.065	0.227	0.352

Food Constituents in Heads and Refuse Cabbage.

—	Heads per cent.	Refuse matter per cent.
Water	98.50	91.02
Ash	0.21	3.58
Protein	0.41	1.42
Crude fibre	0.38	1.32
Nitrogen-free extract	0.46	2.41
Fat	0.04	0.25
Total	100.00	100.00

These results would indicate that cabbage is a very watery food and contains very little dry matter, but that the relative amount of protein in the dry matter would class it as relatively more nutritions than is usually recognized. The results in the above tables show the different fertilizing elements found in the various parts of the cabbage plants to be as follows:

Fertilizing Material Found in the Different Parts of Cabbage Plants.

(Per cent. in Fresh Material.)

—	Heads. Per cent.	Refuse leaves. Per cent.	Root. Per cent.
Phosphoric Acid	0.023	0.080	0.111
Potash	0.087	0.402	0.762
Nitrogen	0.065	0.227	0.352
Lime	0.019	0.441	0.107

An average crop of cabbage will yield per acre, say, 6,750 mature heads weighing three and a half pounds each, or 23,625 pounds. This will easily allow for ten per cent., or 750, immature heads. These, together with the refuse matter from the 6,750 mature heads, will average about two pounds each, or 15,000 pounds. The 7,500 roots, averaging one-quarter pound each, will make 1,875 pounds. Figuring on this basis, with the above amounts of fertilizing material, we find the following:—

Pounds of Fertilizer Found in Cabbage from One Acre.

	Heads. Pounds.	Refuse. Pounds.	Roots. Pounds.	Total Pounds.
Phosphoric Acid	5.43	12.00	2.08	19.51
Nitrogen	20.55	60.30	14.28	95.13
Potash	15.35	34.05	6.60	56.00

Varieties.

The use of descriptive words or phrases given to variety names confuses the grower. Oftentimes these descriptive words or phrases mark no real variety difference. As an example may be cited the Jersey Wakefield cabbage. The following descriptive words or phrases are used by different seedsmen to distinguish their stocks: Our Own Jersey Wakefield, Extra Choice Jersey Wakefield, Pedigree Jersey Wakefield, Improved Jersey Wakefield, Extra Select Jersey Wakefield, Select Very Early Jersey Wakefield, Special Stock Jersey Wakefield, etc., as well as the addition of the seedsmen's firm name, as per example, Maule's Prize Wakefield, Vaughan's Selected Early Jersey Wakefield, etc. Sometimes these descriptions mark real superiority of stock, but the practice of usage of the above has been so much abused as to have little or no significance.

The time is fully ripe for the American Seed Trade Association to take steps to simplify the variety names of vegetables. This can be largely done by eliminating descriptive words or phrases and firm names, as well as the use of such synonyms as are well known. In the Yearbook of the Department of Agriculture of the United States for 1900, it is stated that American seedsmen catalogued "685 real or nominal varieties of cabbage." So for the above reason I am not going to take up space describing varieties. Suffice to say, study the catalogues of good, reliable seed houses, study the varieties that do best in your locality, and this can easily be done by mingling with your fellow growers; try, and test, in a very limited way, new varieties, and adopt them when they show marked superiority.

American Methods.

The latest authentic information obtainable from the United States Department of Agriculture, Bureau of Statistics, relating to the extent of the cabbage industry in that country, is the twelfth census concerning the crop of 1899. Although these figures are somewhat old, they may be of value in showing the extent of the industry ten years ago in the States:

State.	Acreage.
New York - - -	25,261
Illinois - - - -	7,082
Ohio - - - -	6,970
Wisconsin - - -	4,400
Michigan - - -	4,028

A total of 150,156 acres was devoted to cabbage production in the United States.

The total imports of cabbage into the United States from all countries, 1904 to 1908, were as follows:

Year.	No. of Heads.	Value (a).
1904	1,313,707	$70,328
1905	8,729	589
1906	66,260	4,336
1907	5,808	390
1908	8,073	584

A farm crop report is issued by the State Board of Agriculture of Wisconsin, and from it and the Secretary of the Board I gathered that the average acreage for the past three years was approximately 5,000 acres and has not materially changed in the past five years. The average yield per acre for 1909 is given as twelve tons, the quality is given at 90 per cent., and the average price $5.75 per ton.

In dealing with the cabbage crop of the Northern States, it will be found to be on a much different basis to what an Ontario grower would expect. This is apparently caused by a sort of reciprocity between the Northern and Southern States as regards cabbage growing. As is well known, cabbage is a cool weather crop and, in consequence, we find such States as Georgia, Florida, Carolina, Tennessee and Virginia growing cabbages which mature and are marketed in the north during late winter or early spring months, and the Northern States in turn supplying the Southern markets during the late summer and fall months. Owing to this arrangement of supplying markets, the growing of cabbage has very largely been taken out of the hands of the market grower and fallen into the hands of the farmer, and thus instead of being a garden or truck crop it becomes practically a farm crop, grown by a farmer who disposes of the crop to the shipper (usually a local man), and by him consigned or sold to a commission merchant or firm, and by them sold to the retailer. Owing to the high protective tariff on cabbage entering the United States, the Ontario growers are barred from shipping cabbage into those markets.

The cabbage growing sections in the States visited where a business is made of storing cabbage for winter markets is very largely confined to

(a) Average value at foreign ports whence imported.

the States of Wisconsin and New York, and in the former State to the Racine and Appleton-Shiocton districts, and in the latter State to the Rochester and Syracuse districts.

Kraut factories were found in the five States visited, but predominate in the States of Ohio and New York. This applies more especially to the Clyde-Sandusky district in Ohio, where there are eight factories, and the Geneva district in New York State, where in a radius of less than fifteen miles may be found five factories devoted to the business of making kraut.

All the sections visited do more or less of a shipping business direct from field to car. In speaking of varieties, they can be divided into two classes, Domestic and Danish. In the former the varieties will be largely All Seasons, All Head, Sure Head, Early Summer and some Flat Dutch. All are used in the manufacture of kraut and for shipping during the late summer and fall months. The Danish class will include Danish Bald Head, Hollander, and varieties of that type, and are stored for supplying the markets during the winter months.

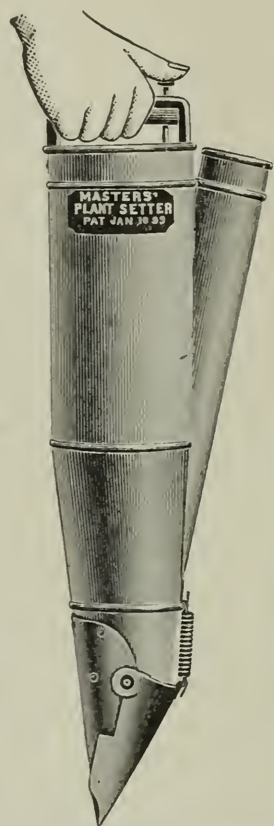
Saginaw District.

This district lies in the vicinity of the city of Saginaw and in latitude 43.20 to 43.30, and is perhaps the largest in the State of Michigan, having an acreage of approximately 1,200 acres, an average yield of 10 to 12 tons per acre, and price paid at cars or factory varies from $4 to $6 per ton. No winter storage is practised. Varieties grown are Domestic and very little Danish. Soil varies from black sandy loam to clay.

Appleton-Shiocton District.

This district lies along the Chicago and Northwestern and Green Bay and Western Railways in the State of Wisconsin, and comprises a distance of about sixty miles, with storage houses at Appleton, Green Bay, Seymour and Shiocton. As the methods used vary in the different places mentioned in this district, a description of some of them may be of interest. At Shicoton there are two storage houses, the dimensions of which are 40 x 150 feet. The driveway through the centre is eleven feet wide, stalls 8 feet wide, and run from the driveway to within two feet of the wall. This two-foot space between the end of the stalls and the sides of the building serves a double purpose. First, it allows a good circulation of air from small doors or vents along the side of the building, and also the passage of a man to look after the opening and closing of the inside ventilators, according to weather conditions. Saplings four or five inches in diameter are placed across these eight-foot stalls, allowing a space of two or three inches between each sapling and about one foot above the floor. On these the cabbage are piled to a depth of four feet, stump down, then another row of saplings is placed across the stall in a manner similar to the first lot but about eight or ten inches above the heads of cabbage that have been placed in storage. Cabbage are placed on these to a depth of three feet, then racks are used. These are eight feet long and two feet wide. The long sides are two by two or three inches. Slats are 1 x 2½ inches, with the space of a slat between two. The method of placing the cabbage on them is as follows: A row of racks are placed one above the other, one foot space between them, beginning at the back end of the stall. The cabbage are placed on these racks, and when one is full another row of racks is placed in front of the filled ones, and this is continued until the front of the stall is reached.

After the stalls are filled the driveway is used, the cabbage being piled on it to a depth of three feet and upwards. This district is the farthest



A Hand Transplanter.

north in which cabbage are stored, being in latitude 44.30. The soil varies from muck on lowland to clay on the upland. Seed in this district is usually sown April 20th to May 1st, and cabbage put in storage house from October 12th on. A preference seems to be given to Long Island grown seed. Average date of killing frost about Sept. 12th. Acreage about 600. Transplanting machines used largely.

Machine transplanters are a great aid to the grower, as with one a team of horses, a driver and two boys to set the plants, four acres can be set in a day. Should the ground be dry, the cask can be filled with water and by means of an automatic check valve each plant is watered at the roots before being covered with dry dirt. Some growers, with smaller acreage, use a hand plant-setter. These stand about 30 inches high, about 6½ inches in diameter and hold water enough to set 125 plants at one filling; an added advantage is that fertilized water can be used and an acre per day can be planted without stooping, thus doing away with the hardest feature of cabbage planting.

Green Bay.—The canning factory proprietor is the dealer and largest grower here. He has storage capacity for 2,000 tons—4 houses, 2 at farm and 2 in town; houses in town heated with steam pipes in cold weather; uses ventilators on sides and overhead, racks one foot apart and stores one layer deep. Has railroad tracks into the town houses and can load inside. Average yield for district, 8 tons per acre. Does not approve of contracts, for the following reason: Should price of cabbage be high at delivery time the average grower feels as if the dealer was cheating him, and if price of cabbage be low at delivery time the grower sometimes buys cabbage from his neighbour cheaper than the dealer is paying under his contracts and unloads them on the dealer with a profit on the cabbage he did not grow.

Racine District.

This is probably the oldest large shipping and storage section for cabbage in the State, some large storage houses being located at Racine. At Berryville, a small shipping station between Racine and Kenosha, there is a house 40 x 200 feet, with a capacity of 1,000 tons cabbage. The owner places the shrinkage of cabbage at 10 per cent. to February 1st; after that date it gets heavier. His business is 20 years old and he is growing 125 acres at Somers this year. Owing to continuous cropping of cabbage, soil is infected with what is known locally as "Yellows," which attacks the cabbage very shortly after planting. There is also some trouble with black rot, but not serious. Land is very dear in vicinity of Racine and Berryville. There is none for sale, but $300 per acre is offered for it. Stable manure is used largely. This is usually supplemented with commercial fertilizer. Manure costs $1.40 and upwards per ton and is shipped in from Chicago. Date of setting cabbage plants in field varies from June 20th to July 10th. Soil varies from sandy loam to clay and clay loam. The last killing frost in spring varies from April 7th to May 31st, with April 27th as the average, and the first killing frost in the fall from September 30th to November 7th, with October 17th as the average. Average rainfall is 31.65 inches. The cabbage growing district lies in latitude 41.35 to 41.45. A large kraut factory in Racine takes the product from a number of acres. A description of a storage house in this district which was built four years ago, at a cost of $3,000, may be of service.

Size of house 40 x 80 feet, height to eaves 12 feet, 9-inch brick wall, 2-inch air space, 4½-inch brick wall—an air space of 1½ inches—matched sheeting, also heated on both sides by means of a small hot water heater and 2-inch pipe; 4 ventilators on each side 1½ x 3 feet; 3 ventilators on the comb of the roof and one on each gable end. Roof sheeted and paper lined and runs right up to the comb; stalls 8 feet wide, 12 feet deep; passage way betwen stalls and walls 2½ feet wide and 6 feet high; racks over passageway, also over driveway, right to roof; racks one foot apart and cabbage stored one deep. Capacity of storage house 400 tons. In conversation with the owner of the above house, the question was asked, "If you were building again, where would you improve upon the present house?" His answer was, "I would not put on the inside sheeting, and would burn more coal." That is to say, he would not build the house quite so warm, and in cold weather would use the hot water heater and pipes to keep out the cold and at the same time keep the house dry.

Riverdale District.

This district lies in the north-eastern portion of the State of Illinois and runs east into the north-western part of the State of Indiana—from Riverdale, Ill., to Highlands, Ind.—and includes about 2,000 acres of cabbage, all domestic and used for kraut and shipping. Lake County Produce Company is a co-operative association of farmers, manufacturing kraut and shipping cabbage at Highlands, Ind., which has been very successful. The yield varies from 12 to 15 tons per acre. Cabbage is shipped in refrigerator cars about August 27th, with an A shaped rack 3½ feet high and 2 feet wide at bottom, running lengthwise of the centre of the car. Cabbage are piled on both sides and over this rack, about 4½ or 5 feet deep in the car; twelve tons or more of cabbage in a car. Ice costs $4 to $4.50 per ton, and the A shaped rack is used to carry the cold air from the ice bunkers and distribute it out through the cabbage. Average price paid for past five years, $5.50 per ton, all domestic grown, some Faultless, which seems to be a strain of All Head.

The dealer was loading 8 refrigerator cars with cabbage on August 28th. He used a rack 6 inches wide and 4 feet high, through centre of car lengthwise for ventilation. Average plot is 3 or 4 acres, none over 15 acres. All domestic, no storage, some imported. Holland seed of an Improved Brunswick variety used with success. Some black rot, but not serious. Some trouble with club root. Land, nice loam, worth $1,500 to $2,000 per acre, held for investment. Rents for $9 to $10 per acre.

Clyde-Sandusky District.

It is estimated that there are 3,000 acres of cabbage grown in this district. Eight kraut factories. Average yield 12 to 14 tons. Average price $5 to $6 per ton. "Yellows" very bad, so much so that older districts are quitting the growing of cabbage, and kraut factories are seeking acreage further away from factory. All domestic. Some growers complain of time lost at factory, waiting to unload. The farmers in this district are of a fine class, manure heavily and supplement with commercial fertilizers. Planters used almost exclusively and clean cultivation practised. A rotation of potatoes, cabbage, corn and wheat is very largely used.

New York State is divided into two districts, known as Rochester and Syracuse Districts.

The Rochester District reaches from Albion on the west, to Lyons on the east, and from Webster on the north, to Geneva on the south, and it embraces local districts where both domestic and Danish stock is grown, also districts where cabbage is grown for kraut factories.

Acreage about 500, almost all fall shipped. No large storage houses. Using ordinary box and stock cars (Nov. 3rd). Average grower has 6 to 10 acres cabbage. Soil, loam approaching black, subsoil gravelly. Plow deep, 9 inches. Barnyard manure, ½ ton commercial fertilizer, used per acre—1-2 Ammonia, 10 Phosphoric, 8 Potash. Rotation used, potatoes, cabbage, wheat and hay. Plant in field June 1st to July 4th. Harvest from field as late as November 15th. Paul Martin, progressive grower, saves and selects his own seed of Surehead and Holland varieties, very upright, outside leaves very few; has small storage house, 3 air spaces, stone basement used for potatoes, cabbage on first floor and apples overhead. Uses A shaped racks 4 feet high and 1½ feet wide at bottom, placed 3 feet apart on the floor, and piles cabbage between racks four feet deep with good success, no trouble from freezing.

Henrietta.

Acreage 250. 15 per cent. Danish, balance domestic. Storage house cement blocks, air space and matched sheeting. Cabbage in bins 8 or 9 feet deep and bins 4½ feet wide and 1 foot air space between. Cabbage piled stump down. Average price past five years about $5 per ton. Prices in 1907 averaged $8 per ton, in 1908 ranged from $15 to $22, in 1909 started at $8, dropped to $5, now (Nov. 3rd) $6.

Hall's Corners.

One dealer here last year loaded over 500 straight cars of cabbage, also several part cars. This year will not load 200 cars. Cabbage a failure on account of dry weather and lice. 10 per cent. Danish, balance domestic. Small storage, average price paid past five years about $6 per ton. Trouble experienced in growing plants owing to root maggot. Screening and salt used, but not satisfactory. Plants shipped in by express from Pennsylvania and Maryland for $1.25 per 1,000 laid down, and are getting very good results. Some black rot, but not considered serious. Soil, clay loam.

Seneca Castle.

Acreage very heavy. Crop almost a complete failure this year owing to dry weather and aphis. One grower on Otley road harvested 12 tons from 5 acres. Some growers turned sheep on their cabbage fields. Storage house 40 x 120 feet, frame, 2 air spaces, frost proof, or nearly so; 6 ventilators on roof, 10 on each side, 6 inches square; bins 3½ feet wide, air space between, slat bottoms, 1 foot above floor, driveway through the centre, 2 foot space all around house, bins filled 6 feet deep with cabbage, stump up, then slat floor, then cabbage 4 feet deep. The reason floor is used is so as not to tramp the cabbage when placing them in the bins. House holds 600 tons. Cabbage is brought in by cars from Skaneatles, and is extra choice stock.

Syracuse District.

The older portion of this district lies along the Syracuse and Binghampton branch of the D.L. & W.R.R and reaches from Onatavia to Cortland, with large storehouses at Apulia and Homer. All along this valley the farmers seem very prosperous dairymen, growing cabbage as a side

Cabbage Stored in Bins—Syracuse District.

line. Soil, clay loam. Stock very good, yields heavy. Variety Danish, some red. Seed beds screened on account of root maggot, but has not proved satisfactory; plants raised in New Jeresey and shipped in by express for early crop. Apulia, four storage houses, total capacity, 2,200 tons.

The largest building is 40 x 150 feet, and has a capacity of 1,000 tons. These houses are built of four thicknesses of boards, two of paper, and have 2 air spaces, including the studding. They were the only storage houses I saw that used glass in the upper side ventilators. The sashes were double glazed and board shutters used on the inside, the reason for using glass being that by admitting light the cabbage would not bleach so quickly, but would keep green longer than where kept in darkness.

The storing here is in bins 3 feet wide, with space of eight inches between each bin and a two foot space left all around the inside of the building. The cabbage are piled in these bins six feet deep, then a floor is laid and cabbage piled 5 feet deep, then another floor and 4 feet of cabbage on this. The floors are laid for the protection of the cabbage, the men standing on the floors when placing the cabbage in storage or removing them. The above method is used for three of the houses. In the other small house, shelves are used. These shelves are about 7 feet in width and are spaced nearly two feet apart. The cabbage is stored on them as shown in the cut.

This dealer uses a method of loading cars out of storage not practised elsewhere. The cabbages are loaded out of the storage bins direct on to the waggon; they are then taken to the weigh scales and weighed and then to the car, where two men stand at the door and take the cabbage, six men trim, and as it is trimmed it is placed in the ends of car. The refuse is then put in the waggon and taken to the scales and weighed and thence to the dump, thus giving net weight of clean cabbage and keeping storage house very clean. This dealer started into business here fifteen years ago, handling two cars of cabbage, and has built up a business handling 600 to 700 cars annually.

Homer.

This town has also two large cabbage storage houses, capacity 2,000 tons, and three or four small ones. The bin method is used. One of the dealers here who has been in business twelve years said his shrinkage varies from 15 per cent. upwards, depending on how late the cabbage is held, and the average price ranged between $8 and $9 per ton. Mostly Danish stock grown, some Autumn King, and it seems to be giving satisfaction.

At Albion, N.Y., there is a modern cabbage storage equipment. The building is 200 feet long, 60 feet wide, and 20 feet to the eaves. This building is built out of brick, and the brick were laid so as to leave a four-inch air space between the walls, each wall being plastered with Portland cement, on the inside wall building paper and matched sheeting. The roof has an arched ceiling with doors that can be let down for the purpose of ventilation, and it also has ventilating towers running out through the roof.

A railroad track runs through the centre of this building, so that cabbage can be loaded either in or out, without weighing on small scales. On each side of the track there are bins 33 inches wide in the clear; 6-inch studding is used between these bins, thus allowing a 6-inch air space for ventilation purposes; 3-inch slats are nailed on the studding 3 inches apart. Floors are put in, dividing the bin into three sections, regarding height. The bins are about 20 feet deep, so that each bin is 33 inches wide, 20 feet deep and 20 feet high. All doors and windows are double. In addition to this, in the end of the building and above, there is installed a 60-inch fan run by a 5 h.-p. electric motor, and from that fan a pipe 20 inches in diameter branches each way and runs over the centre of the top of the bins and is gradually reduced until it gets down to 6 inches at the far end of the building. This pipe has openings about every ten feet and is so graduated as to draw the air equally from all points of the building.

On the floor under the bins and running lengthwise of the building and in about the centre of the bins is an air duct about 16 inches wide, with openings where the 6-inch space is between the bins. Every 15 feet on the outside of the building are small doors and openings about a foot square, from which ducts lead to the large long ducts that run lengthwise under the bins. When they want to change the air in the building the fan is started and this draws the air in through the ducts and up through the cabbage and out of the building at the fan. The claim is made that the air in the house can be completely changed in about an hour's time.

This building has been run for a number of years and the owner claims that cabbage is taken out with less shrinkage than from any other building in the country.

Other Methods of Storage.

In the Syracuse district I saw a dealer who, when his storage house is full, piles cabbage on a clean piece of sod, three deep, and covers this with marsh hay. If snow comes before hard frost sets in, the snow helps to protect the cabbage, and they will come out of those quarters with less loss and shrinkage than if placed in a storage house. If, however, cold weather sets in without any snow, the loss and shrinkage is very heavy.

Most growers of late cabbage either in the United States or Canada have some unmatured cabbage left in the fields unharvested. With some growers this is left to be turned under by the plow. With others the cabbage are taken and stored in pits, as recommended and described in "Storing cabbage for seed," or they are taken and planted closely in cold frames and the frames covered with coarse litter or manure, and it is surprising how those soft heads will fill out or mature in the pit or cold frames. This method is well worthy of trial by most of our Ontario growers.

SAUER KRAUT INDUSTRY.

This industry, which is so closely related to that of cabbage production, is in its infancy in this Province. Some of the pickle manufacturers have started the making of kraut during the past two or three years. One manufacturer was visited who put up 1,000 barrels of kraut this year. Three years ago none was made. New Ontario is the heaviest consumer of it and the demand is increasing very fast.

As an evidence of the extent of this industry in the United States I quote the following from a letter received from the Secretary of the National Kraut Association: "It would be an impossibility to give you any accurate figures as to the number of kraut factories, the amount of kraut made, or cabbage used for making kraut, in the United States, the kraut business being most peculiar, in the fact that almost anyone can manufacture kraut in a limited way. There are probably several hundred concerns in our country which would consider themselves manufacturers of kraut. Many retail firms will cut sufficient cabbage to manufacture their own kraut, and call themselves factories. There are about twenty-five members in the Association who manufacture something over 3,000 carloads of kraut per year; this would probably figure in the neighborhood of 100,000 tons of cabbage. The average price paid for cabbage would be between $5 and $6 per ton to the farmer. There has been a very large increase in the manufacture and consumption of kraut during the past five years, but I can give no accurate figures as to the percentage of increase. Nearly forty per cent. of the kraut manufactured was sold in cans."

One would naturally think that the best cabbage for boiling would be the best for kraut, but those who make it say not. The manufacturers prefer a solid head of good size and medium earliness. All Head, All Seasons and Surehead are the varieties chiefly used in the manufacture of kraut.

It is not necessary for me to go into details of manufacture and distribution. From the above it will be seen that much may be accomplished in developing this industry in this Province.

How to Make Sauer Kraut.

Take good sized, firm cabbage of the Drumhead type, remove the outer green leaves of the heads, then the core. The heads are then put into the kraut cutter, to be cut in the longest, finest strings possible. This should be put into the barrel as soon as possible; if left exposed to the air without being salted, it will hinder fermentation and is also apt to turn grey or black. Clean, tight barrels should be used, a layer of the cut cabbage about six inches deep is put in and this is strewn with salt. The amount of salt used should not exceed 3 per cent. of the amount of cabbage (in weight 3 lbs. salt to 100 lbs. cabbage). After the layer of cabbage is salted, it is pressed or stamped down firmly and evenly so as to expel the air. In this manner layer upon layer is packed in, until the barrel is filled. The cabbage is then covered with a clean cotton cloth and this is covered with a perforated hardwood cover, which is weighted down with stones or other weights to prevent the air from coming in contact with the kraut. Always keep the kraut covered with brine.

By salting, the greater part of the water contained in the cells of the cabbage is extracted, and in combination with the salt forms the brine.

Kraut requires the most careful attention while it is in a state of fermentation. The best temperature will be found to be 59 to 64 degrees Fahrenheit. After fermentation it will keep best in a cool place.

CAULIFLOWER.

Ontario Methods.

The cauliflower industry of this Province is as yet confined to the market growers in the vicinity of large cities and towns. They supply the markets from the month of August, until heavy frost stops production in the fore part of November. The early markets are supplied from the States of Florida and California from February until May. They can be carried safely in refrigerator cars without heating or damage in transit.

Cauliflowers are also grown in quantity for the pickle factory. This is usually done under contract—that is, the grower signs an agreement or contract with the pickle manufacturer to grow a stated number of acres or tons, usually tons, of cauliflowers, for a stated price. The usual price paid in this Province varies from $25 to $30 per ton. Some cauliflower has been imported from Europe by pickle manufacturers, but when freight and duty were paid upon the same it was found to be more expensive than home grown stock at the above prices. It is impossible to give an accurate statement of the amount of cauliflower used annually by pickle manufacturers in this Province, but a conservative estimate would be about 550 tons.

Cauliflowers delight in a cool, moist atmosphere, and for that reason most growers do not have success in trying to produce early ones. For the general crop of cauliflower the culture does not differ essentially from that of late cabbage. The soil is prepared the same, the seed is sown and the plants are set in the same manner, but the culture given to the cabbage by the average grower will not suffice for the cauliflower, which insist on thorough tillage and liberal treatment.

Soil.

The soil for the production of cauliflower will depend partly on the climate. In a warmer climate a heavier soil is required than in a cool one. Generally speaking, a good rich loam, with a cool, retentive subsoil, will prove ideal for the growing of this crop. In the past, many growers have supposed the character of the soil to be of more importance than the condition of the same, but, in the light of recent developments, this seems to have been a mistake. Outweighing either character or condition of soil, stands climatic influence or conditions and this seems to have more to do with success or failure in growing this crop than any other one factor. There is no crop about which there is so much uncertainty as the cauliflower. No calculation can be made as to the exact time of sowing the seed or setting the plants that will insure success. The early, the intermediate, and the late plantings are in turn profitable, and by early, intermediate, and late plantings, I mean plantings that are made a week or so apart. So it will be seen that it is almost a necessity to make a series of plantings, one or more of which will invariably succeed. Cauliflower is more sensitive to checks in its various stages of growth than cabbage.

Seed.

In the seed bed, a strong, sturdy growth should be encouraged rather than a rapid one. Seed should be sown during the month of May, the exact date depending on the soil and climatic conditions governing the different portions of the Province. At Guelph, on a rather strong clay loam, we prefer to sow seed the first week in May.

Planting.

The best time to set plants is just before or after a rain, but they can be put out at any time, providing the soil has been kept moist by previous frequent cultivation. In dry, clear weather the planting should be done towards the close of the day. The plants to be set out should not be too large or they will be liable to button, especially is this liable to happen should the conditions be in any way unfavorable to growth. If large plants must be used, extra pains should be taken in setting, in order that there may be as little check in their growth as possible. With cauliflower, as with cabbage, large plants are easiest to grow, but for the reason stated it is less desirable to use them. The plants are usually set in rows three feet apart, and are spaced two feet apart in the row. They should be ready for planting in the field in five or six weeks' time after sowing the seed.

Cultivation.

This should start almost immediately after planting so as to keep up a steady, vigorous growth, for if the plants are checked they are liable to either button, that is, to form a small, miniature head, prematurely, or to continue their growth so late as to fail to produce heads at all. Level cultivation is usually practised as for ordinary field crops. This should be fairly deep at first, working shallower and narrower as the plant makes growth and should be kept up until the leaves are so large as to be liable to be broken off either by the horse or cultivator, in their passage between the rows, or until the plant shows signs of heading. The crop may be seriously injured or delayed by cultivation after the plants begin to head. At this time the soil should be undisturbed, so that the roots may occupy the entire space. Dry weather and the compact nature of the soil after cultivation ceases check the growth of the plants and promote the formation of heads, provided the plants have attained a proper age and size.

Blanching the Heads.

The value of cauliflowers for use or market depends almost entirely on their being white and tender. To have them so, they must be protected from the sun. Heads which are left exposed to the sun become yellow in color, or even brownish purple, if the sun's rays are very hot. Such heads acquire a strong, disagreeable flavor and are unsaleable. There are various ways of covering the heads, but it is nearly always done with the leaves of the plant. The practices in use in this Province are as follows: When the heads are about the size of a coffee cup, they are tied with twine or wire, bent so as to form a loop on one end and a hook on the other end, the leaves are all gathered up and the wire placed around them, hooking the one end into the loop, thus holding the leaves in an upright position and covering the head proper from the rays of the sun. The tying should be done when the plants are dry and during the warm part of the day

Cauliflower Plant Tied with Straw Band.

when the leaves are supple. Some growers prefer to tie their plants up tight, while others like to leave the top of the plant as open as possible so long as the sun does not spot them. By leaving the top slightly open the pressure of the leaf on the head is decreased, thus allowing it to broaden out more than where the plant is tied up tight. This artificial blanching of the head is most important early in the season while the sun is hot. The field should then be gone over every other day. Another object gained by tying late in the season is to protect the heads from frost. A frosted cauliflower is practically worthless for market, as it is nearly certain to turn black after one or two days' exposure. Heads which are well covered will usually stand ten or twelve degrees of frost without injury, depending on the amount of cloudiness or moisture present.

Cutting and Marketing.

The frequency of cutting will depend on the season and climatic conditions. In summer the heads will remain at the proper stage for cutting no more than a day or two, while late in the season they may be left a week without becoming overgrown. Frequent cutting is desirable, as it is best to let the heads get as large as possible, but not allowing them to become loose and warty. The gain in size increases the selling price, and the flavor also appears to improve as the heads approach maturity. It is better, however, to cut a head too soon than to leave it too long, for a small, solid head will sell for more than a larger, loose one. To judge when a head has reached full size requires some skill and experience. Usually this can be told by the way it forces the leaves outward. Upon examination it will be seen that the surface of the head becomes more distinctly grained as it approaches maturity. To examine a head do not untie the twine, but part the leaves at the side and the condition of the head can be easily seen. There are two methods used in cutting. Some growers prefer to cut and trim in the field. For this purpose a long, thin-bladed knife is used. The head is cut with enough of the stalk to leave two or three full circles of leaves to protect the head. The leaf is trimmed off by some growers even with the top of the head, or "flower"; others prefer to trim the leaf as low as possible without showing the bottom of the head, "curd" or "flower." A good many growers prefer to cut the stalk or stem of the plant below the bottom leaf and draw the heads to the packing shed, there to be trimmed and packed. The reason for cutting below the bottom leaf is to check growth in the remaining part of the stump or stalk; when it has no leaf, growth ceases. The heads must be handled with care to prevent the "flower" from becoming bruised or soiled. A bruise will turn black in a short time and thus injure the sale of the head. Slatted bushel boxes and berry crates are favorite packages used for the marketing of cauliflower. These should be lined with clean paper and the heads packed carefully therein, so as to carry without bruising. Cull carefully, discarding all flowers that will not grade as first class. Dispose of these to pickling factory.

Keeping.

At the end of nearly every season most growers will have more or less small unmarketable heads in their fields. These can be used for the purpose of keeping or prolonging the season. When the weather gets cold so as to check plant growth, in the fore part of November, the plants that show signs of heading are stripped of their larger outer leaves, are taken up and carted from the field to be set close together either in a cellar, under a greenhouse bench, or in beds covered with hot bed sash. When set in beds care must be taken to protect them from freezing. This is done by using straw or coarse litter, covering the sash with it. When planting the heads, just enough moisture should be given to keep the plants from wilting; if too much water is given they are liable to develop rot. A method used in Denmark is to make a bed of moist sand about four inches deep in a cool room protected from frost. Towards the end of the season, the heads are cut with a piece of the stem three or four inches in length which is stuck into the sand. All the outer leaves are removed except the inner course, which are trimmed down fairly close, The heads are then covered with flower pots. Sometimes early in the season the market price may be low and retarded development of the head may be desired. For this purpose the plants may be cut below the bottom leaf when the plants are nearly mature. They are then carted to a shed or some shady place and set up on the stump end, where they can be kept in this condition for a week or so, depending on where they are kept and weather conditions.

Varieties.

The varieties of cauliflower differ among themselves less than those of most cultivated vegetables. Their tendency to degenerate, especially under unfavorable conditions, and the readiness with which they may be improved by selection, has given rise to many so-called varieties. The growers in this Province may be said to use one strain or another of Dwarf Erfurt.

The Ohio Experimental Station, in 1889, in a variety test of cauliflower, reported twenty varieties under test as being so nearly identical with Early (Extra Early) Erfurt, as to be considered strains of that variety. Cauliflower seed is grown in France, Germany, Italy and Denmark. Puget Sound, in the State of Washington, is the only place in America where cauliflower seed can be grown successfully. Danish seed seems to be given the preference by discriminating growers and commands a somewhat higher price.

Composition of the Cauliflower Plant.

To show the relation of the cauliflower crop to soil exhaustion and the value of the refuse portion for fertilizing purposes, the following analyses are included. They were made by Mr. J. F. Harries, and are embraced in a study he is making of the chemical composition of the cauliflower. The plants were furnished him by the garden department of the College, during the season of 1909, and represented a good average crop. They were grown on a fairly rich clay loam. The samples were taken when the heads were in the best condition for market, and at different times covering a period of about a month. To make the terms Head, Leaves, and Root, clear, the following definition will apply. Head—represents that portion of the plant known as "curd" or "flower," and is the part partaken of as food. Leaf—is all leaf growth. Root—embraces not only root, but that portion of the stalk between the head and root.

The following represents an average of the different samples:

DRY MATTER AND PRINCIPAL CONSTITUENTS OF DIFFERENT PARTS OF THE MATURE CAULIFLOWER PLANT.

Components.	Heads per Cent.	Leaves per Cent.	Root per Cent.
Water	93.16	91.09	85.07
Dry Matter	6.84	8.91	14.93
Total	100.00	100.00	100.00
Organic Matter	6.12	7.28	13.20
Mineral Matter	0.72	1.63	1.73
Dry Matter	6.84	8.91	14.93
Pure Ash	0.712	1.571	1.589
Sand and Silica	0.008	0.059	0.141
Crude Ash	0.72	1.63	1.73
Lime (CaO)	0.067	0.402	0.281
Magnesia (MgO)	0.021	0.058	0.076
Phosphoric Acid (P_2O_5)	0.102	0.105	0.151
Potash (K_2O)	0.245	0.225	0.464
Soda (N_2O)	0.084	0.216	0.328
Sulphate (SO_3)	0.064	0.218	0.138
Nitrogen	0.34	0.365	0.359

An acre of ground planted with cauliflower in rows three feet apart and plants two feet apart in the rows will allow for 7,260 plants, allowing for misses and ground used for headland or turning at the ends of the rows, say, 7,000 plants to the acre. Allowing that 6,000 plants head up and are harvested, yielding, say, five tons of heads per acre, the refuse matter, consisting of leaves from the 6,000 mature and 1,000 immature plants, will average 2½ lbs each, a yield of 17,500 pounds per acre and 7,000 stalks and roots averaging ¾ pound each will make 5,250 pounds.

Combining the above figures it will be found that an average crop of cauliflower will require during its growth the following amounts of plant food per acre:

Pounds of Fertilizer Found in Cauliflower From One Acre.

	Heads. Pounds.	Leaves. Pounds.	Roots. Pounds.	Total Pounds.
Phosphoric Acid	10.2	18.4	7.9	36.5
Potash	24.5	39.4	24.4	88.3
Nitrogen	33.9	63.8	18.8	116.5
Lime	6.7	70.4	17.2	94.3

Cauliflower Growing Under Glass.

Cauliflower is also grown under glass by a few growers who have found it to be a profitable crop. Although Florida and California ship cauliflower which are strong competitors against the greenhouse grown, as they are on the markets at the same time, yet greenhouse grown cauliflower will usually command a price fifty per cent., or upwards, higher than stock shipped in from these States. This is owing to the acknowledged superiority of the greenhouse grown product, such as less acidity, more delicate flavor, whiteness and finer texture, in comparison with outdoor grown stock.

Although the forcing of plant life is an expensive enterprise, and one not to be entered into lightly, or unadvisedly, yet I can see no reason why a demand for greenhouse grown cauliflower cannot be built up in this Province, providing some good grower would undertake to supply the goods and, by doing some advertising and building up a reputation for quality and reliability, make a success not only of the growing of cauliflower under glass, but the building up of a profitable business as well.

Seed of the Snowball or Dwarf Erfurt type is sown in flats or beds, about November 1st, if the crop is to be marketed in April or May. When the plants are in their second leaf they are given their first transplanting, about two inches apart. This is followed by a second transplanting, this time into pots of the 3 or 3½-inch size. When they have made good, strong, stocky plants, they are planted into the permanent bed. By the second transplanting, root development is encouraged, and by the use of pots the change can be made into the permanent bed with the slightest possible check to the plant. It is a well known fact to the cauliflower grower that this crop cannot be stunted without serious loss; from the start to the finish the one main object is to keep up a steady growth.

Ground beds are always used for this crop. The soil should be a rich loam, into which should be thoroughly incorporated plenty of well rotted manure; a liberal dressing of fine bone meal should be worked into the surface—say one pound for every 20 square feet of bed.

Some growers use a dressing of air-slacked lime before planting; others prefer to use a small handful of shell lime sprinkled around the plant. The distance apart of setting plants varies with the different growers from 18 to 22 inches each way. The intervening space between the plants is usually utilized by some quick-growing crop, generally radishes.

A day temperature of 65 to 70 degrees F., with a drop of 10 to 15 degrees at night seems to be the best for this crop.

Care should be exercised in watering, and although cauliflower like moisture, care must be used not to get the soil too wet.

When the plants commence to develop, a little nitrate of soda worked into the soil will be found helpful. The methods of bleaching the heads differs from the outdoor crop. Breaking the leaves down over the head, even tying the leaves, is not as satisfactory as the placing of several thicknesses of paper directly over the head. Folded newspapers answer this purpose.

Green aphis can be kept in check by ordinary fumigation with either tobacco stems or any of the prepared forms of nicotine. Cabbage worms will generally put in an appearance and will need to be picked off.

The prices received for this crop vary from as low as $1.50 to as high as $5 per dozen, with perhaps an average of $3.50. This would give a return of about 13 cents per square foot of bed for plants set 18 inches apart. The above returns do not take into account the radish crop, which occupied the ground when the plants were first set and which should give a return of 10 to 15 cents per square foot of bench, allowing for the space occupied by the cauliflower plants. Some large greenhouses were seen at Mattituck, N.Y., where the grower harvested two crops of radish and one crop of cauliflower. This was done by growing the plants in a separate plant house, and if enlargement of plant, neatness and thrift are evidence, he is well on the way towards the goal they call success.

Cauliflower in the United States.

It is almost an impossibility to secure any figures as to the extent of the cauliflower industry in the United States in latitudes or districts similar or applicable to districts in Ontario. The conditions in the Buffalo district in New York State would, probably, be the nearest approach to those in this Province. The growing of this delicious vegetable is as yet largely in the hands of the market grower and the grower who grows under contract for the pickle factory. The two districts to which exception is taken are both in New York State, viz., the Buffalo and Long Island districts.

Long Island Cauliflower District.

This lies in the Eastern portion of Long Island, and from figures furnished by the Long Island R. R. Industrial Department the following is noted: In 1905 the freight shipments of cauliflower by rail amounted to 10,075 tons, and the express service handled 3,500 tons of cauliflower, a total of 13,575 tons of cauliflower for that year. In 1909, the cauliflower special train ran from Sept. 10th to Dec. 20th inclusive. This train carries nothing but cauliflower and has been known repeatedly to carry over five thousand barrels, or thirty carloads, of cauliflower at a time. The shipments by freight for 1909 were 17,969 tons. This will give a better insight into the size of the industry as conducted on the Eastern end of Long Island than any other example that may be cited. The truckers at the western end of the Island, lying close to and adjacent to the City of Brooklyn, also grow many tons of cauliflower. These are sent into the New York markets in large truck waggons and are not included in the above figures.

The methods used by the growers at the Eastern end of Long Island from Calverton to the extreme east end of the Island vary very little, except in what appear to be minor details. A large number use the horse transplanting machine for setting the plants, others still cling to the old-fashioned method of planting by hand. Stable manure varies in price, depending on the season of the year, from $1.40 to $1.90 per ton on the cars. Commercial fertilizers are used freely by most growers. Methods of production of plants, planting and cultivation, differ very little from those practised by the growers of this Province. It is in their methods of tying up, preparation and packing for market, where they differ, not only from growers elsewhere, but among themselves. The Long Island cauliflower grower practises three different methods of tying his plants for bleaching purposes; this is for the purpose of saving time when cutting. When the plants get to the tying stage a man carrying a small bundle or sheaf of long rye-straw in a sack (made for the purpose and tied around his waist) passes down between two rows of plants. When he sees a plant which needs tying he draws a few straws out of the bundle, making a short band of them. Then he passes both arms around the outer leaves of the plant, drawing them together and tying them with the straw band, so as to exclude the rays of the sun.

Another method is to select two nice long leaves, one on each side of the plant, say lengthwise, of the row. Then all the other leaves on that quarter of the plant on the side where you selected your first leaf are folded over the flower or curd, then the quarter of the leaves directly opposite are treated in the same way, then either one of the remaining quarters is treated likewise, and then the last and remaining quarter is folded over the others. The operator now takes the leaves he first selected and tucks or draws the end of the upper one through or under the one below it, forming half a knot. This is called tucking, and while it seems difficult very little practice makes it so simple that it is surprising how fast you can tie cauliflower in this way. The plant, when tied, is inclined to be balloon-shaped and by folding (not breaking) the leaves over each other, the bottom portion of the leaf bows out and away from the "flower" or curd, thus allowing it a better chance for development.

Some growers vary this tie by having the "tuck" crossways of the row at the point of tying, and lengthwise of the row the next time, while other growers will carry a bunch of toothpicks or some short pieces of rye straw in the pocket and stick one into the tuck to distinguish one day's tying from another.

The main object of having the three distinguishing ties is that when the time for cutting comes all those tied on a certain day are cut at the same time. The assumption is that, if all the plants are not ready for cutting, they should be, and, if the grower had not used the three different marks for tying, he would be compelled to look at every head before cutting.

There are two methods of packing, known as short cut and long cut. Long cut is almost always put up in the field. Barrels are taken to the field and placed at convenient distances apart along the row or driveway. With a good, strong, sharp knife the plant is cut a short distance above the bottom leaf. Another cut three or four inches above the top of the head or flower removes the surplus leaf growth; the balance of the leaf is folded over the head as a protection when packing it in the barrel. Usually second-hand ventilated barrels are used and the cauliflower should be well and tightly packed with the top of the barrel nicely rounded. The top hoop of the barrel is removed, a piece of burlap or bagging is placed over the cauliflower for a cover, the hoop is replaced and fastened on one side; the operator leans over the barrel, pressing the heads of the cauliflower and drawing the cover as tightly as possible, drives the hoop down and nails it in place, thus holding the cauliflower securely.

Short cut are put up both in the field and packing house. When put up in the field the barrels are distributed in the same way as for long cut. The head is cut in much the same manner, with perhaps not quite so many leaves attached and is trimmed much the same as in Ontario. It is then placed in a basket which, when full, is taken to a barrel, and a layer placed in the barrel with the head of the flower facing in, a good strong sheet of paper is placed over each layer and an inch or so of excelsior or marsh hay is added and then another layer of cauliflower. This is continued until the barrel is well filled, when the cover is put on in the same manner as described for long cut. Field packing can only be carried on when the weather is fine and dry. Some growers prefer to use the packing house altogether and, when this is done, it necessitates the removal of all trimmings, and a little more labour, but it permits of better grading being done and barrels are labelled No. 1 or No. 2. A considerable amount of cauliflower is grown for pickle manufacturers and when delivered to salting stations the head or "flower" is cut out entirely from the plant with no leaves attached. In 1908, a Mr. Young had 15 acres and delivered to the salting station 90 tons 300 lbs., at $40 per ton. The average price paid at salting station the past five years has been $35 per ton, and the average yield per acre for the same period has been slightly over four tons per acre.

There is a marketing association in this section known as the Long Island Cauliflower Association. By loading solid or full cars the railroad gives a reduction of four cents per barrel delivery at New York market. The Association charges the grower the four cents, but in return the Association looks after the supply of empty barrels and seed, keeps a man at the New York end to look after markets, and pays a dividend to the holders of stock. It also diverts shipments to other markets as well as acting as agent in accepting orders from commission merchants in other cities.

Buffalo District.

In the vicinity of Buffalo, N.Y., cauliflowers are grown and shipped in quite large numbers. The varieties grown are Snowball and Early Dwarf Erfurt. The usual date of sowing seed is about May 20th, so as to produce the flower the latter part of September and during October.

They are grown on soils of varied nature, clay, sandy loam, clay loam, gravelly loam, and black muck, and on all of these with success, depending on the season. Barnyard manure is used largely, also a commercial fertilizer analyzing 4-8-7. The Erie County Growers' and Shippers' Association use a crate for the shipment of cauliflower which holds 12 heads and these are trimmed with the outside circle of leaves about an inch longer than the head is high. By trimming the heads in this manner the heads can be packed in the crates alternately on their face and on their stump, and so far this method has proved satisfactory. All goods are graded and sales pooled. Crates cost 13 cents each. During the season of 1908, 33,816 crates were handled at an average return of 55.22 cents per crate to the grower. In 1909, 34,926 crates were handled at an average net price of 62.7 cents each. The cauliflower shipping season opens with the Association about August 20th and ended in the season of 1908 on November 5th, and in 1909 on November 26th.

BRUSSELS SPROUTS.

The cultivation of this, one of the most delicious of the cabbage family, does not differ materially from that of cabbage and cauliflower.

Most of the information contained herein was secured from Mr. Frank H. Case, a grower on the eastern end of Long Island, who for the past fifteen years has been growing and selecting this vegetable with a view of having the sprouts more firm and smooth and, at the same time, keeping a watchful eye on quality.

A variety of strain of the half dwarf is usually grown. Seed is sown on Long Island from June 1st to 10th and transplanting to the field takes place when the plants are five or six weeks old.

A sandy soil in good tilth with plenty of available plant food in it, seems best suited for this crop. About four months from the sowing of the seed they will be ready for picking.

Harvest and Marketing.

The harvest lasts in the field until the ground freezes up for the winter. An extra good yield would be a quart per plant. The Sprouts

A Good Specimen of Brussels Sprouts.

grown on Long Island are all marketed in quart berry boxes. The little heads are broken off the stems. taken to the packing shed and washed or well rinsed in clean water. They are then trimmed (that is, the loose outside leaves are removed and the small stem trimmed), and are carefully packed in the berry boxes, special care being taken to put the little heads in firmly, so that they will not shake or damage in transit. Care is also used in having the sprouts in the top layer top or headside up and many growers have their sprouts in regular rows.

Brussels Sprouts are sent by express from this section to supply markets as far west as St. Louis and Denver. As an evidence of the extent of this industry in this section, during the year 1905, there were shipped by express 160 tons of Brussels sprouts. The average price received this season has been low on account of the acreage being large and the crop heavy. They are worth in New York City at the present writing (Jan. 6th) from 6 cents to 12 cents per quart, strictly fancy bringing a little more. A crop grown by Mr. Case in 1904 netted over $400 per acre. Last year the crop was nearly a failure and netted him a trifle under $100.

The market has doubled in the consumption of this vegetable during the past five years, and most growers think it will double again during the next five years.

To Ontario growers contemplating the growing of Brussels sprouts, Mr. Case offers the following advice: Sow seed for this latitude from May 1st to 8th and plant out in the field in rows 36 inches apart and 30 inches in the row, working both ways with the horse cultivator, hand hoeing frequently, while the plants are small, and store in a locality where there is plenty of snow in the following manner: Cut the plant even with the top of the soil. Put into a windrow about three feet high, A-shaped, being careful to have the tops up and on the outside. Cover with straw to the depth of a foot or so. After the sprouts have settled, the row proper will be not over two feet high. It is preferable to have this row run north and south for the same reason as given in pitting cabbage. Be sure and keep the snow off the apex, even in zero weather, if there be so much that the plants cannot get ventilation.

CABBAGE SEED PRODUCTION.

It is estimated that the American seed trade handles annually about 600,000 pounds of cabbage seed; less than half of this is imported from Europe, consisting mostly of early varieties. The remainder is produced chiefly on Long Island and Puget Sound, on the Pacific coast. Some seed is also grown in New York, Rhode Island, Connecticut, Eastern Virginia, and some few of the Middle Western States. The source of supply of the cabbage seed used in America, as given me by a reliable authority, is as follows:

Long Island	20 per cent.
Washington State	30 per cent.
Elsewhere in the United States	10 per cent.
Imported	40 per cent.

Cabbage seed may be produced by three methods from solid or perfectly developed heads, from partially or half-formed heads and from stumps from which solid heads have been removed.

From Solid Heads. This is practised for obtaining extra selected stock seed, or seed to be used for growing a commercial or field crop.

From Partially or Half-Formed Heads. With stock seed produced as above for starting the crop. A crop of commercial seed may be raised from partly developed heads. This is the method pursued by leading commercial seed growers. The advantages claimed for it are later sowing and such plants winter better than do solid heads, also heavier seed production and the promotion of earliness in the crop grown from such seed. The growing of seed for this crop is so timed that the plants will be just coming to a partial heading stage when it will be necessary to take them up for winter storage.

On Long Island, the sowing of the seed for Early Jersey Wakefield is done from the 1st to the middle of July, for medium early varieties such as All Head, about June 20th, for late varieties about June 10th, transplanting the plants to the field about five or six weeks after sowing the seed. Cultivation is carried on the same as for a crop of cabbage. About the middle of November the plants are taken up for storage.

Storing the Plants.

The general practice in storing is to run a cabbage plow close to the edge of a row of plants, loosening and lifting them. Every eighth or tenth row is then made into a trench to receive the plants which are taken out of the rows This is made wide and deep enough for plants to be packed closely therein, three or four plants in width, roots down, slightly slanting, the roots being covered slightly with soil, and the tops but a trifle above the ground. The trench is then covered with earth by means of a large plow throwing up big furrows on and over the plants on each side. An asparagus ridger is then used to move the dirt over on to the middle of the trench, and it is dressed up with the centre slightly higher, to keep water off and prevent hard freezing.

The trenches are uncovered in spring by running a plow as closely as possible to be buried plants, throwing the furrow away from the plants. The remaining dirt is then removed with a large wide hoe, leaving the plants ready to be taken out.

Planting.

In the spring, as soon as the soil can be worked, the plants are set out in rows or furrows, which may be made in the same field in which the plants are stored. These furrows are made with a medium-sized plow, going and returning in the same furrow, and they are four feet apart for early and five feet for later varieties. The plants are laid about two feet apart in the row or furrow, the stem of the plant parallel with the row, the head of the plant raising the stem, so that it will be on an angle of 30 or 40 degrees. The root is covered by the use of large hoes drawing the soil from the side of the furrow on and over the root of the plant. Cultivation is kept up the same as for an ordinary crop. After the seed stalk grows up, the cultivator is used to throw earth up to the seed stalk to support it, so that when the plants begin to bloom they are growing on a ridge.

In planting out solid heads it is necessary to use a knife to cut the head so as to allow the seed bud to make its appearance. This is usually done by cutting the head across the top, making two cuts in the shape of a cross, cutting the head in quarters. Care must be taken not to cut so deeply as to injure the tender bud.

Seeds from Stumps.

Stumps from which extra choice heads have been removed are wintered over in much the same manner as partially formed heads. This method is not to be recommended for the production of good seed.

Harvesting.

When the seed pods have passed what seedsmen call their "red" stage, they begin to harden, and as soon as a third of them turn brown the entire stock may be cut. The cutting should be done on a clear, dry day, early in the forenoon, when the dew is on. For this purpose a long, heavy-bladed knife is used. The seed stalks are gathered in small heaps five or six stalks to a heap, the heads all one way, lying across the ridge on which they have been growing, the butt of the stalk in the hollow between two of the ridges. They are allowed to remain there for from three or four days to upwards of a week to become dry.

Threshing.

This is generally done by laying a large cloth on the ground, one man bringing the small heaps of seed stalks and laying them on the cloth, while the other man beats the seed out with a flail. Some of the growers beat the seed out over the side of a barrel, holding the butts of the seed stalks in their hands; others use a threshing machine for the purpose.

Cleaning.

The seed is cleaned by running it through a fanning mill, after which it is spread on a cloth in the drying room and left for several weeks to become thoroughly dry. It is then run through the seed cleaner and stored in sacks ready for shipment.

On Long Island an average yield of seed is from 300 to 500 pounds per acre, and the price paid the grower ranges from 35 to 50 cents per pound.

INSECT ENEMIES AND FUNGUS DISEASES OF THE CABBAGE AND CAULIFLOWER.

Flea Beetle.

This insect, also known as the ground flea, is very troublesome in some parts. The general remedies used are tobacco dust sprinkled over

A Club-Rooted Cabbage.

the beds, just as the plants make their appearance above ground, also land plaster and Paris green mixed in the proportion of one pound of Paris green to twenty-five or thirty pounds of plaster dusted very lightly on the plants, early in the morning, when the dew is on and the plants are a few days old.

Cabbage Root Maggot.

This is one of the most serious pests that trouble the grower of early cabbage. As yet no sure remedy has been devised, and the best thing to do is to use preventative measures such as planting cabbage in a new place each year, as far removed as possible from the ground on which cabbage or any of the allied crops were raised the preceding year. Cook's carbolic wash is also used successfully; this is made as follows: One pound of hard soap, one pint of crude carbolic acid, one gallon boiling water. Dissolve the soap in boiling water and while still hot add the carbolic acid and emulsify thoroughly. For use dilute the above with 30 to 50 times its bulk of water; apply a cupful to the root of the plant. Tarred paper disks about three inches in diameter, with a slit from one side to the middle and placed around the stem of the plant, are also used with success.

Where it is found that the root maggot troubles the young plants in the seed bed, the use of cheese cloth screens for covering the bed is fairly satisfactory. Boards ten or twelve inches in width are laid on edge so as to form a frame, this is then covered with cheese cloth, thus preventing the fly from laying eggs on the young plants. The objection to this plan is that it tends to make the young plants of a spindly growth. Mosquito bar-netting is also used and seems to be an improvement over cheese cloth on account of allowing more light to the young plants.

Cutworms.

The most successful remedy for this pest is the poisoned bran mash made as follows: Mix half a pound of Paris green in fifty pounds of bran, adding the poison to the bran a little at a time, stirring continually until the whole is tinged with a green color, then add water sweetened with sugar or molasses until the mixture is sufficiently moistened to crumble through the fingers. The mash should be scattered about the plants that are liable to attack, in the evening. The worms will feed on this mixture in preference to the plants.

Cabbage Butterfly.

The most effective remedy for this troublesome insect is pyrethrum insect powder—one pound thoroughly mixed with four pounds of flour and placed in an air-tight jar or can for twenty-four hours, so that the poison may become thoroughly incorporated with the flour. The mixture can be applied with a powder gun or a cheese cloth bag, dusting the plants lightly. This powder will kill the insects, but is perfectly harmless to human beings. Pyrethrum can also be applied in a liquid form, as follows: Dissolve two ounces of the powder in three gallons of luke-warm water and spray at once. Hot water applied at a temperature of 130 degrees F. will kill the worms and not injure the plant.

Aphis or Plant Lice.

These are very troublesome, some seasons, to the growers of cabbage and cauliflower, prolonged dry, hot weather being favorable to their increase. Kerosene emulsion and strong soap suds are the usual remedies applied, but are not satisfactory, especially where the acreage is large.

Fungus Diseases.

For most of these diseases there is no remedy and it is advisable for the grower to keep a close lookout for the advent of these diseases in his soil and to use preventive measures at all times, clean culture and crop rotation being the principal means.

Club Root.

Preventive measures are: Practise crop rotation and do not grow cabbage or any allied crop, such as cauliflower, kale, Brussels sprouts, khol-rabi, turnips or radish, on any soil oftener than once in three years. Do not use manure from stock fed with infested roots. Burn all refuse from infested crops. The application of lime, two or three tons per acre, has a beneficial result. Winter ridging of the infested land curtails the disease to a limited extent on the following crop. It can be carried from one piece of soil to another by the roots of the plant; if the seed bed is infected, the plants from that seed bed will infect that part of the field to which the plants are transplanted.

Black Rot.

The first symptoms are darkening of the leaf veins. Avoid low, damp soils. Practise rotation of crops as recommended for club root. Some varieties of cabbage are much more resistent to this disease than others. Houser, St. Louis, Drumhead and Savoys may be especially mentioned as being strongly resistent to this disease.

Wilt.

Wilt, in some parts known locally as "yellows," is caused by a fungus which attacks the roots, causing the leaves to wilt and die. No good remedy is known. Avoid infested land and use preventive measures as outlined above.

Stem Rot.

This disease affects the cauliflower much more than it does the cabbage crop. It is a bacterial disease and its development is favoured by moist, close weather. There is no satisfactory remedy known for it. The avoidance of damp soils and locations might be of some benefit, but it is not practicable with the cauliflower.

Damping Off.

Damping off is usually associated with too moist a condition of the soil or atmosphere. When the plants are in the bed avoid overcrowding and give plenty of air.

Blackleg or Mildew.

This is a disease which attacks the stems of young plants either when wintered over or in the hotbed. It is prevented and kept in check by keeping the seed bed dry. A dressing of sand or air-slacked lime is also beneficial.

For further and more complete directions regarding Fungus or Insect Pests, not only affecting cabbage and cauliflower crops, but other vegetables, write to the Ontario Department of Agriculture for a copy of Bulletin 171.

BULLETIN 204.] [JUNE, 1912.

Ontario Department of Agriculture

WOMEN'S INSTITUTE BRANCH

Decay of the Teeth

ITS CAUSE AND PREVENTION.

A popular impression has long existed that caries, or decay of the teeth, is of comparatively recent origin, and that it is due to an artificial mode of life in a departure from the laws of nature, and to artificial environments. It has been held that our early progenitors knew not the

Germs of tooth decay.
(Magnified 1,000 times.)

pains of toothache, and retained their dental organs to a late period in life. Actual observation has proven this to be untrue, as the study of the skulls of mummies has shown that man in all ages has suffered from the ravages of caries to a greater or less degree. It is a disease which is as old as the human race, and has probably caused more pain and distress to the human family than any other disease with which man is afflicted.

It would naturally be expected that a condition so universal in its extent so ancient in its origin, and so distressing in its results, would have been carefully studied and long since understood. The fact really is that until within the last thirty years, or even less, no sucessful steps were taken toward a study of the cause and prevention of the disease. Much dental work was done, and many good results obtained, but the results obtained were to remedy this evil, rather than to discover the cause, and prevent the decay.

The cause is now definitely known, and much work has been done along remedial lines, and with very good results. It has been demonstrated that dental caries is due to a number of factors, but the principal and basal one is the growth of oral bacteria. The bacteria during their growth produce an acid (lactic acid), which is the destructive agent in the disease.

Bacteria belong to the vegetable kingdom, and are in many respects analogous to the higher plants. They are not, as they are so frequently spoken of, microscopic animals. There are many of them which serve a useful purpose, just as the higher forms of the vegetable kingdom do, and they all should not be looked upon as disease-producing. Only a comparatively few varieties have been studied and classified. A vast number may be looked upon as useless, since investigation has been unable to discover any office, useful or otherwise, which they perform.

In the human mouth, there are many forms of bacteria that are so commonly found that they may be looked upon as being almost indigenous. Among those forms found more or less constantly in the mouth are those which produce lactic acid under favorable conditions, under other conditions they entirely fail to develop. Thus it is seen that for the production of decay we must have conditions prevailing which make the bacteria effective. Those conditions are moisture, a desirable soil, or food in which to develop, and a certain amount of heat. In the mouth we have always present two conditions, moisture and warmth, and in many cases the third.

The various foods, particularly the starches, are, by the ferments of the mouth, changed into forms admirably suited for the growth of these acid-producing bacteria. In the pits of the teeth, or in any of the irregularities of their surfaces, or between the teeth, food lodges. This provides nourishment for the bacteria, which, in their growth, split up the sugars and starches, building up into their own substances such elements as are necessary for their growth, and leaving others, and at the same time giving off, or excreting, certain by-products, among which is lactic acid. This acid, which is particularly active in its newly-formed state, attacks the calcic, or lime salts of the tooth. The enamel, being largely composed of these salts, is dissolved, thus causing a large depression. These bacteria in their development protect themselves by a gelatinous material which they give off, and by means of which they become attached to the surfaces of the teeth. Under cover of this, the process is continued, lactic acid is constantly formed, and the tooth tissue is gradually dissolved until the central portion of the pulp, commonly called the nerve of the tooth, is reached.

When the disease has reached the pulp, or occasionally before it reaches it, we have a condition known as pulpitis, or ordinary toothache. This is simply an inflammation of the pulp. The usual symptom is severe pain, which is increased by the application of heat or cold, but particularly cold. This may be temporarily relieved by the patient himself simply washing out the cavity with warm water, and applying oil of cloves, creosote or any anodyne on a pledget of cotton, and covering it with another piece of cotton. He should see his dentist as soon as possible afterwards.

The next step in this disease of the tooth is the destruction of the pulp itself. The pulp, as a result of these bacteria, becomes disintegrated and putrescent. If any of this material, which is filled with bacteria, passes through the end of the root we have another condition set up. Gases form and cause pressure and irritation, and there is a general inflammation around the end of the root with pus forming. The tooth feels longer than the others, is sore to pressure, great pain is caused by the application of heat, and it is relieved by cold. This is commonly spoken of as an abscessed tooth. Relief can only be given in these cases by cleaning out the cavity and opening up the tooth so as to allow the pus to escape. This can be done by the dentist, and a patient will get very little relief until he consults one.

There are many conditions of the tooth and mouth which are secondary causes of decay, enabling the bacteria to produce these disastrous results.

1. The first and most important is the general care taken of the teeth by the individual.
2. The food eaten.
3. The use given the teeth, i.e., people who masticate their food well, and eat food that requires thorough mastication, are less subject to caries.
4. Irregularities of the teeth; teeth that are irregular, and are not in the relation to each other that nature intended them to be, are more susceptible to decay.
5. The general health of the patient; on this depends largely the number and variety of bacteria in the mouth.
6. A hereditary tendency to caries.

The Dentist Needs the Co-operation of the Patient.

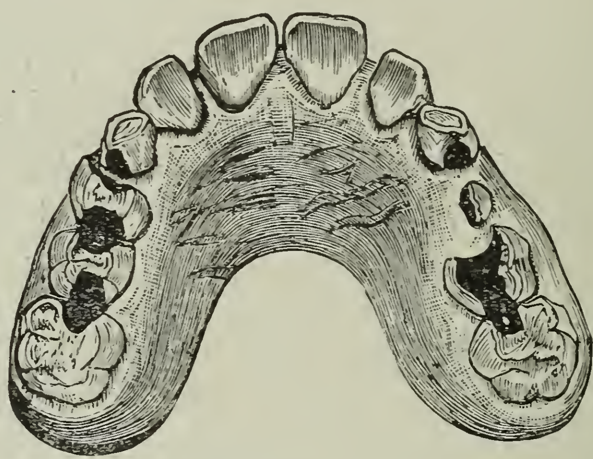
We have now the cause of decay briefly defined, and knowing the cause, what is the remedy?

Many people; too many, leave the care of their teeth entirely in the hands of the dentist, and do not follow closely any of his instructions. Others, and by far the greater number, take absolutely no care of their teeth, until they have lost many of them, and are in danger of losing all. They then rush to the dental practitioner, demanding that he save the remaining teeth, a thing which, in many cases, is impossible.

A dentist who has not the co-operation of his patient from the very beginning cannot produce the best possible results. He may do excellent work, but unless the patient assists him, he cannot hope to prevent a recurrence of caries, but simply postpones the time when the teeth will be lost.

Absolutely Clean Teeth do not Decay.

What can be done? The answer is very simple, and is based on the assertion that an absolutely clean mouth will be absolutely free from caries. As it is impossible, however, to obtain this condition of absolute cleanliness, we have to be satisfied with as near an approach to it as possible.



Caries in Temporary Molars, by which the Permanent Molars have been affected.

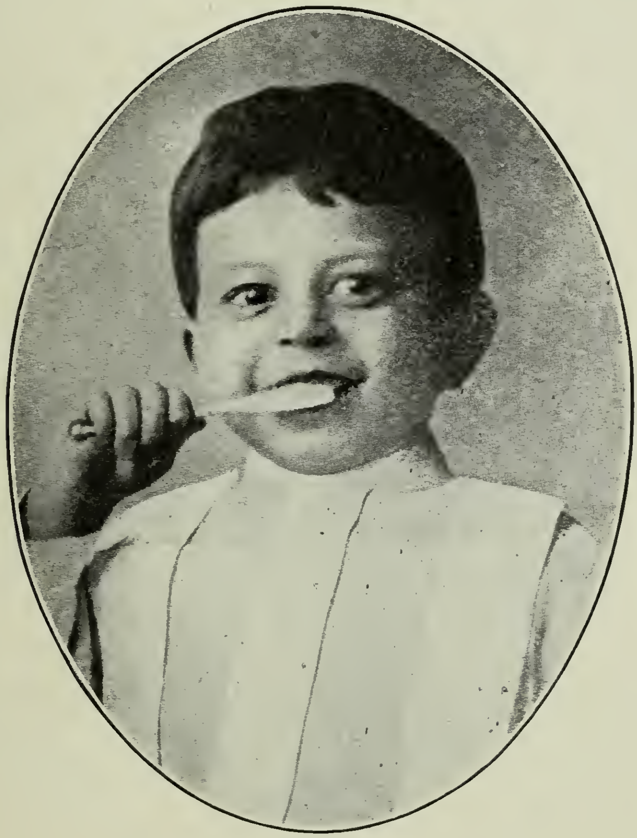
The degree of cleanliness attained will determine largely the extent to which caries will exist.

In the mouth it is possible to control, in some measure, the rapidity with which bacteria develop. This can be done by antiseptic mouth washes, but only to a limited extent. But one should not depend very largely on this. It can be readily shown that thorough mastication reduces the number of bacteria in the mouth. By the act of vigorous chewing they are brushed off the teeth, and out of their resting places, are mixed with the masticated food, and carried into the stomach to be destroyed by the acid of the gastric juices. After a meal, particularly one which consists of food requiring prolonged mastication, bacteria will be found much less abundant than before the meal. If, however, the mouth is well cleansed, and carefully freed of all food particles immediately after the meal, the increase of bacteria is greatly lessened; and, if the saliva is normal, and the teeth and mucous membrane are in a healthy condition, the development of bacteria will be greatly retarded.

If starchy food, like bread, crackers, etc., is allowed to remain in the mouth, it will greatly assist the development of acid-producing bacteria. The same effect is also produced by saccharine foods, such as sugar, candy, and other sweets. This leads to the conclusion that keeping the mouth clean by frequent and careful removal of food, retards the growth of bacteria, because it reduces the soil in which these microscopic plants develop. When the mouth is kept free from starchy and saccharine foods, it deprives these acid producers of the elements needed for their growth.

Cleanliness of the Teeth Prevents Other Diseases.

Besides protecting the teeth, such cleanliness reduces the likelihood of acquiring diseases. It is evident that, if disease germs enter a neglected



Pleasure in Cleaning the Teeth.

mouth and mucous membrane, where food particles in all stages of decomposition abound, serving as a soil for their development, they will grow in number, and in virulence, much more rapidly than in a clean, well-cared for mouth. A clean mouth is one important safeguard against disease.

It will be naturally suggested that, if decay or caries of the teeth is the result of an acid, why is the remedy not an alkaline mouth wash?

Here we are confronted with one of the apparent contradictions in bacteriological study. Acid-producing bacteria develop best in an alkaline medium, and cease to grow when the substance in which they are growing becomes more than one half of 1 per cent. acid. They are victims of their industry, and are killed by the acid which they produce.

Acid saliva is met with only occasionally, and is not usually accompanied with any marked carious action. Therefore, an alkaline tooth-wash, useful though such a preparation may be, cannot be looked upon as a much-sought-after agent that will eliminate caries from the catalogue of human ills.

As has been said before, the organisms are attached to the teeth by means of a gelatinous material which they throw out around themselves. They reproduce under this covering, and thus the acid which is formed in the process of their growth is concentrated, and acts very rapidly on

The Result of Neglect in Care of Teeth.
Not healthful nor pretty.

the teeth. These gelatinous coverings may be readily removed, but are usually located on a part of the tooth difficult of access. The abrasion of mastication will remove them, unless in a protected part of the tooth. As saliva has the property of penetrating this covering, the bacteria in this way obtain their food.

Teeth Suffer From Lack of Experience.

The teeth in a general way suffer from lack of nutrition, and lack of exercise. In addition to this they suffer from lack of surface polish, which would make them more resistant to carious action. When it is said that the decay of the teeth is brought about by civilization, it is not intended to assert that caries was unknown among the uncivilized people, for, as has been said previously, caries has been known in all ages. But any observer will gather from a study of skulls of different races, and of different ages, that civilization has a great deal to answer for in regard to caries of the teeth. It is known not only that teeth have deteriorated, but also that there has been a gradual narrowing of the jaw, which is becoming so marked as to cause justifiable alarm. The primary cause which has led to this, is lack of use. To produce strong teeth is almost as simple as to produce strong arms—use them. If children could be sent to a chewing school as they are sent to a kindergarten, there would be marked improvement in the race.

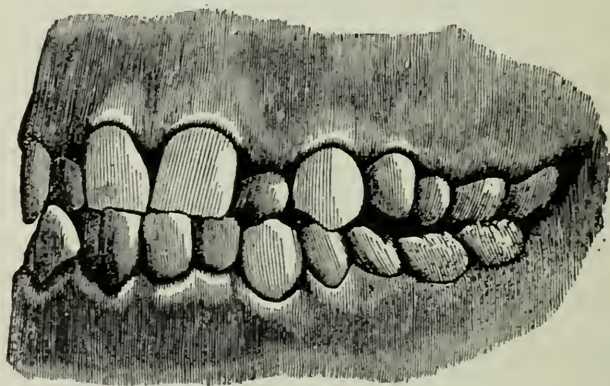
There is but little food for the child which affords any exercise for the teeth and the muscles of the jaw; and there is but little advice or encouragement given to induce children to masticate their food properly. The average meal for the average child is likely to be a bore, and he hurries through it, washing his food down with water in order to seek a more congenial occupation. It is necessary that children have at each meal some wholesome article of food that calls for vigorous mastication, and the parent should see that the child masticates it properly. If this plan is persisted in, the habit will soon become established and will never be forgotten. Bills for dentistry will be reduced, the child's teeth will become strong and well polished, and there will be distinct enlargement of the jaw and a strengthening of the facial muscles. There can be no exaggeration of the marvellous results achieved by vigorous mastication. It is because uncivilized races live upon food that is tough and but imperfectly cooked, and which requires a great deal of chewing, that they are invariably shown to have excellent teeth, free from irregularities and firmly planted in the jaws, to which are attached strong facial muscles.

It is not the purpose to advocate any particular diet, but merely to call attention to the fact that the presence of teeth in the mouth cries aloud for such a modification of the diet of the child as will produce in them functional activity. Even the temporary teeth must have a goodly amount of exercise since exercise insures a goodly amount of blood supply, and upon this depends not only their own preservation and usefulness, but also the size and shape of the jaw, and the texture of the permanent teeth which follow. While the jaw is undeveloped and the bones are soft, it it obvious that it is more susceptible to the various influences which affect it than after full development has taken place. And during this period exercise will do much to insure proper development. Even after eruption, permanent teeth are not fully formed. Exercise of the teeth then is necessary to assist in their proper development, which is not complete till several years after their appearance.

In addition to the careful mastication of food and a careful selection of food, the child should be taught to cleanse its mouth just as carefully as it does its hands and face. This habit, once instilled into the child, will always remain. Even at the early age of two years, a child can be taught to use a brush, and before that time the nurse should carefully wash its mouth with a boracic acid solution.

Irregularity of Teeth and Decay.

Irregularities of the teeth have a marked effect on the frequency with which caries occurs in the mouth. All teeth are naturally so shaped that they touch the adjoining teeth at but one point. If the teeth are irregular and in contact over a considerable area of their surface, a large portion is beyond the reach of a tooth brush, food lodges there, disintegrates and forms an excellent location for the development of bacteria. The cause of these irregularities cannot be considered in detail here, but it is well to emphasize the fact that the premature loss of the temporary teeth is responsible for many irregularities of the permanent ones. This is not the only cause, as thumb-sucking, mouth-breathing, etc., also produce their irregularities, and it is necessary to check these bad habits; but it is more important to properly care for the temporary teeth of the child. Consider the consequences of neglect. The teeth decay, the pulp becomes involved and exposed, causing the child pain and discomfort. It is afraid



Irregularity of Teeth.

to masticate its food, and consequently bolts it, its stomach is overworked, then follows indigestion, intestinal trouble, ending very possibly in undermining the health of the child. In addition to this the jaws and teeth are not being used. As a result, the jaws do not develop, the gums become inflamed and spongy, the teeth more susceptible to decay, with consequent tooth-destruction and death of the pulp, abscesses are formed from which pus exudes into the mouth, and altogether there is a generally unhealthy condition of the mouth which can only act detrimentally to the child.

Realizing the immense benefit which simple food and hygienic methods will bring about, mindful of the truth that mastication will polish the teeth and stimulate healthy nutrition, appreciating the fact that inherited tendencies may be overcome, or their effects minimized by careful attention to the laws of health, still it is recognized that such developments take time, and the fruition of our ambitions cannot be reached in a day. In the meantime, teeth decay, yet how few are willing to give up fifteen minutes of each day to the care of their own or their children's teeth, though it can be shown that such a course would result to a great extent in immunity from caries. As to the number of times a day which it is necessary to cleanse the teeth, no definite statement can be made; this will depend on the shape and regularity of the teeth, the conditions of the secretions, the food eaten, the amount of mastication performed, the care with which brushing is done, and on the frequency of the more thorough polishing by the dentist.

How to Brush the Teeth.

It is self-evident that rapidly decaying teeth require more attention than those which are apparently extremely resistant to caries, and in some cases the frequency with which the teeth are brushed must in a measure be governed by the occupation of the patient. The teeth, if brushed properly, can never be brushed too often, but much injury may be done by unskilled brushing. Using too hard a brush, and too coarse a powder will wear the teeth to an injurious degree. People usually brush their teeth back and forth over those surfaces which are naturally kept clean by the muscular action of the face and lips. They overlook altogether those portions of the teeth where the food lodges and is difficult of access. To reach these places the bristles of the brush should be placed on the gums above the teeth (for the upper teeth) and by turning the wrist the brush is brought down toward the grinding surfaces, the bristles passing into and cleansing the spaces between the teeth. For the lower teeth reverse this order, placing the brush on the gums below the teeth and rotate the handle upward. In this way the gum tissue is not injured but is kept clean and healthy, while with the ordinary method the tissue in these spaces is more or less injured. Laceration of the gums is caused by wooden tooth picks. Silk floss should be *very carefully* used. It is necessary to employ both of these articles at times for the sake of comfort, but only the coarse particles of food can be removed by them, and they play little or no part in the prevention of caries. It may be added that injury to the gum tissue between the teeth, if severe, will eventually lead to its absorption, thus endangering the life of the tooth and rendering it more susceptible to caries.

When to Brush the Teeth.

Self-respect and a desire for a better feeling in the mouth induces nearly everyone to brush their teeth in the morning; another two minutes may easily be taken after the morning meal for a second brushing, and the business of the day may then be started with a clean mouth and wholesome breath. If it is at all possible, the teeth should be brushed again after lunch, and all should make it an imperative rule that no food should be taken after the teeth have been cleansed for the night. The custom of giving a child a biscuit to eat as it goes to sleep has been productive of great evil. Partial dentures should never be kept in the mouth at night, as the adjoining teeth are sure to be attacked by caries. As to the use of mouth washes, tooth pastes and powders, everyone should be governed by the advice of their dentist. There are many mouth preparations on the market; some have virtues, but it is wise to be advised in their selection.

It is the duty of parents to watch the teeth of their children just as carefully as they do their general health. A child should be frequently taken to a dentist who will have the child's interest at heart; the temporary teeth can thus be watched and filled, and so retained as long as nature intended they should. Parents should remember that it is just as important for the health of the child that the temporary teeth be retained in a sound and useful condition until the time of their exfoliation, as it is that the adult's teeth should be attended to. It is difficult for parents to distinguish between the first permanent molars, which erupt about six years of age, and the temporary teeth. Many of these first permanent molars are lost because of this inability to distinguish, and the child suffers an irreparable loss, for these first molars are really the most important teeth in the mouth. They serve the important function of preserving the requisite space for the other teeth, their early loss meaning an imperfectly developed arch.

Diet.

The diet of the child should be carefully regulated and, as soon as the child is of sufficient age to masticate, it should be given meats as well as starchy foods. Proper meats should be chosen—such as good beefsteak—as there is nothing better to give exercise to the teeth and jaws than the mastication of these. This also gives a mixed diet, which is preferable to an entirely carbohydrate or starchy diet. Children should not be given soft bread or soft food of any kind in excess. Give them their starchy food in such a form that they must masticate it. Do not allow them to drink in order to assist mastication.

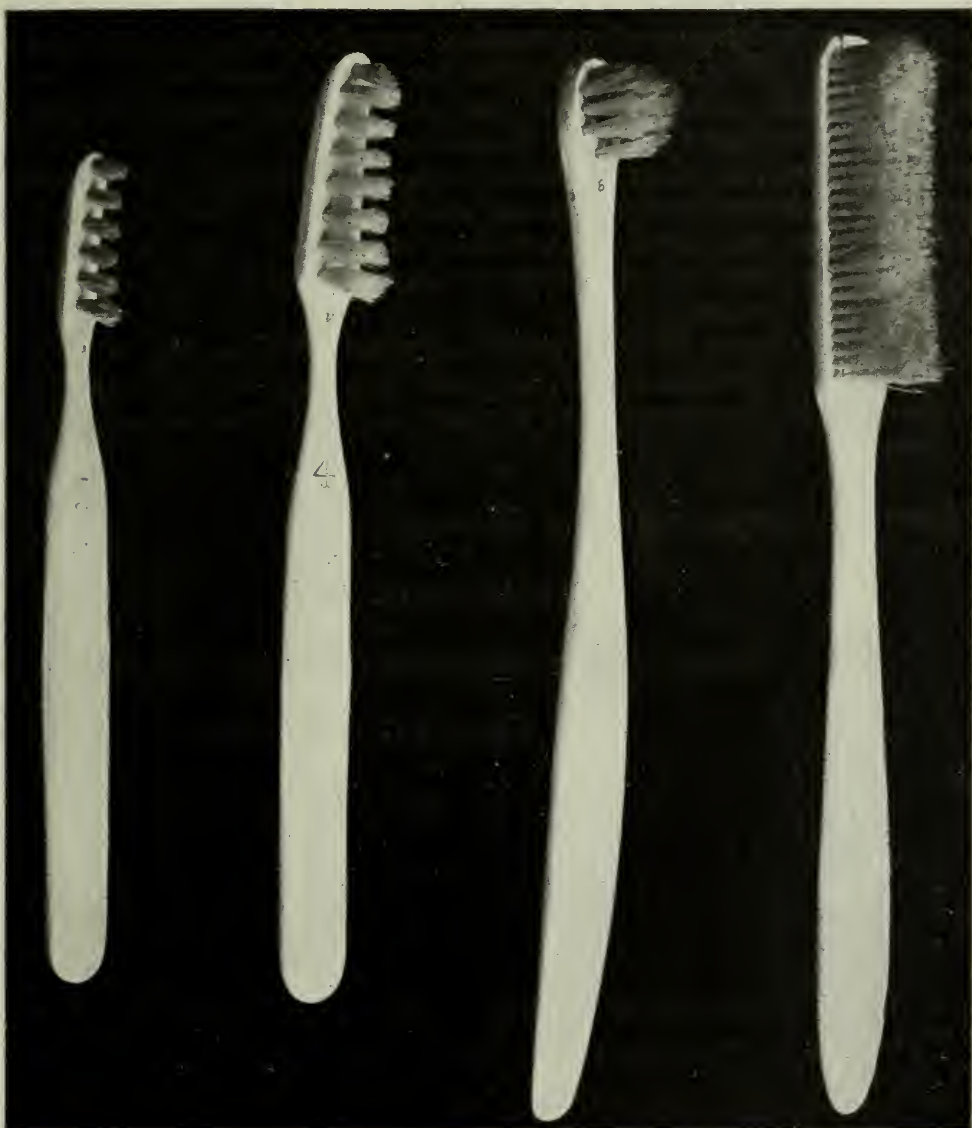
If the child visits a dentist frequently he soon loses any fear that he may have, and, if the parents follow out the dentist's instructions, the child will soon acquire very good dental habits, and good dental habits will mean better teeth and better facilities for mastication, and this in turn will give the child an opportunity to grow up into a more robust adult than if handicapped with decayed teeth and an unhealthy mouth.

Choice of Tooth Brush.

In choosing a brush for the teeth do not select too large a one, and do not use one from which the bristles come out or break off, for, if they do, and lodge between the teeth, they will cause irritation and injury A moderately stiff brush is better than one that is too soft. Above all things, use the brush frequently and carefully. Regular polishing by the dentist is necessary to keep the teeth free from all deposits which in many mouths form very rapidly.

Need Teeth be Lost.

With ordinary care from the individual, no teeth need be lost; and, if they are lost, the blame rests entirely upon their owner.



From left to right.—The first three are properly made tooth brushes, the first being that for a child. The fourth brush shows kind commonly used, but which is not the best.

To Preserve the Teeth.

1. Keep the mouth clean and free from debris.
2. Masticate the food thoroughly.
3. Visit a dentist at regular intervals.
4. Follow his instructions carefully.

SPECIAL ANNOUNCEMENT.

The Ontario Dental Society, at its annual meeting in the spring of 1909, appointed an Educational Committee with instructions to launch a campaign with the object of educating the public in the proper care of the teeth and in the means of preventing dental decay. This Committee was continued in office at a subsequent meeting of the Society, and has been organizing educational work throughout the Province by the appointment of local committees in many localities.

The Committee has secured charts, lantern slides and exhibits for use in connection with public lectures and discussions on Oral Hygiene, and will gladly render any possible service to officers of Women's Institutes or other organizations which desire to assist in this work by way of arranging public lectures.

The Ontario Dental Educational Committee will be glad to loan the charts, slides, etc. (without charge), and give any further information or assistance within their power to any organization which desires to take up this work.

Address all communications as follows:

To the SECRETARY,

Educational Committee of the Ontario Dental Society,

Care of Dental College,

240 College Street, Toronto.

Pages 13 to 16 inclusive contain information copied from "Oral Health" and illustrate charts which have been used in dental instruction in the Toronto schools.

FOOD & TOOTH DECAY

FOODS WHICH ARE

CLEANSING & PREVENT DECAY.

FIBROUS FOODS GENERALLY.

EXAMPLES:

Fish, Meat, Poultry, Lettuce, Cress, Radish, Celery, Uncooked Vegetables (Cooked Vegetables are as a rule cleansing but in less degree than the uncooked), Stale Bread with Crust, Twice Baked and Toasted Bread of all kinds, Savouries, Fresh Fruits, Fatty Foods of all kinds, Soups, &c.

COARSE AND FIBROUS FOOD

IS A

NATURAL TOOTHBRUSH!

ISSUED BY THE EDUCATIONAL COMMITTEE OF THE ONTARIO DENTAL SOCIETY
BY COURTESY OF BOARD OF EDUCATION TORONTO—DEPT OF MEDICAL INSPECTION

FOOD & TOOTH DECAY

FOODS WHICH ARE

NOT CLEANSING & PRODUCE DECAY.

STARCHY AND SUGARY FOODS
WITHOUT FIBROUS ELEMENT.

EXAMPLES:

Sweet Biscuits & Cake, Bread & Marmalade, Bread & Jam, New Bread without crust, Bread soaked in Milk, Milk Puddings, Porridge & Milk, Stewed Fruit, Honey & Sweets of all kinds, Cocoa & Chocolate.

WHEN THE ABOVE ARE EATEN

CLEANSING FOODS SHOULD FOLLOW!

ISSUED BY THE EDUCATIONAL COMMITTEE OF THE ONTARIO DENTAL SOCIETY
BY COURTESY OF BOARD OF EDUCATION TORONTO DEPT OF MEDICAL INSPECTION

BRUSHING THE TEETH.

CARD 1.

Place the side of the brush, bristles up, flat on the upper gum, as high up as possible. (Position 1.)

POSITION 1.

POSITION 2.

By turning the wrist, rotate the bristles downward over the upper gum and teeth, clear of the lower teeth and gum until the brush lies, bristles down, flat on the lower gum, as low down as possible. (Position 2.)

ISSUED BY THE EDUCATIONAL COMMITTEE OF THE ONTARIO DENTAL SOCIETY
BY COURTESY OF BOARD OF EDUCATION, TORONTO, DEPT. OF MEDICAL INSPECTION

BRUSHING THE TEETH.

CARD 2.

From Position 2, with a reverse turn of the wrist, rotate the bristles upward over the lower gum and teeth, clear of the upper teeth and gum, to Position 1 again.

POSITION 2.

POSITION 1.

Repeat these movements as often as necessary, on the outer surfaces of all the teeth, both front and back.

ISSUED BY THE EDUCATIONAL COMMITTEE OF THE ONTARIO DENTAL SOCIETY
BY COURTESY OF BOARD OF EDUCATION, TORONTO, DEPT. OF MEDICAL INSPECTION

BRUSHING THE TEETH.

CARD 3.

The inner surfaces should be brushed as carefully as the outer surfaces.

Brush the Upper Teeth Downward and the Lower Teeth Upward.

Brush the uneven grinding surfaces vigorously in all directions.

MOUTH BREATHING!

Usually Caused by

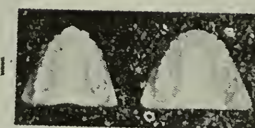
Adenoids, Enlarged Tonsils and Irregular Teeth

A Mouth-breather from Adenoids and Irregular Teeth

Adenoids Removed, Irregular Teeth Corrected, Nasal Breathing Restored

Note the dull strained expression. | Note the brighter expression.

The narrow upper dental arch and projecting front teeth produced by mouth-breathing.



Shows upper dental arch widened and the front teeth drawn in to permit lips to close.

CORRECT THE MOUTH-BREATHING BEFORE TEETH AND FACE ARE AFFECTED

EFFECT OF DECAYED TEETH

ON

PROGRESS IN SCHOOL!

Decayed Teeth and an Unclean Mouth

RESULT IN

PAIN PUS

BOLTED FOOD

INDIGESTION

INATTENTION

MALNUTRITION

EYE-STRAIN

DISEASE

THESE PHYSICAL HANDICAPS CAUSE

RETARDED

MENTAL DEVELOPMENT

THE "SIX-YEAR MOLARS."

CARD I.

They Belong to the Second Set.

These four molars come at six years, one on each side of the upper and lower jaws, just back of the last tooth of the First Set.

They are usually mistaken for teeth of the First Set.

The baby's first tooth is eagerly looked for.

IT IS MORE IMPORTANT TO LOOK FOR THE FIRST OF THE SECOND SET. THE "SIX-YEAR MOLARS."

BULLETIN 205.] OCTOBER, 1912.

Ontario Department of Agriculture.

ONTARIO AGRICULTURAL COLLEGE

DAIRY SCHOOL BULLETIN

Part I.

Cheese Making and Butter Making.

INTRODUCTION.

The supply of Dairy School Bulletin, number 172, published in May, 1909, is exhausted. It has been thought well to issue two bulletins to take its place, one for the use of farmers, and the other of special interest to cheese and butter makers.

Factorymen who are desirous of securing a copy of the bulletin published in the interests of the farmers may do so upon application to the Ontario Department of Agriculture, Toronto.

While the bulletin presented herewith is quite complete, cheese and butter makers will find additional information of value in the annual reports of the Dairymen's Associations. These reports may be secured upon application to the Department.

It is gratifying to note the hearty co-operation on the part of the makers and producers with the dairy instructors of the Province in their efforts to raise the standard of cheese, and establish uniformity. While much improvement has been made during the past few years in factory conditions and methods of work, we must be prepared to make still further advance, if we are to maintain the proud position which Ontario cheese now holds in the British markets.

THE ALKALINE SOLUTION: ITS PREPARATION AND USE.

By R. Harcourt, B.S.A., Professor of Chemistry.

Causes of Acidity in Milk. The development of acid is caused by the breaking down of milk sugar into lactic acid, through the influence of certain acid-forming ferments in the milk. But even sweet milk, immediately after it is drawn from the udder, will have an acid reaction with certain indicators. This acidity is not due to lactic acid nor any free acid in the milk, but to the acid nature of the ash constituents, possibly also to the carbonic acid gas it contains, and to the acid nature of the casein. When phenolphthalein is used as an indicator, freshly drawn milk will generally show as much as .10 per cent. of acid and immediately after exposure to the atmosphere, lactic acid germs commence breaking down the milk sugar. At a temperature of 70° to 90° F., these germs multiply at an enormous rate, consequently lactic acid will develop very rapidly in milk during a warm or sultry day or night. Cooling retards the action, but even at a temperature of 40° to 50° F. they will multiply and considerable lactic acid will be formed. Milk intended for cheesemaking should not contain more than .20 per cent. acid when delivered at the factory; where as it does not usually smell or taste sour until it contains .30 to .35 per cent. A further development of acid will cause the milk to curdle, or, in other words, will produce coagulation of the casein. There is, however, a limit to the development of acid; for, after a certain point, the germs which break down the milk sugar are destroyed by the acid they produce, and there is no further increase in acidity.

In many ways a knowledge of the acid contents of milk or its products is of value. In most cases, a determination of the percentage of acid in the milk when delivered at the factory will indicate the care the milk has received previous to that time. The acid test may be of value in selecting milk best adapted for pasteurization, or for retail trade, or manufacture of high-grade products. At the present time, however, the chief uses made of the alkaline solution in dairy work are to determine the acid in cream intended for churning, and the acid in milk and whey in the various steps in the process of the manufacture of cheese. Both in ripening cream and in cheesemaking, acid is developed, and the alkaline solution is now frequently used to measure the amount of acid present and thus control the work.

How to Measure the Acidity. The measurement of the amount of acid or alkali in a solution depends upon the fact that it always takes a definite quantity of alkali to neutralize a definite quantity of acid. Thus, for instance it always takes a definite quantity of caustic soda to neutralize a definite quantity of lactic acid, sulphuric acid, or any other acid. If, then, we know the strength of a given caustic soda solution and measure the amount of it used to render a definite amount of milk or cream neither acid nor alkaline, but neutral, we can figure the amount of acid in the sample taken. To make such a determination we require the following:

1st. A standard solution of caustic soda, usually made of the strength known as .111 normal.

2nd. An indicator—some chemical which, added to the milk, indicates by change of color when enough of the alkaline solution has been added to render the milk neutral. Phenolphthalein is the one most commonly used for this purpose. It is made by dissolving 10 grams of phenolphthalein in 300 c.c. of 80 per cent. alcohol.

3rd. A burette, graduated to 1-10 of a cubic centimeter, in which to measure the amount of the solution used.

4th. A pipette, to measure the milk or cream.

5th. A glass or porcelain cup, and a stirring rod. A complete outfit suitable for use in butter and cheese factories may now be procured from almost any of the dairy supply firms.

For the information of those who want to make their own alkaline solution or who may wish to check the strength of a solution on hand, the following directions are given:

Preparation of Solutions. The caustic soda solution may be prepared by a druggist or one who has a delicate balance at hand by carefully weighing out 4.4 grams of pure sodium hydroxide and dissolving in one litre (1,000 c.c.) of water. But impurities in the sodium hydroxide and lack of delicate enough balance make this method unreliable.

The most accurate way of preparing this solution is by standardizing it against an acid diluted to the same strength as the alkaline solution wanted. As it requires an experienced chemist to prepare this acid of the strength required, it is important that it be got from a reliable source.

Having on hand, then, a .111 normal solution of acid, the object is to make a solution of the alkali, 1 c.c. of which will exactly neutralize 1 c.c. of the acid. For this purpose, dissolve 5 grams sodium hydroxide ($NaOH$) in one litre of water. If the soda contains much carbonate, it must be removed by adding a little of a solution of barium hydroxide, boiling, and filtering off the precipitated carbonates. The relative strength of the acid and alkali solution is next determined. This is done as follows:

Rinse out a clean burette two or three times with the acid solution, and then fill it with the same. Note the exact point at which the surface of the liquid stands in the burette; measure out 10 c.c. of the alkaline solution and deliver into a clean beaker, glass or porcelain cup. Dilute with about 50 c.c. of water, add three or four drops of the phenolphthalein indicator, and then stirring all the time, let the acid from the burette drop slowly into the alkaline solution, until the color first produced by the indicator is just destroyed. This is the neutral point. Now, again note the exact point at which the surface of the liquid stands in the burette. The difference between the two readings is the amount of acid required to neutralize the 10 c.c. of alkali. If care be taken in coming to the neutral point slowly, it will be seen that one drop finally destroys the last of the light pink color. This work should be repeated until accuracy is assured. The following is an example of results:

1st. 10 c.c of alkali required 11.5 c.c. of acid for neutralization.

2nd. 10 c.c. of alkali required 11.45 c.c. of acid for neutralization.

3rd. 10 c.c. of alkali required 11.5 c.c. of acid for neutralization.

In this case, we would accept 10 to 11.5 as the relative strength of the two solutions. The alkali is, therefore, the stronger, and must be diluted. If 1.5 c.c. of water be added to 10 c.c. of the alkali solution, 1 c.c. of the alkali ought to exactly neutralize 1 c.c. of the acid. Therefore, for every 10 c.c. of the alkali solution add 1.5 c.c. of water. Measure out the amount of the solution and pour into a clean dry bottle. Calculate the amount of water required to dilute the alkali to the proper strength, and add it to the contents of the bottle. Mix well, and test correctness of work by proving that 10 c.c. of the one solution will exactly neutralize 10 c.c. of the other. If it does this, the solution is correct.

TESTING THE ACIDITY OF MILK OR CREAM. By means of a pipette (a 10 c.c. is a convenient size) measure out a definite quantity of the milk or cream to be tested and deliver into a beaker or cup. If distilled or rain water is handy rinse out a pipette once, and add the rinsings to the sample. Dilute with 50 c.c. of water, and add three or four drops of the indicator. Now, having the alkaline solution in the burette, carefully note the point at which the surface of the liquid stands in the burette and then cautiously let it drop into the cream or milk being tested. Keep the sample well stirred while adding the alkali. The acid in the sample will gradually be neutralized by the alkali added until at last a uniform pink color appears, which will slowly fade away. The most delicate point is the first change to the uniform pink color, which the sample shows when the acid contained therein has been just neutralized. Because of the influence of carbonic acid of the atmosphere the pink color is not permanent unless a slight excess of alkali solution has been added. The operator should not, therefore, be led to believe by the disappearance of the color after a short time, that the neutral point has not been reached. Having decided on the neutral point, again read the burette at the surface of the liquid, and the difference between this reading and the first is the amount of alkali solution used to neutralize the acid in the sample taken.

The calculation of the per cent. of acid is simple. The alkaline solution used is of such a strength that when a 10 c.c. pipette is used, the number of cubic centimeters of alkaline solution required to neutralize the acid in the milk or cream has simply to be multiplied by 0.1. Thus, if 5.6 cubic centimeters of the alkali be used then $5.6 \times 0.1 = .56$ per cent. acid.

To insure accuracy the utmost care and cleanliness must be observed in every detail of the work. All water used with the milk or cream or in making the alkaline solution should be either distilled or pure rain water. The burette and pipette, after being washed, must be rinsed out two or three times with the solution they are intended to measure.

The knowledge the operator may gain from such tests will not only make it possible for him to turn out more uniform products, but it will also enable him to act with confidence and more intelligently to pursue the work he may have on hand.

MILK AND CREAM TESTING.

G. Rickwood.

It is necessary to test milk in order to ascertain its commercial value. The percentages of the different constituents of milk, especially fat and casein, will differ considerably in different milks, and for this reason we must have some means of knowing the extent of this variation. If the milk is used for buttermaking, then the fat of the milk will be the index of its value, for it is the fat alone which is used for the manufacture of butter. In the manufacture of cheese, fat and casein are used, and in order to know the true value of milk for this purpose, we must know the amount of fat and casein which the milk contains. It can readily be seen that a rapid, accurate, inexpensive and reliable test would be of inestimable value to the dairyman. For testing milk-fat, the Babcock test has been found to give best results, and it is one of the necessary qualifications of a dairyman that he understand, and be able to operate this test. It is rapid, in that it only takes a few minutes to make a test. Its accuracy has been vouched for by chemists who have made analysis of milk in order to compare results obtained by the Babcock test. It is inexpensive, as the prices range from about $4 for a small size hand machine, to $25 or $30 for a large factory size machine. It is also reliable. Anyone with a little experience and using necessary precaution can obtain accurate results. The details necessary to consider in making a fat determination by the Babcock test are given briefly as follows:

1. Have the milk at a temperature of 60° to 70° F.

2. Mix the milk thoroughly by pouring it from one vessel to another, allowing it to run down the side of the vessel to prevent foaming. If the sample is not thoroughly mixed, a representative sample cannot be obtained.

3. With a 17.6 c.c. (cubic centimeter) pipette, measure this quantity of milk into a milk test bottle. To do this, suck the milk into the pipette, and quickly place the forefinger over the top to prevent the milk running out. Allow the milk to drop out until the surface of the milk is level with the 17.6 c.c. mark, which is on the stem above the bulb. Now place the tip of the pipette into the top of the bottle and allow the milk to run out slowly by removing the forefinger.

4. Add to the milk in the bottle, 17.5 c.c. of commercial sulphuric acid at a temperature of 60° to 70° F., having a specific gravity of 1.82 to 1.83. Hold the bottle slanting and allow the acid to run down the side and under the milk. Use a graduate for this purpose. It is not a safe practice to use the pipette, as the acid may be drawn into the mouth, causing severe burning.

5. Mix the milk and acid thoroughly by giving a gentle rotary motion. Do not close the neck of the bottle while mixing.

6. Place the bottles in the machine, making sure they are properly balanced, and whirl at full speed for five minutes. The speed is indicated on the machine. Do not exceed the speed so marked.

7. Add hot water at a temperature of 140° to 160° F. to float the fat into the neck of the bottle.

8. Whirl again for two minutes.

9. Remove the bottles from the tester and set in a water bath, which reaches to the top of the fat, at a temperature of about 140° F. for a few minutes before taking the reading.

Theory of the Babcock Test.

A 17.6 c.c. pipette will deliver, practically, 17.5 c.c. of milk.

17.5 c.c. at an average specific gravity of 1.032 = $(17.5 \times 1.032) = 18.06$ grams.

18 grams is the weight of the milk required for a test.

The volume of the neck of the milk test bottle between zero and 10 is 2 c.c.

2 c.c. of melted fat, at a specific gravity of .9 = $(2 \times .9) = 1.8$ grams.

The relation of 1.8 is to 18, as 1 is to 10, or 10 per cent. of the original volume of the milk. This is why that weight or volume of milk is taken and why the neck of the bottle is divided into 10 equal parts.

Notes.

1. Always make sure that the bottles and pipettes are clean before using.

2. Be careful to get the exact measurement of milk for the test.

3. If the milk is covered with thick cream, or is partially churned, it may be prepared for sampling by heating, then pouring from one vessel to another. Heating to 100° to 110° F. is sufficient for this. When it is thoroughly mixed, take the sample as quickly as possible and cool to about 60° F. before adding the acid.

4. If the sample is frozen, warm both the frozen and liquid parts and mix thoroughly. Never test a sample immediately after being drawn from the cow. Allow to stand at least one hour.

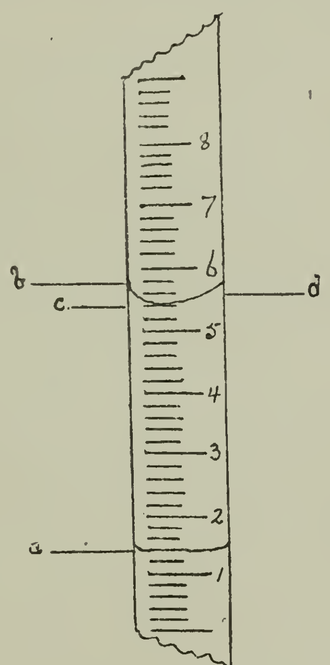
5. If the milk is sour or thickened, it is necessary to add an alkali to dissolve the casein. A small amount of strong ammonia or concentrated lye will answer, stirring and mixing it well until the sample has become liquid again.

6. The quantity of acid must vary with its strength. If it is too strong use less, if too weak use more, but if the acid is very much too weak or too strong, it should not be used. Weak acid is preferred to strong acid. Carboys or bottles containing acid should be stoppered with glass or earthenware stoppers, as the acid is very corrosive and will burn or eat stoppers made of organic material or metals.

7. Avoid pouring the acid directly on the milk. After the acid is in the bottle there should be two distinct layers—milk on top and acid underneath, with no charred material in between. Do not allow it to remain long in this condition.

8. The water added to the test bottles should be soft or distilled. If hard water is used the addition of about 8 or 10 cubic centimeters of sulphuric acid to the gallon will soften it. This will prevent foam above the fat.

9. It is advisable to use a pair of dividers or compasses for measuring the fat column. The points should be placed at the upper and lower limits of the column to get the length, and then place one point at zero and the position of the other point will show the percentage of fat in the



sample tested. The accompanying illustration will show the correct method of reading milk tests when the fat is at 130° to 140° F. Correct reading A to B, not to C or D.

10. Burnt or cloudy readings may be caused by:

(*a*) Having the temperature of the milk or acid too high.

(*b*) Using acid which is too strong, or using too much acid.

(*c*) Allowing acid to drop directly on and through the milk.

(*d*) Allowing the milk and acid to stand too long before mixing.

11. Light or cloudy readings or floating particles of curd are usually caused by:

(*a*) Temperature of milk or acid too low.

(*b*) Using too weak an acid or not enough acid.

(*c*) Careless mixing, or insufficient shaking to unite the milk and acid thoroughly.

12. The accuracy of the test bottles and pipettes used in Canada is provided for in an Act of the Dominion Parliament known as the Milk Test Act, which requires that all bottles and pipettes shall be tested for accuracy of graduation by the Standards Branch, Department of Inland Revenue at Ottawa, and that each bottle and pipette shall be marked at the time of testing with the letters G.R. (or first letter of reigning Sovereign) inside the Crown, thus: | G.R. |.

13. Carefulness and exactness are absolutely essential in every detail if accurate results are to be obtained in milk testing.

14. Sulphuric acid weighs about 18 lbs. to the gallon and costs 2½ to 4 cents per lb. A gallon will make 250 to 260 tests.

Composite Samples.

A composite sample is a sample composed of a number of smaller samples taken from the same source at different times and kept by use of preservatives, the object being to obtain an average test of the number of smaller samples without the labor and expenses involved in the testing of each lot separately. This method is used by cheese factories and creameries, and by Cow Testing Associations. In creameries and cheese factories a small sample is taken from each daily delivery of each patron and kept in bottles, one for each patron. Several kinds of preservatives are used, the most common being a mixture of seven parts of Potassium Bichromate to one part of Mercuric Bichloride (Corrosive Sublimate). Potassium Bichromate may be used alone if the samples are not to be kept longer than two weeks, enough being added to give the milk a lemon yellow color. If the mixture is used, it will require as much as will lie on a ten cent piece to preserve a pint for one month. Corrosive sublimate may be used, but it is rather dangerous, as it does not give any color to indicate that the milk contains poison. Formalin is sometimes used, about 20 drops (1 c.c.) per pint of milk, but it also is colorless. Tablets are now being prepared and sold by the Dairy Supply Houses, which may be used with excellent results. The amount of preservative used will depend to a certain extent upon the condition and size of the sample and the length of time over which the testing period extends, and also the manner in which it is treated. At the end of the period the mixture of samples may be tested with the Babcock Test, and if the work of sampling has been done properly the test should be an average percentage of the fat in the different lots of milk.

Notes on Composite Sampling and Testing.

1. Pint or half pint milk bottles stoppered with cork or rubber stoppers answer fairly well for composite sample containers, although bottles fitted with glass stoppers are preferable, as they are not so likely to carry mould spores into the milk

2. The bottles should be kept tightly stoppered to prevent evaporation of the moisture, which will cause the test to be too high.

3. Better results can be got by keeping the bottles in a cool place and out of direct sunlight.

4. It is absolutely necessary that each bottle should have a distinguishing mark—either name or number. Stove pipe, or bicycle enamel, answers very well for the purpose. Paint is not so lasting. Another method is to write the name or number on a gummed label, stick it on the bottle, and coat it over two or three times with shellac, or the glass may be roughened with a whetstone or file, and the number written on with a lead pencil.

5. Place the preservative in the bottle before any milk is put in. It may be necessary to add a little more later if the sample shows indication of spoiling. Avoid using too much preservative as it hardens the casein in the milk, making it difficult to test and oftentimes causing a burnt or charred reading.

6. The sample for the composite jar should be taken after the milk has been poured in the weigh can. An ounce or half ounce dipper is often used for this purpose. A sampling tube, or milk "thief," is also very satisfactory. It is very difficult to accurately sample frozen milk, and patrons should be warned against sending milk in that condition.

7. Each time a fresh sample is added, the jar should be given a gentle rotary motion to mix the cream and the fresh milk with the part containing the preservative. Avoid shaking the jar violently, as that has a tendency to churn the contents.

8. To prepare composite samples for testing, heat the sample to 105° to 110° F. by placing in warm water, to loosen the fat adhering to the sides of the bottle, then mix thoroughly by pouring. Take the sample quickly and place in the test bottle. Set the test bottle in water at 60° to cool the milk before adding the acid. Strict attention paid to this point of cooling will usually prevent burnt readings. Sulphuric acid appears to act more strongly on samples containing preservatives, therefore it is advisable to use slightly less acid. If difficulty is experienced with burnt readings caused by an excessive amount of preservative, it is recommended to add the hot water at two different times, filling to the bottom of the neck of the bottle and whirling one minute and then filling to about the 8 per cent. mark and whirling again for another minute.

9. To find the correct average test of the milk from a herd of cows, find the total pounds of fat and total pounds of milk, multiply the pounds of fat by one hundred and divide by the pounds of milk. There is often considerable difference between the correct average test found in this way and the test obtained by adding the different tests together and dividing by the number of cows tested.

Example:

Correct Average Test.

Cow No.	1—340 lbs. milk,	testing	4.3 per cent.	=	14.62 lbs. fat.
" "	2—460 " "	"	4 "	=	18.40 " "
" "	3—760 " "	"	3 "	=	22.80 " "
" "	4—620 " "	"	3.5 "	=	21.70 " "
Total....	2180 lbs. milk				77.52 lbs. fat.

If 2180 lbs. milk contain 77.52 lbs. fat,

then 100 lbs. milk (per cent. = 100) $\frac{100 \times 77.52}{2180} = 3.55$ per cent.

Incorrect Average Test.

$4.3 + 4 + 3 + 3.5 = 14.8$, divided by number of cows $= \frac{14.8}{4} = 3.7$ per cent.

Cream Testing.

The percentage of fat in cream can be obtained as easily and as accurately by the Babcock Test as the percentage of fat in milk, and this is one reason why the Oil Test is being replaced by the Babcock Test in cream gathering creameries.

Cream test bottles with specially graduated necks to contain 30, 40, or 50 per cent. of the quantity taken are used.

The same weight of cream as of milk is necessary, namely, 18 grams, but since cream has less specific gravity, or is lighter, than milk, due to the larger proportion of fat, it is necessary to use more than 17.6 cubic centimetres. Sweet cream testing 25 per cent. fat has a specific gravity similar to that of water, so that if an 18 c.c. pipette is used, and the pipette is rinsed with a small quantity of water, the weight of the cream will be nearly 18 grams. Very rich cream, ripe, or gassy cream, or fresh cream from the separator, cannot be measured with an 18 c.c. pipette and have 18 grams in weight. It is therefore necessary to weigh such cream to get accurate samples. Several satisfactory cream scales are on the market. The Torsion, Fairbanks, and Philadelphia are classed among those giving satisfaction.

No definite amount of sulphuric acid can be given for testing cream, as some samples seem to require more than others in order to get satisfactory results, but as a rule less than 17.5 c.c. are required. A good guide is to notice the color of the mixture of cream and acid. It should be a dark chocolate color, but not black.

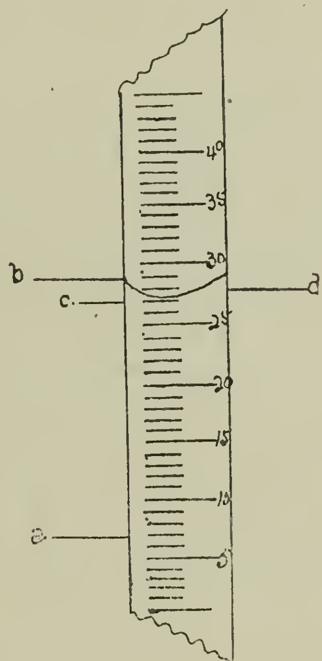
In milk testing the bottles are whirled for 5 minutes before adding the water, but in cream testing this is not practised, as it usually results in cloudy readings.

The usual method is to add hot water immediately after mixing the cream and acid and whirl for five minutes; or better still, add the water at two different times, filling up to the neck of the bottle and whirling

4 minutes, and then filling nearly to the top and whirling again for 2 minutes. The fat column should be a bright, golden color.

Cream tests should be read at a temperature of 130° to 140° F., and the fat measured to the bottom of the meniscus or curve at the top of the column. Errors due to expansion of fat amount to from one-half to one per cent., if the reading is taken immediately after whirling in a steam tester.

The accompanying illustration shows the correct methods of reading a cream test in a 6-inch gram bottle. Correct reading A to C, not to B or D.



Composite samples of cream are made and cared for similar to those of whole milk, but the sample for the composite bottle needs to be taken with greater care and accuracy.

The variation in the percentage of fat and the variation of the pounds of cream cause a wide range in the commercial value, therefore it is necessary to take a proportionate, or aliquot, sample as well as a representative sample.

This is done very easily where the cream comes to the creamery in individual cans, by using a sampling tube, or a graduated pipette, and taking one cubic centimetre for every pound of cream delivered. Where the haulers take the sample at the time of collecting the cream, it is rather difficult to carry out this principle, and some buttermakers relieve the hauler entirely of this responsibility, and only ask that they take a representative sample, the buttermaker taking the proportionate sample from this when it arrives at the creamery.

The following tests show a comparison of weighed and measured tests from monthly composite samples:

Measured.	*Weighed.*	*Measured.*	*Weighed.*
17.5 p.c. fat.	18 p.c. fat.	33.5 p.c. fat.	34 p.c. fat.
18.5 " "	19 " "	34 " "	35 " "
22 " "	22.5 " "	37 " "	38 " "
28 " "	29 " "	36.5 " "	37.5 " "
29.5 " "	30.5 " "	41 " "	42.5 " "

The Oil Test.

This means of ascertaining the butter value of cream is still employed in a few sections. It is simply a churning process.

The cream collector is supplied with a pail 12 inches in diameter in which the depth of the cream supplied by the patrons should be carefully measured. After thoroughly mixing the cream the collector should take a representative sample, filling the test tubes carefully to the mark, which should be five inches from the bottom.

To Make an Oil Test. Upon arrival at the creamery, set the samples in a warm place, as over the boiler, and leave over night to ripen thoroughly. They will not churn properly unless well ripened.

The next morning, place the samples in water at a temperature of about 90° F., and as soon as the cream will flow freely from one end of the tube to the other, place in the oil test churn and begin churning. Should the cream at any time cool and thicken, place the samples in warm water to liquefy the cream again. Continue churning until there is evidence of a clear separation of the fat, then place the samples in hot water, at a temperature of from 160° to 170°, for from fifteen to twenty minutes.

If the separation be complete, the fat will be clear and yellow, and there will be three distinct columns with sharp lines of division between them, viz., a column of clear fat on top, one of whey next, and one of curdy matter at the bottom. If there be not a clear separation, cool to about 90 degrees, churn again and proceed as before.

To Take a Reading. There is a chart prepared for the purpose. Place the bottle in an upright position on the "base line" of the chart, move it along until, when looking by the right side of the bottle, the top of the column of fat comes even with the uppermost slanting line on the chart. Next, still looking to the right side of the bottle, observe the line to which the bottom of the fat comes; the number on this line gives the reading.

A small rule made specially for this purpose is more convenient than a chart. This, however, will give a correct reading only when the test-tubes have been filled precisely to the mark. The chart consists of a sliding scale, and gives the proportion of oil regardless of the depth of cream taken or the diameter of the test-tubes.

Sometimes the fat, though clear, is somewhat open. In such cases, or when the fat is not clear, allow the samples to become cold, and then place in water at a temperature of about 120 degrees F. before taking a reading. About 120 degrees F. is a very suitable temperature at which to take readings.

MEANING OF THE READING. Cream that gives a reading of 100 in the oil test will make one pound of butter for every inch of such cream in a cream pail 12 inches in diameter; cream testing 120 will make 1.2 pounds of butter per inch. To find the pounds of butter, multiply the number of inches by the reading and divide by 100.

THEORY OF THE TEST. A standard or creamery inch is one inch of cream (in a 12 inch pail) testing 100.

One inch, therefore, contains 113 cubic inches. One pound of butter contains about 25 cubic inches of butter oil, which is 22 per cent. of 113. Therefore, any cream which will yield 22 per cent. of its volume in butter oil will yield one pound of butter per inch. Tubes filled to the depth of five inches with cream which gives 1.1 inches of butter oil will yield one pound per inch, as 1.1 is 22 per cent. of 5.

A reading of 100 by the oil test would, therefore, theoretically, be equal to 22 per cent. of fat.

DISADVANTAGES OF THE OIL TEST.

1. It places a premium on sour cream by measuring in the pail, because the sour cream occupies greater bulk than sweet cream.
2. More time, labor and expense is involved by churning every sample at each delivery.
3. The difference in churnability of the various samples makes it difficult to get good results.
4. The chart is graduated to read in tens, so that the test of the cream must be read in tens, although the correct reading may be between.
5. The amount of cream is measured, while in the Babcock test it may be accurately weighed.
6. It is very difficult to have the number of pounds of butter shown by the chart and the churn results agree.

SKIM-MILK, BUTTERMILK OR WHEY.

As the percentage of fat in skim-milk, buttermilk and whey is usually very small, the best method of testing these is by the use of the double-neck test bottle. There are several different kinds of double-neck bottles in use, but those having the two necks joined together, and extending perpendicularly from the centre of the bottle, seem to give best results, as they are much stronger and less liable to give burnt readings.

The latest form of double-necked bottles are graduated to read in hundredths of one per cent. up to twenty-five hundredths, and the manufacturers claim that it is not necessary to add anything to the reading. The difficulty that was often encountered by having the contents foam and bubble over has been largely overcome by having a vent put in the tube in the bulb of the bottle. This also aids in emptying.

17.6 c.c. of skim-milk, buttermilk, or whey are taken into a test bottle and the test is completed in the usual way. Very fine readings can be taken, as a small amount of fat can be made to extend over a long space in the small neck. Considerable difference of opinion exists amongst authorities on milk testing with regard to the correct method of reading the double-neck bottle; but chemical analyses indicate that the addition of 0.5 to the Babcock reading would give the most accurate results.

The fat column in the small neck can be raised or lowered slightly to assist in getting accurate readings by pressing the finger gently on the top of either neck.

It is recommended to use a little more than 17.5 c.c. of acid in testing skim-milk; also to turn the tester a few revolutions faster per minute, and whirl for a longer time. Whey does not contain such a large percentage of solids as milk, and usually about 10 c.c. of acid are sufficient to cause a clean separation of fat.

The whole-milk bottle is not suitable for testing skim-milk, buttermilk, or whey, as it is almost impossible to make an accurate reading of such a small amount of fat when it is extended over a broad surface. However, the milk test bottle might be used to indicate whether or not much fat is being lost.

Testing Cheese for Fat.

1. Obtain a representative sample by cutting a slice from the outside to the centre of the cheese, or by taking plugs from different parts.
2. Cut the sample as finely as possible and weigh 2 grams or 5 grams into a milk-test bottle, or 9 grams into a cream bottle.
3. Add sufficient warm water at a temperature of 120 degrees F., to make about 18 grams in the bottle.
4. Keep the sample warm and mix occasionally, until the cheese and water form an emulsion.
5. Measure 17.5 c.c. of acid. Add a little at a time and continue mixing until the curd is all dissolved.
6. Sometimes, slightly more than 17.5 c.c. of acid are required for a test. Sufficient has been used when the mixture turns a dark chocolate color.
7. The hot water may be added before whirling in the tester.
8. To find the per cent. fat multiply the reading by 18 and divide by the number of grams used. For example: 5 grams give a reading of 8.5, the percentage of fat in the cheese $= \frac{8.5 \times 18}{5} = 30.6$.

Babcock Test for Butter.

1. Secure a representative sample of butter and place the vessel containing the butter in a tub of water at 100° F., and stir until the butter becomes a thin paste.
2. Weigh 4.5 grams or 9 grams into a cream bottle.
3. Add enough water at 70° F. to make 18 grams.
4. Add 17.5 Sulphuric Acid and mix thoroughly.
5. Continue the test the same as a test for cream.
6. Per cent. of fat $= \dfrac{\text{Reading} \times 18.}{\text{No. of grams used.}}$

Example. 4.5 grams butter taken.
Reading = 22.
Per cent. fat=22×18÷4.5=88 per cent. fat.

The Lactometer and the Detection of Adulterations in Milk.

The lactometer is a special form of hydrometer used to determine the specific gravity (sp. gr.) of milk. The term specific gravity means the weight of a certain volume of any liquid or solid substance compared with the weight of the same volume of pure water at 4° C.

There are different kinds of lactometers, but the Quevenne is the most suitable for milk-testing. By means of it we can determine rapidly the relative weights of milk and water.

The Quevenne lactometer is standardized at a temperature of 60° F.; if the milk to be tested varies from this, corrections may be made according to the following rule: For each degree in temperature *above* 60, add .1 ($\frac{1}{10}$) to the lactometer reading, and for each degree *below* 60, subtract .1 ($\frac{1}{10}$) from the lactometer reading. This rule is practically correct, if the temperature is kept within a range of from 50° to 70° F. It can be readily recalled when we remember that the density of milk *increases* with a *reduction* of temperature and decreases with a rise in temperature. The scale on the lactometer is graduated from 15 to 40, and indicates a specific gravity of from 1.015 to 1.040.

Note. The correct lactometer reading (or L.R. at 60° F.) + 1,000 ÷ 1,000 indicates the specific gravity.

The lactometer reading of whole milk usually ranges from 29 to 34, although it may fall as low as 27, or go as high as 35. The lactometer reading of skim-milk varies from 33 to 38. The reading should be taken soon after placing the instrument in the milk; if cream be allowed to rise on the milk, the reading will be too high, and the bulb of the lactometer will be floating in partially skimmed milk. Milk should be cooled and allowed to stand some time (one to three hours) after being milked before taking the lactometer reading. Otherwise the readings will be too low.

The composition of milk is about as follows:

Fat	3.6	per cent.	
Casein	2.5	"	8.9 solids not fat.
Albumen	.7	"	
Sugar	5.0	"	
Ash	.7	"	
Water	87.5	"	
	100.00		

It is the solids not fat in milk that cause its specific gravity to exceed that of water, and consequently its lactometer reading to be greater, as the percentage of solids not fat increase.

A number of different rules have been prepared for the calculation of milk solids when the lactometer reading and the percentage of fat are known. Of these, the following has been quite generally adopted. To find the per cent. of solids not fat in a sample of milk, add two-tenths of the per cent. of fat to one-quarter of the lactometer reading; and to find the per cent. of total solids add one and two-tenth times the per cent. of fat to one-quarter of the lactometer reading.

The following rule also is sufficiently accurate for practical purposes and has simplicity to recommend it. To determine the per cent. solids not fat, add the lactometer reading at 60 degrees and the per cent. of fat together and divide by four (4). Example: L. R. = 32, Fat 4% $\frac{32+4}{4} = 9\%$ S.N.F.

Adulterations.

By the use of the Babcock test in conjunction with the lactometer, we are enabled to determine both the nature and the extent of an adulteration.

The percentage of fat in milk varies and can also be influenced by skimming, therefore the lactometer alone is of little use in determining adulterations. The solids-not-fat are fairly constant, and thus afford a means of detecting adulterations.

Watered Milk. To find the per cent. of pure milk in a watered sample, multiply the per cent. S.N.F. in it by 100 and divide by the per cent. S.N.F. in the pure milk. This subtracted from 100 will give the per cent. of extraneous water in the watered sample. To take an example:

The per cent. of solids-not-fat in a sample of pure milk is 9; but after being watered the per cent. of solids-not-fat in the watered sample is 7.2. Find the per cent. of pure milk in the watered sample.

Per cent. of pure milk in watered sample, $\frac{7.2+100}{9} = 80$ per cent.

Per cent. of extraneous water = 100 — 80 = 20 per cent.

Note. When a sample of pure milk cannot be obtained, use 8.5 in the early part of the season, and 9 in the latter part, for the per cent. S.N.F. in pure milk.

The per cent. of *water added to the pure milk* may be estimated as follows: The per cent. S.N.F. in a pure sample, multiplied by 100, divided by the per cent. S.N.F. in the watered sample, less 100. The above may

$\left(\frac{9 \times 100}{7.2}\right)$—100 equals 25 per cent. water added, or

be worked out as follows:

To 80 lbs. pure milk, 20 lbs. water were added, then to
1 lb. pure milk, $\frac{20}{80}$ lbs. water were added.
To 100 lbs. pure milk, $\frac{20}{80} \times \frac{100}{1}$ lbs. water were added,
equals 25 lbs. water added to 100 lbs. milk, or 25 per cent.

Notes.

1. Have the temperature of the milk uniform throughout, and as near 60° F. as possible when taking the lactometer reading.

2. Always mix the milk well before taking a lactometer reading.

3. Do not have milk on the upper part of the stem of the lactometer when reading, as this weighs the lactometer down and causes the reading to be too low.

4. Have the lactometer free from the side of the vessel, and perfectly still when taking a reading.

5. A high lactometer reading accompanied by a low per cent. of fat indicates skimming, *e.g.*, L. equals 34, F. equals 2.4.

6. A low lactometer reading accompanied by a low per cent. of fat is indicative of watering, *e.g.*, L. equals 22, F. equals 2.4.

7. A normal lactometer reading with a very low per cent. of fat indicates both watering and skimming. Also, if the lactometer reading of a sample of milk be low, yet not so low accordingly as the per cent. of fat, this is indicative of both watering and skimming. Both of the following indicate watering and skimming; L. equals 31, F. equals 2; L. equals 26, F. equals 1.8.

The Hart Casein Tester.

This is a simple test for determining the casein content of milk. The test has been introduced by Dr. E. B. Hart, of the Wisconsin Experiment Station, and its development and use is likely to prove of considerable value to the cheese branch of the dairy industry. No more ability or skill is required to make a casein test than is necessary in making a Babcock test for fat, and the test can be completed in a few minutes.

The principles involved in this method as outlined by Dr. Hart are:

1. The construction of a special bottle with a graduated scale whereby the percentage of casein can be read when a definite volume of milk is used for a test.

2. The precipitation of the casein by dilute acetic acid.

3. The agitation of the precipitate with chloroform to dissolve the fat.

4. The application of a definite centrifugal force in order to mass the casein into a pellet.

5. Reading the per cent. of casein.

The details connected with the determination of casein are briefly as follows:

1. Measure 2 c.c. of chloroform into the test bottle.

2. Add to this 20 c.c. of a .25 per cent. solution of acetic acid at a temperature of 70 degrees F.

3. Measure accurately 5 c.c. of sweet milk at a temperature of 70 degrees.

4. Place the thumb over the opening of the bottle, turn the bottle over by rotating the hand and shake the contents vigorously for fifteen to twenty seconds.

5. Place the tests in the centrifuge and whirl for 7½ to 8 minutes at a speed of 2,000 revolutions per minute for a 15 inch diameter machine.

6. After whirling, allow the tests to remain for ten minutes to allow the pellets to relax slightly, before taking the readings.

Notes on the Casein Test.

1. Use only the best quality of chloroform.

2. See that the temperature of the milk and acid is as nearly 70 degrees F. as possible.

3. Use a watch to take the time in shaking the test and do not mix more than 20 seconds.

4. Make sure that the speed of the tester is correct. It is advisable to use a metronome for this purpose when the whirling is done by hand power.

5. Curdled samples of milk cannot be tested for casein.

6. Composite samples preserved with bichromate of potash for from three to four days can be tested more or less satisfactorily, but samples containing other preservative and those with bichromate of potash which are kept for a longer time, do not appear to give reliable results. Therefore, the test will need to be improved in this particular before it will be suitable for factory conditions.

7. A comparison of the results of the Casein Test with those of chemical analysis, conducted at the Ontario Agricultural College during the summer of 1908, shows the casein test to be quite accurate. The average percentage of fat in 22 samples of sweet milk was 3.72. The average percentage of casein in these samples as determined by the Hart method was 2.395, and by a chemical analysis 2.415—a difference of only .02 per cent.

BOILERS, ENGINES, STEAM-FITTING.

GEO. TRAVIS.

Of all the apparatus necessary for the manufacturing of cheese and butter, the steam boiler seems to be the most essential. From it we get steam power for operating the other machinery, and steam for regulating the temperature of the milk and cream, and for other heating purposes as well; hence the selection, setting and care of the boiler, coupled with the construction of the arch and chimney so as to get the best results from the economic viewpoint, are matters of great importance to cheese and butter manufacturers.

Selecting a Boiler.

When selecting a boiler, get one of sufficient capacity to furnish all the steam required without forcing the fire under it. A boiler cannot be forced beyond its capacity without injuring it. There would also be a waste of time and fuel forcing a steam boiler.

Setting Boiler.

In setting a boiler a good substantial foundation for the arch or furnace should be provided. The arch is really a part of the boiler and unless it is properly built, good results cannot be obtained.

It is best to get a plan for building an arch from some reliable boiler maker. Then have the masonry done by an expert. Provide good fire brick for lining and have them laid with fire clay. Make the side walls of the arch thick with good common brick. This will make it more substantial and retain the heat longer, thus lessening the cost of fuel.

Chimney.

Where coal is being used for fuel the chimney should be built of brick. The area should be at least one-fifth greater than the combined area of all the flues. The height depends largely upon its location—the higher the better.

Firing the Boiler.

Boilers newly set should not have fires put under them until the mortar of the brick work has had time to harden naturally. When fire is started, heat very slowly and let the steam go through all the pipes before any pressure is put on them.

Care of Boiler.

Before lighting the fire in the morning, care should be taken to see that the boiler has sufficient water in it. The glass gauge in the water column cannot always be depended on at sight, therefore it is best to open the tap at the bottom of the glass to make sure that the pipes leading to, or from it, are not stopped with scale or mud. See that the safety valve is in working order. This is the most important valve in connection with the boiler. Every boiler should have a blow-off pipe at the bottom. In addition to this, it should have a surface blow-off or some "scumming" apparatus. Nearly all foreign matter held in solution in water on first becoming separated by boiling, rises to the top in the form of what is commonly called "scum," in which condition much of it may be removed by the surface blow-off. If not removed, however, the heavier particles will be attracted to each other until they have become sufficiently dense to fall to the bottom, where they will be deposited in the form of scale, covering the whole internal surface of the boiler below the water line, with a more or less perfect non-conductor of heat. Where the water is very hard, some good boiler compound may be used with good results. Different waters require different treatments. For ordinary water "sal soda" is all that is necessary.

The blow-off at the bottom should be opened enough each day to let any lime or mud that might have accumulated, escape. If this is not done, there is danger of the pipe being filled with dirt, thus excluding the water from the pipe. Then there is a danger of it becoming hot and bursting, causing a great deal of trouble.

If the pipe from the pump or injector which feeds the water into the boiler be attached so that the water will be fed in through the blow-off pipe, this danger will be largely overcome.

Pipe Fitting.

As there are also more or less steam pipes about the factory that need repairing, it is quite necessary that the maker should know how to do his own pipe fitting.

For ordinary work the tools required are, pipe, tongs, cutter, vise, and stock and dies. With these at hand any pipes or joints that may be leaking can be quickly repaired and will save the expense of sending out for a steamfitter. Steam escaping from bad joints or leaking valves makes a disagreeable noise, and money is evaporating into the air.

Engines.

The engine bed or foundation should be solid. If possible have the engine in a room separate from the boiler, as there is always more or less ashes and dust from the furnace and flues. This makes it difficult to keep clean. Any sand or grit lodging on the slides help to wear them out sooner than it otherwise would.

Some of the chief points to be observed are: See that it is kept clean, well oiled, and properly packed to prevent steam from leaking.

Before starting the engine, open the taps of the cylinder to let the water out, turn the fly-wheel over once, then open the throttle valve gradually until the engine gets in full motion.

Pulleys and Belting.

The following rules for finding the size of pulleys and the required length of belting will be found useful in fitting up a creamery or in placing additional machinery.

To find the diameter of a driven pulley, multiply the diameter of the driver by its number of revolutions, and divide the product by the number of revolutions the driven pulley should go. The result will be the diameter of the driven pulley.

Example. Diameter of pulley on the engine, 40 inches; speed of engine, 160 revolutions; speed in main shaft, 200 revolutions: $40 \times 160 \div 200 = 32$, which is the diameter in inches required for the driven pulley.

To find the required size of a driving pulley, multiply the diameter of the driven pulley by the number of revolutions it should make, and divide the product by the revolutions of the driver.

Example. Diameter of the pulley in intermediate is 4 inches, which is required to run 900 revolutions per minute; revolutions of shaft, 200: $4 \times 900 \div 200 = 18$, which is the diameter in inches of the pulley required to drive the intermediate at proper speed.

To find the length of belt for any two pulleys, add the diameter of the two pulleys together, divide this sum by 2, and multiply the quotient by $3\frac{1}{4}$. Add the product to twice the distance between the centres of shafting, and the result will be the required length of belt.

Example. Two pulleys are 8 and 24 inches in diameter, and 8 feet is the distance between the centres of shafting. $8+24=32$, $32\div2=16$, $16\times3\frac{1}{4}=52$ inches=4 feet 4 inches, and 4 feet 4 inches + 16 (twice the distance between the centres and the shafting)=20 feet 4 inches, which is the length of the belt required.

Rules. To find the circumference of a circle multiply the diameter by 3.1416. To find the diameter of a circle, multiply the circumference by .31831. To find the area of a circle multiply square of diameter by .7854. Doubling the diameter of a pipe increases its capacity four times.

SEPARATORS AND THE SEPARATION OF MILK.

GEORGE TRAVIS.

Factory or power separators may be divided into two classes—the steam or turbine, and the belt machine. A book of directions is furnished with each new separator, therefore general directions only can be given.

Turbine Separator.

In setting it up, a solid foundation should be provided. It does not matter how solid a wooden floor is, it will vibrate more or less from the running of a churn or other machinery. With a stone, brick or cement foundation a separator is independent of any vibration from other machinery and will run much better, and for a longer time. If setting the separator on a cement floor probably the most permanent method of fastening it down is as follows: First mark the exact location for the holes. With a square draw a line through the centre where the holes should be, then drill the cement to the desired depth (6 to 7 inches). To do this a common cold-chisel may be used providing the bit is wide enough for the body of the chisel, though a pointed chisel for this purpose is preferable. The dust may be removed from the hole while drilling by a small bellows, or blowing through a small rubber or glass tube. Have the bolt head somewhat rounded and place the bolt in the hole with the threaded end up, making sure to have it perpendicular and in line, and the necessary height above the floor, then pour melted lead in the hole around the bolt. If a method is desired whereby the bolts can be removed from the floor, drill holes as above, plug with wood, bore with a bit at least one-eighth of an inch smaller than the lag screws used and fasten down with lag screws. Another method whereby separators may be changed without drilling new holes is to drill the holes in the cement nearer to the centre than any separator will be likely to require, fasten a 2 inch by 4 inch piece of wood to the floor and bolt the separator to it.

In putting down a cement floor to be used for separators, it is well to have a pier built about two inches higher than the floor and about the size of the separator base. This tends to prevent dirt from lodging under the separator when scrubbing the floor.

If a stone or brick pier (bricks are neatest) has to be built, the nature of the soil will determine the depth to excavate, and the size of the frame or base of the separator will determine the length and breadth. The exact specifications are given in the book of instructions furnished with the separator.

Place the separator in position, being careful to have the separator frame perfectly level every way. Determine this by placing the spirit level upon the planed top of the frame.

The pipe to convey the steam to the separator may be the same size as the fittings of the separator, provided the distance from the boiler is not over twenty-five feet. When the distance is more than this, the size of the pipe should be one-quarter inch larger for every twenty-five feet of piping, to overcome the effects of friction and condensation of steam.

Exhaust pipes are usually made of galvanized iron, and should never be reduced in size at any point smaller than the outlet on the separator, and should be put up as straight as possible to convey the steam from the separator. It may be carried out at the side of the building. In either case, a piece extending upwards should be put up to cause a draught. Placing the exhaust pipe out through the roof is preferable when the surroundings will permit it. Have the pipe long enough to be higher than any part of the roof, in order that the draught may not be interfered with by change of wind. A drain pipe must be provided in any case at the lowest point on the pipe, to allow water to escape readily. If this should be in the making-room, a trap to prevent annoyance from escaping steam may be put on the drain pipe.

Belt Separator.

The directions given for the foundation of a turbine will apply to this. First place the intermediate or jack in position. This should be at an angle of at least 45 degrees in front or behind the driving shaft. Level it by placing a level perpendicularly on the planed rim of the separator pulley of the intermediate. Be sure to have the shaft of the intermediate parallel with the driving shaft.

The pulley provided for the driving shaft should be of sufficient width to allow the belt to be shifted from the tight to the loose pulley of the intermediate, and of the proper size to give the exact speed required.

Next place the frame of the separator in position. Level it in all directions by placing the level on the planed top of the frame. Line the separator with the intermediate, so that looking from the intermediate the right hand edge of the small pulley of the separator is in line with the right side of the large pulley of the intermediate, having the vertical centre line of the spindle level with the under side of the intermediate pulley.

The separator bowl should revolve to the right, or with the sun, the same as the hands on a watch. The intermediate should run from the separator, so as to place the draw belt on the upper side of the intermediate pulley, with a view to remove some of the weight of the bowl from the foot-step bearing when the separator is running. If an idler or belt-tightener is used, always place it on the "return" side of the belt—*never* on the "draw" side.

Do not use the belt tightener any more than is absolutely necessary, as it shortens the life of the belt very materially. It would be an improvement if the intermediate could be adjusted to suit the stretching of the separator belt.

Wipe all the bearings well with a cloth, to remove all grit and dust. A little coal oil upon the cloth will be found helpful where any coating of dried oil is met with. See that all oil tubes are clear and free to feed oil. Wash the bowl and all parts that the milk comes in contact with. If everything has been properly attended to as directed it is ready to start. If a turbine, turn on steam very gradually to allow the water to get out of the steam pipes, when the required amount of steam may be turned on. When speed has been reached, start the feed of milk.

If a belt machine, and only one in use, put all belts in position, and start the engine slowly, allowing the speed to increase gradually. If more than one separator is used, it is better to start the engine at full speed, then shift the belt from the loose to the tight pulley after starting the separator by pulling the belt with the hand until the bowl has attained some speed. Then shift the belt from the loose pulley part way on to the tight pulley, moving it at intervals until on full. From 6 to 10 minutes should be required to get up speed. Full speed is ascertained by means of speed indicators. A 100 notch wheel should be counted for one minute, and a 50 notch wheel for one-half a minute, in order to know the number of hundred revolutions the bowl is revolving per minute. After speed has been reached, the milk should be turned on full speed, until both cream and skim-milk flow from the respective spouts; then it should be closed off until the cream is of the desired thickness. The cream should be the guide in operating the separator.

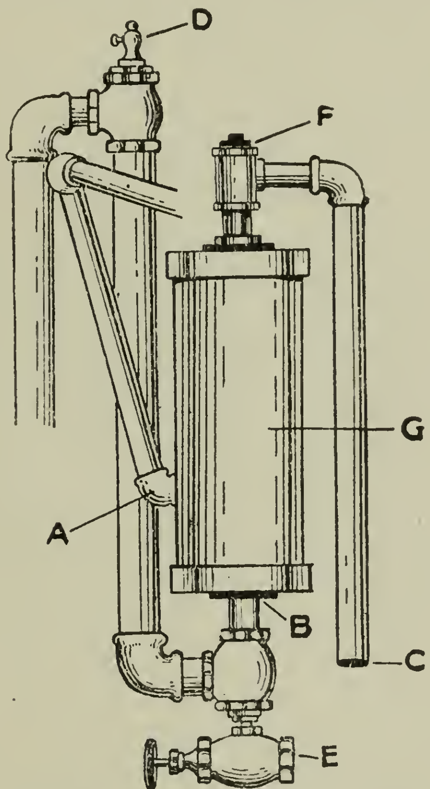
The cream left in the bowl when all the whole milk has been put through should be forced out with warm water. From one to two pails will be needed for this purpose. Shut off the feed-tap for a few seconds when about half the quantity has gone through; then turn it on again, allowing the remainder to complete the operation. Pure warm water is preferable to skim-milk, as it is nearer the specific gravity of the cream, and consequently displaces it more readily.

Allow the bowl to stop of its own accord after the power has been removed; never apply any brake or friction to the intermediate. Remove the solid matter found at the extreme outside of the bowl and burn it at once. Clean out all milk tubes with the spiral provided; wash with tepid water thoroughly; scald with steam or boiling water; then place on a draining rack where the bowl and its parts may dry. Never close the bowl when wet inside, as it will cause it to rust. Leave it open when not in use so it will be thoroughly dry.

In ordering the parts for the separator always specify exactly what is wanted by the use of the proper name and number of the same. This can be found by consulting the book of instructions furnished with all machines. A duplicate set of the delicate or wearing parts of any machine should be kept on hand for emergencies.

Milk fresh and warm from the cow is in the best possible condition for a perfect separation. The difference in specific gravity between the fat and other portions of the milk is then greatest, and it is also more fluid, as there is no development of lactic acid, nor chemical changes due to its exposure to the air. At the creamery, it is not met with in this favorable condition; consequently it is necessary to produce artificially as many of the favorable conditions as possible to get the best results. When milk is received at a temperature below 85° it should be heated to from 90° to 100°.

A tempering vat should be elevated at a suitable height to allow the milk to flow into the separator; and it should contain enough milk to employ the separator for at least four minutes. If large bodies of milk are heated to the desired temperature in a vat before separating, acid develops too rapidly and clogging of the separator bowl is likely to follow.



Skim-milk or whey pasteurizer.

A. Milk inlet 1¼" pipe. B. Steam inlet. C. Overflow 2". D. Small valve on steam pipe to prevent suction of skim-milk back into steam pipe. E. Valve to drain heater. F. Plug which may be removed in order to see if heater is filling with material from skim-milk. G. Heater 6" diameter, 18" long with caps screwed on each end.

Should any accident happen whereby the separator is stopped, the milk would likely develop acid enough to thicken, when it could not be separated.

While it is doubtless true that better butter can be made by pasteurizing the whole milk before separating, still the improvement is not enough to compensate for the extra labor required in cleaning the separator and utensils. There is also the fact that the separator bowl will need to be retinned often if separating pasteurized milk.

If the skim-milk is to be pasteurized after being separated, it may be elevated by a pump, and just before entering the tank, allowed to pass through a heater used for pasteurizing.

The cut will show how the heater may be made. A union should be put in the steam pipe somewhere near the heater, as it will be necessary to take the heater apart quite often to be cleaned. This can be done best by burning in the furnace.

For dividing the skim-milk among patrons, the skim-milk weigher is found to be quite satisfactory.

CREAMERY BUTTERMAKING.

M. ROBERTSON.

Owing to the fact that the greater number of our creameries are operated on the cream-gathering system, this part on buttermaking will pertain altogether to the above-mentioned system of operating a creamery. To those interested in the care of milk for whole milk creameries, we would refer them to "Care of Milk" for cheesemaking, which is discussed in this bulletin. The same directions would apply to milk for creamery supply.

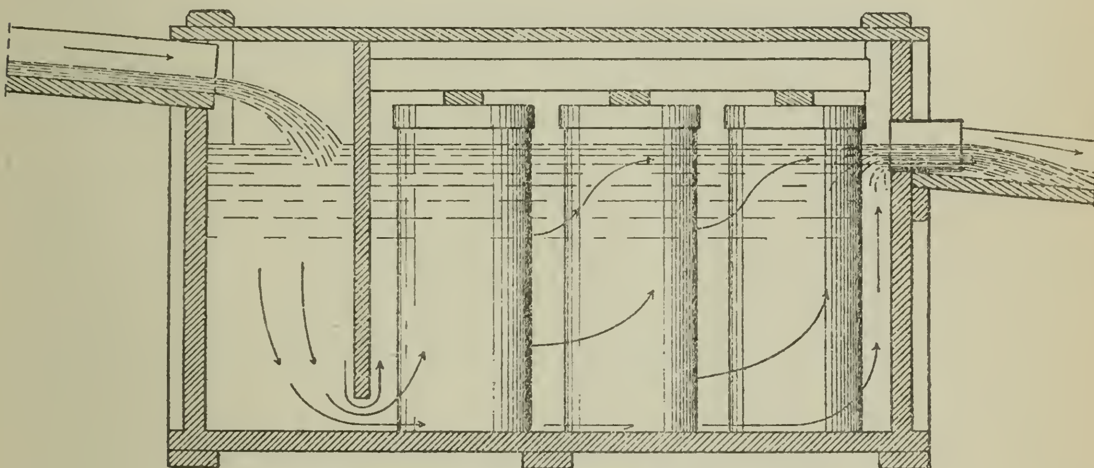
With the hand power separator as an important factor in our present creamery system, much of the work which was formerly done at the creamery is now done on the farm. The responsibility for doing this work well has been transferred from the buttermaker to the patron; hence much depends on the patron's knowledge of, and interest in, the work.

Care of Separators and Utensils.

Cleanliness is essential in all good dairy practice. All utensils and machinery should be of the very best, with no open seams or crevices in which dirt may lodge. No rusty cans or pails should be allowed in dairy work. Every piece of dairy machinery, every utensil used, should be thoroughly cleansed immediately after being used. First rinse with warm (not hot) water, then wash in water as hot as the hand will bear, using some washing compound in this water. Lastly, scald with the hottest water that can be obtained. After scalding, place outside in a pure atmosphere to dry. Never use the so-called "dish cloth" to dry dairy utensils; scald them, and they will dry themselves. Use a brush when washing to cleanse each part. The separator must be washed after each operation. The "once per day" washing is a filthy, as well as expensive habit, as a separator will rust when not properly cared for.

Care of Cream.

Keep the cream in clean, well-tinned vessels, preferably shot-gun cans. Cover the can to keep out all dust and foul air. *Cool quickly,* immediately after separating, to at least 50° F. Maintain this low temperature until the cream is delivered at the creamery, or to the hauler. If a cold well, or spring water, is available, this may be used for cooling. If cold water is not available, then an abundant supply of ice (one ton per cow) should be secured for cooling purposes. The loss entailed by the manufacture of poor butter, from improperly cooled cream, would pay for mountains of ice. Where cold well or spring water is available, the cream can be effectively cooled by placing the shot-gun cans in a box, as illustrated below, through which the water runs from the well or pump, to the watering trough.



Tank for Cooling Cream in Cans.

With a box made according to the illustration, an abundance of cold water passes around the cream, and little stirring is required. Cream should be delivered to the creamery at least every other day.

Percentage of Fat Required in the Cream.

The separator should be regulated and operated so as to deliver a cream which will test between 30 and 35 per cent. fat. By this we mean that every hundred pounds of the cream will contain from 30 to 35 pounds of fat. The reasons for desiring this percentage of fat in the cream are:

1. The high testing cream is less bulky, therefore it will take less cooling and work in caring for it.

2. It will leave more valuable skim-milk at home for feeding purposes.

3. It will mean less quantity for the cream haulers, also less vat room at the creamery and a smaller quantity of ice will be needed for cooling purposes.

4. A more exhaustive churning can be obtained from a rich cream than can be got from a thin testing cream, which means less loss in the buttermilk and more money for the patron. Also the high testing cream can be churned at a lower temperature and a better quality of butter be made.

5. The cream with a high percentage of fat will keep sweet much longer than will a low testing cream, providing other conditions are equal, therefore it is more likely to reach the creamery in proper condition.

Transportation of Cream.

Where possible, the ideal method of getting the cream from the farm to the creamery is for the patrons to deliver their own cream. This plan saves the cream-hauling cost, which is one of the big items of expense in connection with our present system of operation. Also, the patron and maker are brought more in contact with each other, which tends to discourage the sending of poor cream.

Where the patrons are unable to deliver their own cream, it should be hauled to the creamery in individual cans. By this method each patron's cream reaches the creamery unmixed with that of other patrons' and the maker is able to inspect the cream and assist those who are sending poor cream in improving the quality; also the weighing and sampling are directly under the maker's control.

Where cream is mixed in large cans or tanks by the cream collectors, it is very discouraging to those patrons who are taking proper care of their cream. The sampling and weighing must also be done by the hauler, which is often far from satisfactory.

Receiving the Cream.

Where patrons are delivering their own cream, or where individual cans are in use, the maker should inspect each can, rejecting all cream unfit for the manufacture of good butter. Each can should be carefully weighed and sampled and the weights recorded on a cream report sheet. Sampling should receive careful attention. The use of the McKay sampler is of great assistance in securing a proper sample for the test.

Where large cans are used, which necessitates the driver doing the weighing and sampling, the drawer's load should be weighed when it reaches the creamery. The weight is then compared with the total weight recorded on the driver's cream books. This is a check on the driver's weighing. To check the carefulness of his sampling, his samples should be tested ocasionally, and the total fat which he has on his cream books figured out. Then by taking a representative sample of his load of cream the total fat on his wagon may be found. In this way the fat on his wagon and the fat on his cream book can be compared and the accuracy of his work determined.

Pasteurization.

Immediately after the cream is received it should be pasteurized. By pasteurizing we mean the heating of the cream to a temperature of 180° to 185° F., and then quickly cooling to ripening or churning temperature. No phase of our creamery work is so beneficial as pasteurization. No phase of the work is so generally neglected. Why? Many creamery men say "it is too expensive," others say "it is too much labor." Neither answer is correct. Our creameries are not pasteurizing for the same reason that our creamery patrons are not storing ice to cool their cream. They do not know, or realize, the great benefit to be derived from it. The patron who neglects a supply of ice, or other facilities for cooling his cream, and the creameryman who neglects to pasteurize are both in the same canoe. Both are floating down, instead of paddling up, the stream of progress, as they should, and as they would, did they once realize the benefits that would accrue from cooling and pasteurizing.

What Does Pasteurizing Do?

1st. It kills the greater number of bacteria in the cream. Some of these bacteria are disease producers; others injure the flavor of the butter.

2nd. It assists in making a more uniform product of butter.

3rd. It creates a clean seed-bed for the sowing of a pure lactic acid culture.

4th. It enhances the keeping quality of the butter.

Ripening.

By the term ripening, we mean the souring of cream. This is done by the addition of a pure, lactic acid culture to the cream immediately after pasteurizing and cooling. In most of our creameries the cream is ripe enough before it reaches the creamery. The benefit of the culture in this kind of cream is the production of a desirable and uniform flavor in the butter.

Cool the cream to a temperature between 60° to 70° F. Use about 10 per cent. of good culture (more if the cream is very bad), and allow the cream to develop .4 to .5 per cent. acidity. When the proper percentage of acidity has developed, cool the cream to churning temperature, and churn as soon as possible. Pasteurization and a good culture will do more to improve the quality of Ontario butter than any other treatment which the cream can receive.

How to Prepare a Culture.

A culture is a propagation of pure lactic acid germs, used for ripening cream and milk. (The preparation of a culture is described under Cheesemaking in this bulletin, and as the preparation for both cheese and butter is the same, the method of preparing a culture will be found under the above heading.)

Churning and Working.

By churning we mean the gathering of the fat globules together into butter, by means of concussion. The question is often asked, "What is the proper churning temperature of cream?" No definite temperature can be given. The churning temperature is influenced by:

1. The character of the butter-fat.
2. Acidity of the cream.
3. Percentage of fat in the cream.
4. The amount of cream in the churn.

1. The fat is influenced by the proportion of soft and hard fats. Also by the period of lactation, and feed of the cows.

2. A ripened cream is more easily churned than an unripened cream.

3. The richer the cream (up to 35 per cent.) the more quickly it will churn, because, other conditions being equal, the fat globules are more numerous and come in contact more easily.

The churning temperature may range from 50° to 60° F., and even wider. Aim to have the cream churn in not less than 30 minutes and not more than 45. If cream is churned too quickly there will be a heavy loss of fat in the buttermilk; the butter will be soft and mushy; it will be hard to wash free of buttermilk; and will have poor keeping qualities. If the cream is churned too cold it will take much longer to churn, wasting time and power and the butter will tend to gather in hard, small granules, which will be difficult to work and salt. Avoid either extremes; try to have the cream churn in proper time. The butter should be of a waxy texture, which will "knead" easily, when working in the salt.

Stop the churn when the granules of the butter are about the size of large grains of wheat. Draw off the buttermilk and wash well with water somewhere near the churning temperature of the cream. Use about the same amount of wash water as there was cream to start with. Nothing but pure water should be used. If the butter has been churned at the proper temperature, and the churning "stopped" at the right time, one washing should be sufficient. Where the butter is soft and mushy two washings are advisable. About 10 to 12 revolutions of the churn are sufficient for washing.

Salting and Working.

Butter is salted, or not salted, according to the requirements of the market for which it is made. The amount to use depends on the market. From four to six pounds of salt for every one hundred pounds of butter fat, or from three to five pounds for every hundred pounds of butter contained in the churn, should be sufficient.

After the butter has been washed and drained, sprinkle on about half the amount of salt, then revolve the churn one-half turn, and add the remainder of the salt. Now adjust the rolls and work until the salt is evenly mixed through the butter. Uneven mixing of the salt causes mottled butter. Usually from fifteen to eighteen revolutions of the churn are sufficient.

Use only the best brand of salt. Sift the salt with a fine sieve before applying it to the butter. Keep the salt in a clean place, as it readily absorbs foreign odors.

Printing and Packing.

The neatness, style and kind of package is a creameryman's advertisement to the trade. The packages, in whatever form they are put up, should be neat, clean and attractive.

If made into pound blocks, they should be oblong with square corners and have no holes or finger marks. The prints should weigh 16¼ oz. to allow for shrinkage. Each wrapper should have printed on it, in tasty form, the name of the creamery, together with some special trade mark. The prints should be packed in boxes suitable for shipping.

If the butter is put into 56 lb. boxes, the boxes should be made of spruce, well paraffined, and lined with good parchment paper. Two sizes of paper are best for lining. One, a paper 12½ inches in width, and the other narrower, 11½ inches, and both 52 inches in length. These papers should be soaked for 24 hours before using, in a strong brine solution, containing one ounce of formaldehyde to prevent mould. The butter should be packed solidly, and the top neatly finished Weigh each box of the butter. A 56 lb. box should contain from one half to three-quarters of a pound extra, to allow for shrinkage.

Storing and Shipping.

As soon as packed, the butter should be immediately put in the creamery refrigerator. This refrigerator should be kept at as low a temperature as possible—below freezing is best. The butter should reach the market as soon as possible. It is a perishable article, and depreciates with age.

In shipping, see that the boxes are handled carefully, and that they are not soiled. Ship in well-iced refrigerator cars; examine each car before loading. Refuse cars that are dirty and foul-smelling.

Cleaning the Churn.

Start the churn revolving on the slow gear, rinse out all particles of butter with three or four pails of hot water, let this drain out and fill churn one-fourth full with boiling water with a small handful of Wyandotte added; wash off the rolls and place these in the churn and wash with the fast gear for one or two minutes. (If left much longer it will wear the holes in the end of the board for the rolls.) Allow to drain, take out rolls and rinse with two or three pails of hot water. Once or twice a week the churn should be steamed and given a wash with lime water. This will keep the churn sweet and clean, and by giving the rolls and inside of the churn a scrub with dry salt occasionally it will prevent the butter adhering.

A Good Whitewash for a Creamery.

Take one-half bushel of unslacked lime; add sufficient boiling water to slack it, and keep it hot. Then prepare one-quarter bushel salt, by dissolving in warm water, two pounds of glue dissolved in seven pounds of water; add six ounces of bi-chromate of potash and one-half pound of whiting. Mix salt, glue, bi-chromate and whiting together and add to the lime. Apply with brush or spray.

CHEESE-MAKING.

Alex. McKay.

The Curd Test.

Provide tin or porcelain cups sufficient in number to test the milk of at least the number of patrons supplying milk to the factory. A convenient size is two inches in diameter and three inches deep. Each cup should be plainly numbered. Provide a box of tin or galvanized iron with a neat fitting cover, large enough to hold the cups. For convenience, this box should have both water and steam connections. In taking the samples for making the tests place the number of the cup opposite the patron's name from whose milk the sample was taken. Place them in the box already described, adding water to the depth of the milk in the cups. Raise the temperature of the samples to 86° F. Set the samples by using one dram of a dilute rennet solution made of a strength of one part rennet to twenty-four of water. Stir in the rennet with a knife having a solid metal handle, being careful to sterilize the knife between the stirring of each sample so as not to contaminate one sample with flavors from another. When firm enough, cut with the same knife, using the same precautions to sterilize between the cutting of each sample. Raise the temperature gradually to 98° F. and handle the same as nearly like the milk and curd in the vat as possible. If looking for "bitter" flavors, and the milk is in a sweet condition, it may be advisable to add a few drops of culture to the samples before setting, as this flavor is rarely detected without acid. This test is particularly valuable in detecting flavors which develop in the curd but cannot be detected in the milk. It is also valuable for convincing patrons who may doubt that the flavor of their milk is as bad as represented by the cheese-maker, as it is possible to have them see and smell the curd made from each patron's milk as delivered at the factory.

The Preparation and Use of a Culture.

First provide suitable cans of good tin, which are well soldered, and about twenty inches deep and eight inches in diameter. It is better to have a duplicate set, as this gives a better opportunity for keeping them in good condition. When the milk is in small lots it can be more readily heated and cooled than if kept in larger quantities. For convenience in heating and cooling, a special box large enough to hold the cans containing the culture for one day's use should be provided. This box should be made of wood, or if made of metal, should be insulated, so as to maintain a constant temperature while the culture is setting. This is essential if best results are to be obtained. The box should be supplied with steam and cold water connections.

Better results may be obtained by using the milk from the same source each day, as we are more likely to get a uniform flavor and acidity from day to day by so doing. After selecting the milk, place the cans in the tank with cold water, and cover the cans with a granite plate, thus guarding against contamination from outside sources. Heat gradually to a temperature of 185° F. This may be done without stirring the milk. Hold at this temperature for a few minutes to make sure that the milk in the cans has reached this temperature. Then run off the hot water and turn on cold water, and cool (in the same manner without stirring the milk), to a temperature of about 60° F. In case proper means for heating and cooling, such as described, are not available, then stirring will be necessary. Now add a small amount of the mother culture sufficient to give the desired acid at the time required for use. In our work we find that about one ounce (by measure) to ten pounds of milk gives very good results. In starting a culture it is advisable to use a commercial, or pure culture. These may be obtained from the Bacteriological Department of the College, or from any of the dairy supply houses. Special temperatures are required for the first propagation of these cultures. Empty the mother culture into a quart of pasteurized milk cooled to a temperature of 75° to 80° F., and allow to stand until coagulation takes place. It is advisable to propagate a commercial culture at least two or three times before using. If the culture is to be kept more than 24 hours, it is advisable to set accordingly, by using a lower temperature and using less of the mother culture. Aim to produce the same acidity from day to day. When the culture is first broken up, take out a small quantity to propagate the culture for next day. A glass sealer should be provided for this purpose. The indications of a good culture are as follows: The whole mass is coagulated, no liquid is found on top, and it has a mild acid flavor, pleasant to the taste and smell.

A culture may be used to advantage when the milk is maturing slowly, or when it is tainted or gassy. One-half of one per cent. is the greatest quantity that should be used, and this only when the milk is known to be in sweet condition.

Milk should be set slightly sweeter when culture is used. With gassy milk its use is especially beneficial. Culture with bad flavor or with too high an acidity should not be used. All utensils must be thoroughly cleansed and sterilized before using in culture making.

Co-operation Between Maker and Patron.

That there has been a marked improvement in the milk delivered to the factory for cheese-making is quite apparent from the improved quality of the cheese produced, but there is still room for more co-operation between the maker and his patrons; first by the maker keeping his factory and its surroundings in a better condition as to cleanliness and sanitation, thereby making it a more attractive place, which the farmer can look at with pride instead of disgust; secondly, by returning the by-product, whey, in better condition. This latter can be accomplished only by the pasteurization of the whey and the proper cleaning of the tank. It is useless heating the whey unless it is all removed each day and the tank thoroughly washed.

There can be no hard and fast rules given for heating the whey, as this must be varied according to the conditions at the factory, although there are a few general principles which must be observed if this work is to be done successfully and profitably. The heating should be commenced as soon as possible after the first whey is put into the tank. This should be done for two reasons—first, to take advantage of the temperature the whey is already at, and second, to prevent the further development of acidity. The whey should be heated to at least 150° F. in order to obtain the best results. Care should be taken not to exceed 160° F., as heating above this temperature will cause the whey to become slimy.

The benefits to be derived from pasteurizing whey are: It conserves the food value of the whey in the preventing of the development of acid; it insures a more even distribution of the fat in the whey; it also prevents the spread of contagious disease through the whey when being returned to the farm and fed to young stock; the sweet whey is not so hard on the cans as is sour whey, and the cans are more easily cleaned when the whey is kept clean and sweet. According to experiments made, the whey may be heated at a cost of from 50c. to $1.00 per ton of cheese, according to the efficiency of the equipment of the factory.

Milk for Cheese-making.

To obtain the best results, it is necessary to have the milk delivered at the factory clean, sweet, and of good flavor, and we would strongly advise cheese-makers to reject all milk which is not in a fit condition for the manufacture of first-class cheese. The maker who receives milk other than of this kind is acting dishonestly towards his better patrons who are furnishing a first-class quality of milk.

Testing for Ripeness.

This may be done with the acidimeter or the rennet test; good results may be obtained by the use of either test.

No definite degree of acidity can be given as a rule to go by. The proper rule is to set at the acidity that will give the best results later in the process or will allow the curd to remain in the whey until properly "firmed," which will usually take from 2¾ to 3 hours from the time of setting to the time of dipping the curd with the right amount of acid developed. This will be found to be slightly less than the acidity of the milk at setting as shown by the acidimeter.

If using the acidimeter and making colored cheese, the acidity should be ascertained before adding the color to the milk, as it is more difficult to detect the neutral point with the color added.

Another point to note carefully when using the acidimeter is the effect of the presence of rain water in the milk. When the milk is diluted, less milk is taken in the sample, and will show a less degree of acidity than is contained in the milk to the extent of the percentage of dilution, thereby misleading the operator.

If color is used it should be thoroughly mixed with the milk before the rennet is added, using one to one-and-one-half ounces of color per thousand pounds of milk. Add color in amount as the market may require.

When making early spring cheese it is usually necessary to make a quick-curing cheese in order to reach an early market.

To make this class of cheese it is advisable to use a large quantity of rennet and a small quantity of salt, as this hastens the ripening process and overcomes the tendency of milk at this time to make a dry, hard cheese due to the low per cent. of butter-fat in the milk and the tendency of this class of milk to develop acid rapidly. Heat the milk to 86° F. and stir slowly while heating. When the desired acidity is obtained, add the rennet, using four or five ounces per thousand pounds of milk, or sufficient to coagulate the milk firm enough for cutting in fifteen or twenty minutes.

Commence to cut early, using the horizontal knife first, cutting slowly lengthwise of the vat.

Then with the perpendicular knife cut crosswise and afterwards lengthwise of the vat. We would advise strongly the use of the ¼-inch wire knife, as this leaves the curd in better condition for the moisture to escape with the least possible loss in the whey, as the cubes are smaller, and more uniform, and are not so easily broken as the larger ones.

Commence stirring at once with agitators or the McPherson rake. Stir carefully for ten or fifteen minutes, then see that the curd is free from the sides of the vat before applying heat. This loosening of the curd from the sides of the vat can be done at this stage with less loss than if done immediately after cutting, as the curd has become somewhat firmer and does not break up so readily. Curds should be handled carefully and in such a manner that the cubes will not be broken, nor allowed to mat together. Rough handling or breaking of the curd causes a serious loss to both quality and quantity.

Heat to a temperature of 98° F. in 1½ hours from the time of setting. We formerly advised taking the agitators out soon after heating was completed with the idea that we were able to firm the curd better with the small rake, but since the introduction of the ¼-inch knife, we have found that we get better results, with less labor, by allowing the agitators to run for a longer time.

We still advise removing part of the whey so as to guard against the danger of a rapid development of acid at the time of dipping, as the curd can be removed more quickly with a small amount of whey. This can be accomplished by removing one of the paddles until the whey is reduced; then replace the paddle and allow the agitators to do the stirring, as they do it more gently and with less danger of harming the curd. There is nothing gained by harsh treatment of the curd, as such treatment will allow the moisture to escape only in so far as it breaks the curd. It is much better to allow the curd to firm by natural agencies, namely, acid development, heat, and rennet action. Acid usually develops very rapidly in the spring, therefore it is necessary to be prepared to remove the whey quickly when sufficient acid has been developed, which may be from .16 to .19 per cent. as shown by the acidimeter. Curds at this stage should be nice and firm (not hard or harsh), and be kept in a loose, open condition in the sink a sufficient length of time to allow the free moisture to escape, as the moisture can be removed at this stage with very much less loss than it can later on. Leave the curd about 8 inches deep in the curd sink. When it is well matted, cut into strips 6 to 8 inches wide and turn upside down, and in about fifteen minutes turn again, piling two deep. Continue turning every fifteen minutes until the curd is ready to mill. When the curd is well matted and flaky and shows .7 to .8 per cent. of acid it should be milled, and well stirred afterwards. This stirring should be repeated often enough to prevent the curd matting until ready to salt. This will be when the curd has mellowed down nicely and shows 1 to 1.2 per cent. of acid. Stir and air the curd well before adding the salt, as this improves the texture and flavor of the cheese. Salt at the rate of 1½ to 2 pounds of salt to 1,000 pounds of milk. It is important that the temperature of the curd from dipping to milling should not go below 94° F. After milling allow the curd to cool gradually to about 85° F. when ready to salt. Put to press at a temperature of 82° to 84° F. Weigh the curd into the hoop, tighten the press gradually and leave the cheese 45 minutes before taking out to dress. When dressing, use plenty of clean hot water and what are commonly called "skirts." These cloths help to make a good rind on the cheese, keep them clean, and cause the cheese to come out of the hoop more readily. Turn all the cheese in the hoops every morning, and allow no cheese to be taken to the curing-room that do not present a clean, neat appearance.

Summer Cheese.

In making summer cheese one ounce of color to one thousand pounds of milk is usually sufficient, but this may be varied according to the requirements of the market. Use from 3 to 3½ ounces of rennet extract per thousand pounds of milk, or sufficient to coagulate the milk for cutting in 25 to 30 minutes. If this limit is exceeded we have too great a loss in the whey. The cutting and firming of the curd is the same as given for spring cheese.

It may be necessary to raise the cooking temperature slightly higher, as we may be dealing with milk of a different composition from that used in the spring. The acidity should be allowed to develop to such a point that is found from day to day to give the best results in the working of the curd later in the process, aiming to have the curd with good body, well matted and in a flaky condition when ready to mill. At this time it should have an acidity of .7 to .8 in about two hours from the time of dipping. The curd should be well stirred after milling, and, if cut crosswise of the grain, the stirring may be done better and with much less labor. Curd should be well matured, stirred, aired thoroughly and cooled to a temperature of 85° F. before salting. Use from 2 to 2½ pounds of salt on the curd from one thousand pounds of milk.

Fall Cheese.

When making fall cheese it is a mistake to use too much culture or to ripen the milk too much, giving the cheese the appearance of having been made from over-ripe milk, which is very objectionable in fall cheese; rather use a smaller amount of culture, not more than one-quarter of one per cent., and add it to the milk when there is a small quantity in the vat, as it starts a gradual fermentation which continues all through the process. Always heat the milk to at least the temperature of the culture before the culture is added. Set slightly sweeter than usual, as we are able to work closer to the "sweet line" all the way through, owing to the fact that we receive the milk in better condition.

Gassy Milk.

The presence of gas in the milk retards the development of acid, and as acid is necessary in the manufacture of cheese, we should make the condition as favorable for its development as possible without injury to the body of the curd. To do this, use ¼ to ½ per cent. of good culture, as by so doing we introduce into the milk an abundance of the lactic acid bacteria, which will, under favorable conditions, overcome the gas-producing bacteria.

The next step is to ripen the milk slightly more than usual before setting. When cutting, aim to have the cubes as even in size as possible. Allow the acid to develop slightly farther before applying the heat, stir carefully, and heat slowly, aiming to have the curd in normal condition at dipping. Use the same temperature for cooking and the same acid for dipping as with a normal curd. A gassy curd does not require so much stirring as a normal curd, because the moisture leaves it more readily. Mill as soon as the curd is well matted and the acidity has developed to .8 to .85 per cent. About half way between milling and salting commence piling the curd. Allow it to stand 15 or 20 minutes, then spread it out, stir and pile again. Continue to do this until the curd feels mellow. Give plenty of fresh air before salting. Use a normal amount of salt and put to press at a temperature of about 80° F., if possible.

Over-ripe Milk.

What is over-ripe milk? It is milk with one of the agents used in cheese-making out of proportion; or milk with the lactic acid developed in too great a degree in order to obtain the very best results in converting the milk into cheese. What are the agents used in separating the solids from the moisture or water content of the milk? They are rennet, heat, and acid development, together with the cutting of the curd to get it into a convenient condition for the escape of the moisture. The heat should not be applied until enough milk is in sight to fill the vat. Why? Because as we raise the temperature, we make more favorable conditions for the development of acid. Heat as quickly as possible to 82° or 83° F., and after testing for acidity, set at this temperature. Why? Because, first, 82° is less favorable for acid development than 86° F., and the time for heating to 86° is saved; and what is more important, you are able to get the rennet in sooner and a larger quantity of it, thereby getting the acid under control more quickly; if not under control, it is difficult to get it to work in conjunction with the other agents which contract and expel moisture from the curd. In handling over-ripe milk it is always advisable to use more rennet—at least one ounce more, per thousand pounds of milk, for several reasons: first, that it may coagulate the milk more quickly; second, it gives a firmer curd more quickly, and renders the curd less liable to be broken when handling it, thereby saving to a great extent the great loss which usually is sustained from making over-ripe milk into cheese. It also helps to break down the caseous matter in the cheese, giving it a better texture. Commence cutting the curd early and cut rapidly so as to keep pace with the rapid firming of the curd. If this is not done the curd will get into a condition which makes it very hard to cut properly. Use the ¼-inch knife rather than cut the curd four times, as it leaves the curd more uniform and in better condition than when it is chopped finely. Heat quickly, and if necessary, raise the temperature two or three degrees higher than for normal milk.

Here is where a great many cheese-makers make a mistake, by stopping the stirring and running off part of the whey when the curd is quite soft; while the whey is running off, the curd is matting, then they go at it with the little rake and break it all up, thereby liberating a lot of the milk solids, giving them a high acid reaction in the whey, and the result is, they have a sweet curd and a sweet cheese. Just stop and think for a minute which is likely to do the more effectual work, you with the rake, or the acid development in conjunction with the heat and rennet action? The natural tendency for this kind of curd is to run together, so the best way is to keep it stirred in all the whey until it firms up a little. Hard raking does not firm the curd, except in so far as it breaks the cubes. If agitators are used, the curd can be kept apart and the whey lowered quite soon enough without resorting to this rough handling. One can readily see that if the whey be lowered quite close to the curd while it is in a soft condition that it will be quite difficult to keep it from matting; and while you are keeping it apart with a small rake, you are breaking it up, causing a loss, and also causing rough texture in the cheese. It is always advisable to have the whey run down shortly before the dipping point is reached to avoid being caught with too much acid. When the curd is in a soft condition it is advisable to dip with slightly less acid and to keep it in a loose open condition in the curd sinks until all the surplus moisture is drained from the curd. If the curd is still a little weak, mill slightly earlier than usual. If not, treat as a normal curd. Mature the curd well before salting.

Ripening or Curing Cheese.

The ripening or curing of cheese is one of the most important points in the process, as no matter how well a cheese is made, if the curing is not properly done the quality cannot be the finest. Therefore it is necessary to provide a room where the temperature can be controlled at all times. It is important some means be provided to control the moisture in the room so as to prevent the growth of mold, which occurs where too much moisture is present. An excessive shrinkage takes place if there is too little moisture in the room. Proper temperature and moisture may be obtained by building an ice chamber in connection with the curing room and having a free circulation of air over the ice. This cools the air and causes a deposit of the moisture on the ice. In putting the cheese in the curing room, place them straight and even on the shelves and turn them every morning except Sunday. Keep the room well swept and looking clean and tidy. Use good strong cheese-boxes, have them dry, and of such a size as to fit the cheese nicely.

Weigh carefully, and stencil the weights neatly on the boxes. Load the cheese on clean wagons, and provide canvas covers to protect them from rain and heat while on the way to the station.

REPORT OF THE CHEESE MEETING OF THE WESTERN DAIRYMEN'S ASSOCIATION, O. A. C., DECEMBER 13, 1911.

Mr. D. A. Dempsey, Stratford, occupied the chair, and in opening the meeting called attention to the general high prices and good quality of the cheese during the past season. He referred to the many innovations in the dairy business, such as shipping milk and cream to the cities for ice cream, homogenized milk, etc., which are lessening the cheesemakers' supply considerably, but believe the people who had stood by the factory would reap the greatest benefit in the end.

Mr. Dempsey next called on Professor Dean, who welcomed the delegates to the College, and then took up some of the main points in the work done at the Dairy Department in the past year.

Two cheese made from the same weight of milk were exhibited. They furnished a striking object lesson in the difference in real value of milk for cheese-making purposes and of the unfairness of paying for milk by weight. Though many factors influence the make, it was found that the relation of the yield of cheese to the fat and casein is fairly constant, between 1.5 and 1.6 pounds of cheese for each pound of fat and casein in the milk.

Professor Dean then made reference to some investigational work carried on to clear up a number of objections to the Hart-Casein Test.

The following table shows the results, tested Saturday, December 9, 1911.

No. of Test.	Per Cent. of Casein.	Method of Testing.	Operator.
1 and 2	2	With motor	Mr. McKay.
3 and 4	2	With hand speed 56	Mr. Rickwood.
5 and 6	1.9 and 1.9	" " " 54	" "
7 and 8	1.9 and 1.9	With motor (acidity .15)	Mr. McKay.
9 and 10	2 and 2.1	(Monday, Dec. 11) With hand speed 56	Mr. Golding.
11 and 11	1.9 and 1.9	" " " 56	Mr. Rickwood.
12 and 12	2.2	" " " 50 (turns)	" "
13 and 13	1.9 and 1.9	With motor (acidity .2)	Mr. McKay.
0 and 0	2.4 and 2.4	" " " .55) (Tuesday, Dec. 12)	" "

The tests were made between Saturday, December the 9th, 1911, and Tuesday, December the 12th, 1911, and a number of factors, including the personal factor (the work was carried on by three men), percentage of acid, speed of the machine, and the temperature of the milk and acid, were dealt with. The extreme variation of the personal factor was 2-10ths of 1 per cent., which the Professor considered within the limits of error. From Saturday to Monday the sample had developed .15 per cent. of acid, and tested 1.9. On Monday night with .2 per cent. of acid it still tested 1.9. By Tuesday it had developed .55 per cent. acid, which meant coagulation. The presence of this amount of acid evidently tended to too much loss.

One tester was run by electricity, and one by hand. The speed varied from fifty to fifty-six. Fifty-six is the proper speed for the machine. Where the speed was fifty, 2 per cent. was got, while with the full speed it was 1.9 per cent. The packing of the casein in the Hart Casein Test is the result of centrifugal force. It is safe to conclude all these results are within the limits of error, but further experiments and tests will be needed before definite statements could be made on this point.

With regard to the effect of temperature of milk and temperature of acid, in one case where the temperature of the milk was 76 degrees, the increase in the percentage of casein was 2-10 of 1 per cent. All other cases were within the limits of error, that is, the tester got 2.2, 2.1, 2.2, 2.4, 2.1, 2.15, 2.1, and 2.1, the temperature of the acid varying from 70 to 74 degrees, and the temperature of the milk from 64 to 78. With reasonably careful work, accurate results or results within the limit of error could be got with the Hart Casein Test for milk.

Experimental work was carried on to ascertain the loss from over-ripe milk during hot weather. As an average of four years' tests it was found there was a loss of 2.1 pounds of cheese per thousand pounds of milk. No plainer lesson on the importance of having the milk delivered in a sweet condition could be shown.

Some very surprising results were obtained from moisture tests of the rind, first, second and third inches of cheese, when the cheese was green, when one month old and over, every week during the ripening period. It was found the loss was practically altogether in the rind and first quarter of an inch of the cheese. Under good average curing conditions there is practically no loss after the first quarter inch, and none after the first inch. Tests of a large number of samples from both Western and Eastern Ontario have shown the moisture content to be practically the same for cheese one month old as for green cheese.

Asked as to how he would account for loss of weight, Professor Dean said in some cases this could not be done, while in others the loss could be accounted for through loss of moisture in the rind. His own judgment was that there were losses other than moisture. He held the theory that in the process of ripening, gases are produced at the expense of cheese-making material, thus accounting for extra loss.

The effect of temperature during the ripening process was dealt with. Experiments have been conducted for the last ten years, and the best all-round results were got by taking the cheese directly from the hoops, putting them in ice-cold storage, and ripening them at a temperature of 40 degrees. For the season of 1911 cheese treated in this way averaged 93.43 points when scored by Mr. Herns. Cheese left in the ordinary ripening from one week, and then transferred to cold storage, averaged 92.96 points, and cheese ripened in the ordinary room with a temperature of 60 to 75 degrees averaged 90.42 points. Thus we have better quality and less shrinkage in the cheese put directly in the temperature of 40 degrees.

Mr. Herns reported that thirty-three factories pay by test in Western Ontario, an increase of five over 1910. There were twenty-one cool curing rooms. Eleven factories fed the whey at the factory, six less than in 1910. The temperature of the curing rooms averaged 72 degrees for the month of August, one degree higher than the average for the same month last year.

Thirty-seven whey tanks were cleaned every day, thirty-eight every week, twenty-nine every two weeks, and thirty-three every month. An increasing amount of attention is being paid to this work in the west.

After considerable discussion on the cooling of cheese, a committee on Resolutions was appointed, which drafted the following resolution:

"Whereas in the opinion of this meeting some definite temperature should be established for milk sent to cheese factories;

"Be It Resolved,—That the night's milk for daily delivery be cooled immediately after milking to a temperature of 65 degrees or under, and that the temperature of this milk should not be higher than 70 degrees when delivered at the factory. If for any reason it is found necessary to mix the night's and morning's milk, the night's milk under these conditions should be cooled to a temperature of 60 degrees Fahr. or under, immediately after milking, and milk so mixed should be delivered at the factory at a temperature not higher than 75 degrees F. To keep milk over Sunday for Monday morning delivery, it is recommended that the milk be cooled immediately after milking, to a temperature of 60 degrees or under, and held at this temperature until delivered at the factory."

This resolution carried, and it was decided to have copies printed to be read at the annual meeting of each factory.

Two experiments in salting were conducted at the College. One along the line of basing the weight of salt on the weight of milk versus the weight of curd, gave no difference in the cheese; in the other experiment, the use of two pounds of salt per 100 pounds of curd was compared with 2¼ pounds. Seventeen experiments were made, and the milk averaged 3.5 per cent. of fat, and 2.2 per cent. of casein. So far as results indicate, it would seem advisable to use 2¼ to 2½ pounds of salt per 100 pounds of curd, rather than 2 to 2¼ pounds, a better flavor being obtained by the heavier salting. The quantity best to use seems to depend on how the work is done, and the condition of the curd in regard to moisture at the time of salting.

The question of the yield of cheese from milk poor in fat compared with that from milk rich in fat, and the percentage of fat in cheese made from rich milk, and that from normal milk, was then discussed. Twenty experiments were conducted at the College from April the 3rd to the last of October. Two lots, "A" and "B," were made. In fat content "A" lots averaged 35.72, and "B" lots 36.11. The average test of the milk for the season was 3.4 fat, and 2.23 casein for "A," and 3.7 fat and 2.4 casein for "B."

Two cheese exhibited, one from milk testing 3.7 per cent. fat and 2.4 casein, and the other from milk testing 4 per cent. fat and 2.9 casein weighed 72 pounds and 79.25 pounds respectively. The average percentage loss in the whey from A and B lots made throughout the season was 1.7 per cent. and 1.9 per cent. respectively.

According to this work there is no great difference in the fat per 100 pounds of cheese, but there is a difference in the size of the cheese made from the same quantity of milk. It hardly stands to reason that two lots of milk from which these cheese were made should be paid for at the same rate per pound. This difference in yield is, no doubt, partly due to the high percentage of casein.

REPORT OF THE CREAMERY MEETING OF THE WESTERN ONTARIO DAIRYMEN'S ASSOCIATION, O. A. C., DECEMBER 14, 1911.

The President, Mr. W. W. Waddell, Kerwood, occupied the chair, and called on Professor Dean, who, after welcoming the butter-makers to the College, briefly referred to the increase in the sale of cream for various "side lines," such as the manufacture of ice cream. He also called attention to the necessity of the creamery men keeping on the alert to prevent the sale of renovated butter, or of oleomargarine, which some members maintained is being sold as "Glen Crown Creamery."

Composite Samples.

The work of comparative testing from weekly and monthly composite samples was then discussed. Professor Dean believed that, while the right and best way is to test each and every delivery of cream, yet monthly composite samples give for all practical purposes a fair and accurate result, and show the average quality of cream delivered for the month. Experimental work with three patrons throughout the whole season showed a difference of less than 1 per cent. between fat determined by the daily test, and fat determined according to the composite plan tested monthly.

Where composite samples were left exposed to the air, evaporation apparently took place, and it was found that the average of fat was 2.6 per cent. higher where the bottle was left open in a warm room, than in the test made in the usual way. Composite samples should be kept in a cool place, and in closed bottles, if accurate results are to be arrived at by this plan.

Some work was done in keeping cream in crocks. There was little difference in the temperature or acidity of the cream, whether kept in a well-glazed crock, or in one chipped or cracked, but the cream in the latter in every case had a bad aroma in from 44 to 52 hours after placing the cream in the crock. This is doubtless one reason for many patrons' cream being off in flavour.

Pasteurizing of Cream.

Professor Dean also called attention to experiments made by the Guelph Creamery Company in the pasteurization of cream, which had been carried out at a cost of about three cents per hundred pounds of butter, all the cooling having been done with water. The cost of pumping was included in this.

Lbs. Cream.	Lbs. Coal.	Power K.W.H.	Water, gal.	Lbs. Butter.	Cost.
2455	73	4.25 .041 cts. per lb.	1690 of butter.	876	Coal 14.7 Water 16.9 Power 4.8 36.4c.
4600	125	4.6 .032 cts. per lb	2240 . of butter.	1601	Coal 25 Water 22.4 Power 5.2 52.6
3400	85	3.2 .026 cts. per lb	1110 . of butter.	1210	Coal 17 Water 11.1 Power 3.6 31.7
1749	58	4.3 .032 cts. per lb	502 . of butter.	670	Coal 11.7 Water 5. Power 4.7 21.4

The cost of pasteurizing here has reference to only the mechanical part of the work; just the water, coal, and the power used in pasteurizing the cream. The cream came in at temperatures ranging from 60 to 72 degrees.

Live steam was used for heating and the condensed steam allowed to escape. Electric power costing 1⅛ cents per kilowatt hour was used. Coal cost $4.00 a ton and water .10 cents per 1000 gals. The cream was cooled in each case to the temperature at which it arrived at the Creamery. The water was ten cents per thousand gallons as it reads on the meter. City water was supplied from the city main and the cream pasteurized at 170 degrees. The labor problem was omitted altogether. In the last experiment the water was pumped, using an exhaust pump, and the cost was about the same.

Where two cooling vats were used better and quicker work was done than where only one was employed.

Mr. Rickwood discussed "The Results obtained from collecting cream in ordinary milk cans and in jacketed cans on temperature and acidity of cream delivered."

During June, July and August the cream haulers took a jacketed can and an ordinary can on the same waggon. They divided the patrons' supply of cream after it was weighed, putting half in each can and cared for each as on an ordinary trip. When the cream came to the factory, the temperature of the cream, the amount of fat, the weight and the acid were taken. The temperature in July was 74 degrees in the ordinary can and 69 degrees in the jacketed can. There was very little difference in the acidity. On July 5th, which was very hot, the temperature in the ordinary can was 77 degrees, in the jacketed 73 degrees. On August 10th the ordinary can was 79 degrees and the jacketed can 74 degrees, and on August 17th they were 74 and 71 degrees respectively. There was a difference of three to four degrees in nearly every case between the jacketed and the ordinary can. Some of this cream came twelve miles in an open wagon. Mr. Rickwood's experiments were carried out with ordinary thirty-gallon and ordinary jacketed cans.

Mr. Forrester affirmed that the cream that was brought in on a closed wagon and well covered would be from five to seven degrees cooler than where it came in exposed to the sun on a long haul of ten to twelve miles. This work was done with eight-gallon cans.

Mr. Herns, after reviewing the growth of the creamery business, and the work of the past season, dealt with the question of moisture, salt, churns, and pasteurizing. Buyers say there is a lack of uniformity of salt in some Western Ontario butter, while Quebec butter does not show this. Mr. McMillan thought that much of the lack of uniformity resulted from not estimating the amount of butter in the churn at different times. This could be done by weighing and testing the cream, and weighing the salt. In reply to an enquiry by Mr. Herns on the salt test, Mr. Rickwood replied that by allowing a churning to drain some time before salting, a different result was secured than when it was worked immediately after salting. Having the salt wet or dry also varied results, as butter retains more wet salt than dry.

Mr. George A. Putnam, Director of Dairy Instruction, was next called on, and thanked the dairymen, cheese-factory men, and creamery men for their hearty co-operation in dairy instruction work. He stated that the attitude of the producer, the manager, the owner, and the maker had changed greatly in the last few years. This has been largely due to co-operation, and having first-class men in the extension work. Mr. Putnam believed the most important feature of all is to get the raw material to the creamery in proper condition, and hoped to see more attention paid in the not too distant future to the special instruction of patrons in this particular.

Mr. Lund took up the question of using powdered milk as a "starter," where the regular skim milk could not be obtained. It contains only two per cent. of moisture, so that bacteria have very little chance to increase in it. In mixing it, one should aim to have the same percentage of solid in the mixed liquid as in the skim milk, so that one part of powder to ten parts of water makes it about right. Twelve churnings were made, part with regular skim milk starter, and part with powdered milk starter. These all scored practically the same, and there seems no danger of getting a bad flavor with the powder.

Mr. Barr devoted three months during the summer of 1911 in conducting experiments on the pasteurization of cream and the use of pure cultures, the object of the work being to obtain some definite information on pasteurizing and using a culture in all kinds of cream. The work was conducted at the Renfrew Creamery, Renfrew, Ont., the cream being selected from the regular supply. This cream was put in one of the creamery cream vats and divided into different lots, each lot being treated differently.

The following tables will show the result of the average score on the flavor of the butter from a number of these experiments:

Average Score on the Flavor of the Butter from the Same Cream Sweet, and After Standing 24 Hours at a Temperature of from 51 to 62 Degrees.

Condition of Cream.	Average Acidity in Cream.	Average Score for Flavor—Possible 45.			
		Raw Cream without Starter.	Raw Cream with Starter.	Past. Cream without Starter.	Past. Cream with Starter.
Sweet	.30%	40.79	41.58	41.87	41.92
Sour	.55%	40.64	41.05	41.75	41.79

These experiments show that when the cream is delivered to the creamery fairly sweet and clean in flavor, there is not a very great difference in the flavor of the butter from raw cream with starter and the two lots pasteurized. These three lots, however, scored considerably higher than the lots from raw cream without starter. There is little difference between the lots from sweet cream and those from sour cream, or the same cream kept 24 hours longer.

Total score sweet cream lots 41.54
Total score sour cream lots 41.30

Average Score on the Flavor of the Butter from Cream Delivered at the Creamery in a Sour and Slightly Tainted Condition.

Average Acidity in Cream when received.	Average Score or Flavor—Possible 45.			
	Raw Cream without Starter.	Raw Cream with Starter.	Past. Cream without Starter.	Past. Cream with Starter.
.54%	38.75	36.47	40.73	41.10

This table shows plainly that adding starter to raw sour cream did not improve the flavor, also that pasteurization improved the flavor a good deal.

The loss in pasteurizing all kinds of cream showed a little over three-quarters of one per cent. The higher the acidity the greater the loss.

Mr. Barr was of the opinion, however, that it would pay creamery men to pasteurize, as the improvement in quality would more than pay for the loss and extra cost of pasteurizing. From the results of the experiments conducted, he considered that it was doubtful if it would pay to use a pure culture in pasteurized cream. He favored heating the cream to 150 degrees and holding it at that temperature for about 20 minutes.

EXTRACTS FROM A SPEECH BY MR. G. G. PUBLOW, CHIEF DAIRY INSTRUCTOR FOR EASTERN ONTARIO, BEFORE THE EASTERN DAIRYMEN'S ASSOCIATION, IN JANUARY, 1912.

Note.—Mr. Publow visited Great Britain last summer (1911) in the interests of the dairymen of this Province, and there gained a great deal of valuable information regarding Canadian cheese in the British markets which should be invaluable to both makers and patrons of our factories. The following are a few of the outstanding points:

"In order to obtain as full information as possible I interviewed a large number of merchants dealing in Canadian produce in the principal cities of Great Britain, and succeeded in obtaining much that should be of assistance to us in the preparing of goods to suit the English consumer. It seemed to be the general opinion amongst all those men that what we consider our best Canadian cheese are suitable for any of their markets and compare very favorably with their home-made cheese and those from other countries. They also stated that they had noticed a general improvement in our cheese from year to year. In comparing our average cheese with the average English and Scotch makes, it was evident, however, that they excelled us somewhat in flavor and texture, and the principal reason for this is the superior condition of the milk supply, the sanitary conditions at their dairies being much ahead of ours. I was much surprised to find the demand in England very strong for a mild-flavored cheese, for I had been given to understand that the English people were lovers of cheese with a well-developed, or even sharp flavor. But I was informed that the English demand for milder cheese was growing by leaps and bounds, the quality that was in greatest demand, and at best prices, being those of mild flavor, close, smooth cutting, with a meaty texture. This fact should at once cause us to realize the need of better care of the milk at the farms, as it is only possible to make such cheese from clean sweet milk. An enormous market exists in Great Britain, but at the same time we should not forget that there will always be competition of a formidable character, which will require our best efforts to meet.

"Amongst the more common complaints was that of broken boxes, and it was quite evident that the trouble is largely due to the boxes themselves, many of them not being properly built. Every care possible is exercised in handling the boxes by the transportation companies, who are obliged to cooper or replace breakages for which they or their employees are directly responsible. The covers fall off, the heads and bottoms fall to pieces; many boxes are too large for the cheese and others are not high enough in the band, all of which tend to give the shipments an unsightly appearance.

"As a rule our cheese are stored in the transportation companies' warehouses and samples only are taken to the importers' salesrooms, where sales are made according to samples, and delivery is given to the retail men by the transportation company. Of all the places visited, I found the best facilities for storing cheese at the Commercial Surrey Docks, London. The facilities there are all that could be desired. There appeared to be a larger percentage of broken boxes at Bristol than at any other place, this being accounted for by the extra handling the cheese received as a result of having to be reshipped by train, and consequently more complaints regarding the frailty of our cheese boxes were made to me at that place."

"Practically all merchants complain of the losses in weights, which vary from one to three pounds on a box. This bears out arguments of past years against the shipping of our cheese in such a green, uncured condition. I found some lots running from three-quarters of a pound to two pounds a box short I also saw a few cheese weighed singly which fell short from three to five pounds a box. This, of course, was not a natural shrinkage. Evidently they had been improperly weighed at the factories. Not much complaint is made if they do not go over one pound short, in fact I was told that they rather expected it, and considered it a natural shrinkage, but when they fell short two and three pounds, and sometimes more, then there was trouble for someone, as frequently the margin of profit looked for was offset. The lots from the Eastern Section that were running short were generally found to be from factories that were following the practice of shipping to the hoops. Our competitors are much wiser in this respect, and very few Scotch or English cheese are placed on the counter before they are two months old, while cheese from New Zealand seldom reach their destination much under three months. The loss of weight is inseparably connected with their next common complaint, which is that of leanness of quality. This year this defect was more pronounced than usual, as, owing to the great shortage of cheese in Great Britain, the cheese went to the consumer almost immediately after their arrival from Canada. This is a defect easily remedied, and means that we simply must discontinue the practice of shipping our cheese at such an early date.

"The greatest general complaint on quality is to the effect that our cheese are not smooth enough in texture, not spreading easily, especially our summer or hot weather cheese. We cannot remedy this condition by leaving more moisture in the curd, without having a pure milk supply. Much of the dry texture is due to over-salting and high-curing temperatures. It is along these lines that other cheese excel ours, but with proper facilities for cooling the milk and cool-curing rooms for the cheese, there is no reason why they should.

"Frequent complaints are made against the size of many of our cheese, many being too heavy for the general trade. Many of the retail stores are in charge of women or girls, and cheese weighing over 80 lbs. are hard for them to handle, and the smaller cheese, ranging from 75 to 80 lbs., enjoys the greatest popularity on this account. Occasionally shipments of 100 lbs. cheese are wanted for window show purposes, but these are not frequent. In many of our sections the size of cheese has increased owing to the increased cost of boxes, but the practice does not meet with favor in England, and we should bear in mind that if we are to cater to this market, we must give them the goods which the people desire."

"I found that practically every man who was getting our best types of cheese said that they were practically as good cheese as they required, and I came to the conclusion that all we had to do was to imitate our best conditions. If we can get all our conditions as good as our best, we need not be afraid of any competition. It is up to us to improve our average conditions. We must have better sanitary conditions under which the milk is produced, and it must be delivered at the factory at a lower temperature, and we must keep the cheese for a longer period. It is not advisable for us to increase the moisture in our Canadian cheese. They want a close cheese, and they want them smooth and meaty. They want a cheese that will spread easily, but it would not be safe for us to increase the water content in these cheese unless we get sanitary milk and better conditions in which to ripen them. That is the one way in which our people would get more money."

"Cheese from one factory that were sent to the Old Country on a special order, when they were held for some time, were found to be rank in flavor, and samples were returned to this country. They were the foulest smelling cheese I ever saw, and I think it could be traced largely to the water. What we are concerned about is the manner in which the cheese go to the consumer. When they are shipped earlier many of the taints are not noticed. I wish I had had some of the makers with me, because if they had seen some of our cheese in the Old Country they would practise different methods.

"Wherever there is the least suspicion of the water being wrong, the wash water should not go into the whey tanks. Arrange, if possible, to drain the wash water from the tank. If, however, the wash water goes into the whey tank and is thoroughly pasteurized, there is no danger of any taint going back into the cans."

"The sounder the milk is the more moisture you can leave in the cheese with safety, but the more moisture you leave in them the more necessary it is to have a lower temperature to cure them. The reason our cheese show that leanness is largely due to heavy salting, and high acidity at time of dipping."

Asked what acid test was used, Mr. Publow said: "They test by the iron, but nearly every factory has the acidimeter test. Cultures are used and all the work done thoroughly."

"Cheese are sold according to quality, and very little according to the country it comes from. For instance, a shop keeper is going to retail ten cheese a day (many of them sold more than that). The first thing in the morning, the cheese are taken out of the boxes and stripped of their bandages, cut up, labelled, and placed on the counter. Those of mild, clean flavor, and close smooth body and texture, being labelled finest Cheddar, best Cheddar, and so on, and the best price asked (it may be eight pence per pound). Those that are slightly open or coarse in texture, or acid in flavor, may be sold for sevenpence, or may be marked down to sixpence. Before I came away I saw them selling from sevenpence to tenpence, according to quality. I saw cheese from the same factory, graded, and a difference of six cents being asked for them on the counter. If such a thing as that would take place in this country there would be very little need for men to go around trying to persuade cheesemakers and farmers to do what is in their best interests. This grading is largely done by the retail man, and it appeared to me as though that was where he made his money. Supposing I bought 500 finest Brockvilles or finest Bellevilles or finest Peterboros, and when I came to cut these cheese up I found that they were not up to the standard, I would likely return them to the importer, or ask him to make good. If I had bought them as slightly under finest, I would expect to find a percentage of fine cheese, and the larger the percentage of fine cheese in the lot, the more money I would make, and, as a result of the large percentage of fine cheese from many factories, certain brands were in splendid demand."

"I found that not only were our cheese being sold in the large cities and towns, but they were sold in the country villages as well. When I visited the Cheddar Valley (the home of English Cheddar cheese), I found cheese from this Ingersoll section being retailed there, and it was giving good satisfaction. The best cheese (of English make) I saw was at this place. I was very much surprised to find that there was only a small quantity of cheese made in the Cheddar Valley. When speaking to some of the farmers of this place, they said that they had turned their attention to the city milk supply, as owing to the increased demand for milk and cream, the price realized per gallon was greater than if it had been made into cheese, and there was a saving in labor as well, and that they were not likely to go back to the manufacture of cheese."

"I also had the privilege of visiting several of the farms and dairies in Scotland, and had the opportunity of seeing the conditions under which the milk was being produced and manufactured, and there is no doubt but what the English and Scotch makers have a great advantage over our Canadian makers, as they, nearly all, have full control of the milk supply. As a rule the cheese-maker pays the farmer a cheese rental for the cows, the farmer furnishes the feed, and the cheese-maker takes full charge of the herd for a year; the milking and caring for it is under his supervision. The milk is not allowed to remain in the stable for any length of time after it is drawn, but is taken direct to the dairy, where it is strained and cooled. There was every evidence that they realized the importance of cleanliness in connection with their work. I found the stables very clean, some of them being scrubbed twice a day. The cows were brushed and the udders washed before milking. As a rule the milking was done by women, and in some cases I saw them washing their hands after milking a cow, before milking another, and this appeared to be their regular custom, as they had been given no previous notice of my visit. I was anxious to see their every-day conditions, for when comparing their make of cheese with ours, I was somewhat at a loss to know why it was that they could retain so much moisture, and have the flavor remain sound. If there is one thing more than another that will impress you, when visiting those dairies, it is the thoroughness with which the makers do their work. They do well, what they know. When discussing with them their method of making, they laid special stress on having the milk work slow. They did not want it to work faster than three to three and a half hours. The curds are cut rather coarse (the curd knives used are similar to our old style ½-inch mesh), they heat slowly, and pay special attention to the raking and firming of the curds in the whey. They appear to aim at uniformity in size and neatness in finish, in fact, all of them were as well finished as the best at this show to-day, which is saying a good deal. They press for three days. They are taken out of the hoops every morning and turned, and special care is taken to insure good rinds. This would appear to be very essential, as their cheese are taken to market without boxes. The output of each dairy is placed separately on the floor of the warehouse and sold in block, and being neatly finished, and even in size, they look very attractive. Many of the dairies (owing to their good reputation) were bringing from two to four shillings a hundred weight more than the regular market price. I would advise factorymen here who are making a superior quality to brand the cheese with the name of the factory and the district in which it is made, for the time is not far distant when you will be rewarded for your pains."

"As to the future outlook for our cheese on the English market I would say that if we study the tastes of the people, and give them what they think most of, it appears to me as though the market would be almost unlimited. The thing for us to do is to continue our work of education for a clean, cool milk supply, and have the curing-rooms of our factories so improved that the temperature can be controlled close to 60 degrees, and keep the cheese until they are sufficiently ripe to give a good account of themselves, thus we will be doing the proper thing."

BULLETIN 206.] **NOVEMBER, 1912.**

Ontario Department of Agriculture.

ONTARIO AGRICULTURAL COLLEGE

DAIRY SCHOOL BULLETIN

Part II.

Dairying on the Farm

NOTE.—The Department has thought it well to issue two bulletins to follow Dairy School Bulletin, No. 172, issued in May, 1909, the supply of which is exhausted. Part I. of the new issue will be found of special value to manufacturers of butter and cheese in factories, while Part II. is intended for the farmer and his family. Part I. may be secured by farmers by applying to the Department of Agriculture, Toronto.

INTRODUCTION.

BY H. H. DEAN, B.S.A., PROFESSOR OF DAIRY HUSBANDRY.

DAIRY FARMER. The past winter has been one of exceptionally high prices for all kinds of dairy products. The cow is undoubtedly the best paying animal on the farm if she is fed and handled properly. However, in order to make a cow pay it is necessary that her owner shall possess certain qualifications. The most important of all is that he or she shall have a real liking for cows—not only because of the money which they earn, but he or she must like them simply because they are cows. A person who really likes cows will take pleasure in feeding and looking after them. To him or her it is not drudgery. This person will always treat cows kindly and considerately. There will always be a bond of sympathy between the owner and the cow. Each will strive to do the best possible for the other.

The owner of cows must study their habits, likes and dislikes. He or she must feed them liberally and make them as comfortable as possible.

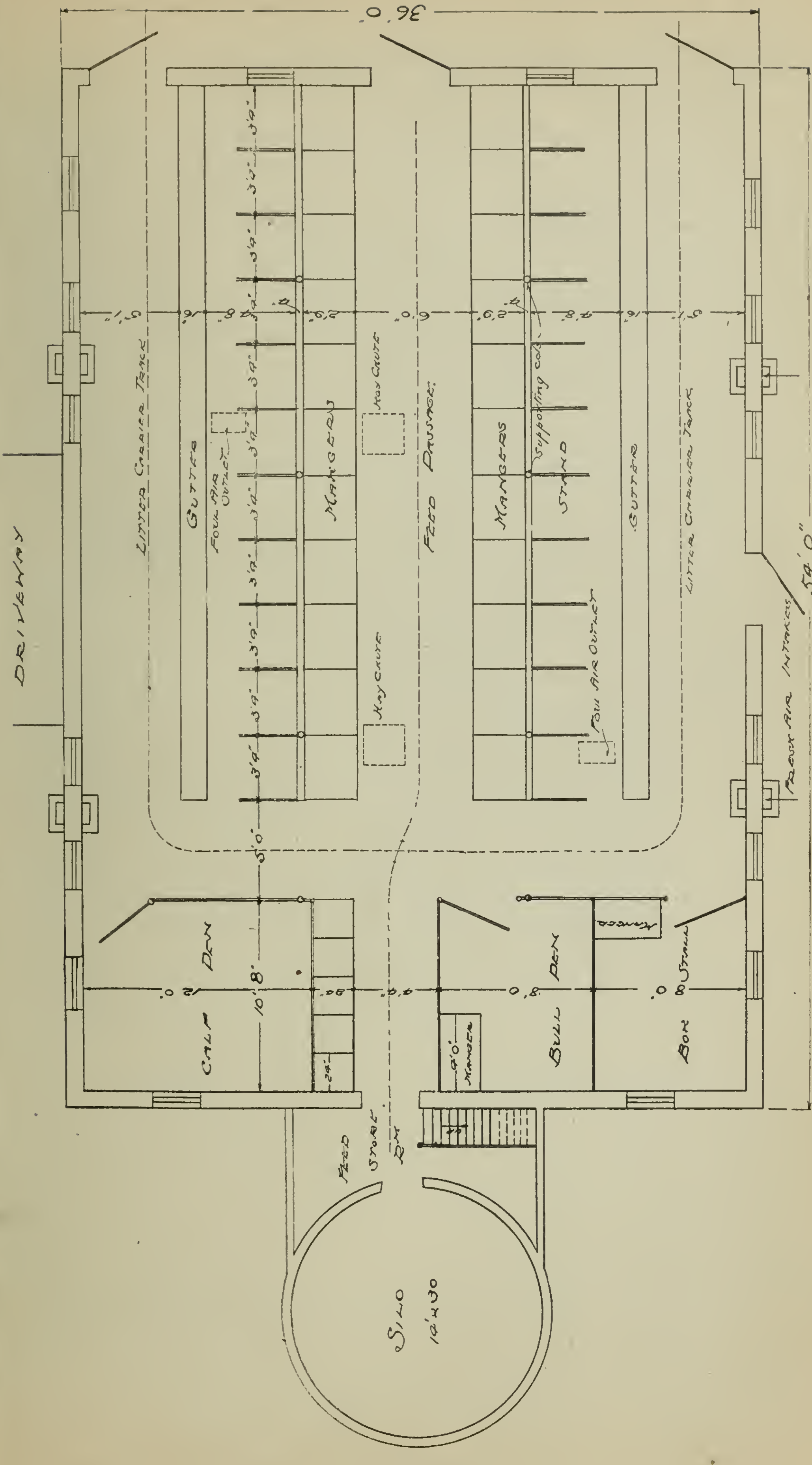
Unless he or she is prepared to be a student of cows, success is not probable. To the dairy farmer we should say, know your cows individually. This can be best done by weighing the milk from each cow daily, once a week, on two consecutive days each month, or even once a month. Samples for testing should also be taken on the day or days for weighing in order to know the percentage of fat in the milk. This, together with a close observation of the feed consumed by a cow, will enable a dairy farmer to determine whether or not his cows are making a profit. It will also enable him to intelligently weed the poorer cows.

Dairy Cows may be purchased or they may be bred. Frequently good cows may be bought at reasonable prices, but generally speaking they must be reared by the dairy farmer. For the dairyman who cannot afford to keep pure-bred cows, it is desirable to select grade or native cows and breed these to a pure bred male belonging to one of the dairy breeds. Do not cross breeds. Select one and stick to it. Great attention should be paid to the sire, as milking quality in the female depends more on the sire than on the dam. Dairy farmers do not sufficiently realize the importance of this point. Excellent dairy cows may be secured at small cost by using a dairy sire belonging to a dairy breed and a dairy family. In this way a herd of ordinary or inferior breeding may soon be transformed into a herd of good milkers. The fundamental mistake made by many breeders of dairy cows is in the use of inferior or what are commonly called "scrub" sires. The patrons of every cheese factory and creamery ought to have the use of a pure-bred bull at nominal cost. It would pay the factories to adopt some co-operative plan to secure this result.

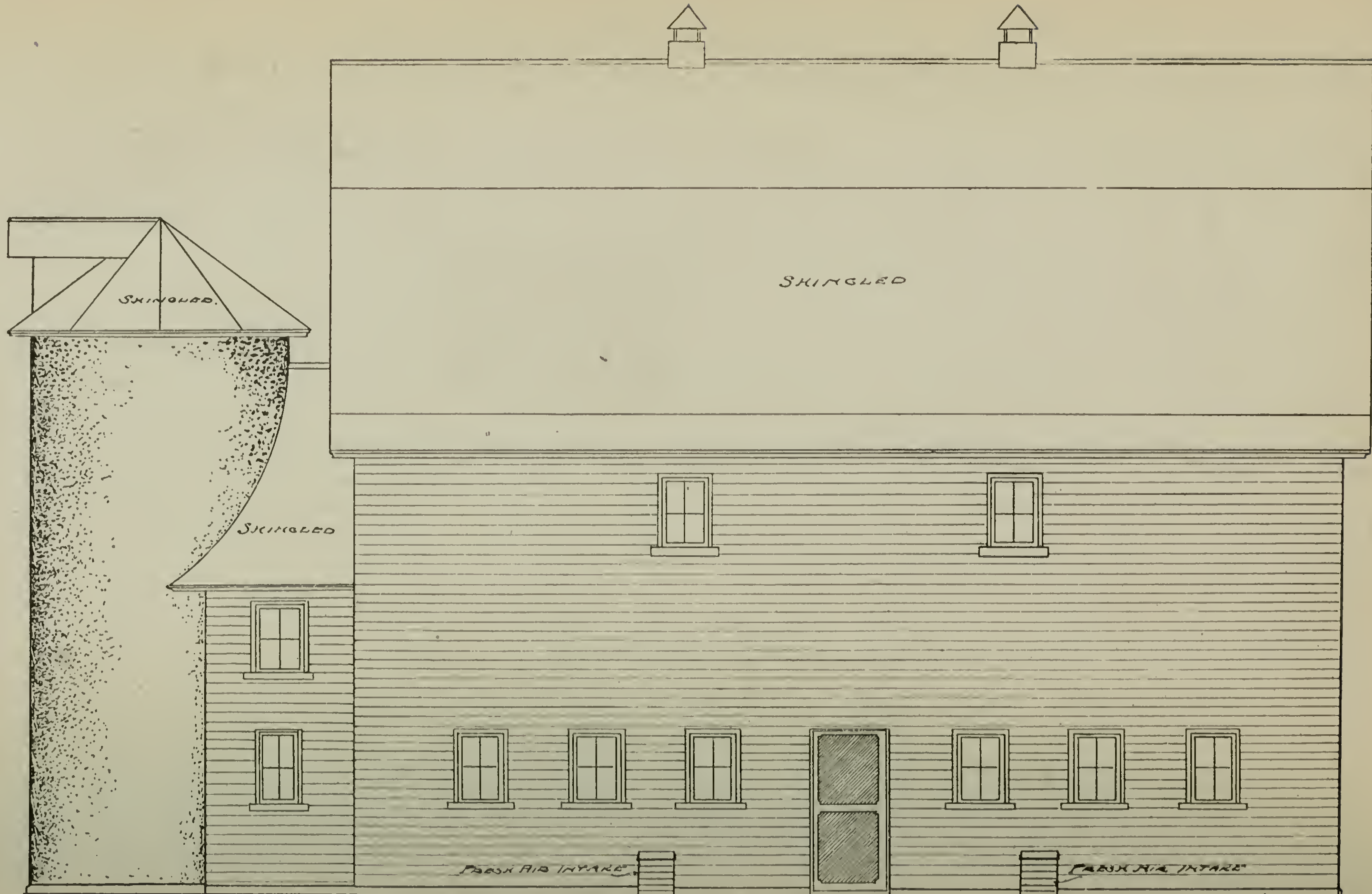
Calves and heifers for the dairy should be kept in a thrifty condition but not too fat. The should commence milking when about two and one-half years old. At the end of the second lactation period and during all future years they should produce not less than 6,000 lbs. of milk or 250 lbs. butter yearly. This may be taken as a minimum standard of production for profitable dairy cows. Stated another way, they should earn from $25 to $100 per cow each year, above the cost of feed.

Dairy Stables. The chief requirements of a dairy stable are that it shall be light, clean, and healthful. The first is got by having plenty of clean windows, the second by having cement floors, with stalls of proper length and a gutter or drop behind the cows, and the last by having the stable well ventilated, and whitewashed at least once a year.

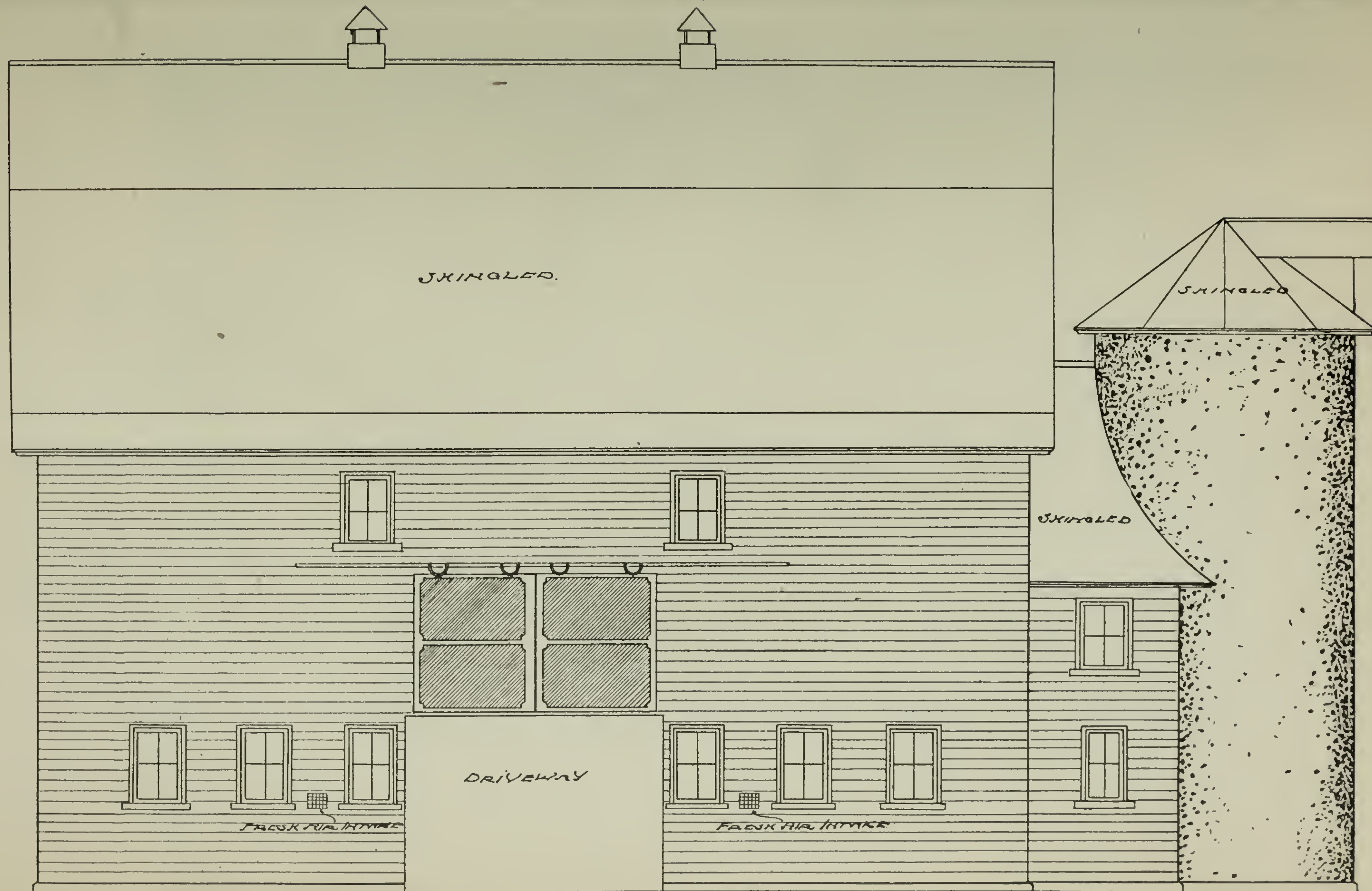
The following illustrations of a modern dairy barn are self-explanatory. The two systems of ventilation in general use—the "King" and "Rutherford"—are illustrated.



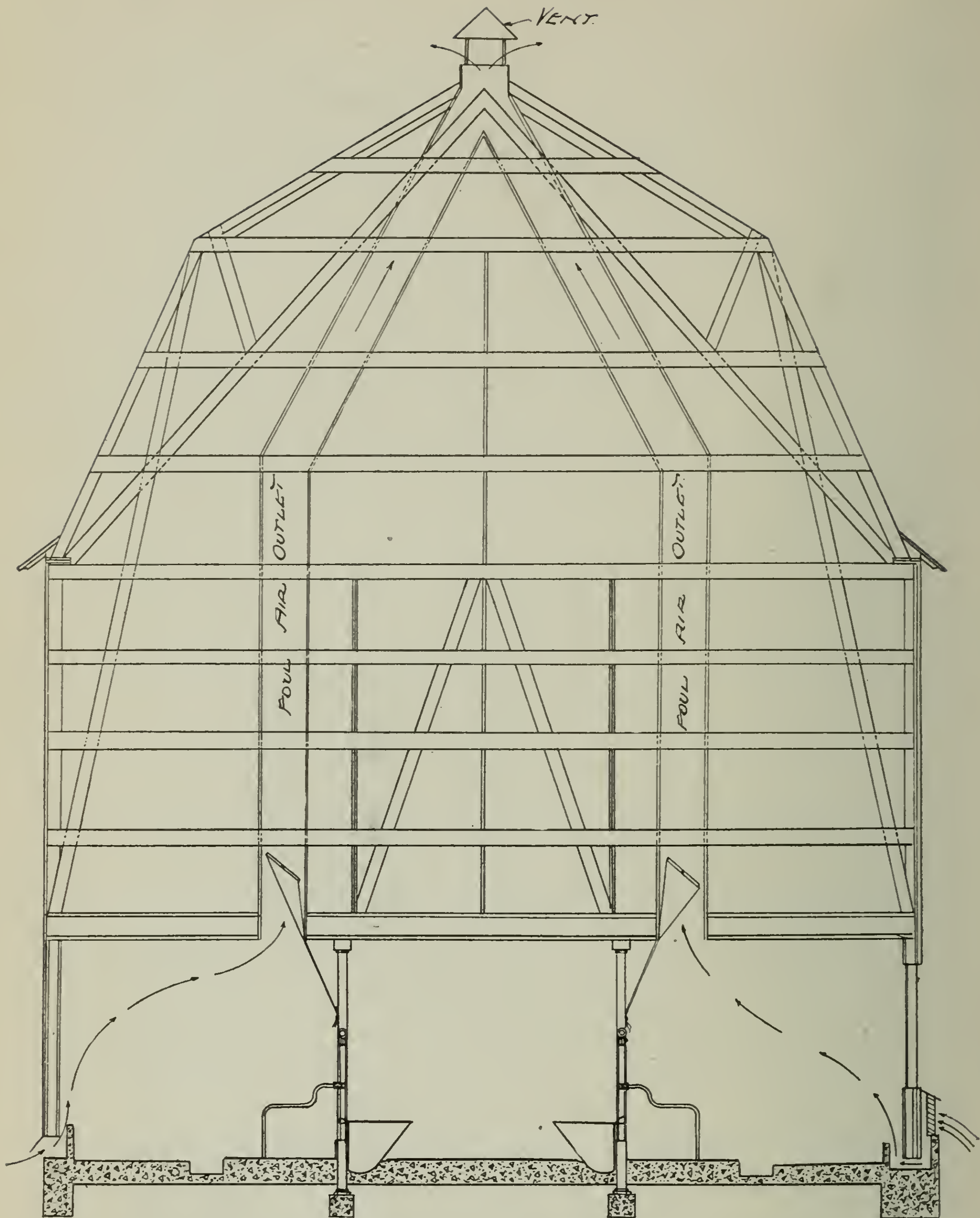
Ground Floor Plan of a Modern Dairy Barn.



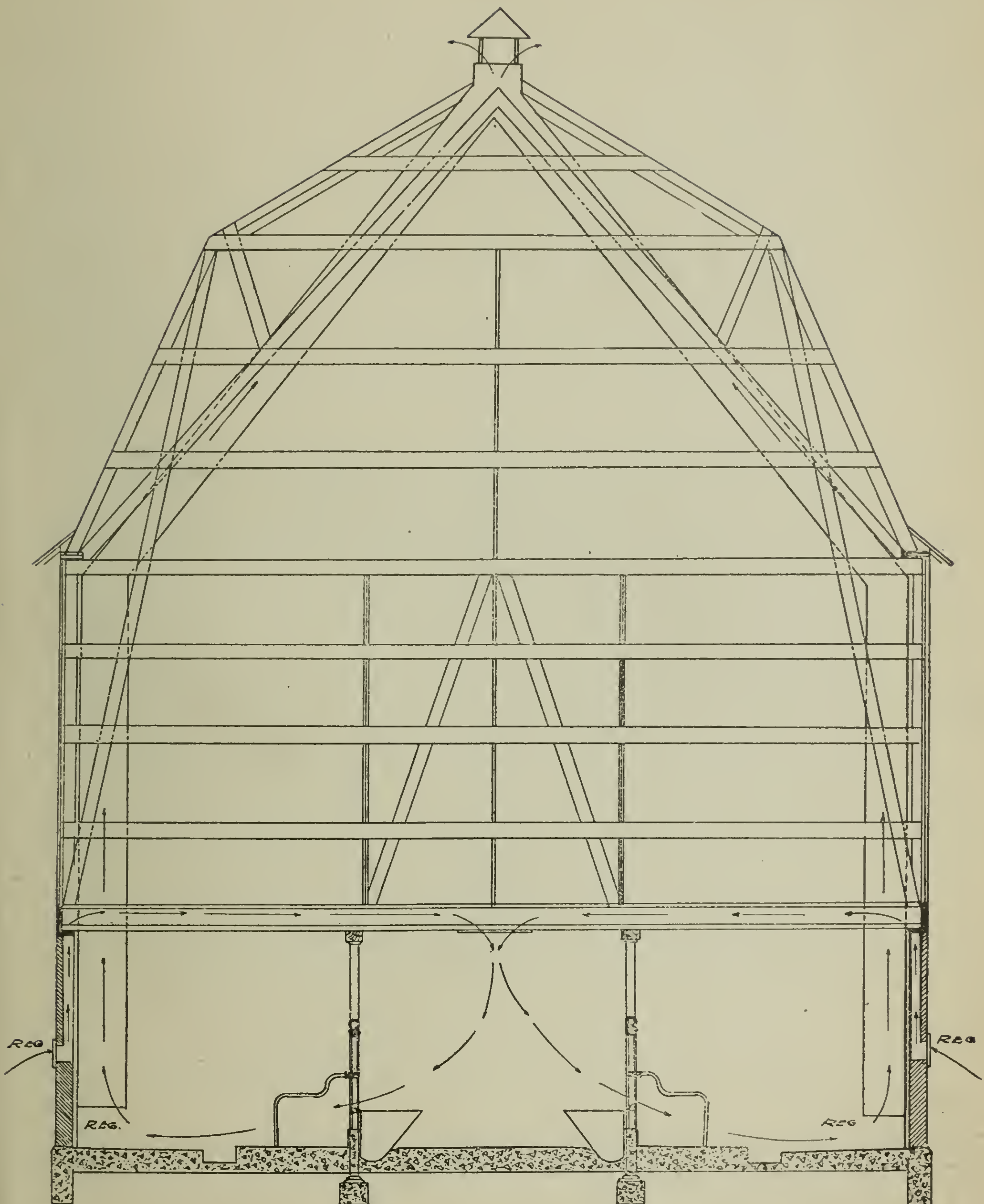
Side Elevation, Showing Rutherford System of Fresh Air Intakes.



SIDE ELEVATION, SHOWING KING SYSTEM OF FRESH AIR INTAKES.



RUTHERFORD SYSTEM OF VENTILATION.



KING SYSTEM OF VENTILATION.

Summer Feeding. Cows are expected to, and should give the best returns of the year while on good pasture. Grass is their natural food. They should not be turned out too soon in the spring, however, especially if milking heavy, as the young grass does not contain enough nutrients to keep up the milk flow. Fall grain pastures are very similar in this respect. There is also danger of giving the milk an undesirable flavor.

Special provision should be made for feed during the summer when the ordinary pastures become dried up. An excellent mixture for this is that recommended by Professor C. A. Zavitz, viz., 57 lbs. of oats, 30 lbs. early amber sugar cane, and 7 lbs. red clover, a total of 88 lbs. per acre. To work in with a rotation of crops, the following combination might be used: 4 lbs. timothy, 5 lbs. orchard grass, 7 lbs. red clover, and 2 lbs. of alsike clover, making 18 lbs. per acre. On fields that may be allowed to remain in permanent pasture for several years, Professor Zavitz recommends 4 lbs. meadow fescue, 3 lbs. tall oat grass, 2 lbs. timothy, 2 lbs. meadow foxtail, 5 lbs. alfalfa, 2 lbs. of alsike, 2 lbs. of white clover, a total of 24 lbs. per acre.

Alfalfa is a crop which dairy farmers should grow extensively. It is excellent for green fodder, pasture, hay, and for green manure. It should be cut for hay when about one-quarter in bloom. When well cured, a ton is almost equal to a ton of bran for milk production. Mixed with corn, it is very valuable for ensilage. Sow on a clean, fertile, well-drained soil, using plump seed of a hardy variety at the rate of 15 to 20 lbs. per acre. It may be seeded on fall grain in the spring, or with a light seeding of spring grain, or alone early in July on a moist summery fallow. Do not pasture or cut the first year.

Green peas and oats, or summer silage are also very valuable to supplement pastures. Summer silage is an excellent feed. It can be kept with very little loss, can be handled more cheaply than other crops, and may be covered with new silage, if necessary, and kept until wanted.

Where pasture is abundant, it seems doubtful if grain feeding pays, but where very short, from three to eight pounds of grain may be fed when the milk flow varies from 20 to 50 lbs. When a small amount of grain is fed while on pasture, corn is well adapted. When the grain ration exceeds five pounds per day, the grain mixture should be partly made up of bran, cottonseed meal, oats or gluten meal.

The great reason for the decrease in milk production during summer is that the cows do not get enough food. The excessive heat, and short pastures soon mean hungry cows, if no special provision is made to supply green feed in the hot months. Cows are better pastured in the late evening, during the night, and in the early morning.

Plenty of pure fresh water and clean salt are essential. From one to three ounces of salt per day should be fed, depending on the milk production.

Winter Feeding. In winter feeding we must recognize that the cow needs a certain amount of food to maintain the body. This amounts usually to from 50 to 60 per cent. of all she can consume and is called a maintenance ration. Since she must be kept alive she should be fed the other 40 per cent. to 50 per cent. which would go entirely for milk production. The cow's nature calls for a very bulky ration, best supplied by corn silage. This, however, should be supplemented by alfalfa or clover hay, roots and meal. Alfalfa or red clover hay, if fed fairly liberally with silage makes a very satisfactory ration. Where good roughage is fed one pound of grain per day for each pound of butter fat produced per week is a fair guide. Timothy hay is not a satisfactory food. Too many men put their cows on short rations when not milking. A moderate amount of meal, provided you have no clover or alfalfa, fed while the cow is dry gives good returns later. With very heavy milkers there is some danger of losing them from "milk fever." Ordinarily, it is well not to milk the cow any more than is required for the calf during the first two or three days after calving. When a cow is attacked, the "air treatment" is effective.

Typical Ayrshire.

The following are suggestions for daily rations for cows milking fairly well:—

1. Corn Silage .... 35 lbs.
   Clover Hay .... 12 "
   Wheat Bran .... 4 "
   Oats (ground) .... 3 "

2. Corn Silage .... 40 lbs.
   Alfalfa Hay .... 15 "
   Corn (ground) .... 3 "

3. Clover Hay .... 20 lbs.
   Mangels .... 25 "
   Oats (ground) .... 3 "
   Corn (ground) .... 3 "

4. Corn Silage .... 40 lbs.
   Clover Hay .... 10 "
   Mangels .... 30 "
   Wheat Bran .... 4 "
   Ground Oats .... 3 "
   Gluten Meal, Cottonseed Meal, or Oil Meal .... 1 lb.

The following table giving the digestive nutrients in one pound of some common feeding stuffs, is based on Bulletin 154 from Cornell Station:

Kind of Food	Total dry matter	Pounds of digestible nutrients			Nutritive Ratio
		Protein	Carbo-hydrates + (fat x 2.25)	Total	
Green fodder corn, 1 lb.	0.20	0.010	0.125	0.135	1:12.5
" peas and oats, "	0.16	0.018	0.076	0.094	1:4.2
" red clover, "	0.29	0.029	0.164	0.193	1:5.6
" alfalfa clover, "	0.28	0.039	0.138	0.177	1:3.5
Corn silage, "	0.21	0.009	0.129	0.138	1:14.3
Potatoes, "	0.21	0.009	0.165	0.174	1:18.3
Mangels, "	0.09	0.011	0.056	0.067	1:5.1
Sugar Beets, "	0.13	0.011	0.104	0.115	1:9.4
Carrots, "	0.11	0.008	0.082	0.090	1:10.3
Turnips, "	0.10	0.010	0.077	0.087	1:7.7
Timothy hay, "	0.87	0.028	0.465	0.493	1:16.6
Mixed hay, "	0.87	0.062	0.460	0.522	1:7.4
Red clover hay, "	0.85	0.068	0.396	0.464	1:5.8
Alfalfa hay, "	0.92	0.110	0.423	0.533	1:3.8
Corn fodder, "	0.58	0.025	0.373	0.398	1:14.9
Corn stover, "	0.60	0.017	0.340	0.357	1:19.9
Pea straw, "	0.86	0.043	0.341	0.384	1:7.9
Wheat straw, "	0.90	0.004	0.372	0.376	1:93
Oat straw, "	0.91	0.012	0.404	0.416	1:33.6
Corn, (grain) "	0.89	0.079	0.764	0.843	1:9.7
Wheat, " "	0.90	0.102	0.730	0.832	1:7.2
Rye, " "	0.88	0.099	0.700	0.499	1:7.1
Barley, " "	0.89	0.087	0.692	0.779	1:7.9
Oats, " "	0.89	0.092	0.568	0.660	1:6.2
Buckwheat, " "	0.87	0.077	0.533	0.610	1:6.9
Peas, " "	0.90	0.168	0.534	0.702	1:3.2
Corn and cob meal, "	0.85	0.044	0.665	0.709	1:15.1
Wheat bran, "	0.88	0.122	0.453	0.575	1:3.7
Wheat middlings, "	0.88	0.128	0.607	0.735	1:4.7
Low grade flour, "	0.88	0.082	0.647	0.729	1:7.9
Gluten feed, "	0.92	0.194	0.633	0.827	1:3.3
Gluten meal, "	0.92	0.258	0.656	0.914	1:2.5
Linseed meal (new process) 1 lb.	0.90	0.282	0.464	0.746	1:1.6
Cotton seed meal, "	0.92	0.372	0.444	0.816	1:1.2
Sugar beet pulp, "	0.10	0.006	0.073	0.079	1:12
Apple pomace, "	0.233	0.011	0.164	0.175	1:14.9
Skim-milk (separator), "	0.094	0.029	0.059	0.088	1:2
Buttermilk, "	0.10	0.039	0.065	0.104	1:1.7

To find the pounds of nutrients in any given number of pounds of any feeding-stuff multiply the weight of nutrients in one pound as given in the table, by the pounds fodder, meal, etc., which you expect to feed.

Two standards for feeding, a German and a Wisconsin have been worked out giving an approximate total of 24.5 lbs. of dry matter, and a nutritive ratio of about 1 to 6.6. The nutritive ratio refers to the amount of protein in relation to the carbohydrates and (fat. multiplied by 2.3).

By referring to the preceding table we find that ration No. 4 contains digestible material as follows:

Feeding Stuffs.	Total dry matter.	Pounds of digestible nutrients.			Nutritive ratio.
		Protein.	Carbo-hydrates. + (fat x 2.25.)	Total.	
Corn Silage, 40 lbs..............	8.40	0.360	5.160	5.520	....
Clover hay, 10 "	8.50	0.680	3.960	4.640	....
Mangels, 30 "	2.70	0.330	1.680	2.010	. ...
Bran, 4 "	3.52	0.488	1.812	2.300	....
Oats, 3 "	2.67	0.276	1.704	1.980	....
Oil Cake, 1 "	0.90	0.282	0.464	0.746	....
	26.69	2.416	14.780	17.196	1:6.1
Wisconsin standard......... . .	24.5	2.20	14.900	17.100	1:6,8
German standard..........	24.0	2.50	13.400	15.900	1:5.4

By using the table as directed any farmer can readily find out the amount of digestible material in a ration and compare it with the standards given. If he finds that the ration is too low in protein or muscle forming material then bran, oil-meal, gluten meal, peas or clover hay should be added to the ration, and if necessary some of the more carbonaceous foods such as silage may be reduced. However, silage, roots, beet pulp, etc., give a succulency to the ration which is very important in the economical production of winter milk.

Cotton seed meal is probably our richest protein concentrate to-day and is a very valuable food for balancing up rations deficient in protein. Do not feed more than two or three pounds per day, especially to animals far advanced in the gestation period.

Have a regular time for feeding. While variety sometimes is alright, yet when a good ration has been chosen it should be followed carefully with very few changes. Silage and hay are best fed after milking.

Paying Patrons. Milk is valuable for buttermaking in proportion to the fat which it contains, and the pounds of fat delivered in the milk or cream should form the basis of dividing proceeds among patrons of the creameries.

As butter consists of fat, together with about 16 per cent. of water, salt, and curdy matter, there will always be more butter than the fat contained in the milk or cream. This excess of butter over fat constitutes what is known as the "overrun." The "overrun" in whole milk creameries varies from 12 to 16 per cent., *i.e.*, 100 lbs. fat in the milk makes from 112 to 116 pounds of butter, and this "overrun" belongs to the patrons, unless otherwise understood. It is unwise for creamery managers to take this "overrun" as part payment for manufacturing.

In cream-gathering creameries the overrun usually varies from 15 to 20 per cent.

For calculating the yield of butter from fat in the milk, adding one-sixth to the fat is near enough for practical purposes.

Cheese is made largely from two constituents in the milk, viz., fat and casein; therefore, the method of dividing proceeds among the patrons of cheese factories is more complicated than for creameries. Three systems are now in use among factorymen:

1. Paying according to the weight of milk delivered regardless of its quality.

The principle of this plan is that it assumes all milk to be of equal value per 100 pounds for cheesemaking. It rests on a false assumption, is unjust, and it tends to promote dishonesty. Factorymen and honest patrons who complain that some of the milk is skimmed and watered by dishonest patrons, deserve little sympathy, because a remedy is within the reach of all at a very small cost. The milk of all patrons should be tested regularly, and be paid for according to its value for cheesemaking.

2. Paying according to the weight of the fat delivered in the milk, the same as at creameries.

The principle of this system is that it assumes all milk to be valuable for cheesemaking in proportion to the fat which it contains. The system is manifestly more just and equitable than the first named, and is to be commended in preference to "pooling" by weight of milk. The chief weakness of the plan is that the yield of cheese is not in direct proportion to the fat contained in the milk; therefore it gives an undue advantage to the patrons sending milk containing a high percentage of fat.

3. Paying according to the fat and casein in the milk, the casein being represented by the factor 2, added to the percentage of fat.

The principle of this system is that it assumes milk to be valuable for cheesemaking in proportion to the fat and casein contained in it, and it further assumes that the percentage of fat + 2 represents the available fat and curdy compounds in milk for cheesemaking.

The application of the third system is very simple. To illustrate: the tests for fat of patrons' milk are 3.0, 3.5, 3.8 and 4.0. The percentage of fat and casein are $3 + 2 = 5.0$; $3.5 + 2 = 5.5$; $3.8 + 2 = 5.8$; and $4 + 2 = 6.0$. The pounds of fat and casein are calculated by multiplying the pounds of milk delivered by the percentage of fat and casein. Thus, if the first patron had 1,500 lbs. milk he would be credited with 1,500 × 5 ÷ 100 = 75 pounds of fat and casein. If the second delivered 2,000 pounds milk he would be credited with 2,000 × 5.5 ÷ 100, or 110 pounds of fat and casein, and so on with all the others. The value of one pound of fat and casein is ascertained by dividing the net proceeds of the sale of cheese by the total pounds of fat and casein delivered.

The following table gives a summary of the results obtained during five years' experiments, in which 250 experiments were made with nearly 200,000 pounds of milk, which contained percentages of fat varying from 2.7 to 5.5.

Av. p.c. fat in milk.	Lbs. cheese made per 100 lbs. milk.	Lbs. cheese made per 1 lb. fat in milk.	Lbs. cheese made per lb. fat and casein or p.c. fat + 2.	Lbs. loss of fat and casein in whey.		Per cent. lost in curing in four weeks.	Average score.	
				Per 1,000 lbs. milk.	Per 100 lbs, cured cheese.		Flavor max. 35.	Total max. 100.
2.87	8.75	3.04	1.79	2.71	3.09	4.26	30.4	89.9
3.22	9.03	2.80	1.72	2.75	3.15	4.43	30.2	89.4
3.83	10.02	2.61	1.71	3.34	3.21	4.10	30.8	90.3
4.23	10.67	2.53	1.71	3.21	3.02	4.05	31.0	90.4
4.74	11.44	2.41	1.69	3.64*	3.18*	3.07	31.0	89.8
5.21	12.13	2.32	1.68	3.40*	2.80*	3.53	31.5	91.6

* Fat only. Casein not determined.

The Hart Casein Test has proven satisfactory, and enables us to obtain the percentage of casein in milk, but it does not change the principle of this third method.

Skim-milk and Whey. The value of skim-milk for young calves and pigs is much increased by feeding it sweet. The whole milk creamery should heat all skim-milk to 185 degrees, before it leaves the creamery. Sweet skim-milk is probably worth 15 to 20 cents per 100 pounds. It has also about the same value for grown pigs when sour, if fed along with meal.

Buttermilk has about the same value as sour skim-milk, if it does not contain too much water. When selling buttermilk in bulk at the creamery a convenient way is to value it at so much per ton of butter. From $5 to $8 per ton of butter is a fair price

Experiments made at the Ontario Agricultural College showed that 100 pounds of whey were equal to 14 pounds of meal in the production of bacon. Both skim-milk and whey had a marked influence in the production of firm bacon. When selling whey in bulk at the factory, it is usually valued at from five to ten dollars per ton of cheese

The by-products of cheesemaking and buttermaking are valuable factors in adding to the wealth of dairymen by means of feeding bacon hogs and young cattle for beef and the dairy.

All these by-products ought to be pasteurized at the factory before returning them to the farm. Whey heated to 160° F. for one hour in the whey tank will likely destroy the germs which produce tuberculosis in hogs and other animals. . All cheese factories ought to pasteurize the whey. It improves the feeding quality, lessens danger of spreading disease, and reduces danger from bad flavors in milk and cheese, as most of the organisms causing these flavors are killed by heating. The cost of pasteurizing the whey has been estimated at 50 cents to $1.00 per ton of cheese.

CARE OF MILK.

By Alex. McKay.

Milk is the raw material from which the cheese or butter maker manufactures a valuable and concentrated food product. It is a perishable article and very susceptible to contamination; it should be supplied only from cows in good health, furnished with an abundance of wholesome food, pure water and having free access to salt at all times. Cows giving milk should not be allowed to eat turnips, rape, foul weeds, brewers' grains, distillery slops, musty or decayed food, or anything that will impart an objectionable flavor to the products, as injury to the milk from any cause results in a positive loss to the producer. It is very important that there be no dust or bad odors in the stable at the time of milking. Before commencing to milk, the udder and flank of the cow should be brushed or wiped with a damp cloth to remove loose hairs or fine particles of dust or filth, as these are usually laden with undesirable germs. The milker should be clean, kind and sympathetic and free from any contagious diseases. Use only tin pails, being careful to see that all seams are well soldered, so as to facilitate cleaning. Wash and scald thoroughly all utensils used in handling milk. First rinse them with water, then wash well with water at a temperature of about 120° F., and then scald or steam. Do not wipe with a cloth, but place to drain where they will get plenty of sunlight and pure air. Use a brush in preference to a cloth for washing tinware. If these few simple rules are followed we should be able to produce milk in a fairly clean condition, and clean milk means milk with a comparatively low bacterial content. But, be as careful as we may, we find that we are unable to produce milk which is free from germ life, so the next step is to employ means of keeping this life in check. The only practicable way is to reduce the temperature so as to make unfavorable conditions for its development. The simplest and most effective way of doing this is to provide a tank large enough to contain cans that will hold at least two milkings. Before commencing to milk, this tank should be filled with cold water into which the empty cans are placed, and as each cow is milked the milk should be strained into the cans. By handling the milk in this way the cooling is practically done as soon as the milking is completed. The milk should be covered up as soon as possible to prevent contamination from the surrounding atmosphere, and sufficient cold water added to the tank to reduce the temperature of the milk to at least 65° F., and for keeping it at that temperature over night. In keeping milk over Sunday, cool to 55° F. and hold at that temperature.

Tank for Cooling Milk and Hoisting Apparatus.

This tank may be so arranged that all the water pumped for watering stock may be run through it before it reaches the stock watering trough, thereby saving the labor of pumping this extra amount of water. Ice is almost a necessity for keeping Saturday night's or Sunday's milk. The warm milk should in no case be mixed with that already cooled. Where possible send to the factory in separate cans. If this is not done, the morning's milk should be cooled before mixing with the evening's milk. The whole secret of keeping milk in good condition is to be found in cleanliness and low temperature and under no conditions should chemicals be used for preserving milk.

"Lack of cleanliness and leaving the milk at high temperatures cause bad flavors and poor texture in cheese, and require more milk to make a pound of cheese."

Bitter Milk. There are two classes and two sources of bitter milk. The first has a bitter taste when freshly drawn. The second develops the bitterness only after standing some time, and it increases in intensity.

This is due to the growth of bacteria. When fresh milk is bitter it may be due to feeding of Swedes, cabbages or the eating of certain herbs. Again, certain cows develop a bitterness in their milk when far in the lactation period, and this usually occurs when the cow is receiving dry feed. When this occurs the grain ration should be reduced so that the cow will be receiving no more than is really needed for her production. It is said two or three doses of epsom salts at intervals of three days is effective in some cases in removing this condition.

Colored Milk. Red milk may be due to the work of bacteria. It usually results from the presence of blood in the milk. Some plants such as field horsetail, knot grass, sedges and rushes are said to give color to the milk. Where bloody milk occurs it is not necessarily due to any diseased condition of the cow. It is due to the rupture of a small blood vessel, allowing blood to escape into the milk cistern or ducts. It does not usually appear more than twice and cannot be stopped or prevented. Bloody milk should be rejected. Blue milk is caused by a bacillus, which enters the udder through the milk ducts.

Certain drugs are excreted through the milk, so that the use of certain medicines may give an abnormal odor, or flavor. Some of these are volatile oils, salts, rhubarb, arsenic, mercury, lead, zinc, iron, ammonia, and some acids. Poison ivy may produce such a condition of the milk that severe gastro-intestinal symptoms with weakness are felt by the consumer. Diarrhoea and abdominal pains may result after using milk from cows eating common artichoke leaves. Warts, chapped and otherwise sore teats may be greatly helped by using vaseline frequently.

HAND CREAM SEPARATORS.

By Geo. Travis.

At present there seems to be an unlimited market for sweet cream of good quality. Since cream is a perishable product, that cannot retain its good flavor for any definite length of time, it is necessary to adopt methods for creaming, most favorable for the production of the desired article.

Where milk is properly cared for at the farm, good cream can be produced for buttermaking by means of the shallow pans or deep setting system, but on account of the length of time required to produce cream by this method it is not practicable for the sweet cream trade.

The best known method for creaming at the farm is the hand centrifuge, more commonly known as the cream separator.

Some of the advantages of the cream separator over the old style gravity system are:

The milk may be put through the separator immediately after it has been drawn from the cow, at which stage conditions for efficient creaming are most favorable, and the skim milk is then in the best condition for feeding purposes.

The richness of the cream may be regulated to the desired consistency by adjusting the cream screw. By this means it is possible to extract more of the milk serum from the cream, thus reducing the quantity to be cared for.

There are many other advantages which might be enumerated, such as: Less ice needed for cooling, fewer utensils to be washed, etc.

The chief objections to the hand separator are: the initial cost and the labor involved in turning and washing the machine, but when it is taken into consideration that the increased product made from the saving in loss of fat in the skim-milk over the best of other methods of creaming, these objections may be overlooked.

In choosing a separator it is advisable to select one with sufficient capacity for the amount of milk produced; one which is simple in construction, strong and durable with reasonable care, and one having all parts, which come in contact with the milk, easily washed. The manufacturers should guarantee that the machine will do good work, or no pay.

There are many different makes of separators on the market, but which is the best, it is impossible to say, as no one separator possesses all the points of merit that the ideal might possess. The best separator might be described as that best suited to the special conditions under which it is to be used. For example, the closest skimming separator may be more difficult to operate, or possess other disadvantages in its construction less desirable than a machine which skims less closely, and these disadvantages may more than counterbalance its closer skimming qualities. It would be a very poor separator indeed that did not have some good points, and it would be the ideal if it did not have some weak points. A hand separator may be considered as doing good work when, running at its full capacity, it will produce a cream testing from 30 to 40 per cent. fat, and not leave more than .05 per cent. fat in the skim-milk. To a certain extent the reputation of a separator as to its efficiency for creaming milk will depend upon the one who operates it.

With each separator is sent a book containing full directions for setting up, and operating the machine. These instructions should be strictly followed unless you know of something better, which you have proven to be so by practice.

Select a suitable place in which to locate the machine, where a pure atmosphere can at all times be assured. A well-built milk room in the barn that can be kept free from dust and stable odors, easily kept clean and tidy, may be most convenient, but it is advisable to have a separate milk house built in such a manner that it will be easily kept in a sanitary condition, with good ventilation and plenty of sunlight, not too far from where the cows are milked, so that the milk does not require to be carried to a great distance.

The foundation on which the machine is to be fastened must be solid, and the part of the frame which carries the bowl must be level every way. Before putting the different parts of the machine together each part should be thoroughly cleaned by using a cloth made damp with kerosene or gasoline.

After the machine has been properly put together, before starting, see that the oil cups are properly delivering the oil to each bearing. If at any time the bearings appear to be gummed, a little coal oil may be used with good results.

The number of revolutions required to give the proper speed is usually tabulated on the crank of the machine. Two or three minutes should be taken to get up full speed. The supply tank or feed pan should contain sufficient water, at a temperature of 110 degrees, to fill the bowl. This should be put through the machine first to warm the skimming device and prevent the milk from sticking. The milk then should be turned on full flow, and the supply pan kept well filled until the milk is all in. The speed should be kept as uniform as possible. If the separator is to yield cream of uniform richness, it must be given the same speed at each time of using. Unless the operator times himself by counting the revolutions of the crank per minute, or by the use of some other speed indicator, there will be a tendency to run the machine at too low a speed.

The "Metronome" is a very simple, inexpensive and practical device to time the speed of the separator. It works automatically and can be adjusted to mark time for any separator.

The rate of the inflow and the temperature of the milk will also cause a variation in the richness of the cream. The best practical temperature at which to separate the milk on the farm is from 90° to 100° F.

Milk is never in better condition for separation than immediately after it has been drawn from the cow. If the milk is allowed to cool, as is the case in winter, when the separator is used only once a day, or once in two days, the milk should be warmed to at least 90° F. before it is run through the separator, otherwise there will be a considerable variation in the cream test and also an increased loss of fat in the skim-milk. This increase in the richness of the cream and the excessive loss of fat in the skim milk, resulting from the separation of cold milk, will occur no matter what make of separator is used.

The practice of leaving the separator unwashed from time to time after using cannot be too strongly condemned. Only a clean separator can deliver cream that is pure, sweet, and of a desirable flavor, hence it is very important that all movable parts of the bowl should be taken apart and thoroughly cleansed after each separation. All remnants of milk, cream and slime, should be washed off with tepid water, after which they should be scalded and left exposed to the sunlight if possible until required for further use.

After each separation, the can containing the cream should be set in cold water, and the cream cooled immediately to a temperature as low as possible. The cream should remain in the cool condition until it leaves the farm. This will prevent souring in the summer and freezing in the winter.

When different lots of cream are to be mixed, the fresh cream should always be thoroughly cooled before it is put in with the old cream. Adding fresh, warm cream to cream that has been separated and held for some time causes the development of lactic acid, which if not properly controlled, will cause undesirable flavors in the cream and butter.

FARM BUTTERMAKING.

By Bella Millar.

A dairy instructor once said "Buttermaking begins in the stable but it does not end until the finished product reaches the table of the consumer." Realizing the truth of that statement, care should be exercised in every step of the work and the dairyman's watchword "Cleanliness" should be adopted.

In any line of work it is necessary to have good raw material in order to make a first-class article. In the manufacture of butter, if the raw material, the milk, does not receive proper care, the most skilful maker cannot produce the best quality of butter.

"Prevention is better than cure," thus every effort should be made to keep dust and dirt out of the milk pail. As soon as possible after milking, remove the milk from the stable and strain it through a strainer that is perfectly clean and sufficiently fine to prevent tiny particles being carried through.

CREAMING THE MILK.

Cream separators are very largely used in our farms to-day, and have many advantages over the gravity system of creaming milk. However, some still use shallow pans and deep cans for creaming purposes.

Shallow Pans. When using shallow pans, the milk should be strained into the pans as soon as possible after milking, and then be allowed to stand perfectly still in a pure air, free from draughts, at a temperature of about 50° to 60° F. for 24 to 48 hours.

Remove the cream while sweet by first loosening the cream from the pans by means of a thin bladed knife; then tip the pan and allow just enough skim milk to run over to wet the tin before gliding the layer of cream into the cream can.

Deep Setting System. The day is past for the use of the shallow pan system for creaming milk. If you have not a separator, then use the deep setting system. When using this method, the cans of milk should be placed in cold water and kept at a temperature of 45° F., or lower.

for 24 to 36 hours. By this system ice is required, unless the water be cold enough to cool the milk to, and maintain it at, 45° F. while creaming. If the cans are not provided with taps at the bottom, a cone-shaped dipper should be used for removing the cream. Loosen the cream from the can with a knife. Dip the skimmer in skim-milk or water, then lower it, point first, into the can, and allow the cream to flow evenly into it.

The loss of fat in the skim-milk by gravity creaming, even under the best conditions, is much greater than when centrifugal force by means of a cream separator, is applied.

Cream Separators.

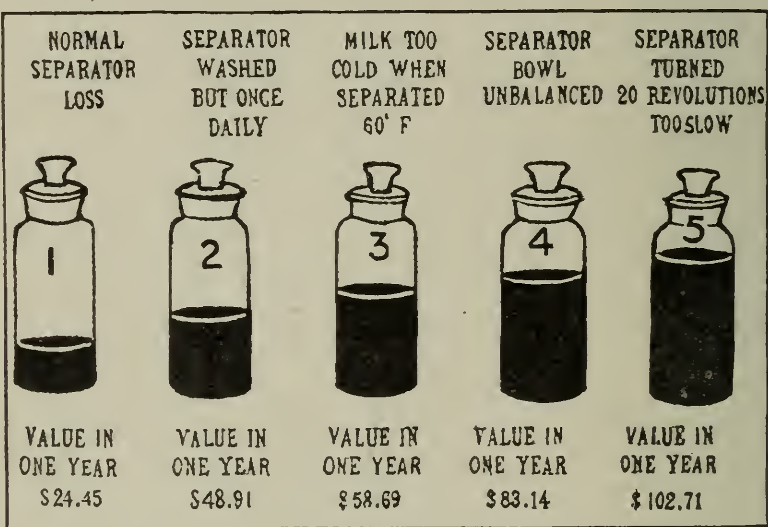
The surroundings of a separator, as well as all its parts, should be kept clean.

Immediately after separating, the cream should be allowed to cool quickly to at least 55° before adding it to the cream can.

The cream should be of such a richness that from 3 to 3½ lbs. of butter can be made from one gallon of cream, or the cream should contain from 25 to 30 per cent. butter fat. This can be regulated by the screw on the separator bowl.

Taking a rich cream for buttermaking means less labor, lower churning temperatures, and less loss in the buttermilk.

With the best separators, well cared for, there will be a certain loss of fat in the skim milk. This loss, under good conditions, has been estimated at about $25.00 a year from a herd of 40 cows. This loss will be much larger when the separator is improperly handled.



The accompanying illustration shows the los proportionately and gives the money value of the fat left in the skim milk (from forty cows) under the following conditions. (1) Normal loss. (2) Loss when separator it washed only once per day. (3) Skimming milk too cold. (4) Bowl out of balance. (5) Separator turned too slow.

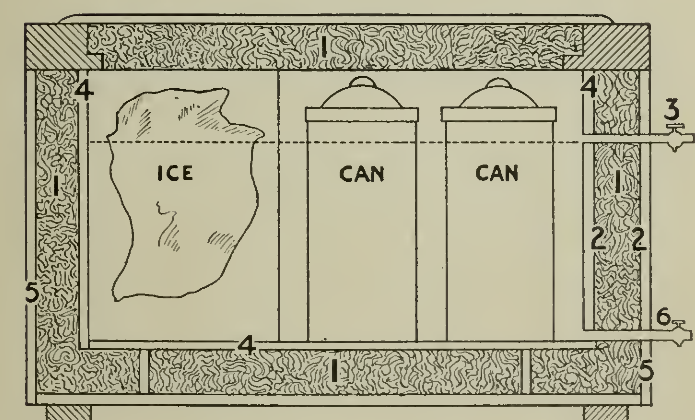
Care and Ripening of Cream.

The cream can should be large enough to hold the cream for one churning and should be provided with a cover.

A simple and cheap cream stirrer consists of a saucer shaped piece of tin about three inches in diameter with a long handle of heavy iron (tinned) fastened to the centre of it.

When collecting cream for a churning, care should be taken to keep it in a clean, cool place, and to stir it thoroughly from the bottom of the can every time fresh cream is added.

Tank for Cooling and Keeping Cream.



1—Mill Shavings 2—Two-ply damp-proof paper. 3—Overflow water-line. 4—Inner tank made of 1 inch lumber. 5—Outer shell of 1 inch lumber. 6—Bottom outlet.

The accompanying diagram illustrates an insulated tank for cooling and keeping cream. Provide an outer shell made of one-inch matched lumber, and tack on the inside thereof two ply of damp-proof paper.

Then make an inner tank (cooling tank proper) of a size to provide for a four inch space, at sides, ends and bottom, betwen outside of smaller tank and inside of larger shell. The cooling tank should be lined with galvanized iron so that it will be perfectly water-tight. Two ply of damp-proof paper should be tacked on the outside of this tank. The cooling tank should be about 22 inches deep, to hold shotgun cream cans 20 inches high. A couple of supports 4 inches high should be placed in the bottom of the larger tank, and mill shavings or dry sawdust packed in the bottom to a depth of 4 inches. Then place the cooling tank inside the larger one, and pack between the sides and ends with shavings or dry sawdust.

Have an outlet at the bottom and an overflow about 18 inches from the bottom. Make the tank large enough to hold the required number of cans 8 inches in diameter, allowing sufficient space for ice and water to keep them cold. A wire partition may be put in between the cans and the ice if desired. The lid should be of 1-inch tongued and grooved lumber, preferably insulated in the same way as the body of the tank. This saves ice. Such a tank is not affected to any extent by outside temperatures and will keep the cream cold and sweet.

A tank 22 inches by 40 inches, inside measurement, will hold 6 cans of cream. Tin cans (20 inches high and 8 inches in diameter) are better for keeping cream than crocks of any kind.

NATURAL RIPENING. In farm buttermaking cream is very often ripened naturally, that is, no "culture," or "starter" is added, but the lactic acid bacteria present in the cream are allowed to develop. This method may be used, if the flavor is satisfactory.

RIPENING BY USING CULTURES. By using a culture to assit in cream ripening, the buttermaker has more control of the flavor and is able to make a more uniform product.

A culture should be selected with care as the flavor developing in the cream will determine, to a large extent, the quality of the butter.

In Part I. on "Cheddar Cheese Making," full explanations are given for making a pasteurized skim milk culture. In farm dairy work some sour cream, sour skim-milk, or buttermilk may be used, if the flavor is alright. One method is to add one or two cups of culture to the cream can when beginning to collect cream for a churning. By doing this the sweet cream becomes inoculated with bacteria that will produce a desirable flavor.

Another method is to keep the cream sweet until twenty-four hours before churning, then heat it to 65° F. and add from one cup to one pint of culture for each gallon of cream. When the cream begins to thicken, cool it to churning temperature, or lower, and hold it at that temperature over night.

Pasteurize and Add Culture. This method of cream ripening is commonly used in creamery practice. By it we have the greatest control of the flavors, but more labor is involved.

Place the can of cream in a vessel of hot water on the stove. Bring the cream to a temperature of 160° to 165° F. Hold it at that temperature for twenty minutes, then cool rapidly to 60°, or 65°, and add a culture to ripen the cream.

Cream from cows that have been a long time in milk is sometimes difficult to churn and can be rendered churnable by means of pasteurization. Bad flavors are, to a certain extent, eliminated by this treatment.

Sometimes cream held at a low temperature develops a bitter flavor. The trouble may be kept in check by keeping the cream at a higher temperature to encourage the development of the lactic acid bacteria, which cause the souring; or, pasteurization may be resorted to.

Cream when ready for churning should have a pleasant acid taste and smell. It should be smooth and glossy and perfectly free from lumps. Cream should not be allowed to become overripe before churning. If for any reason a churning is put off for a day, the development of acid can be checked by lowering the temperature of the cream.

There will be an excessive loss of fat in the buttermilk if sweet cream is added to the ripened cream just before churning.

Although a mild flavored butter is in demand, only a limited amount of sweet cream butter is required for the Ontario markets at the present time. Those catering to this trade should cool the cream and churn at the temperature that will give an exhaustive churning.

Churning.

On many thermometers at 62° the word "Churning" is printed. If the manufacturers placed it there as a guide, many have mistaken it for a rule.

There is no standard temperature for churning, as conditions vary and many things should be taken into consideration; for example, low churning temperatures may be used when we have such conditions as rich cream, not too much in the churn, succulent feed, and cows fresh in milk.

Choose the temperature that will bring the butter in nice, firm granules in from 20 to 30 minutes.

A range of temperatures that will cover most farm conditions would be—54 to 58° F. in summer, and 56 to 64° in winter.

Always strain the cream into the churn, using a perforated tin strainer dipper. The small white specks sometimes seen in butter are caused by particles of curd which should not have been in the cream and would not have been in the churn if a strainer had been used. These particles injure both the appearance and keeping quality of the butter.

In farm dairies the barrel churn is used and having it about one-third full will make the work easier. A great many of the long churnings are caused by having too much cream in the churn. Another cause of long churning is having the cream too cold. If after churning about thirty minutes, there is no sign of butter coming, raise the temperature of the cream a few degrees. Take the cream from the churn, place the can in a vessel of warm water and stir the cream until the required temperature is reached.

With very thin cream it is difficult to gather the butter and it may be necessary to draw off part of the buttermilk and continue the work, revolving the churn slowly.

If the butter breaks and will not gather, but remains about the size of clover seed, take the temperature of the contents of the churn, add a quart or two of water a few degrees warmer, revolve the churn a few times, let it stand a minute or two, then draw off part of the diluted buttermilk, and continue the churning.

If a rich cream thickens during the process of churning and concussion ceases, add enough water at the same temperature to dilute it so that it will drop again.

Difficult churnings are caused in a number of ways but can be avoided if a little thought is given to the question.

When the granules of butter are about one-half the size of wheat grains, add a couple of quarts of water several degrees colder and continue churning until the granules are the size of wheat grains, when the churning as a rule is completed.

If butter comes with the first drawn buttermilk, it is a sign that the churning is not quite completed. Give a few more turns to the churn.

Washing the Butter.

After drawing the buttermilk, rinse the butter with two or three quarts of water before putting on the wash water.

In winter, it is necessary to temper the wash water, taking into consideration the condition of the butter and the temperature of the room. Choose such a temperature that the butter will be in a nice condition for working.

Always put in plenty of water, revolve the churn quickly about a dozen times, then allow the wash water to drain. One wash water will be sufficient, if the water comes away clear, and the butter is firm.

Salting and Working the Butter.

Salt to suit the customer, or market, using a good dairy salt. Although some markets require three-fourths of an ounce to the pound of butter, others prefer less.

The butter may be salted on the worker or in the churn.

Salting on the Worker. The lever butter worker is inexpensive and suitable for farm dairy work. It consists of a V shaped table, simple in construction, and a pole or lever for pressing the butter.

Spread the butter evenly over the worker. Sift on the salt, fold over the butter, and work, by using only gentle pressue. Other methods, such as a sliding or cutting movement, injure the texture of the butter.

If the butter is too hard or too soft, give but a small amount of working, put the butter in a suitable place until it is of proper firmness, then finish the working.

The salt should be evenly distributed, otherwise the butter will be uneven in color.

Salting in the Churn.

Have the butter in an even layer over the bottom of the churn. Sift over it one-half the amount of salt required, tip the churn forward to cause the butter to lap over. Sift on some more of the salt, tip the churn backward to cause the butter to fall over, then add the remainder of the salt. Tip the churn back and forth a few times, then put on the lid, and give a few revolutions, very slowly.

If possible, allow the butter to stand for an hour or two before working. If this plan cannot be followed, it may be worked immediately. The amount of salt required can be estimated from previous churnings. Use a little more salt than when salting on the worker, as more drains off.

Printing and Packing Butter.

All butter packages should be put up neatly and attractively. The one pound brick print is the style most used. It is filled by pressing the printer down into the butter, then cutting off the surplus butter with a ladle.

The parchment paper should be of good quality, of proper size, and should be dipped in cold water before wrapping it on the butter.

Always weigh the first print, to make sure that you are dealing fairly with your customer and with yourself, before proceeding to print the rest of the churning.

On the average farm it requires more than one churning to fill a large butter package, therefore great care should be taken in order that the flavor, color, and salt shall be uniform throughout the tub, box or crock. Line tubs and boxes with heavy parchment paper. Crocks should be well glazed, having no breaks or cracks.

As large packages are often held for some time, endeavor to make the best quality of butter for packing. Pasteurizing the cream, washing the butter twice, salting a little heavier, and working the butter twice, are means that may be employed in the manufacture of butter for packing.

The place of storage is important, and should be clean, cool, and of even temperature.

Protect the packages in transit from the sun, dust, and rain.

The object should be to get the butter to the consumer in the best condition possible.

The Care of the Dairy Utensils.

Dairy tinware should be rinsed in luke warm water, then be washed in hot water containing a little washing soda, using a brush on both the inside and outside. Next, scald thoroughly with boiling water, and place where they will drain and dry. Sunshine and fresh air are beneficial.

The churn should be scalded with boiling water, then cooled with cold water before using. After using, remove particles of butter with hot water. Wash with hot water that contains a little washing soda, then scald with boiling water. Leave the lid off when not in use.

The butter worker, ladle, and printer should be scalded with hot water, scoured with salt, and cooled with cold water before using. After using, remove any butter with hot water, scour with salt, and scald with boiling water. Place the woodenware where it will dry, but do not put it in the sun, or it will warp and crack.

FARM DAIRY CHEESE.

Bella Miller.

The making of Cheddar Cheese is fully described in another part of this bulletin, but for farm dairy work a shorter and more simple process is desired. The following method will require about four hours time, thus enabling the maker to be through by noon.

For every ten pounds of cheese required, take 100 lbs. of milk, (10 gallons). The milk should be of good quality, clean and sweet, as it is impossible to make the cheese of any better quality than the milk from which it is made.

Take the fresh morning's milk and mix it with the night's milk in a vat, or some vessel suitable for holding milk; a clean wash boiler will answer the purpose. Heat the milk to 86°F. by placing a clean can of hot water in it, or by setting the vessel containing the milk on the stove and stirring until the desired temperature is reached.

If colored cheese is wanted, use one teaspoonful of cheese coloring for each 100 lbs. of milk. Add the coloring to a dipperful of milk and mix it thoroughly with the milk in the vat before adding the rennet.

Use one teaspoonful of rennet for every 25 lbs. of milk. Dilute the rennet with a pint of cold water and mix it thoroughly through the milk by stirring with a dipper for about three minutes.

Cover the vat until coagulation takes place, which will be in about twenty minutes, depending on the ripeness of the milk; the sweeter the milk, the longer the time required.

To ascertain when the curd is sufficiently coagulated for cutting, push the forefinger into the curd at an angle of 45°, until the thumb touches it, make a slight break in the curd with the thumb, then gently move the finger forward. If the curd breaks clean across the finger without any flakes remaining on it, it is ready to be cut.

For cutting, regular curd knives are best. Use the horizontal knife first cutting lengthwise of the vat, then cut both lengthwise and crosswise with the perpendicular knife. This gives small cubes of even size.

When curd knives are not available, a long bladed knife may be used, cutting the curd lengthwise and crosswise of the vat in strips about one-third of an inch wide, then cut horizontally. By this method it is difficult to cut the curd evenly.

After the curd has been cut, it should be gently stirred with the hand, or with a small wooden rake for ten minutes before applying heat.

Heat the curd to 98°, taking about 30 minutes to do so. Continue stirring until the curd is ready for dipping; this is usually about 2¾ to 3 hours, from the time the vat was set.

When the curd becomes firm and springy and falls apart when a handful is pressed together, it is ready to have the whey removed.

The whey may be drawn off and the curd piled in one end of the vat, or the curd may be removed from the whey by means of a strainer dipper, spreading a large cheesecloth over a level butter worker and placing the curd on it to drain.

Stir the curd for 10 or 15 minutes, to allow the surplus whey to escape, before salting.

Sprinkle the salt over the curd, allowing one ounce of salt for every 25 lbs. of milk. Mix it thoroughly, and when the salt is dissolved the curd will be ready to put to press. Between 80° and 84° will be a suitable temperature to have the curd at this stage.

The cheese hoop, or hoops, should be made of heavy tin with two handles on the outside. A suitable size for home use would be 7 or 8 inches in diameter and 12 or 14 inches high. It is also necessary to have a wooden follower, which will fit nicely on the inside of the hoop.

Place a piece of cotton at the bottom of the hoop, as a temporary cap, then put the cheese cloth bandage inside the hoop. Carefully pack in the curd, fold over the end of the bandage, place on top a piece of cotton similar to the one at the bottom, then put on the wooden follower and put to press.

If a press with a screw is not available use a lever press. Take a piece of scantling 10 or 12 feet long for a lever. Place the cheese hoop on a strong box about three feet from the wall. Nail to the wall a piece of scantling, and under it put one end of the lever. Put a block of wood on top of the follower for the lever to rest on. A pail containing stones or iron may be used for the weight. Do not apply full pressure at first.

In three quarters of an hour the cheese may be taken from the press, the bandages wet with hot water, pulled up smoothly, and trimmed neatly, allowing one-half inch to lap at the ends. Cover the ends with circles of stiffened cheesecloth; over that place a piece of cotton dipped in hot water. Return the cheese to the press until the following morning, when they should be turned in the hoops and pressure continued a few hours longer.

After removing the cheese from the press, place them in a cool dry cellar to ripen.

Turn the cheese end for end on the shelf every day for a month and afterwards occasionally. These cheese will be ready for use in about 6 or 8 weeks.

To prevent the cheese moulding and to keep them from drying too much they may be dipped in hot melted paraffine wax. Another method to prevent mould is to put a double cloth on the cheese until ready for use. The mould will be on the extra cloth, leaving the cheese clean when it is removed.

SOFT CHEESE MAKING.

N. S. Golding.

In dealing with the subject of soft cheese making, only a general idea of the process can be given, as it has to be altered according to circumstances such as, variety of cheese to be made, the age of the milk, and the temperature of the room in which the cheese are manufactured.

The making of soft cheese is, practically speaking, new to this country, so that the taste for these cheese needs cultivating.

As these cheese will not keep for any length of time, being usually eaten in the fresh state, one must have a ready market for them.

The main object in soft cheese making is to retain in the cheese a high percentage of moisture, together with the fat which produces the soft texture, hence the name, "Soft" Cheese.

I shall describe how to make three kinds of soft cheese, namely, Camembert, Gervais, and Double Cream Cheese. Owing to the large number of different kinds of soft cheese, it would be impossible to describe all.

Camembert Cheese.

Apparatus Required:

½ pint bottle of rennet.
10 cc measuring cylinder (pipette).
1 Thermometer. 1 Dipper.
1 granite pail of convenient size to hold milk.
Straw mats, size 13 inches by 9 inches.
Boards 14 inches by 8 inches, ½ inch thick.
Moulds, small size, 4 inches high, 4 inches in diameter.
Moulds, large size, 5 inches high, 5 inches in diameter.

Process of Manufacture: Five pounds, or two quarts of new milk are required to make one large size, or two small size Camembert Cheese.

First add a small quantity of culture ("Starter"), if required. No culture is needed where good clean, sweet milk can be obtained. The milk is now regulated to a temperature of 86°F. and rennetted at the rate of 1 cc to 10 lbs. of milk, the rennet being diluted in ten times its volume of water, before adding to the milk. Stir the rennet in for five minutes and then stir over the surface with a wooden paddle for two minutes, as this prevents the cream from rising, which causes the cheese to break after they are made.

Cover the pail and leave till coagulation has taken place, which will be in about one hour. The correct stage is when the curd breaks easily over the finger.

Scald the required number of straw mats, boards, and moulds, then cool them in water. Place the boards on a drainer with the straw mats and moulds on top. Next ladle out with the dipper, a little curd into each mould, and repeat the same every twenty minutes, until all the curd is transferred and the moulds are full. In ladling the curd care should be taken not to break it, but obtain it in thin slices. When all the curd has been filled into the moulds, turn the cheese, by putting a straw mat and board on top and turning over.

Leave the cheese on the drainer till the whey has drained off and the cheese are firm enough to turn by hand. After turning, the cheese is left in the mould for six hours longer, when the mould can be removed, and in another six hours the cheese is ready to salt.

Salting is done by rubbing about ½ oz. of salt on the outside of each large cheese and ¼ oz. for the small size. After salting, the cheese are left on the straw mats for 12 hours, where further draining takes place. When the cheese is sold fresh, it is now ready to pack and send away.

NOTE.—The room in which the cheese are made should have a temperature from 62° to 70° F.

Gervais Cream Cheese

Apparatus required:

½ pint bottle rennet.
10 cc measuring cylinder (pipette).
1 Thermometer. 1 Dipper.
1 granite pail of convenient size, to hold milk and cream.
Moulds—2½ inches high by 2⅛ inches in diameter, in a group of six.
Straw mat and board as in Camembert Cheese.
Strips of blotting paper 2½ inches by 7½ inches.
Cloths made of duck material 27 inches square.

Process of Manufacture:

This dainty little cheese is made from a mixture of new milk and cream, the mixture being in the proportion of two parts milk to one of cream, testing 22% to 30% fat.

Take the required quantity of this mixture and bring to a temperature of 70° to 80° F., depending on the temperature of the room. Add the required quantity of culture,—no culture being needed where the milk and cream is sweet and clean. Rennet, at the rate of 1 cc to 10 lbs. of the mixture, is added, but first dilute the rennet in ten times its volume of cold water.

In about six to eight hours after the rennet has been added, the coagulation is firm enough to dip the curd with a dipper into the cloth, previously wet, which should be placed over a basin. The cloths should then be hung up by the four corners and left to drain.

After the curd has been draining for a few hours, open out the cloths and scrape down the sides to aid draining. Repeat the scraping at intervals of a few hours, until the cheese is firm enough to salt.

Turn the curd out of the cloths into a basin and salt at the rate of 1 oz. to 3 lbs. of curd. The salt, which should be fine dairy salt, must be worked in well with a spoon and the cheese left for a short time for the salt to dissolve before putting it into the moulds. The moulds should be lined with clean white blotting paper and placed on a scalded straw mat, or cloth, and the cheese pressed in with a bone spoon. The cheese may then be shaken out of the mould, wrapped, and sold.

NOTE.—Coloring may be done by adding cheese annatto, which somewhat improves the look of the cheese. Use about 1 cc coloring for each gallon of milk and cream.

DOUBLE CREAM CHEESE.

Apparatus required:

½ Pint bottle of Rennet.
½ Pint bottle Cheese Annatto.
Suitable pail for holding cream.
1 Thermometer. 1 Dipper.
10 cc measuring cylinder (pipette).
Moulds—size 2 inches by 3½ inches, 1¼ inches deep.
Cloths of duck material, size 27 inches square.
Butter muslin, grease-proof paper, boards and weights.

Process of Manufacture:

Take any quantity of cream testing about 22% fat. Make the cream at a temperature between 70° and 80°, depending on the room in which the cheese is to be set. When the cream is at the correct temperature, add the required quantity of culture, if the cream is likely to develop bad flavors. Cheese color may then be added if required. (About 1 cc of color to 10 lbs. of cream will usually give satisfaction.)

Rennet is next added at the rate of 3½ cc to 10 lbs. of cream, after diluting it in ten times its volume of cold water. Stir it into the cream.

In about six to eight hours, when the cream has thickened, ladle into dry cloths and hang up and put in a dry place. It is advisable not to put too much into one cloth, as it will be likely to develop too much acid before draining.

A few hours later open the cloths and scrape the sides to facilitate draining, then hang up again. Repeat the scraping at intervals of about three hours, until the curd is fairly firm. Then turn the curd out into butter muslin (used double thick), and salt the curd by adding 1 oz. of salt to every 3 lbs. and mixing it well into the curd. Fold the muslin over the curd, place on a board having another board and weight on top.

When the curd is ready to mould, it should be of a thick pasty consistency but not sticky. Line the tin mould with wax paper and press the cheese in with a knife or bone spoon, making the curd quite flat on top. Fold over the ends of the paper and shake the cheese out of the mould, they are then ready to be eaten; if kept, they should be put in a refrigerator or cold storage until used.

GENERAL NOTES.

The rennet and color are the same as are used in factory cheesemaking.

10 lbs. of milk or cream=approximately, 1 gallon.
1 cc =20 drops.
3½ cc =1 dram.

As regards packing for shipment, we use ordinary rice paper to wrap the cheese in, and then place them in pasteboard boxes of proper size.

In our experimental work last summer the cheese gave good results when packed in glass jars, but they are rather expensive.

When keeping the above-mentioned soft cheese they should be kept in as cold and dry an atmosphere as possible, the best temperature being just above freezing. Camembert and Gervais will keep for about seven days at a temperature of about 50° F. to 55° F, while cream cheese will keep a day or two longer.

When marketing soft cheese, generally speaking, a good trade can be found in winter, but during the summer few retail men like to handle them, as they keep for such a very short time in hot weather.

MILK AND CREAM TESTING.

G. Rickwood.

It is necessary to test milk in order to ascertain its commercial value. The percentage of the different constituents of milk, especially fat and casein, will differ considerably in different milks, and for this reason we must have some means of knowing the extent of this variation. If the milk is used for butter-making, then the fat of the milk will be in the index of its value, for it is the fat alone which is used for the manufacture of butter. In the manufacture of cheese, fat and casein are used, and in order to know the true value of milk for this purpose we must know the amount of fat and casein which the milk contains. It can readily be seen that a rapid, accurate, inexpensive and reliable test would be of inestimable value to the dairyman. For testing milk-fat, the Babcock has been found to give best results, and it is one of the necessary qualifications of a dairyman that he understand and be able to operate this test. It is rapid, in that it only takes a few minutes to make a test. Its accuracy has been vouched for by chemists who have made analysis of milk in order to compare results obtained by the Babcock Test. It is inexpensive, as the prices range from about $4 for a small sized hand machine to $25 or $30 for a large factory size machine. It is also reliable. Anyone with a little experience and using necessary precaution can obtain accurate results. The details necessary to consider in making a fat determination by the Babcock test are given briefly as follows:

1. Have the milk at a temperature of 60° to 70° F.

2. Mix the milk thoroughly by pouring it from one vessel to another, allowing it to run down the side of the vessel to prevent foaming. If the sample is not thoroughly mixed, a representative sample cannot be obtained.

3. With a 17.6 c.c. (cubic centimeter) pipette, measure this quantity of milk into a milk test bottle. To do this suck the milk into the pipette, and quickly place the forefinger over the top to prevent the milk running out. Allow the milk to drop out until the surface of the milk is level with the 17.6 c.c. mark, which is on the stem above the bulb. Now place the tip of the pipette into the top of the bottle and allow the milk to run out slowly by removing the forefinger.

4. Add to the milk in the bottle, 17.5 c.c. of commercial sulphuric acid at a temperature of 60° to 70° F, having a specific gravity of 1.82 to 1.83. Hold the bottle slanting and allow the acid to run down the side and under the milk. Use a graduate for this purpose. It is not a safe practice to use the pipette, as the acid may be drawn into the mouth, causing severe burning.

5. Mix the milk and acid thoroughly by giving a gentle rotary motion. Do not close the neck of the bottle while mixing.

6. Place the bottles in the machine, making sure they are properly balanced and whirl at full speed for five minutes. The speed is indicated on the machine. Do not exceed the speed so marked.

7. Add hot water at a temperature of 140° to 160° F., to float the fat into the neck of the bottle.

8. Whirl again for two minutes.

9. Remove the bottles from the tester and set in a water bath, which reached to the top of the fat, at a temperature of about 140° F., for a few minutes before taking the reading.

THEORY OF THE BABCOCK TEST.

A 17.6 c.c. pipette will deliver practically 17.5 c.c. of milk. 17.5 c.c. at an average specific gravity of 1.032=(17.5 x 1.032) 18.06 grams. 18 grams is the weight of milk required for a test. The volume of the neck of the milk test bottle between zero and 10 is 2 c.c. 2 c.c. of melted fat, at a specific gravity of .9=(2 x .9)=1.8 grams. The relation of 1.8 is to 18, as 1 is to 10, or 10 per cent. of the original volume of milk. This is why that weight or volume of milk is taken and why the neck of the bottle is divided into 10 equal parts.

NOTES.

1. Always make sure that the bottles and pipettes are clean before using.

2. Be careful to get the exact measurement of milk for the test.

3. If the milk is covered with thick cream, or is partially churned, it may be prepared for sampling by heating, then pouring from one vessel to another. Heating to 100° to 110° is sufficient for this. When it is thoroughly mixed, take the sample as quickly as possible and cool to about 60° F. before adding the acid.

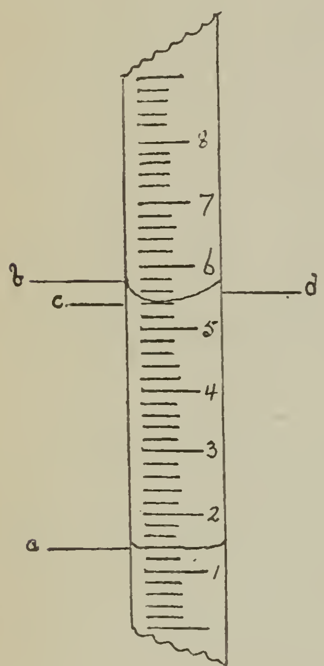
4. If the sample is frozen, warm both the frozen and liquid parts and mix thoroughly. Never test a sample immediately after being drawn from the cow. Allow to stand at least one hour.

5. If the milk is sour or thickened, it is necessary to add an alkali to dissolve the casein. A small amount of strong ammonia or concentrated lye will answer, stirring and mixing it well until the sample has become liquid again.

6. The quantity of acid must vary with its strength. If it is too strong use less, if too weak use more; but if the acid is very much too weak, or too strong, it should not be used. Weak acid is preferred to strong acid. Carboys or bottles containing acid should be stoppered with glass or earthenware stoppers, as the acid is very corrosive, and will burn or eat stoppers made of organic material or metals.

7. Avoid pouring the acid directly on the milk. After the acid is in the bottle there should be two distinct layers—milk on top and acid underneath, with no charred material in between. Do not allow it to remain long in this condition.

8. The water added to the test bottles should be soft or distilled. If hard water is used the addition of about 8 or 10 cubic centimeters of sulphuric acid to the gallon will soften it. This will prevent foam above the fat.



9. It is advisable to use a pair of dividers or compasses for measuring the fat column. The points should be placed at the upper and lower limits of the column to get the length, and then place one point at zero, and the position of the other point will show the percentage of fat in the sample tested. The accompanying illustration will show the correct method of reading milk tests when the fat is at 130° to 140° F. Correct reading A to B, not C or D. For cream, read from A to C.

10. Burnt or cloudy readings may be caused by:—

a. Having the temperature of the milk or acid too high.

b. Using acid which is too strong, or using too much acid.

c. Allowing acid to drop directly on and through the milk.

d. Allowing the milk and acid to stand too long before mixing.

11. Light or cloudy readings or floating particles of curd are usually caused by:—

a. Temperature of milk or acid too low.

b. Using too weak an acid, or not enough acid.

c. Careless mixing or insufficient shaking to unite the milk and acid thoroughly.

12. The accuracy of the test bottles and pipettes used in Canada is provided for in an Act of the Dominion Parliament known as the Milk Test Act, which requires that all bottles and pipettes shall be tested for accuracy of graduation by the Standards Branch, Department of Inland Revenue at Ottawa, and that each bottle and pipette shall be marked at the time of testing with the letters G. R. (or first letter of reigning sovereign) inside the crown.

13. Carefulness and exactness are absolutely essential in every detail if accurate results are obtained in milk testing.

14. Sulphuric acid weighs about 18 lbs. to the gallon, and costs 2½ to 4 cents per lb. A gallon will make 250 to 260 tests.

15. To find the correct average test of the milk from a herd of cows, find the total pounds of fat and total pounds of milk, multiply the pounds of fat by one hundred and divide by the pounds of milk. There is often considerable difference between the correct average test found in this way, and the test obtained by adding the different tests together and dividing by the number of cows tested.

CORRECT AVERAGE TEST.

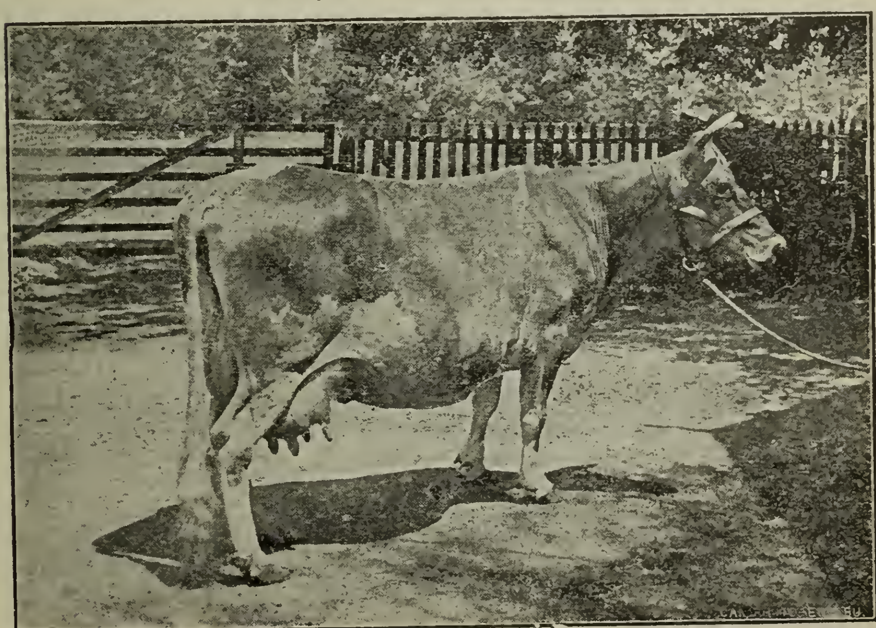
Example:

Cow No. 1.	340 lbs. milk testing, 4.3%=14.62	lbs. fat.
Cow No. 2.	460 lbs. milk testing, 4.0%=18.40	lbs. fat.
Cow No. 3.	760 lbs. milk testing, 3.0%=22.80	lbs. fat.
Cow No. 4.	620 lbs. milk testing, 3.5%=21.70	lbs. fat.
Total...	2,180 lbs. milk. 77.52	lbs. fat.

If 2,180 lbs. milk contain 77.52 lbs. fat,
then 100 lbs. milk (per cent.=100) $\frac{100 \times 77.52}{2{,}180}=3.55\%$.

INCORRECT AVERAGE TEST.

4.3 plus 4=3.0 plus 3.5=14.8 divided by number of cows=$\frac{14.8}{4}$=3.7%



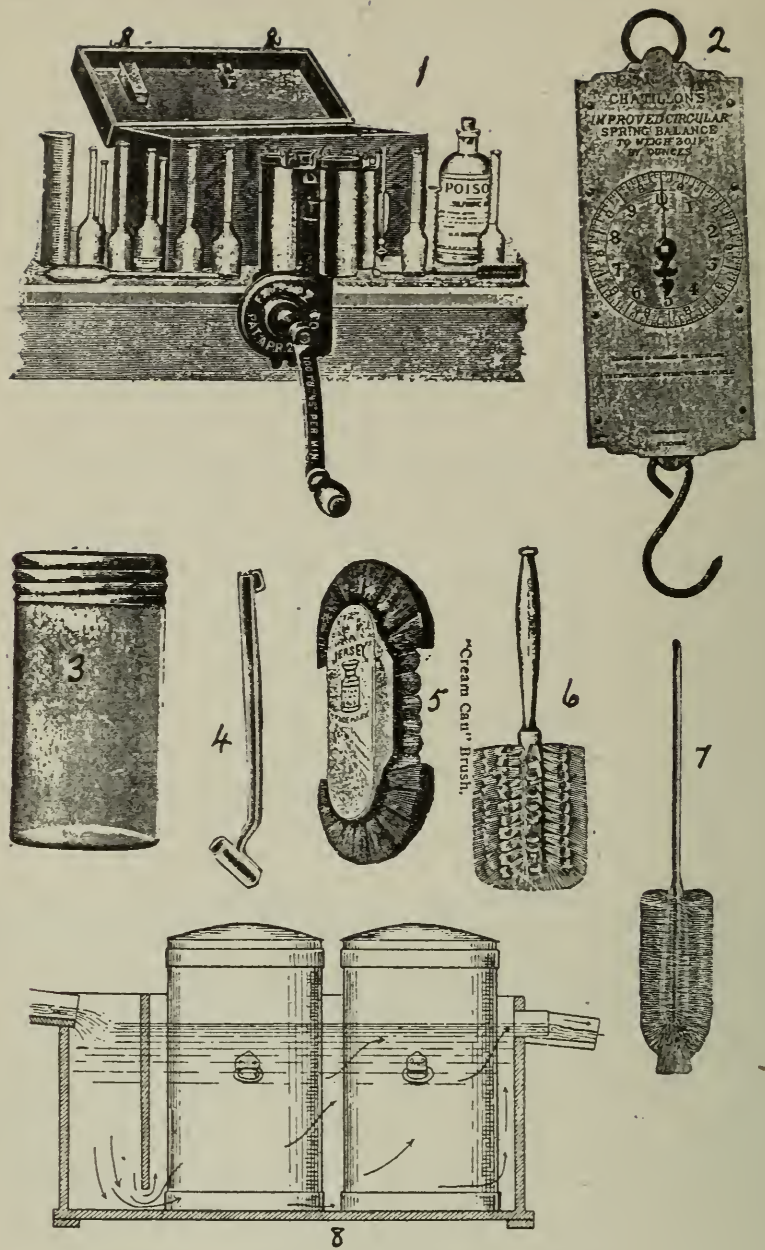


Figure 1—4-bottle Hand Babcock Test Outfit.
" 2—Spring Balance.
" 3—Composite Sample Jar.
" 4—Sample Dipper.
" 5—Can Brush.
" 6—Cream-can Brush.
" 7—Tube or Sample-bottle Brush.
" 8—Tank for Cooling Milk.

Cream Testing.

The percentage of fat in cream can be obtained as easily and as accurately by the Babcock test as the percentage of fat in milk, and this is one reason why the oil test is being replaced by the Babcock test in cream-gathering creameries.

Cream test bottles, with specially graduated necks to contain 30, 40 or 50 per cent. of the quantity taken are used.

The same weight of cream as milk is necessary, namely, 18 grams, but since cream has a less specific gravity, or is lighter than milk, due to the larger proportion of fat, it is necessary to use more than 17.6 cubic centimeters. Sweet cream testing 25% fat has a specific gravity similar to that of water, so that if an 18 c.c. pipette is used and the pipettes are rinsed with a small quantity of water, the weight of the cream will be nearly 18 grams. Very rich cream, ripe, or gassy cream, or cream fresh from the separator, cannot be measured with an 18 c.c. pipette and have 18 grams in weight. It is, therefore, necessary to weigh such cream to get accurate samples. Several satisfactory cream scales are on the market. The Torsion, Fairbanks, and Philadelphia are classed among those giving satisfaction.

No definite amount of sulphuric acid can be given for testing cream, as some samples seem to require more than others in order to get satisfactory results, but as a rule less than 17.5 c.c. are required. A good guide is to notice the color of the mixture of cream and acid. It should be a dark chocolate color, but not black.

In milk testing the bottles are whirled for five minutes before adding the water, but in cream testing this is not practised, as it usually results in cloudy readings.

The usual method is to add hot water immediately after mixing the cream and acid and whirl for five minutes; or better still, add the water at two different times, filling up to the neck of the bottle and whirling four minutes, and then filling nearly to the top and whirling again for two minutes. The fat column should be a bright golden color.

Cream tests should be read at a temperature of 130° to 140° F., and the fat measured to the bottom of the meniscus or curve at the top of the column. Errors due to the expansion of fat amount to from one-half, to one per cent., if the reading is taken immediately after whirling in a steam tester.

SELECTING DAIRY COWS.

The following record sheets are suggestions of what might be used in keeping dairy records. These forms will be supplied free to those who apply to the Dairy Branch, Ontario Department of Agriculture, Toronto. On Form No. 2 can be kept the record of each cow for a number of years.

Record blanks and herd record books are furnished free upon application to Mr. J. A. Ruddick, Dairy Commissioner, Ottawa.

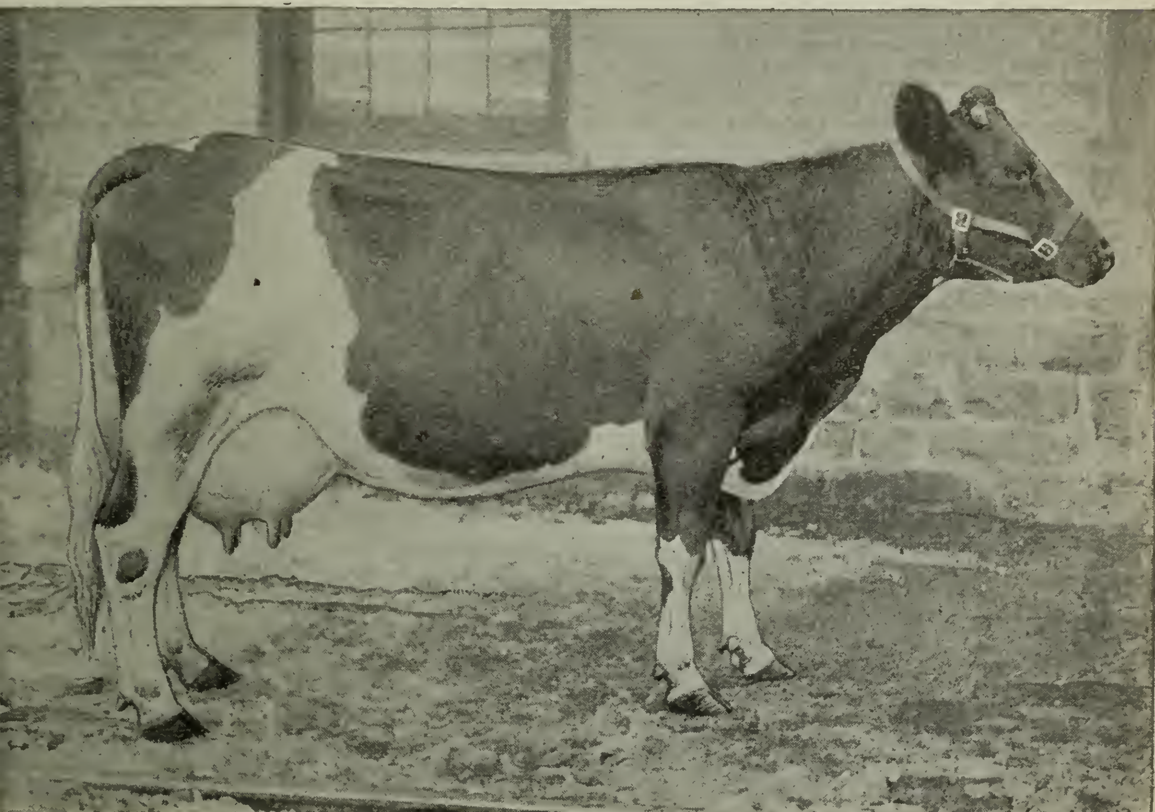
There is no method by which cows can be selected so well as by test. "It is quite practicable for individual farmers to test their own herds, but co-operation through cow-testing associations makes the work easier and cheaper, and at the same time more useful, inasmuch as each member of an association has the information relating to other herds as well as his own." There are now over two hundred cow-testing associations in the Dominion. Complete information regarding the organization and work of these can be obtained by addressing the Dairy Commissioner, Ottawa.

After the actual *weigh* and *test* method of selecting dairy cows, comes the selection by points. If a man has no records to follow, he must select by type and conformation.

There are five essential points to the make-up of any highly productive cow. These are constitution, capacity, nervous temperament, blood circulation, and ability to use her feed so as to yield the greatest amount of milk and butter-fat. *Constitution* is indicated by large nostrils, admitting a large supply of oxygen to the lungs for the purification of the blood. Great depth at the heart with a well sprung fore-rib is essential to a strong constitution. A cow, shallow in the chest and heart and with a poorly sprung rib, cannot give a good yield for any extended period, and she will tend to reproduce weaklings when bred. The dairy cow that is giving a heavy flow of milk produces several times more food for human consumption than a beef animal will do in the same time. When we consider that in this Province she is stabled for so many months, very often in poor quarters and exposed to various disease germs, it is easy to see that a strong constitution is essential.

Capacity is indicated by a large mouth, indicative of a good feeder, good length from the shoulders to the hooks, and with well sprung deep ribs, giving plenty of room for the handling of large quantities of food. Not only should the cow have room for plenty of food, but she should be able to thoroughly digest this food, for undigested food is worse than waste. This ability can only be determined by certain outward signs, such as quality of skin and hair. The skin should be soft and pliable, but not too thin, and the hair fine and silky. A heavy, hard, stiff skin, with harsh hair, indicates low power of digestibility and a tendency to unthriftiness.

Nervous temperament in a cow does not mean a high state of nervousness or irritability, but that the animal has nerves such as make the various parts active, giving tone, vitality and activity to the many parts of the body. This important characteristic is judged by the size and character of her eye. Her face should be broad between the eyes and well disked. The eye should be prominent, bright, clear and mild, but not at all sluggish looking. The prominence and openness of the joints of the backbone is a very important indication. The backbone should be covered with no surplus flesh, for if it is, the cow is using to fatten herself that which should go into the milk pail. The ribs should be wide in themselves, and should have plenty of width between them. This



TYPICAL HOLSTEIN.

can be measured by inserting the fingers between the ribs. Persistency in chewing the cud is a very important point with dairy cows.

The *blood circulation* in the dairy cow, after absorbing the food, passes back to the hindquarters, down through the udder and on through the milk veins, entering the abdomen again through the milk wells. The escutcheon, or that part just above the rear of the udder where the hair grows upward or runs opposite to that on other parts of the body, is supposed to be an indication of the production of the cow. The blood passing to the udder, it is thought, nourishes this, so that the length and spread of it is a measurement of the blood flow in this direction. A surer indication, however, is the size, length and crookedness of the milk veins, and the number and size of the milk wells. All cows have two milk veins, a few have three. These veins should extend far forward, be large, and enter the abdomen through large wells. The size of the wells is one of the best indications of the producing power of a dry cow, as the veins are contracted at this period while the wells retain their normal size. The udder should be long, broad and of splendid quality. The texture of the udder is a most important point. When empty, it should hang in folds of soft, pliable, loose elastic skin. It should be full behind and attached high. If a plumb-bob is dropped from the pin bone it will fall just behind the udder, and one dropped from the hook bone will fall just in front. This development of the fore udder should receive special attention. The teats should be evenly placed, and be of good size. Incurving thighs are most favorable to the greatest udder development.

The extreme *angular form* approaching a wedge shape when viewed from in front, *i.e.,* narrow at the shoulders, on top of the shoulders, and broadening out toward the hindquarters and from the shoulders down, thus giving plenty of chest development, is an outstanding feature of dairy type. There should be a characteristic feminine appearance. The face should be lean and long, with a rather quiet expression, and the forehead broad, giving plenty of width between the eyes. The ears should be of fair size, fine in texture and with a yellow secretion inside. The neck should be fine, of medium length, with a clear throat and light dewlap. There should be no thickening of the neck, no crest on it, and no heaviness of the forequarters.

The bone should be of fair weight and of fine quality. It should have no appearance of weakness and yet should not be coarse.

The hooks and pin bones should be wide apart, and there should be plenty of length between them, with a marked falling away of the flesh on this part. The tail-head should be high. Some think this indicates vigor, but it seems more likely that this conformation finds its strongest point in that it should be unfavorable for the premature birth of calves.

A score card, as used at Farmers' Institute meetings and short courses, is appended. It can only be made use of in gaining some idea of the relative importance of the various parts of the animal. After this has been acquired the score card is not of great value.

Form No. 1

DAIRY HERD RECORD

Owner of Herd..........................Address..........................

Record for Month of..

POUNDS OF MILK GIVEN DAILY

Date of Month	Time	NAMES OR NUMBERS OF COWS						% Fat	Total for Day
		1	2	3	4	5	etc.		
.... 1	A.M. P.M.	......	......	......	......	......	......	......	....
.... 2	A.M. P.M.	......	......	......	......	......	......	......	....
.... 3	A.M. P.M.	......	......	......	......	......	......	......	....
.... 4	A.M. P.M.	......	......	......	......	......	......	......	....
.... 5	A.M. P.M.	......	......	......	......	......	......	......	....
.... 6	A.M. P.M.	......	......	......	......	......	......	......	....
.... 7	A.M. P.M.	......	......	......	......	......	......	......	....
.... 8	A.M. P.M.	......	......	......	......	......	......	......	....
.... 9	A.M. P.M.	......	......	......	......	......	......	......	....
..........10	A.M. P.M.	......	......	......	......	......	......	......	....
..........11	A.M. P.M.	......	......	......	......	......	......	......	....
..........12 etc.	A.M. P.M.	......	......	......	......	......	......	......	....
Total.....	......	......	......	......	......	......	......	......	Total for Month ....

MILK SHEET.—A Form for keeping daily records of a dairy herd. Regular full size forms are supplied by the Dairy Branch of the Provincial Department of Agriculture in the hope that many of the farmers will be induced to keep records of the amount of milk given daily by each cow. Many when they realize the advantages of such records will, no doubt, be induced to keep more complete records in accordance with the rules and regulations governing Cow Testing Associations. Give your local Dairy Instructor or District Representative the results of your record. Additional Sheets may be had by applying to Geo. A. Putnam, Director of Dairying, Department of Agriculture, Toronto, Ont.

Form No. 2

Permanent Record for Individual Cow

NAME ....

Herd No.....................   Registry No...................

SUMMARY OF MILK AND BUTTER PRODUCTION

For the Month of	1913			1914		etc.
	Lbs. Milk.	% Fat.	Lbs. Fat.	Lbs. Milk.	% Fat.	Lbs. Fat.
January	....	....	....	....	....	....
February	....	....	....	....	....	....
March	....	....	....	....	....	....
April	....	....	....	....	....	....
May	....	....	....	....	....	....
June	....	....	....	....	....	....
July	....	....	....	....	....	....
August	....	....	....	....	....	....
September	....	....	....	....	....	....
October	....	....	....	....	....	....
November	....	....	....	....	....	....
December	....	....	....	....	....	....
Yield for Period	....	....	....	....	....	....
Number Days in Milk...	....	....	....	....	....	....
Record 365 Days	....	....	....	....	....	....

SCORE CARD

FOR USE AT

FARMERS' INSTITUTE MEETINGS

(Same as used at Agricultural College, Guelph)

DAIRY CATTLE

SCALE OF POINTS	Possible Score	Students' Score	Corrected Score
A. **GENERAL APPEARANCE**: 16 points.			
Estimated Weight.................**lbs.**			
Form, wedge-shaped, as viewed from front and top; straight top line, and great depth of barrel	5	....	....
Quality, hair, soft and fine; skin, of medium thickness, mellow and elastic; secretion, yellow; bone, fine and clean	6	....	....
Style, active, vigorous, showing strong character; temperament, inclined to nervousness, but not irritable or vicious	5	....	....
B. **HEAD AND NECK**; 8 points.			
Muzzle, broad and clearly defined; mouth and nostrils large	1	....	....
Eyes, large, prominent, clear and placid	1	....	....
Face, lean and somewhat long, fine between muzzle and eyes	1	....	....
Forehead, broad	1	....	....
Ears, of fine texture, and medium size; secretion abundant	1	....	....
Neck, thin, rather long, fine and clean at junction with head; no noticeable amount of dewlap	3	....	....
C. **FOREQUARTERS**; 6 points.			
Withers, lean and sharp; vertebræ, somewhat higher than blades...	2	....	....
Shoulders, light, good distance through from point to point, but sharp on top; smoothly blended into body	2	....	....
Legs, well apart, straight and short; shank, fine and smooth	2	....	....
D. **BODY**; 22 points.			
Chest, deep, full between and back of fore-legs, no depression behind shoulder blade	6	....	....
Ribs, long, broad, and wide apart; well sprung, giving a large, deep barrel	10	....	....
Back, lean, straight and open-jointed; sharp chine and broad loin...	6	....	....
E. **HINDQUARTERS**; 13 points.			
Hocks, wide apart.....	2	....	....
Rump, long and wide	3	....	....
Pin Bones, high and wide apart	1	....	....
Thighs, thin	2	....	....
Legs, straight and set well apart; shank, fine and smooth	2	....	....
Escutcheon, spreading over thighs and extending far upwards	2	....	....
Tail, long and fine, terminating in a switch of fine hair	1	....	....
F. **MILK VESSELS, ETC.**; 35 points.			
Udder, long, wide, deep, but not pendulous, firmly attached, extending well up behind and far forward; quarters, even and free from fleshiness	25	....	....
Teats, large uniform, and evenly placed	5	....	....
Milk Veins, large, long, crooked and branching	3	....	....
Milk Wells, large and numerous	2	....	....
Total	100	....	....

Name..

Animal............................Date..................................

BULLETIN 207.] DECEMBER, 1912.

Ontario Department of Agriculture.

ONTARIO AGRICULTURAL COLLEGE

Ice Cold Storage on the Farm

R. R. GRAHAM.

WHAT COLD STORAGE MEANS.

THE GENERAL MEANING.

The term "cold storage" refers chiefly to the preservation of our perishable products, such as fruit, milk, butter, meat, eggs, vegetables, etc., from premature deterioration and decay, in cold air chambers cooled by ice or some other refrigerating means. It is also associated with the curing of cheese, moth-proof storages for woollens and furs, and many other processes. In fact, the term "cold storage" involves so much nowadays that a large volume would have to be written in order to explain its whole meaning, and its various applications and uses. I wish to emphasize, however, that cold air alone is not "cold storage" in all cases. In most instances of storage it is very essential that the cold air be very pure and sweet, of the proper humidity or degree of moisture, and it should circulate freely throughout the storage chambers. And ventilation, or the renewal of the air in the storages, should be well provided for, especially where large quantities of various classes of goods are stored for any length of time. "Cold storage," then, involves means of controlling not only the temperature, but the humidity, purity, circulation and ventilation of the air within the storage rooms. The degree of these factors varies to a certain extent for the different products and conditions of storage, but "cold storage" proper always involves them all.

WHAT IT MEANS TO THE FARMER.

Cold storage in relation to the farmer means chiefly the use of ice to preserve his perishable products in good condition for such short periods as he may be required to hold them for his own family use, for disposal on the markets or otherwise. An abundant supply of good cold water from a well or spring is very valuable for keeping milk on the farm, or an underground cellar which keeps fairly cool even in the hottest weather serves well in the preservation of perishable products for a few days. These means, then, play no inconsiderable part in cold storage on the farm; but ice is the great factor, for there are many times when its use is indispensable for preventing great losses in farm produce.

THE GENERAL VALUE OF COLD STORAGE.

For the farmer to fully appreciate the need of cold storage in connection with his own business he must understand its place and value in commerce. The following are its chief benefits:

(1) To preserve, or at least lengthen, the life of our perishable products, thus lessening the loss due to their otherwise premature deterioration and decay before consumption.

(2) To increase the length of time during which these products may be used for food, thereby greatly encouraging production.

(3) To make it possible for our people to enjoy a greater variety of food throughout the year.

(4) To make it possible to transport perishable products long distances by railway or steamboat successfully.

(5) To provide the markets with a more uniform supply of perishable goods throughout the year, and thus keep prices more constant from season to season.

(6) To enable the producer to market his products at will; for if the markets are at any time over supplied he can hold his goods until the market conditions improve.

(7) And lastly, it makes it possible for the farmer to supply the market, the customer or the factory with a better article than he could without cold storage.

SOME REASONS WHY OUR FARMERS OUGHT TO STORE ICE AND PROVIDE FOR COLD STORAGE.

From the perishable nature of many products of the farm it is quite apparent that our farmers should store ice and provide for cold storage. We give you herewith a few of the most common advantages:—

(1) To cool the milk and cream;

(2) To preserve butter, eggs, meats and fruits;

(3) To provide for a greater variety of food;

(4) To enable the farmer to market his products at will;
(5) To supply the household refrigerator;
(6) To provide for home-made ice cream and other refreshing deserts;
(7) For use in case of sickness.

The foregoing statements comprise the chief benefits of cold storage to our country and its people; and practical farmers cannot fail to see that they may have a large share in these benefits, if they will make use of it so far as it is possible on their farms, or by co-operative cold storages for the handling and marketing of their perishable products. Each year seems to introduce some new use or application of cold storage in commerce, but in connection with the farms of our country its use is not developing as rapidly as it should. It is believed, however, that it will become more general on the farm in the very near future, as its value is more generally and fully understood.

SOME PROPERTIES OF ICE.

Ice is a crystalline solid formed by the freezing of water. Absolutely pure and distilled water under standard atmospheric pressure freezes or solidifies at a temperature of 32 degrees Fahrenheit or Zero Centigrade. The freezing point of a substance is influenced by the presence of salts, by solids or any foreign matter, and also by pressure to a very slight degree. Common salt brine at its maximum density will not freeze until a temperature of 7 degrees below zero, Fahrenheit, is reached, and a certain strength of calcium chloride brine will not freeze even at 50 degrees below, Fahrenheit, and in the case of fruit juices the freezing point is about 5 degrees below 32, because these juices are not pure water, but a solution of substances in water. Ice always forms on the surface of a body of water and remains there because it is lighter than water. Its specific gravity is .92, that is, its weight is approximately 9-10 of water. Water in freezing expands about 1-10, therefore 1 cubic foot of water produces 1 1-10 cubic feet of ice. A cubic foot of water weighs 62 1-2 lbs.; a cubic foot of ice 92-100 of 62 1-2, or about 58 lbs., and 1 ton of solid ice occupies 35 or 36 cubic feet of space; but as stored in the ice-house it is reckoned that 42 to 50 cubic feet are required for the storage of a ton. The temperature of ice in the very cold weather drops below the freezing point, and twice as rapidly as the water did before freezing, because the capacity of ice for heat is only one-half of what it is for water. As the temperature drops below zero, ice contracts, and this is why large bodies of ice crimple and crack in the very cold weather. As to the strength of ice, it is calculated by Hiles in his book, "The Ice Crop," that "two inches in thickness will usually bear a man, four inches a horse, and ice five inches thick is generally safe for a team of horses and a loaded wagon, weighing two tons. Eight inches in thickness will bear up 150 lbs. per square foot of surface if distributed over an entire field; ten inches in thickness will support 250 lbs. per square foot of surface. It is usual to estimate that ice eighteen inches thick will support a railway train." The melting point of ice is the same as the freezing point of water, namely, 32 degrees Fahrenheit, or zero Centigrade. When 1 lb. of ice melts 142 units of heat are rendered latent or lost so far as temperature is concerned. This brings me to the next topic, the refrigerating or cooling power of ice.

THE REFRIGERATING OR COOLING POWER OF ICE.

The cooling by ice is due chiefly to its melting, and the faster this process takes place the sooner the desired temperature is reached, provided the quantity of ice is large enough. Melting is the physical change of the solid to the liquid form of matter, and this change occurs at a definite temperature for each substance. Water freezes at 32 degrees Fahrenheit, or zero Centigrade, and ice melts at these points. This process of melting abstracts or renders latent a definite quantity of heat, and it is the loss of this heat in the melting of ice that gives it its refrigerating value, for cold is the absence of heat. This heat which is used up in the melting of ice is called the *latent heat of fusion of ice*, and it amounts to 142 heat units per lb. of ice. The practical unit of heat is the British Thermal Unit (B.T.U.), or that quantity of heat which will raise the temperature of 1 lb. of water through 1 degree Fahrenheit. When 1 lb. of ice changes to water the heat that is abstracted is equivalent to what would be required to raise 1 lb. of water 142 degrees Fahrenheit, or required to raise 142 lbs. of water 1 degree Fahrenheit. This quantity of heat is considerable, and accounts for ice being a better cooling agent than ordinary cold water, or even water at 32 degrees Fahrenheit. One pound of ice in melting has therefore 142 times the cooling value of 1 lb. of water in passing from 32 degrees to 33 degrees Fahrenheit, or the refrigerating value of ice as compared with an equal weight of cold water at 32 degrees Fahrenheit, is as 142 is to 1. In respect to the cooling of milk it is the practice to reckon that 10 lbs. of ice have about the same refrigerating value as 100 lbs. of cold well water, that is to say, 10 lbs. of ice and 100 lbs. of cold water have the same effect in cooling warm milk as 200 lbs. of cold water.

RELATION OF THE COOLING POWER OF ICE TO THE COMMON PRODUCTS OF STORAGE.

If we know the specific heat of a substance, that is, the amount of heat required to raise the temperature of a unit mass of the substance one degree, relatively to water, we can determine the quantity of ice necessary to cool a definite weight of that substance to any desired temperature. In the table below is given the quantities of some common products that are cooled 35 degrees by 100 lbs. of melting ice. The temperatures, 75 degrees before storage, and 40 degrees in storage are not used as being correct for all cases, but as being convenient and well within the cooling power of ice. Water is included merely for the sake of comparison as the specific heat of all substances is relative to it.

Name of Product	Specific Heat	Probable temp. before storage	Temp. in storage, say	Fall in temperature	The number of lbs. of each product cooled 35 degrees Fahrenheit by 100 lbs. of ice
Water......	1.00	75	40	35	428.5
Skim milk..	.95	75	40	35	451.05
Fruit (fresh)	.92	75	40	35	465.8
Vegetables..	.91	75	40	35	471.2
Milk	.90	75	40	35	476.1
Cream......	.84	75	40	35	510.12
Fish (fresh).	.82	75	40	35	522.6
Poultry.....	.78	75	40	35	549.4
Eggs	.76	75	40	35	563.9
Beef (fresh).	.68	75	40	35	630.2
Mutton	.67	75	40	35	639.6
Butter......	.64	75	40	35	669.6
Cheese......	.64	75	40	35	669.6
Pork (fresh).	.51	75	40	35	640.3

Note:—In these results observe that water is the hardest to cool, then the fruits and vegetables, which contain a large percentage of water, and easiest of all is the pork. Since the fruits and vegetables cool so slowly they are, therefore, more apt to spoil under normal conditions, and require to be well cared for early after harvesting. The water in them holds the heat and renders cooling very slow. These results indicate approximately the quantity of ice necessary for the cooling of the above amount of these products, provided that the heat is abstracted from the products alone, and therefore this table serves as a rough guide in calculating the amount of ice required for any particular case. In most of our small ice storages there is a loss of 25 per cent. to 50 per cent. cooling power due to poor insulation.

THE STORAGE OF ICE ON THE FARM.

The Ice-House a Necessity.

The most satisfactory way to keep ice is in a good ice-house, designed and built specially for this purpose. The building may consist of only one room filled with ice, or it may be a combination of ice-house and refrigerator, or ice-house and milk-room, or all combined, but in any case there must be a suitable place for the ice. If the farmer has any such building he will get good results, and will be far more likely to store ice every year, than if he has not a proper storage for it. Those who now and again put away a little ice in the winter in some makeshift place as in a bin under the shed, or in the rear of the woodshed, under a lean-to, or in some dilapidated little old building, are not very likely to have very much ice when they come to use it, especially towards the middle of the summer, or later. When they need it most, it is gone.

The Essentials of a Good Ice-House.

(*a*) A Favorable Site. This should be out of the sun as much as possible, and convenient to the house and the dairy.

(*b*) Adequate Drainage. If the ice-house is built on a loose or gravelly soil, natural drainage will be sufficient, but if on a heavy, compact soil, artificial drainage must be provided for as follows: Make an excavation the size of the inside dimensions of the house to a depth of 8 or 10 inches; below the bottom of this, and lengthwise, lay a row of 3-inch tile at a depth of at least 1½ feet, and fill the trench with stones and gravel. The floor of the excavation should slope somewhat on both sides towards this drain so that all the water may get to it readily. Nearly fill the excavation with cobble stones, and finish with a layer of coarse gravel or cinders. The tile drain should lead to a good outlet, and the outlet should be well protected by some kind of screen. (See Fig. 4 and 5.)

(*c*) Free Circulation of Air Over the Ice. Provision should be made for the free circulation of air through the top of the ice-house, otherwise the enclosed stagnant air, becoming warm in contact with the hot roof in summer days, would conduct a great amount of heat to the ice below, and cause a big waste. This is a common neglect in the storage of ice. The remedy is to put a latticed opening or louvre in each gable and a ventilator on the roof. It is also advisable to leave the eaves open beneath, and the wall open for about 6 inches below the plate. By means of all these openings the air can freely pass through the top of the building, and yet no rain or storm can get in to wet the covering of the ice.

(*d*) Good Insulation. It is very necessary, in order to keep ice well. to surround it with plenty of some non-conducting material which can be readily obtained at a reasonable cost. The insulation of an ice-house consists of the wall itself and the packing about the ice; the chief function of the former being to ward off the direct rays of the sun and the weather and to check the flow of heat towards the ice; that of the latter to preserve the ice from direct contact with the warm air. Sawdust of a good quality, that is, dry and clean, is very satisfactory for packing around the ice; planer shavings are still better, but they are not always easily obtained, and they cost far more than the sawdust. Wild hay, straw and chaff may be used if nothing better is available. If sawdust is used, there should be at least 1 foot of it well packed in between the mass of ice and the side walls, 2 feet under the ice and plenty of it over the top. As the sawdust next to the walls settles, some of that on the top should be packed in from time to time. Wild hay is fairly satisfactory for covering the ice on top, being much used where sawdust is not very plentiful, but a greater depth of it is neecssary. If plenty of packing material is used it is not very necessary to insulate the wall particularly; two thicknesses of boarding with insulating paper between constitute a very good wall. This question is dealt with more fully under construction of ice-houses.

(*e*) Banking. The bottom of the house should be well banked with earth, or cinders, to prevent the warm air getting in beneath to melt the ice.

FORMS OF ICE-HOUSES.

The Ice Pit.

The oldest method of storing ice is to pack it away under the ground in a cave or pit. This was a popular method in the long-ago days with the Romans, and is still used in some places. As the drainage is usually poor, and considerable labor is involved in getting the ice out, the method is not very practicable. The waste is large. The sides and bottom of these pits are lined with boards, stone or brick. (See Figs. 1 and 2.)

Stacking.

The simplest and cheapest way to store ice above ground is by "stacking" it. Select a cool, well drained spot on a slope facing the north, put down a few old rails and boards, cover with straw, wild hay or sawdust to a depth of one to two feet. On this foundation place the blocks of ice, packing them together as closely as possible, and if it is freezing weather the cakes may be made almost one solid mass by throwing water over the ice from time to time as the stacking is carried on. It will keep much better in this solid form, as the air cannot get through it so well, but it will be somewhat more difficult to remove for use. Cover the stack of ice with plenty of straw or wild hay and place some cheap

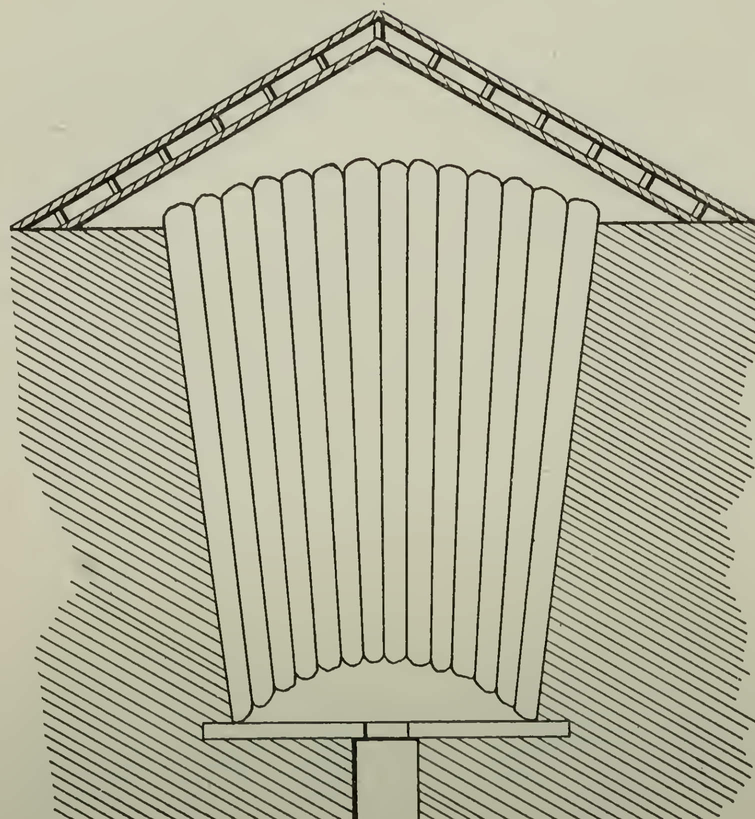


Fig. 1.—The Old Style of Ice Cellar.

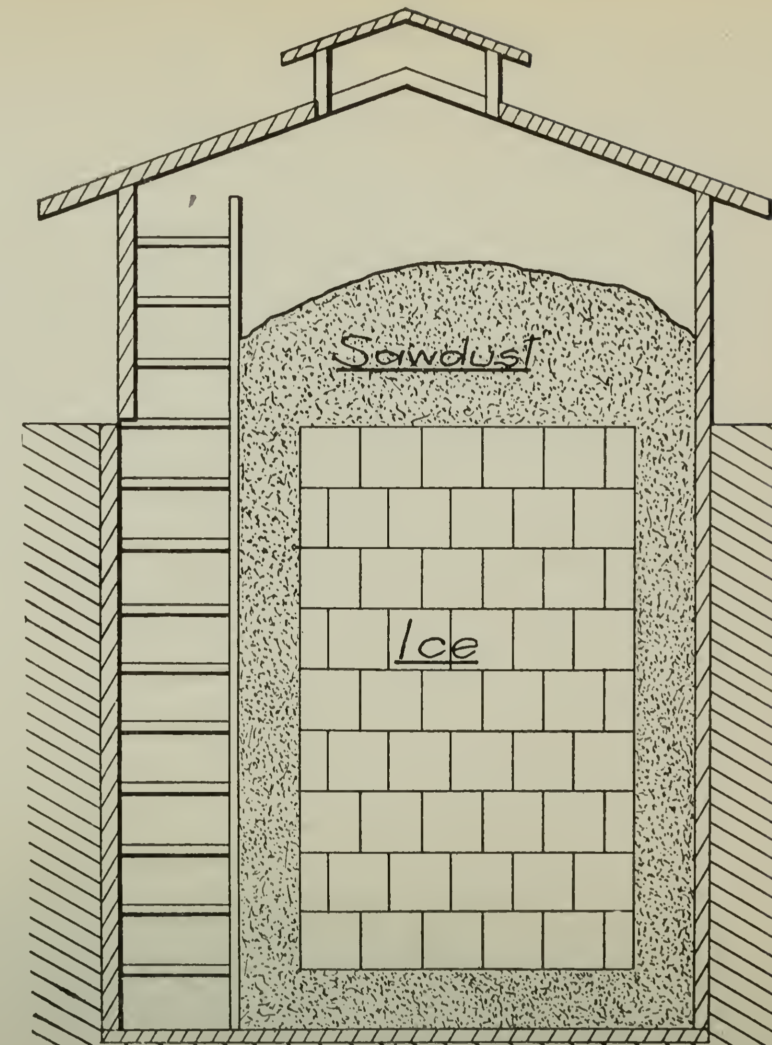


Fig. 2.—Modern Ice Pit.

(From "The Ice Crop," by Hiles.)

temporary wooden protection over it. The waste may not be more than 30 per cent. If a farmer can get plenty of ice easily, and isn't concerned particularly about how much of it wastes, so long as he has enough left for his use through the warm season, and provided he has a suitable place for stacking it, this method may be useful. It is used

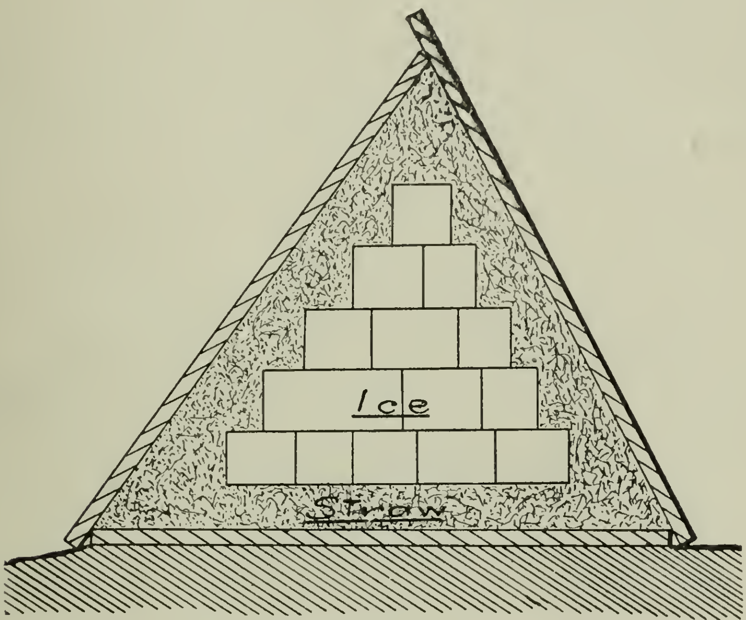


Fig. 3.—A Cheap Method of Storing Ice.

considerably by ice dealers when their storage houses are not large enough. They sell the "stacked" ice first and so do not lose very much of it through exposure. (Fig. 3 and illustrations on page 37.)

MAKE-SHIFTS.

These are ice storages, such as a large bin in the woodshed, the drive shed, the open shed at the barn, in a corner of a mow, or under a straw stack. Those who store only a small quantity of ice, say, five tons, or those who store any only occasionally, may find such places quite satisfactory if they store the ice carefully, cover it well and provide for drainage and circulation. The waste of ice is usually very large from small quantities stored in such places, and because of this fact and others already mentioned these storages are not strongly recommended for general use.

Permanent Ice-Houses.

Form No. 1.—Constructed of Cedar Posts and Rough Lumber.

A very simple and cheap, though rather rough appearing, ice-house may be constructed of a few cedar posts and coarse lumber, material which can be picked up about any farm usually. This construction could often be built to good advantage as a lean-to on the shady side of another building. The posts ought to be put 3 feet deep into the ground, and they should extend about 10 feet above ground, be placed 6 feet apart, and capped by 2 by 4's double. The rough boarding may be nailed on the inside hori-

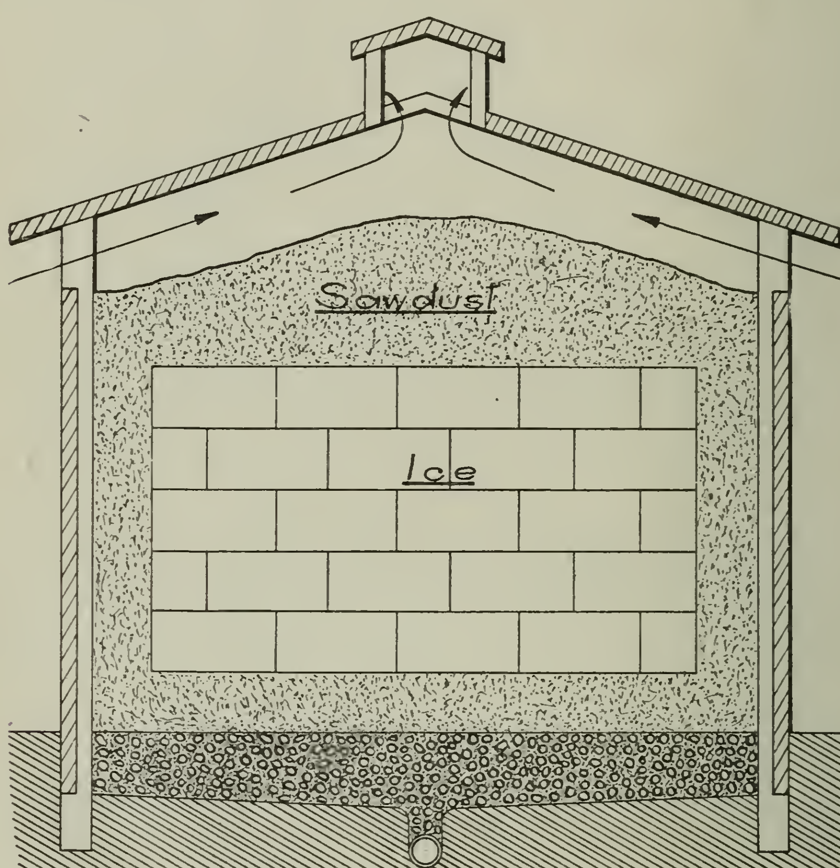


Fig. 4.—Cheap Ice-House.

zontally or on the outside up and down; if the latter, it would be necessary to connect the posts at the bottom and centre by 2 by 4 scantling, and the joints ought to be covered by battens. The gables should be boarded rather loosely in order to let the air pass through freely, but the roof should be well built so that no rain could get in on the sawdust over or around the ice. This form of ice-house may be as satisfactory as any for keeping ice, but it usually lacks style and finish.

Form No. 2.—The Log Ice-House.

A very cheap, easily constructed and satisfactory ice-house can be made of logs where timber is plentiful, as in our northern districts. Pieces of rough boards should be nailed over the joints or spaces between the logs on the inside and plenty of dry sawdust used around all sides of the ice. Drainage and circulation should be provided for as in all other forms.

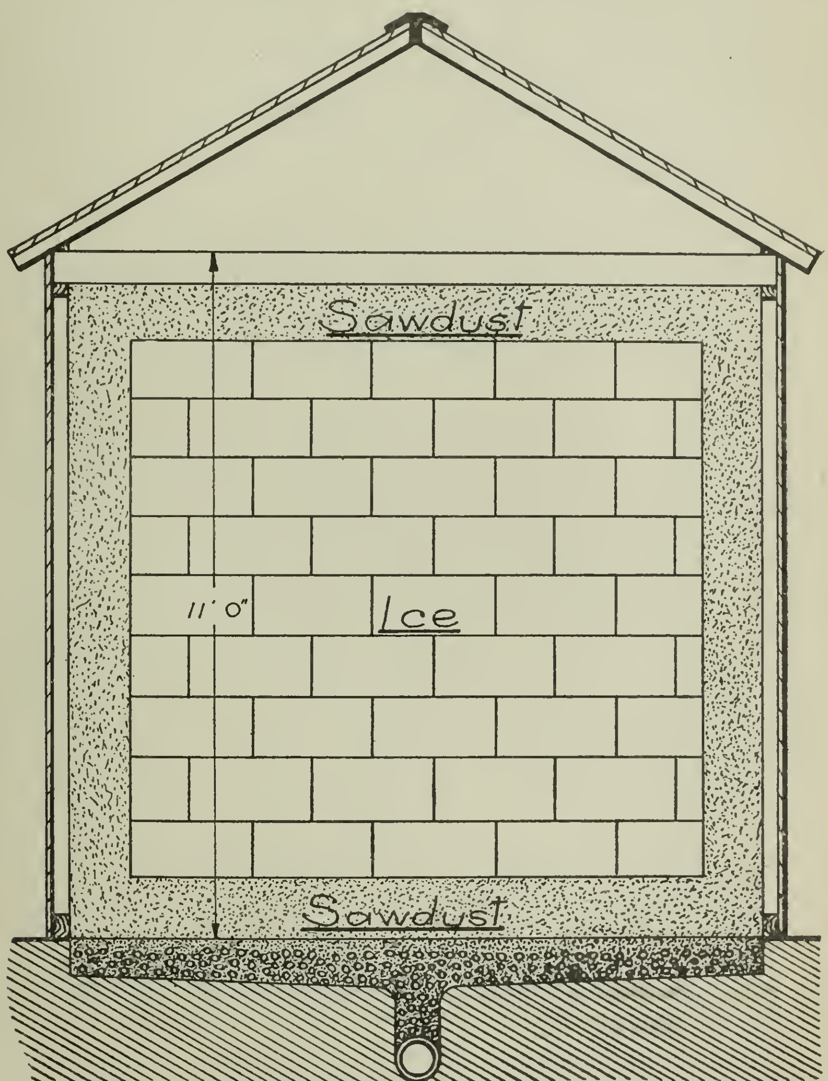


Fig. 5.—Section of an Up-to-date Farm Ice-House.

Form No. 3.—The Standard Type.

Those desiring a better type of ice-house would find that represented by Figs. 5 and 6 very satisfactory. It was designed by Madison Cooper. It is twelve feet square outside and eleven feet high to the plate. It will hold about 20 tons of ice, allowing one foot for sawdust all around the ice. The size is about right for most farmers. The following is Mr. Cooper's description of this ice-house, as given in his text-book, "Practical Cold Storage":

"The sills consist of double 2 x 4's on which are erected 2 x 4 studding, 24-inch centres. These are capped with a double plate of two 2 x 4's, on which rest 2 x 6 joists, 24-inch centres. The studs are boarded up outside with novelty or drop-siding. There is no inside boarding, the sawdust being allowed to fill the space between the studs. The roof is constructed of 2 x 4 rafters, 16-inch centres, boarded and covered with shingles. In each gable is a louvre or slat ventilator for the purpose of allowing free circulation of air. The ice door should be built in two or more sections, hinged to open outwardly. On the inside pieces of 2-inch plank are placed to keep the sawdust or other filling away from the doors."

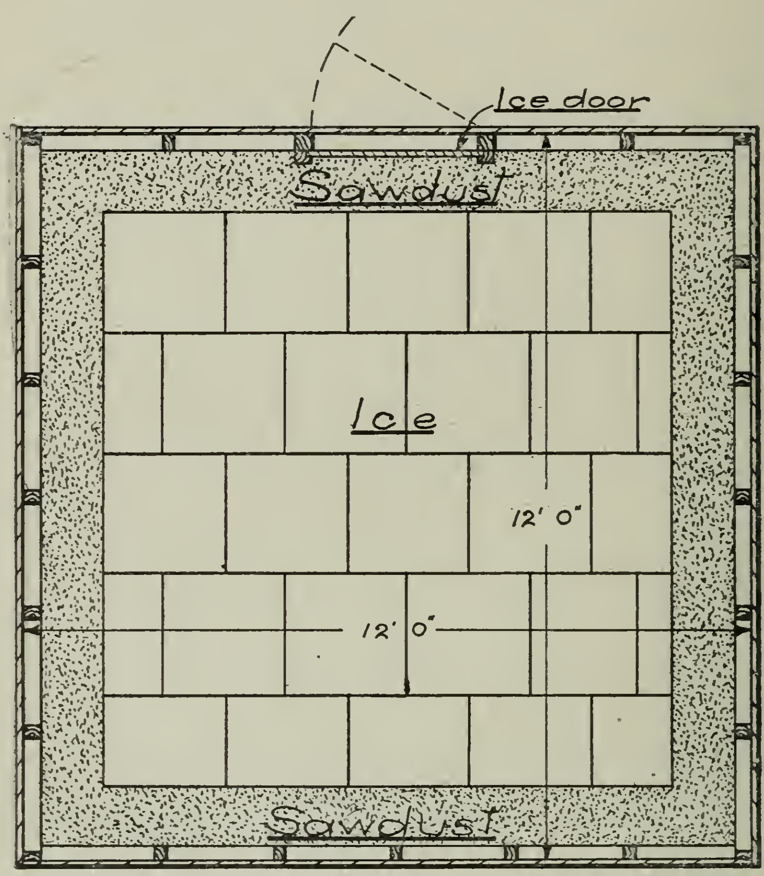


Fig. 6.—Plan of an Up-to-date Farm Ice House.

The Cost.—Mr. Cooper figures the actual cost of material at $30 to $40, and the entire cost of the house at $50, including labor. According to the present cost of material and labor in Canada his estimate is about $25 too low. If the farmer had to buy all the material it would cost about $50 at current prices of lumber, and the labor would probably approximate $20. The material would comprise about 250 feet of rough lumber, 650 feet of drop-siding, 700 feet of 2 by 4's, 85 feet of 2 by 6's, 2 1-4 squares of shingles and about 50 lbs. of nails. Two good carpenters ought to build the house in three days. If the farmer had some timber on his place, and was handy with the hammer and saw, he could put up this house himself for a small outlay. Even if the cost should be as much as $70 or $75 it would pay any farmer well to make the investment. The house would last a lifetime if kept well painted and cleansed out thoroughly each year. The farm equipment is not complete without it.

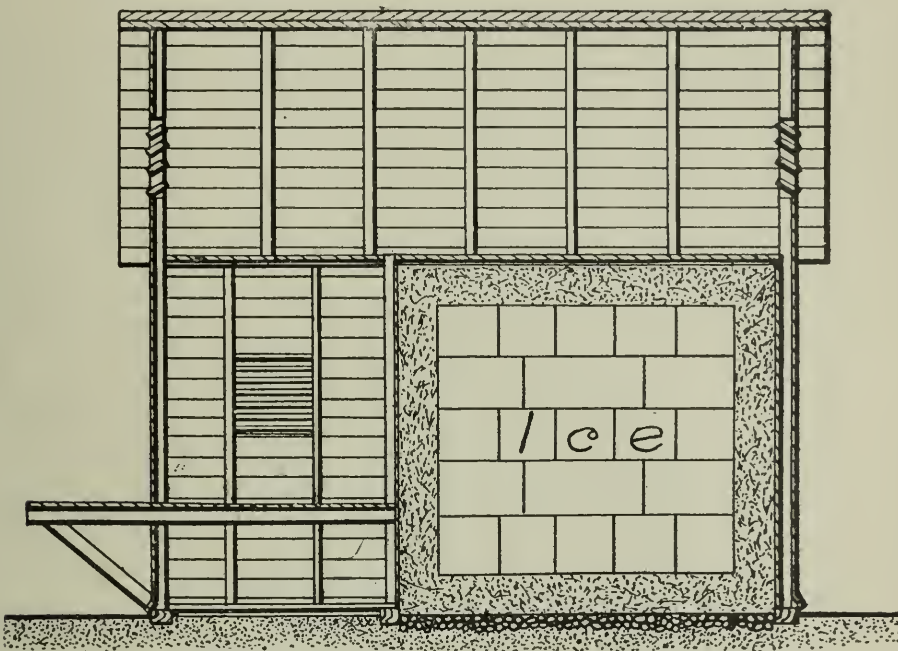


Fig. 7.—Combined Ice House and Milk Stand.
Sectional Elevation.

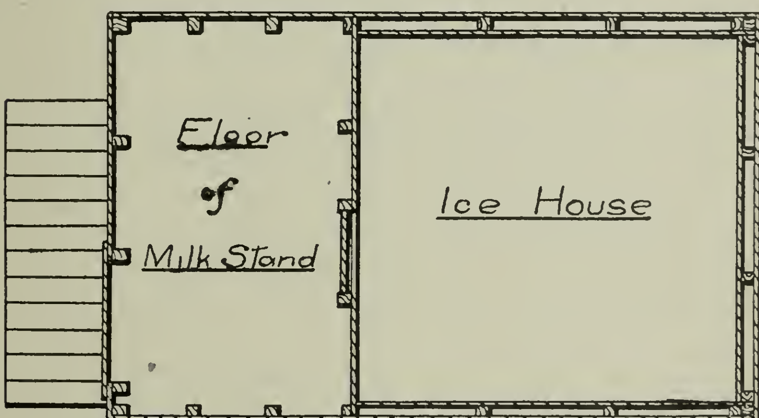


Fig. 8.—Combined Ice House and Milk Stand.
Ground Plan.

Form No. 4.—A Combined Ice-House and Milkstand.

The form illustrated in Figs. 7, 8, 9, is taken from Mr. J. A. Ruddick's Bulletin No. 20, "The Use of Ice on the Farm," and the following is his own description of this system.

"This plan was first brought to the writer's attention by Mı. C. G. Publow, Chief Dairy Instructor for Eastern Ontario, when travelling with him through Hastings and Prince Edward Counties, where many of the progressive farmers have adopted this plan. A model combined milkstand and ice-house was erected on the grounds of the Central Canada Exhibition Association at Ottawa last autumn (1906), and attracted considerable attention. This arrangement, which affords both protection from the weather and dust, and also from animals or insects, if all openings are provided with screens, and convenience for the cooling of the milk, cannot be too highly recommended. Very great improvement would be made in our hot weather cheese if the night's milk was always properly cooled, and the saving of loss in cases where the milk turns sour before reaching the factory would amount to a very considerable sum.

"To utilize the ice for household purposes in connection with an arrangement of this kind, it would be necessary to provide an insulated ice-box in which to put articles of food along with a quantity of ice from time to time. A simple arrangement, which will give good satisfaction, is to make a box in the shape of a trunk of chest, lined with galvanized iron, and divided in the centre by a partition open at

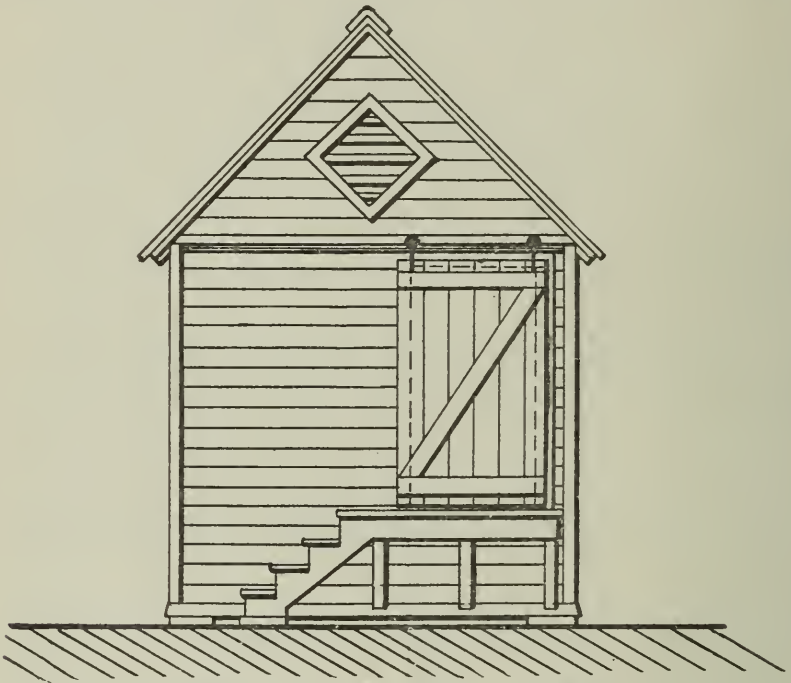


Fig. 9.—Combined Ice House and Milk Stand.
Front Elevation.

the top and bottom to allow for a circulation of air beween the two compartments. The ice can be placed in one side of the partition and articles of food on the other side. A box constructed as follows will give good satisfaction: A layer of matched boards covered with one inch of hair felt and finished with another layer of inch boards. That is to say, the sides, top and bottom will consist of two-ply of matched boards with one layer of hair felt between. The cover should fit tightly and be provided with a cushion of some kind to make it air-tight. The galvanized iron lining is necessary to prevent the dampness from affecting the wood and destroying the insulation. It is necessary to provide a drainage pipe for the melting ice, and the outlet should be tapped to prevent passage of air. If hair felt cannot be procured easily, leave a space of 3 or 4 inches between the outside and inside finish of the box and fill this space with planing mill shavings or thoroughly dry sawdust.

"Those who desire to have a more complete cold storage on a small scale will find a plan and specification in the Dairy Commissioner's Report for 1906."

The Milk Room.—This building is an ice-house similar in size and construction to that already described under Form 3, Figs. 5 and 6, with an adjoining milk-room provided with the proper conveniences for handling and cooling milk or cream. The size of this milk room is 10′ x 6′. It does not need particular insulation, as the object is shelter from sun's rays, protection from dust, animals, etc., rather than an air-tight, well insulated room. Clapboards or drop-siding on the studs would be sufficient wall, but it would be highly advisable to line the inside with match lumber and coat it with whitewash every spring.

The floor should be concrete, finished with a thin layer of cement, and good drainage should be provided for through a trapped outlet, so that all water spilt or used on the floor would get away readily. This room should be kept scrupulously clean, cool, well aired, screened against flies and other insects, disinfected and in every way ideal for the preservation of milk and cream. In it there should be a tank with capacity enough for all the milk cans ever used at one time, a few blocks of ice and some water. A milk room like this is not complete without some contrivance as described below for easily conveying the cans of milk from the wagon to the tank or vice versa. It would also be a great advantage to have the well in the milk room or even just outside for getting the water for the tank and other purposes. The loading platform indicated in the plan extends into the milk room and thus forms an ideal shelter for the cans of milk when it is not necessary to let them down into the ice cold water tank below. The ice may be used for cooling the milk either by being put around the cans in the tank or into long pails or creamers let down into the cans of milk. This milk room should be the regular shelter for the night's milk in the warm weather.

If this building was reasonably close to the house and there was no refrigerator in the kitchen it would be a great aid to the keeping of goods in the hot weather to have an ice-box such as Mr. Ruddick refers to, or some kind of a small refrigerator, in the milk room. These articles are simple in construction, cheap and any handy man could build one in a day or two. The size would depend upon the family and the extent of fresh meat, for example, used in the very warm weather. A box 4 ft. by 2 ft. by 2 ft. and partitioned at about the centre would be a serviceable size for the storage of small quantities of meat, butter, milk, cream, fruit, etc., used daily on the table. The ice box in this chest would hold four medium sized cakes of ice or from 100 to 125 lbs. It should not have to be refilled oftener than once or twice a week. It must be kept well in mind, however, that the circulation of air in an ice-box like this is very poor and the moisture content of the air very high. Therefore conditions are not favourable for keeping perishable goods in any quantity for very long periods, not longer than a few days. Then, since so many articles of food are placed in the same chamber, the difficulty of keeping any one thing well is increased. Do not expect too much of the little ice-box. The cross section diagram illustrates clearly the design and construction of a simple ice-box. However, the household refrigerator is the proper system of cold storage in the home.

The Ice Room.—The ice-house proper is 10 ft. square by 10 ft. high, inside dimensions. The walls are boarded on both sides of the studding and the spaces between the studding are left empty. If these were packed with dry shavings a good deal of the sawdust next to the ice could be dispensed with and the room would hold more ice. With 1 foot of sawdust on all the sides, the bottom and top of the ice, this room will hold 12 tons of ice, and 20 tons if no sawdust were used, but this practice would not be wise unless the walls were very well insulated. It might be a better plan to use the inside sheathing as an extra sheathing outside and allow the sawdust around the ice to fill in between the studding. It would then hold 15 tons allowing for 10 inches of sawdust on

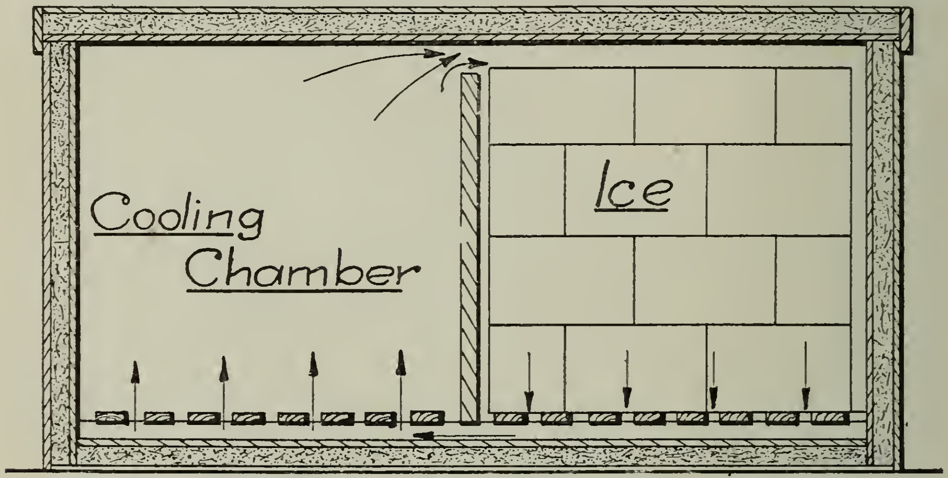


Fig. 10.—Cross Section of an Ice-Box. (Drain not shown.)

the sides and 1 foot below and above the ice. A doorway is shown in the plans through which the ice is brought out into the milk-room as it is required for cooling purposes. The ice house can be filled through this door also.

The Cost.—The material at current prices would cost about $60 and the labor $25 to $30. The total cost then would be somewhat under $100 to the farmer who would have to buy all the material and hire all the work done. The material would consist of about 600 sq. ft. of drop siding, 650 of rough lumber, 3 square of shingles, 800 feet of 2 by 4's, 90 ft. of 2 by 6's, and about 60 lbs. of nails. Two good men ought to put it up in four or five days.

The Care of Milk and Cream on the Farm.

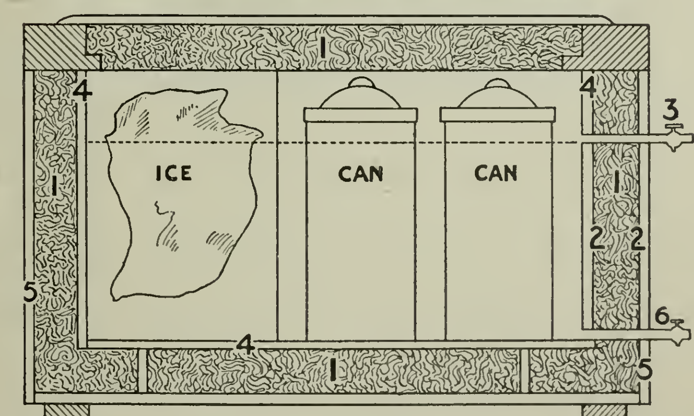
The two diagrams shown below offer valuable suggestions for equipping a milk-room such as has just been described, with cooling tank for either cold water or ice, and a hoist for handling the cans. These appear in two circulars issued by the Dairy Branch of the Department of Agriculture, Toronto, on May, 1912, together with the following extracts:

"The accompanying illustration shows a tank for cooling milk and a crane or hoist for raising the cans from the tank. With such an outfit milk cans may be lowered and raised from the cooling tank with ease, and sweet, cool milk for delivery at the factory is assured during the warmest weather.

Tank for Cooling Milk and Hoisting Apparatus.

"One of the most important factors in the production of cream is that as soon as it comes from the separator it be quickly and thoroughly cooled to a temperature of 50 degrees, and kept cool until it reaches the creamery. Do not mix cold and warm cream.

Tank for Cooling and Keeping Cream.



1—Mill Shavings. 2—Two-ply damp-proof paper. 3—Overflow water-line. 4—Inner tank made of 1 inch lumber. 5—Outer shell of 1 inch lumber. 6—Bottom outlet.

" The accompanying diagram illustrates an insulated tank for cooling and keeping cream. Provide an outer shell made of one-inch matched lumber, and tack on the inside thereof two-ply of damp-proof-paper. Then make an inner tank (cooling tank proper) of a size to provide for a four-inch space, at sides, ends and bottom, between outside of smaller tank and inside of larger shell. The cooling tank should be lined with galvanized iron so that it will be perfectly water-tight. Two ply of damp-proof paper should be tacked on the outside of this tank. The cooling tank should be about 22 inches deep, to hold shotgun cream cans 20 inches high. A couple of supports 4 inches high should be placed in the bottom of the larger tank, and mill shavings or dry sawdust packed in the bottom to a depth of 4 inches. Then place the cooling tank inside the larger one, and pack between the sides and ends with shavings or dry sawdust.

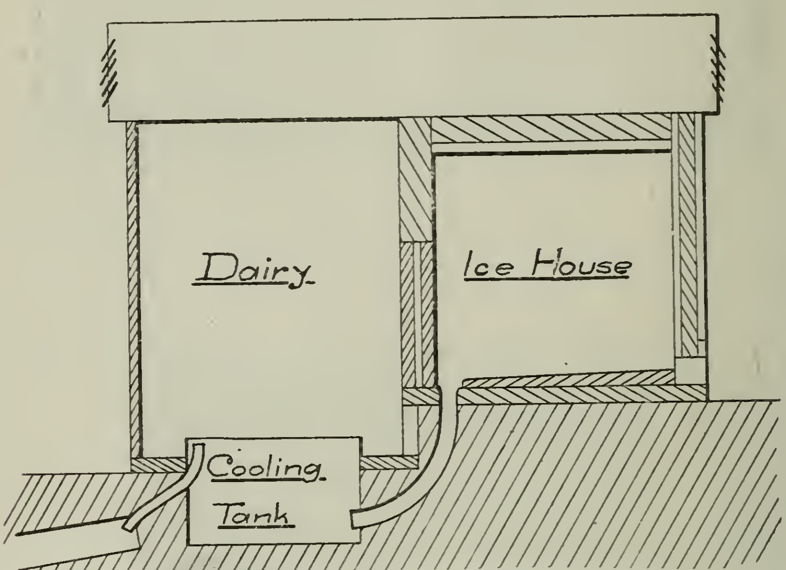


Fig. 11.—Combined Dairy and Ice-House. Sectional Elevation (after Hiles).

" Have an outlet at the bottom and an overflow about 18 inches from the bottom. Make the tank large enough to hold the required number of cans 8 inches in diameter, allowing sufficient space for ice and water to keep them cold. A wire partition may be put in between the cans and the ice if desired. The lid should be of 1 inch tongued and grooved lumber, preferably insulated in the same way as the body of the tank. This saves ice. Such a tank is not affected to any extent by outside temperatures and will keep the cream cold and sweet.

" A tank 22 inches by 40 inches, inside measurement, will hold 6 cans of cream. Tin cans (20 inches high and 8 inches in diameter) are better for keeping cream than crocks of any kind."

Form No. 5.—Combined Dairy and Ice-house.

The particular feature of this arrangement is the utilization ot the cold water from the melting ice for cooling purposes. The value of this, however, is more apparent than real. To insure the use of the water from the melting ice and it being in a reasonably pure condition for use in a tank for cooling milk or cream, the cost of the building would have to be greatly increased. The floor would have to be cemented and a suitable drain as indicated provided for and the wall well insulated in order that it would not be necessary to put any dirty packing like sawdust next to the ice. If ice was taken out very often for incidental cooling purposes a great deal of air would get into the ice chamber and melt a great lot of ice. The dairyman needs the ice stored so that he can get at it often and yet not expose the supply too much. The amount of water per day might not be large enough to do the cooling required, nor would it keep cool very long. If the ice-house held 20 tons the average drainage from it would be scarcely 1 barrel per day for the period May to September, inclusive. The diagram shows, at least, how the idea might be carried out, but the writer has his doubts as to its practicability and value on our farms or anywhere.

SMALL ICE COLD STORAGES.

Some Types of Combined Ice-houses and Cooling Rooms or Small Ice Cold Storages.

Under this heading attention is called to some types of ice cold storages, or buildings comprising an ice-room and a cooling-room for the storage of perishable products. Any of them must be carefully constructed and well insulated, and therefore are much more expensive than any forms of ice houses that have been described. In spite of the greater cost some farmers find it necessary and profitable to have a small cold storage in order to care for their products properly, and to realize the highest value from them. These storages will be far more popular and numerous when the farmers know their value. One of these storages will last probably twenty years if it is well constructed and properly cared for each year. Then as ice is so plentiful and so cheaply harvested in this country, the season's ice supply is a very simple and inexpensive matter.

A Small Cold Storage.

For a refrigeration room, say 4 or 5 feet square, in connection with the farm ice-house, a very satisfactory arrangement is that illustrated in Figures 12 and 13. This is the system referred to above at the close of my quotation from Mr. Ruddick's Bulletin No. 20. A full description and plans of it are given in his annual report for 1906 on pages 56-58, and with his permission they are given complete below. He recommends it as a cheap, easily managed and fairly effective arrangement for securing

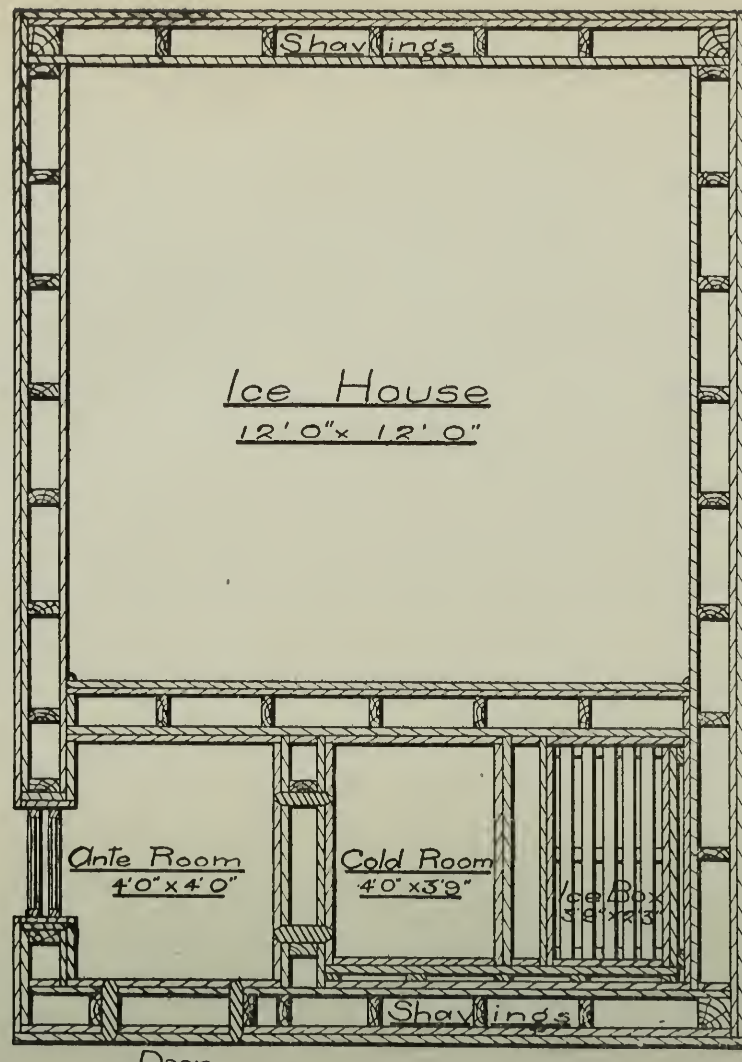


Fig. 12.—Plan of Small Cold Storage (after Ruddick).

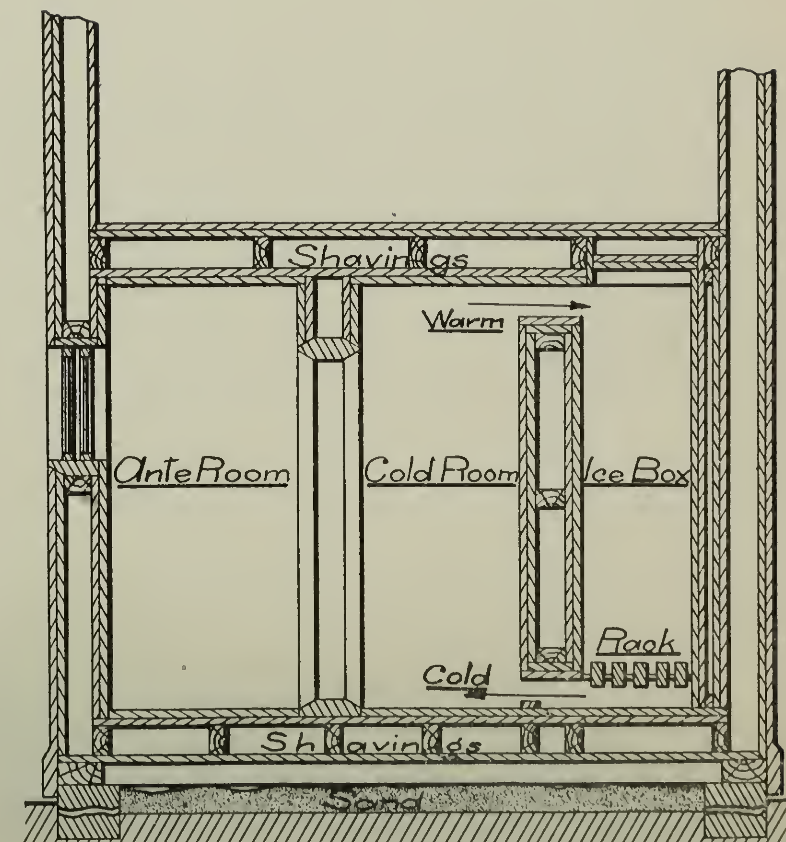


Fig. 13.—Section of Small Cold Storage (after Ruddick).

cold storage on farm or in connection with country stores or butcher shops. The following is his own description of it in the report referred to above.

"All lumber, except clapboards, should be tongued and grooved, and spruce only should be used for the ice-box, cold-room and ante-room. No tar paper should be used, on account of its strong odor.

"The building will be better, and more permanent if placed on a stone or concrete wall. Otherwise it must be well "banked" to prevent circulation of air underneath.

"The extra course of lumber under the siding may be dispensed with on the walls of the ice chamber, but not on the other parts of the building.

"The partitions between the ice chamber and the other compartments, and also between the ice-box and the cooling room, need to be well insulated, as shown, to prevent dampness. A poorly insulated partition against an ice chamber will become cold on the surface and consequently collect moisture. Many refrigerators and cold storages are failures from this cause. Emphasis is laid on this point, because we often find thin partitions placed between the ice chambers and the cool rooms, on the theory that refrigeration secured in this direct way is all that is needed. Dryness in a refrigerator is just as important as a low temperature.

"No proof is shown in the plan. That is left to the fancy of the builder.

"Sufficient room must be left above the small compartments to allow of the blocks if ice being transferred to the ice-box through the ice trap door.

"The window in the ante-room has double sash, each sash being double glazed, giving four thicknesses of glass.

"The floor under the ice-box should be covered with galvanized iron, sloping in one direction, with a gutter at the lowest edge to carry off the water from the melting ice. The drain pipe from the gutter must be trapped to prevent the passage of air. A simple plan is to have the end of the pipe turned down and extending nearly to the bottom of a small dish or vessel of any kind, so that the water will rise above the end of the pipe before the dish overflows.

"Planing mill shavings are highly recommended for filling the spaces between studding and joists as shown on plans. They are always dry and do not become musty. If they cannot be procured, sawdust is probably the next best thing, but it should be *thoroughly* dried before being used.

"The spaces between the studding around the ice chamber should not be filled. Any filling will eventually become damp from the ice, and damp material of any kind has very little insulating value.

"MANAGEMENT.—As there is no floor in the ice chamber, the earth beneath it should be well drained. Cover the surface with 6 to 8 inches of broken brick, coal cinders, tan bark or other similar material of a non-conducting character. If nothing better can be procured use broken or cobble stone, covered with a layer of gravel or sand. This material will make the permanent bed.

"Before filling with ice, put 8 inches of sawdust over the permanent bed. This should be renewed every year. The ice should be packed as closely as possible, filling all spaces with crushed ice or snow, well rammed. Leave a space of 12 inches between the walls and the ice, to be filled with dry sawdust. The top of the ice should also be covered with 12 inches of dry sawdust. If sawdust cannot be procured, cut hay or straw may be used, but the space filled should be 18 inches instead of 12, and the filling well packed.

"To utilize the cold room, fill the ice-box with cleaned ice in lumps as large as convenient to handle. The box shown on the plans will hold about a ton of ice, so that it will not need to be filled often. Care should be observed in keeping the trap door tightly closed. The openings at the top and bottom of the partition between the ice-box and the cold room may be fitted with a slide to regulate the circulation of air.

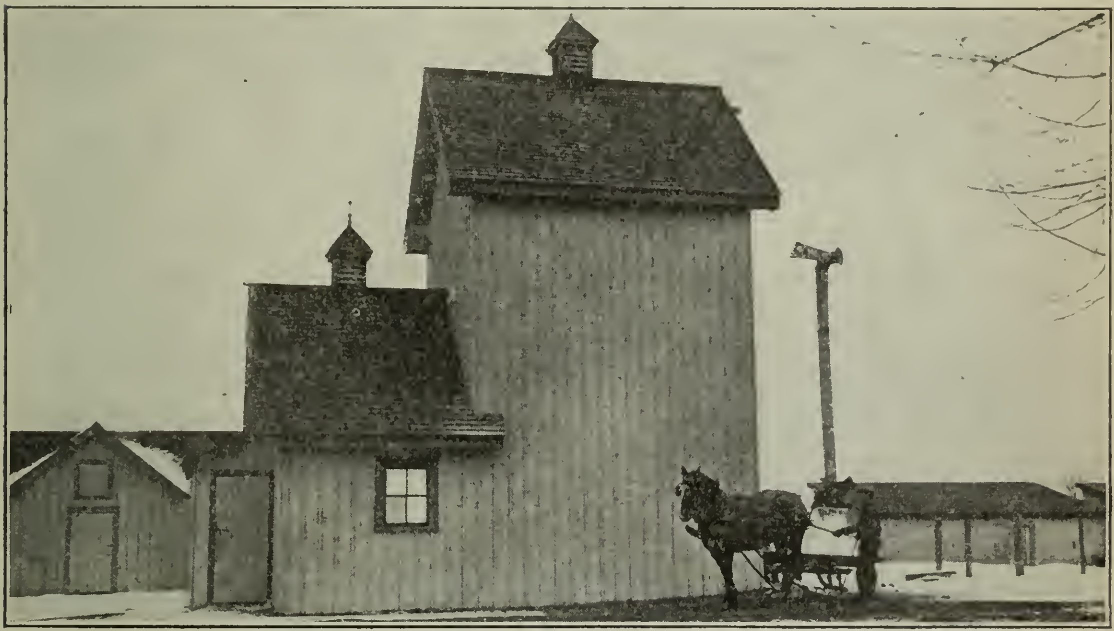
"Particular attention must be paid to the keeping of the doors perfectly air-tight. A cushion of thick felt for the door to close against is about the best thing to ensure a good joint."

The foregoing method is in all essentials the one in use in refrigerator cars cooled by ice. The ice chambers or so-called "ice bunkers" are located in each end of the car. The bunkers are usually double and each half is 6 ft. x 3 1-3 ft. by 3 ft., or thereabouts. Each half has a capacity of a little better than 1 ton of ice, the four bunkers of a car, then, holding about 5 tons of ice. The storage capacity of a car is between 1800 and 2,000 cubic feet.

This system is fairly well adapted for the use of a mixture of ice and salt as the cooling agent. A much lower temperature can be secured with this mixture than with ice alone. An illustration of this method of cooling small chambers was seen at Mr. E. D. Smith's place, Winona, Ontario. He has a small cold storage plant consisting of three cooling chambers, all together, having a capacity of 6 or 8 car loads of fruit. He told me that he got good satisfaction and profit in keeping fruit, especially pears, by using a little salt with the ice. In some of the ice bunkers there are galvanized iron cylinders for holding the ice and salt mixture, the other bunkers being lined with galvanized iron. The year's supply of ice is stored in a separate building, an ice-house, and the ice is conveyed as required, on sort of a tramway to the second storey of the cold storage building where it is broken and then put down into the bunkers through tightly-fitting trap doors. The lower temperature, however, is obtained at the expense of the material in the bunkers for the salt is very corrosive on the galvanized iron. There is always considerable dirt and muss about these bunkers, especially where the salt is used. It is always much colder next to the bunkers than on the other side of the room, the circulation not being very good. The special use of a mixture of ice and salt in small storages is in the "cylinder" system used in many creameries of this province. Instead of bunkers a row of large galvanized iron cylinders are placed along one side of a room 7 ft. or 8 ft. square; the bottoms set in a trough for catching and carrying away the drip; the tops extend through the ceiling and are filled similarly to the bunkers referred to above. For further information of this "Cylinder" system see J. A. Ruddick's Report for 1906, pages 45 and 48 to 50, also his bulletin No. 10, page 6.

The Hanrahan System.

This system of ice cold storage was strongly recommended about twelve years ago by the Provincial Government of Ontario. The Public Works Department at that time prepared, published and circulated a pamphlet describing the system and employed Mr. Hanrahan for a while to advertise the system and supervise the construction of the storage wherever the system was adopted and installed. A number were built in Ontario, one being the present storage at the Dairy and Poultry Departments, O. A. C. Guelph. This plant has given good satisfaction and is still, at the end of twelve years, in a very good condition. Believing that the system has a place among small ice cold storages, and that it might appeal to many desiring to build a storage, I submit an exact copy of the specifications and plans of the plant built at the College to serve as a guide in the construction of such a storage.



The Hanrahan Cold Storage at the Ontario Agricultural College, Guelph, Ont.

The general plan of the building is shown well in the diagrams and photographs accompanying the account of the system. The ice-chamber is 12 ft. square and 20 ft. high and holds about 65 tons of ice. There is no packing used around the ice, as the walls are well insulated. The cooling room is 10½ ft. by 12 ft. by 7½ft. high or it has a capacity of about one-half car. The ratio between the size of these two chambers is 3 to 1. The air circulates between them as indicated in the plans. The ante-room is 5 ft. by 4 ft. by 6 ft. high. A temperature of 40 degrees or even lower can be maintained throughout the average summer weather in the storage chamber. The air is usually quite dry and sweet in the storage-room.

The spaces in the walls were packed with sawdust as noted in the specifications. Planer shavings would have been very much better as they keep their place in the wall far better, remain drier, are less subject to attacks by vermin and less liable to decay and rot. Sawdust is not used

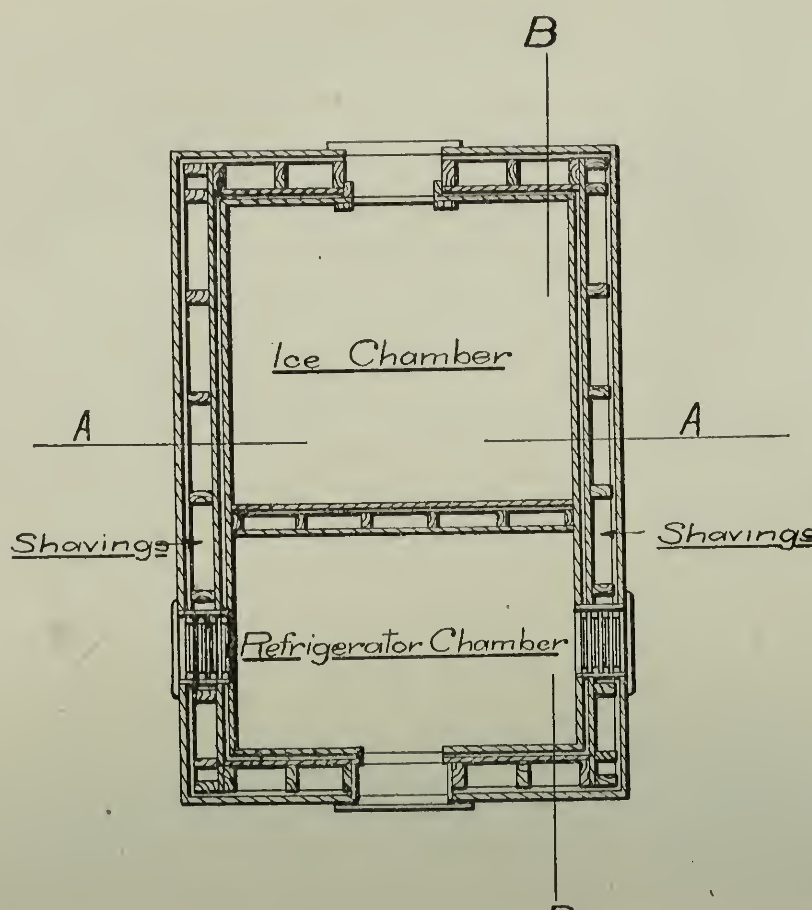


Fig. 14.—Ground Plan.

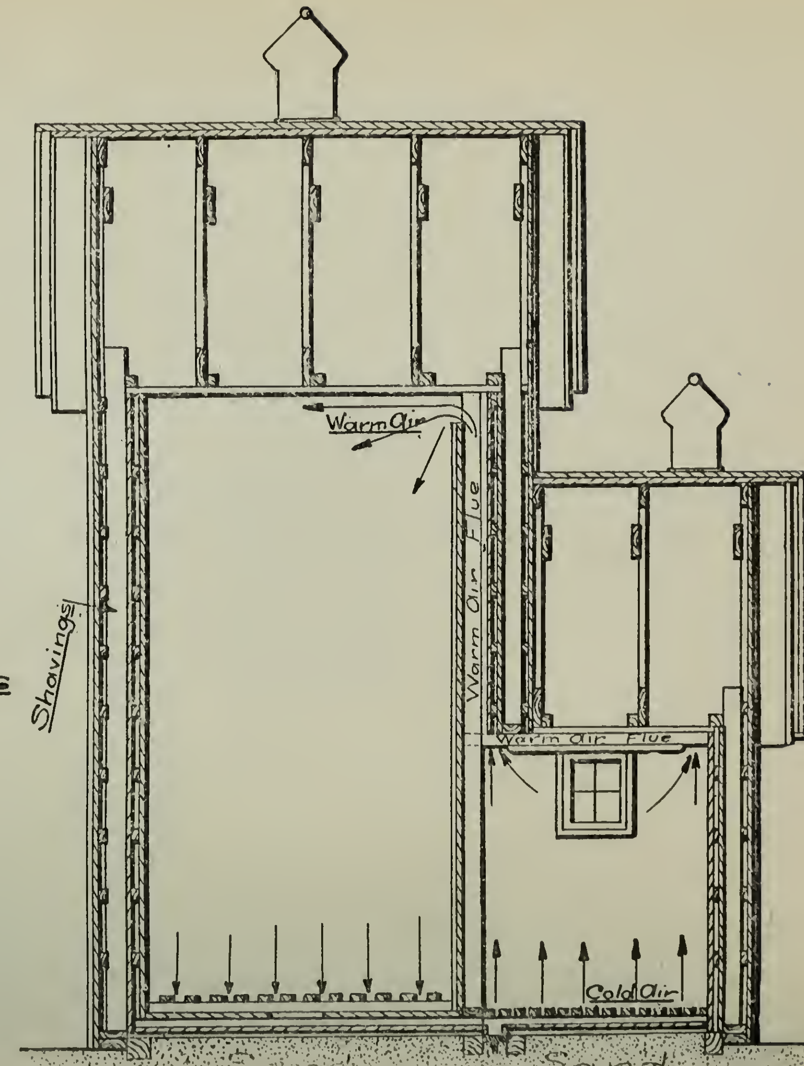


Fig. 15.—Section on line B.B.

Hanrahan System of Cold Storage.

in good storages now-a-days at all. The interior of both the cooling and ice chambers should be treated well with some preservative; shellac for the walls of the cooling chamber and raw linseed oil for the ice-chamber.

The cost is given in the specifications as $210, but it is not likely that this storage could be built for this even twelve years ago, probably $400 would not be too high an estimate for that time. To-day it would cost from $700 to $800.

Plans and Specifications for Erecting Combined Ice-House and Cold Storage Buildings.

"The preservation of the perishable products of the farm, such as fruit, butter, cheese, meat, eggs, etc., is fraught with great blessing alike to the producer and consumer. In any year when an unusually large quantity is produced, if some portion cannot be carried over until the demand recovers, much of it must be wasted, and all of it will be reduced in value. By means of a cold storage system wherein the best existing methods for delaying decay in perishable products are employed, the goods can be held by the producer until the market demands them. The consumer thus secures for his use these delicate luxuries for a much longer period.

"That system of cold storage which will most commend itself will be, first, reliable; second, durable; third, simple in construction; fourth, easy to maintain; fifth, within the reach of persons of limited means.

"The plans and specifications herein presented for cold storage buildings will, it is believed, comply with these conditions, and, if followed closely, will give the maximum results in efficient cold storage.

"The system is known as the Hanrahan System. It is used largely in the United States for long distance transportation and otherwise, and has given excellent satisfaction. It is within the reach of those possessing limited means, and its use will add largely to the profit as well as the pleasure of farm life.

"The principles involved are thorough and continuous circulation of air, the evaporation of all moisture and its condensation on the ice in the ice-chamber. The odors and gases are also absorbed by the melting surface of the ice, with which the air containing them is brought into direct contact. The products are thus maintained in a dry, even temperature, best calculated to resist decay and leave them in the best possible condition when exposed for sale in a normal atmosphere.

"Following this will be found the plans and specifications for a building to cost $210.00 (known as Series "A"). The Provincial Public Works Department, Toronto, will, if desired, furnish plans for larger buildings."

INSTRUCTIONS FOR ERECTING COMBINED ICE-HOUSE AND COLD STORAGE OF THE HANRAHAN AUTOMATIC SYSTEM.

Series "A." Cost of Labor and Materials, $210.00.

Sills.—The sills to be formed of two pieces of 8 x 2 inches, laid flat and half checked at the ends and bedded in dry sand, and of such length as will make an oblong 11 feet 6 inches by 17 feet 6 inches. On this sill erect 8 by 2 inch studs at the points as indicated on the ground plan, and cut off at a height of 18 feet 4 inches for the walls enclosing the ice and 9 feet 2 inches for the walls of the refrigerator chamber, measuring up from the top of the sill.

Ceiling Joists.—Spike on ceiling joists of 4 x 2 inch to each stud, so that the bottom of the joists will be 12 inches below the top of the stud and letting the joist extend so as to give support to the rafters.

Rafting.—The rafters to be 4 x 2 inch and to be cut to fit over the top of each stud, as shown in section on line A.A., and to be well spiked to side of ceiling joists.

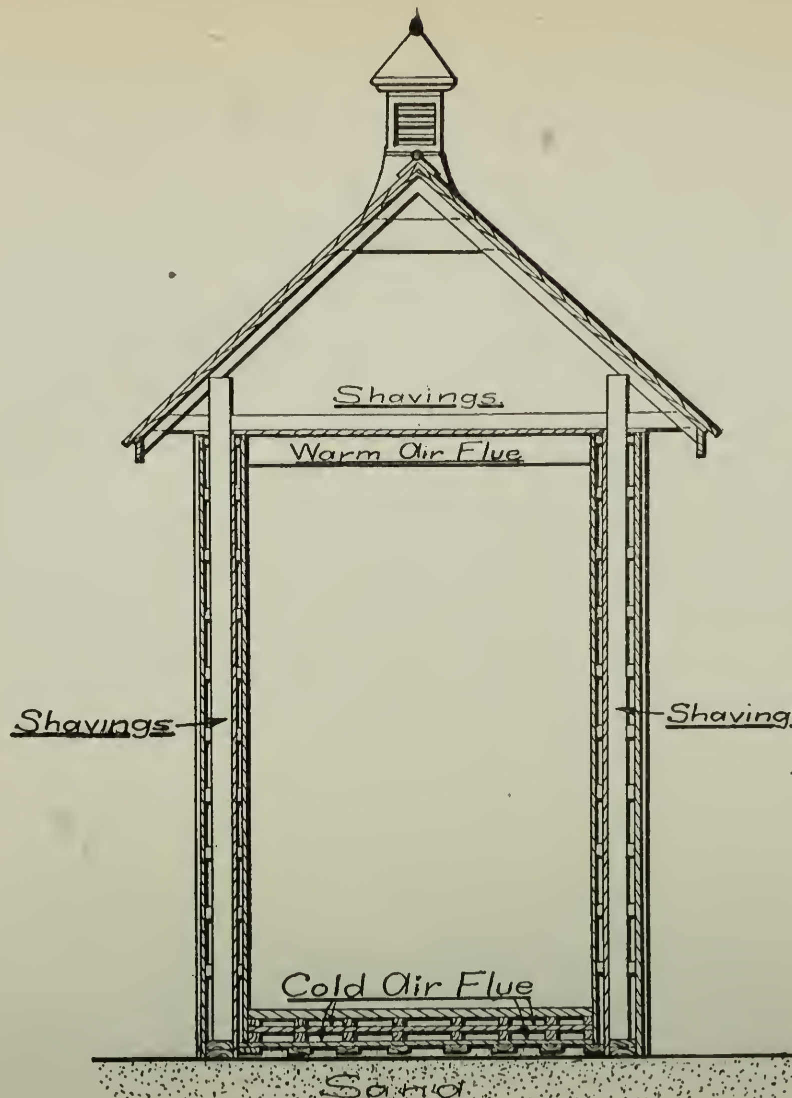


Fig. 16.—Section on line A.A.

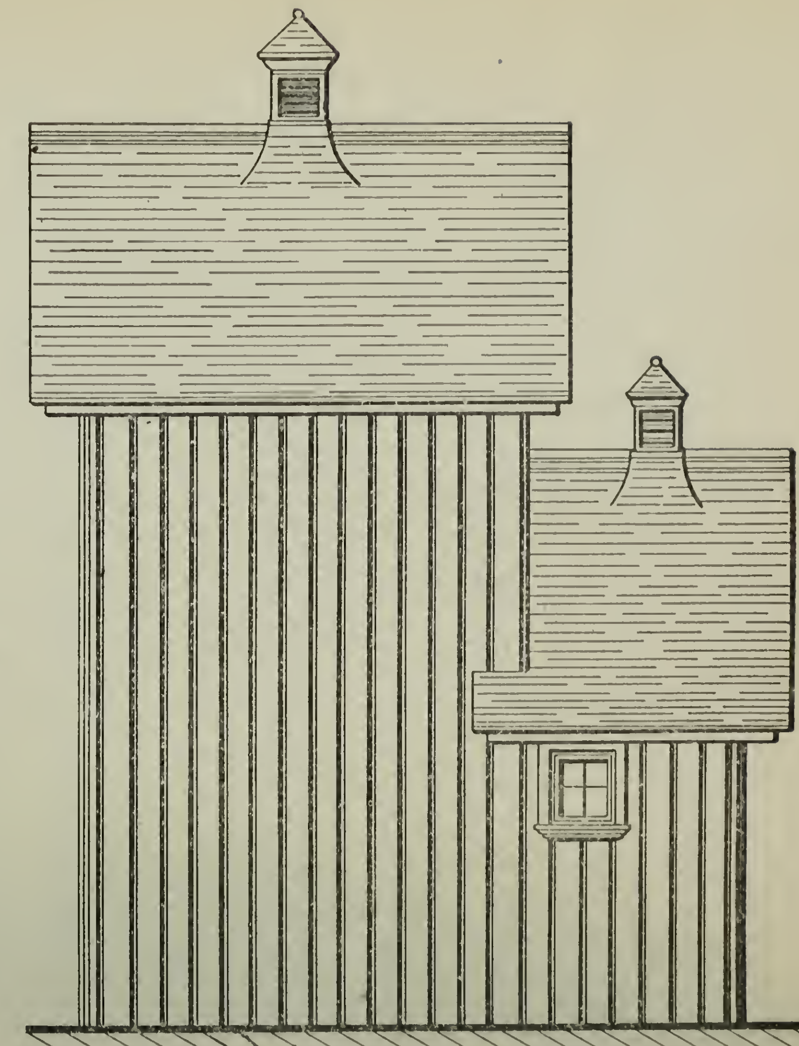


Fig. 17.—Side Elevation.

Hanrahan System of Cold Storage.

Roofing.—The rafters to be covered with 1 inch sound, rough boards and then shingled with good shingles laid showing 4 inches to the weather. The roof ridge to have 5 inch boards and 2-inch roll.

Ventilators.—The ventilators to be put in as shown, the large one to be 18 inches square and the other one 15 inches square. The sides to have ordinary openings and the top capped as shown.

Insulation.—The outside of the studding to be first strapped with 2x2 inch, put on horizontally and spaced as shown, then 10 x 1 inch matched boards well and tightly nailed and each joint covered with a 2 inch bevelled batten. The inside of studding to be first sheeted with 1 inch matched boards, then with paper on walls around corners. In fastening paper on wall with tacks about ⅝ inch long, do not drive the tacks home, let them project about half their length, then take a ball of twine, No. 8 cotton, if procurable, or something similar to a ball of thick yarn, not too hard, run this twine over the heads of the tacks, which must be placed so as to have a line of twine directly under the 2 x 1 inch battens to be put on. When the twine is on, then drive tacks home, on the paper, and over the twine place vertically 2 x 1 inch dressed battens, about 18 inch centres, between these battens fix similar ones horizontally over the twine, and about 36 inches apart. These horizontal battens must be cut true and fitted in tight between vertical pieces, using a mitre box for the purpose. Over these battens lay another layer of paper and twine, put on the same as before, over vertical and horizontal battens, then sheet with matched lumber fixed vertically. Over this inside sheeting, place 2 x 1 inch battens vertically about 18 inch centres from floor to ceiling.

Ceiling.—The ceiling joists to have matched boards nailed to the underside thereof, having three nails to each joist, and the joists to have a batten on the top to prevent the sawdust from working through.

Division.—The partition between the two chambers to be made with 6 x 2 inch studs, as shown, and resting on a sill of one piece of 6 x 2 inch. These studs to be well dressed as the side next to the refrigerator chamber will be exposed. The side next the ice to be sheeted horizontally with 1 inch matched boards, then with paper, and then with another sheeting fixed vertically similar to that used elsewhere. This double sheeting to stop within 10 inches of the ceiling so as to form the warm air flue as shown. From the ceiling of the refrigerator chamber up to the top of these 6 x 2 inch studs put 4 x 2 inch studs, placing them edge to edge with the 6 x 2 inch ones, and thus forming the warm air flue 10 inches wide.

Next form that part of the end wall of the ice chamber over the refrigerator chamber as previously described; this latter to be supported by 4 x 2 inch joists running from the end wall of the refrigerator chamber to the 6 x 2 inch studs of the division partition, as shown in section on line B.B. The underside of these joists to be sheeted with 1 inch sound matched boards, leaving a space 12 inches wide along the end wall of the refrigerator chamber and 10 inches wide along the opposite side.

Collars.—The rafters to have collar ties of 10 x 1 inch as shown, and strips of 4 x 1 inch running therefrom down to the ceiling rafters.

Doors.—The doorway to the refrigerator chamber to be constructed as shown, and fitted with two doors hung to open out. The frame to have a sill of some good hardwood, and the doors to be made of two layers of 1 inch matched material with heavy paper between.

Windows.—The windows in this chamber to be made as shown with 1 inch jambs and head, and 2 inch sill in the frames and the sash in four pieces, each 1½ inches thick, and glazed with four lights of glass, each 10 x 8 inches, the sash to be put in with stops.

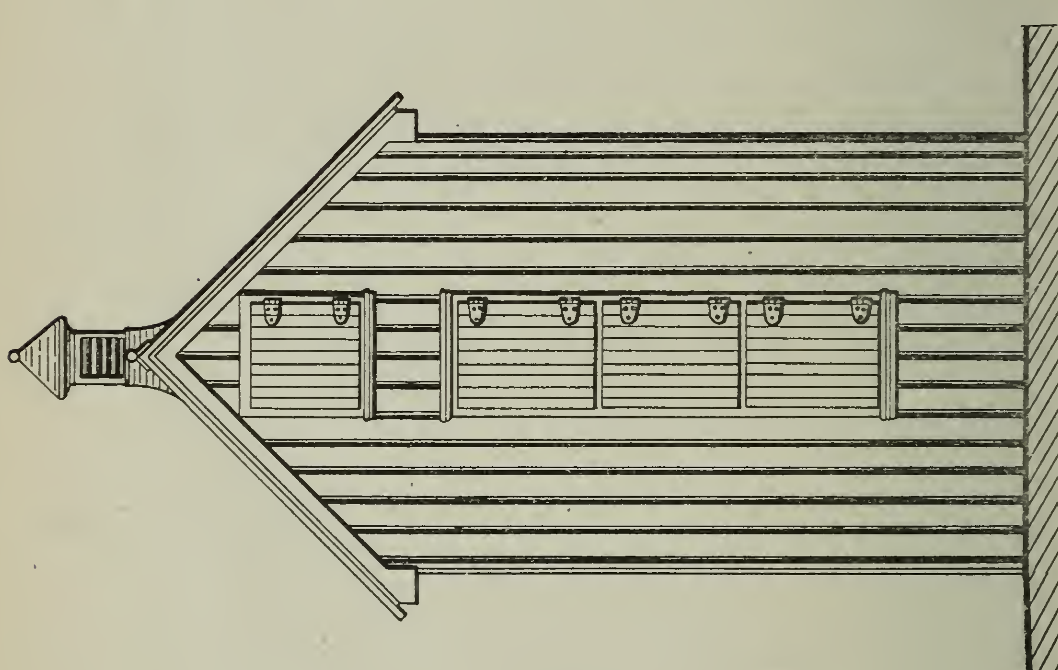


Fig. 18.—Rear Elevation.

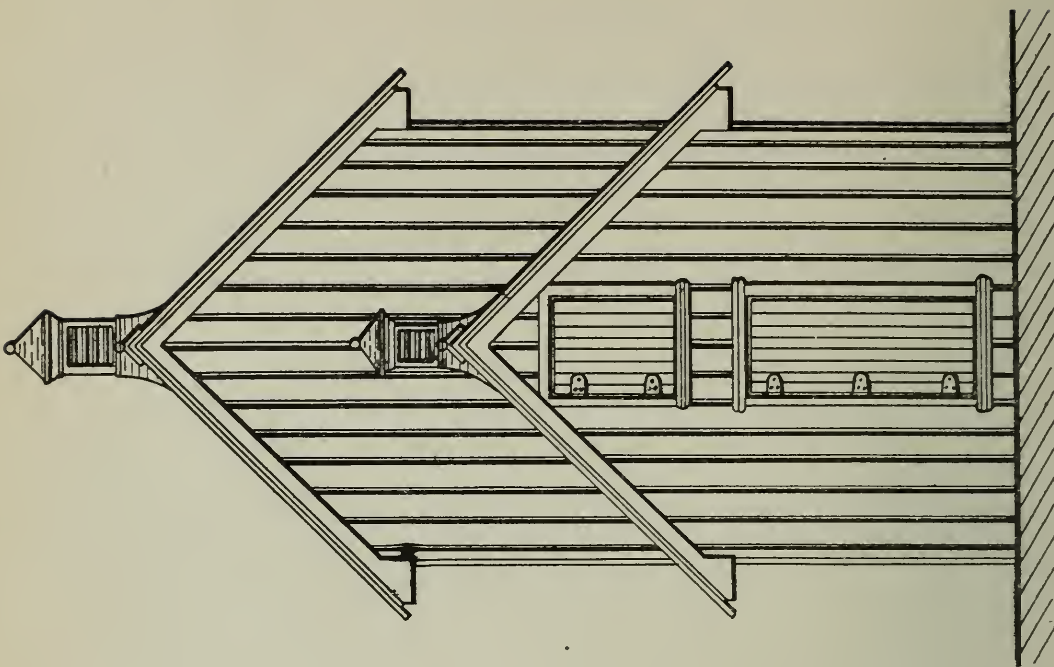


Fig. 19.—Front Elevation.

Hanrahan System of Cold Storage.

Doors.—The doors in the ice chamber to be made to match the outside sheeting, be hung to open out and be in a series of three doors, each 4 feet high, and starting 4 feet above the ground level. Movable 1 inch boards to be put on inside to keep the sawdust in place, as it is packed in as the ice is placed in position.

Doors.—Small batten doors to be put in in the front gable of the ice part, and in the end gable of the other part to give access to the spaces above the chambers.

Floors.—The floor of the ice chamber to consist of 4 x 2 inch pieces laid flat on 6 x 6 inch sills and bedded in sand, and carrying a floor of 1 inch matched boards, having a fall of 1 inch towards the drain; on this floor place eight pieces of 4 x 2 inches, as shown on edge and directly over the first pieces; on these joists lay another floor of 1 inch matched lumber, leaving a space of 1 inch next the dividing partition and another one of 12 inches in the centre running the full length of the ice chamber as shown. Upon this floor lay 3 x 2 inch joists directly over the others and thirteen pieces of 4 x 2 inches laid flat and at right angles to the 3 inch strips, the first piece next the dividing partition to be against the wall and the remainder evenly spaced. Upon this lay the ice supply.

Floors.—The floor of the refrigerator chamber to have 4 x 2 inch strips on 6 x 6 inch sills and bedded in sand, and carrying 1 inch flooring, laid with a fall of 1 inch towards the drain, then 4 x 2 inch strips on edge carrying fifteen pieces of 2 x 1½ inches, evenly spaced and at right angles. This lattice floor to be made in sections convenient for lifting up.

Drain.—A box drain to be formed of 1 inch material and laid with a fall of 3 inches from one side of the building to the other and discharging into a pipe having a trapped inlet below grade and protected by a box cover.

Sawdust.—All the spaces around the studding to be firmly packed with dry sawdust, and all ceilings to have at least 14 inches of sawdust as a cover, as shown by the drawings. Particular care must be taken to have the sawdust well packed and from time to time go over it and press down tightly.

Sand.—The timbers touching the ground must be well bedded in dry sand, and the sand filled in so as to leave all tight and free from any air spaces between the ground and the first floor laid. The outside of the building to be well packed with earth at least 15 inches high.

Shellac.—The inside walls of the refrigerator chamber to be given two coats of good grain shellac.

Note.—Three nails to be used to each joist or stud.

Paper.—All paper used to be heavy "Sulphite" as made by The E. B. Eddy Co., of Hull, or of similar quality.

Note.—The sheeting in the refrigerator chamber to be about 6 inches wide.

Location.—The building to be located on a well drained site, and where possible with the gable of the ice-house facing the south.

Note.—The plans and specifications must be strictly adhered to in order to obtain the best possible results both in saving products and ice.

Note.—See the bill of materials required for the building as described, and be sure to use the right pieces in the correct places.

Bill of Materials for the Erection of a Combined Ice House and Cold Storage Building as per Plans. Series "A." Hanrahan Automatic System.

Sills	4	pieces	6 in.	x 6 in.	x 10 ft.	
Bottom wall plates	2	"	8	x 2	x 10	10 in.
Bottom wall plates	2	"			16	10
Wall studs	16	"			18	4
Wall studs	6	"			10	1
Wall studs	14	"			9	2
Ceiling joists	8	"	4	x 2	x 14	
Ceiling joists	6	"			7	9
Rafters	16	"			10	3
Collar ties	8	"	10	x 1	x 4	
Collar ties	8	"	4	x 1	x 6	
Ridge cap	3	"	5	x 1½	x 14	
For division partition	6	"	2	x 6	x 16	8
For division partition	1	"			10	
For division partition	6	"	2	x 4	x 9	6
Ice chamber floor	8	"	4	x 2	x 9	6
Ice chamber floor	8	"			9	4
Ice chamber floor	8	"	3	x 2	x 8	8
Ice chamber floor	13	"	4	x 4	x 9	8
Refrigerator chamber floor	8	"			6	
Refrigerator chamber floor	8	"		6	x 6	4
Refrigerator chamber floor	15	"	2	x 1½	x 9	6
Cornice			6	x 1	x110	
Cornice			4	x 1	x110	
Ridge roll					21	
Rough boards, 1 in					600 sq. ft.	
Shingles					5000 "	

Ventilators as shown. 2
Outside strapping........ 700 lin. ft. 2 in. x 2 in.
Inside strapping, dressed.. 700 2 x 1
Bevelled battens.........1500 2 x 1
Ice house battens......... 35 pieces 2 x 1 x 16 ft.
1 door 2 ft. 8 in. x 6 ft. 6 in. high, to refrigerator chamber
1 " 2 11 x 6 6 " with frames to suit
3 " 2 10 x 4 " to ice chamber
1 " 2 10 x 3 3 " to lofts
1 " 2 11 x 4 " to lofts
2 window frames and 8 pieces glazed sash to refrigerator chamber
3500 sq. ft. of 1 in. sheeting for walls, floor, ceilings, etc.
2000 sq. ft. of paper
Sawdust for filling
Shellac for walls of refrigerator chamber
Hardware such as nails, screws, hinges, bolts, etc., etc.

A Modification of the Hanrahan.

Attention is called to the diagram (Fig. 20) which illustrates the use of two cooling chambers, one above the other, in connection with this system. A certain butcher of Guelph has this modification of the Hanrahan in his abattoir and he says that it works well. The cold air enters the upper chamber chiefly through wooden flues, not shown in the diagram. which convey the cold air from the ice room through the wall at points just beneath the flooring. The cold air may be admitted also from the lower chamber through openings in the floor. The temperature of the upper chamber is usually about 4 degrees higher than that of the lower. The lower chamber is used for the storage of curing and pickling vats and rougher material, while the upper is for the dressed pork which is not kept there longer than a day or so before marketing. In order to get the best results with this arrangement the ice chamber should be kept

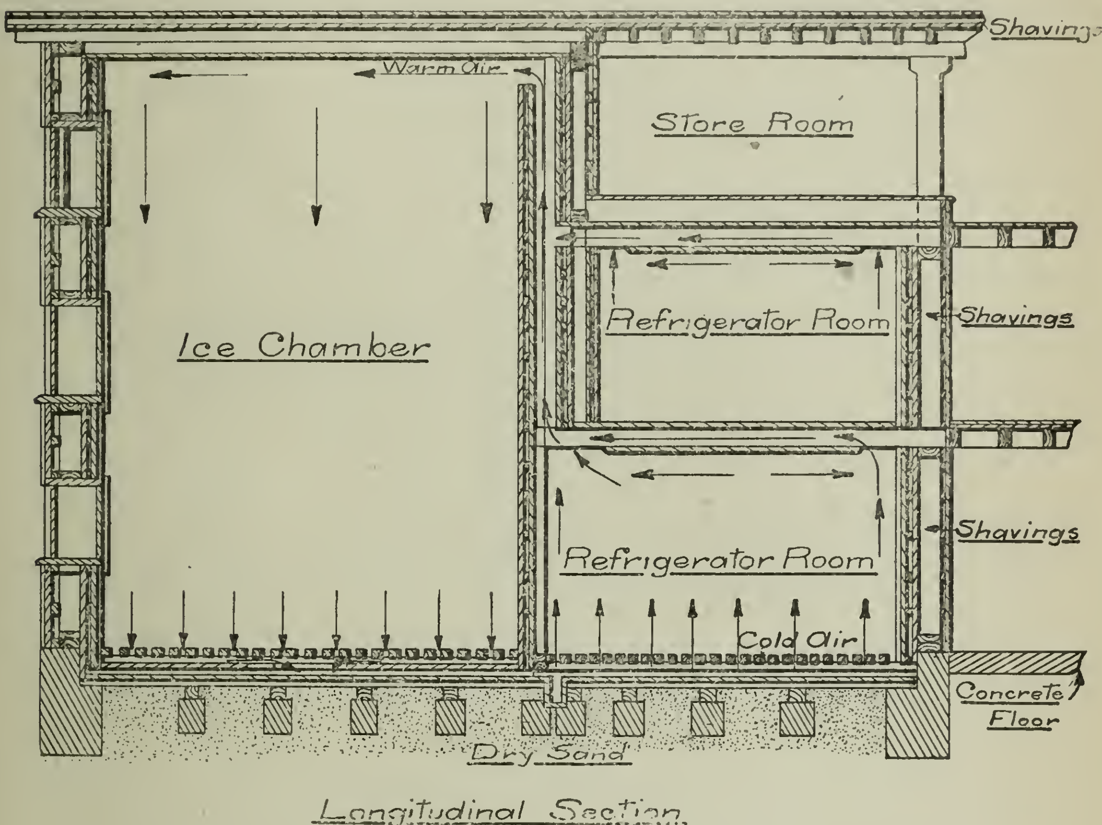


Fig. 20.—Hanrahan System with two Refrigerator Rooms.

well filled, else the temperature of the upper chamber will go too high in the very warm weather. The ice chamber ought to extend well above the top of the cooling chambers. The success of any form of the Hanrahan system depends very largely on the height of the ice in the ice-room.

Ice-Overhead Systems.

These are probably the oldest systems of ice cold storage in use at the present day. Their history is very interesting, but cannot be treated fully here. It was, however, in the United States some twenty or more years ago that various forms were tried with the result that only one or two have proven very successful. These were the Steven and Jackson forms.

and those in use in Canada to-day are very similar to them in principle and construction. The very large plants have not been a success, and have gone almost out of use, but the small and medium sized ones are very rapidly increasing in number, and, I understand, are giving very good satisfaction. They are patented in Canada and handled by companies which make a specialty of refrigerators and small ice cold storages. The main parts, such as the side walls, ceiling, etc., are made and finished in the factories according to specifications received from an applicant. The parts are easily and quickly put together by a few large wood screws on the site. The largest use for these storages is in connection with butcher shops, abattoirs, restaurants, creameries, hotels, institutions of various kinds, florist stores, etc. These are built inside the buildings, in which they are used and hold from one to five tons of ice at one time, according to size. A few larger ones holding say, 90 or 100 tons of ice are in use as separate buildings. There is one at the Jordan Harbour Fruit Experiment Station, Ontario, which holds 90 tons of ice and has two storage rooms with a total capacity of 1½ cars. It is said that a uniform temperature of 40 degrees can be maintained in the storage chambers, and that the ice will last the season under ordinary use. Further information pertaining to costs, names of refrigeration companies, reliable references, etc., may be had by applying to the writer.

HOUSEHOLD REFRIGERATORS.

Reference has been made to the necessity and value of a refrigerator in the home. It seems to me that it is one of the essentials of the house equipment. In building a house provision for the refrigerator should be made in the plans, and it should be made a part of the house just as much as the kitchen or pantry. It could then be located to the best advantage, designed and constructed as desired, and made a permanent part of the house. At the present day there are a great many kinds and grades of refrigerators on the market, many of them being very neat articles, indeed, and capable of giving very good results if they are properly cared for. Refrigerators are usually procured through our hardware men, although they may be bought direct from the firms. The names of reliable firms may be had by applying to the writer.

The Essentials of a Good Refrigerator.

Good Insulation. The walls should be so constructed that they would keep out the heat, at least, reasonably well, otherwise a low temperature cannot be maintained in the food chamber, the foods will not keep well, and there will be a great waste of ice. A great many of our manufactured refrigerators, especially the cheaper grades, are not sufficiently well insulated. The character of the insulation, rather than the design and finish, should be the feature that a purchaser ought to keep well in mind.

Free Circulation. The circulation of air in the refrigerator largely controls the degree of moisture and the purity, and to some extent the temperature of the air in the food chamber. The circulation depends on the relation and connection between the ice and food chambers, and the difference of temperature between the two chambers.

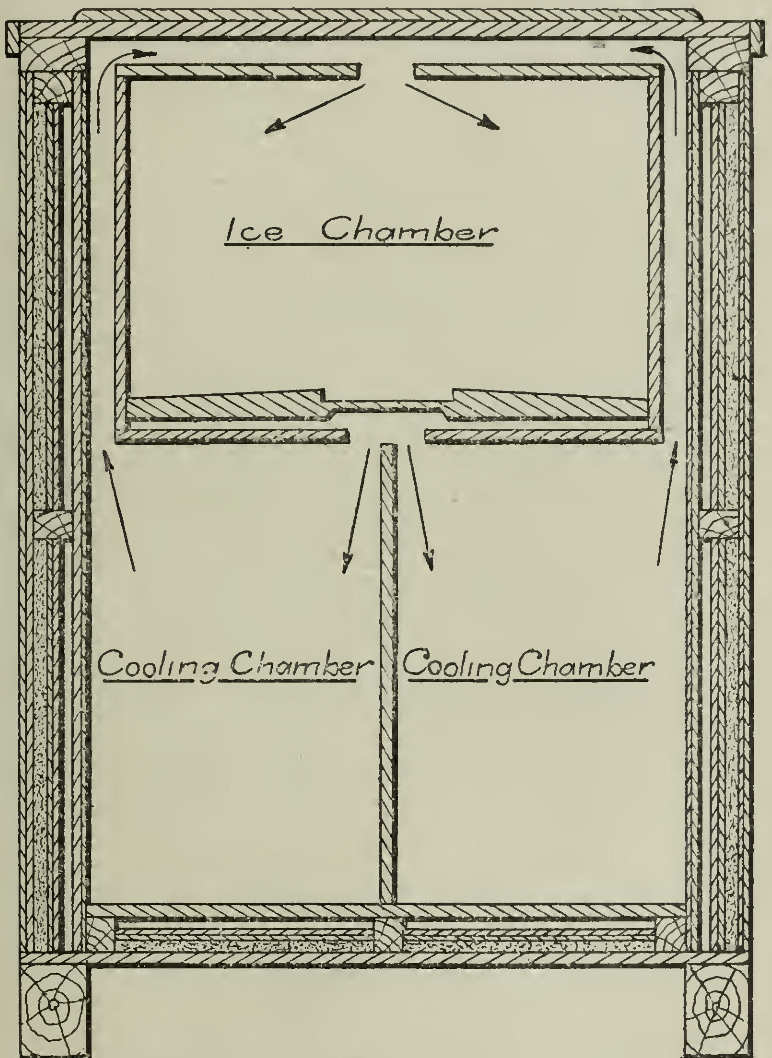


Fig. 21.—Cross Section of an Ice-Box.

Opinions among refrigerator and cold storage men differ as to the proper design of a refrigerator for good circulation; some claiming that the ice box should be above the food chamber, others, that it should be at the side. So far as the average sized household refrigerator is concerned, there is not much difference in the degree of circulation between the two cases, provided that flues are properly arranged to convey the cold air to the bottom of the food chamber, and the warm air to the top of the ice chamber. Arrangements are now being made by the writer for carrying on conclusive tests on this particular point in the very near future.

Easily Kept Clean and Sanitary. The lining of the chambers should be an odorless material; smooth, hard, free from checks or openings, not subject to decay, and something easily kept clean and sweet. The most desirable woods for lining are spruce, hemlock, basswood, and whitewood. A wood lining should be extremely well seasoned, very free from knots and checks, carefully put together, and then well coated with shellac. A good quality of galvanized iron makes a very satisfactory lining for the food chamber. The shelves are made of the same material. The expensive linings used to-day in the high-grade refrigerators are white enamel, porcelain, opalite, etc. These materials make a very sanitary, durable, and highly finished interior.

Durability. A great many of the cheaper grades are poorly constructed from very improperly seasoned material, the result is that the doors and walls soon get out of place. A good quality of oak or ash well-seasoned makes a very satisfactory material for the outside finish. Of course, good care is an important factor in the life of a refrigerator, as it is in anything else.

Reasonable Price. Since a refrigerator is so essential in every home the price ought to be reasonable and well within the reach of all, although any farmer could well afford to expend $25, or even more, on a good refrigerator. A serviceable one ought to be bought for much less.

Size. The sizes suitable for homes vary somewhat. A general idea of the range of sizes may be had from the following list:—

SMALL SIZE

	Height	Width	Depth
Outside measurements	45 in.	27½ in.	17¾ in.
Ice chamber....................	9¾ in.	18 in.	11⅝ in.
Provisionchamber	18¼ in.	20½ in.	12⅛ in.
Shipping weight................	150 lbs.		
Ice capacity, about	70 lbs.		

MEDIUM SIZE

	Height	Width	Depth
Outside measurements..........	49 in.	29½ in.	21¾ in.
Ice chamber....................	10 in.	22 in.	16 in.
Provision chamber..............	22 in.	24½ in.	16 in.
Shipping weight................	200 lbs.		
Ice capacity....................	115 lbs.		

LARGE SIZE

	Height	Width	Depth
Outside measurements..........	57 in.	44 in.	27 in.
Ice chamber....................	27 in.	14 in.	18 in.
Provision chamber No. 1........	12 in.	17 in.	22 in.
Provision chamber No. 2........	19 in.	17 in.	22 in.
Shipping weight................	560 lbs.		
Ice capacity....................	220 lbs.		

These three sizes, or thereabouts, will meet the requirements of almost any home in city or country. The small size is large enough for very small families in the city, the medium for small country homes and the large one for very large families in the city or country. Many of the large refrigerators have two or three separate cooling chambers and this is a very desirable feature when considerable quantities of different foods are stored for several days, because certain products as eggs and butter will absorb odor from fruit and vegetables if stored in the same chamber for even a few days.

Quantity of Ice Required per Week.—The amount of ice that any refrigerator will use per week or month will vary with the temperature of the room where the refrigerator is kept, the amount of goods stored, the insulation of the walls of the refrigerator and the quantity of ice in the ice-box. It is noted that the ice capacity of the small size is 70 lbs., the medium 115 lbs., and the large 220 lbs. These quantities are, in the writer's opinion, rather too high unless the ice is packed in pretty well. In practice the amounts put in at one time are about 50, 90, and 175 lbs., respectively.

It is advisable to keep the ice-chamber as well filled as possible, because the ice will last longer and a lower and more uniform temperature will be maintained in the food chamber below. A large household refrigerator about the size mentioned above and well insulated requires about 30 lbs. of ice per day or from 200 to 225 lbs. per week for average conditions of summer weather. The small or medium size not so well insulated will use about the same amount. Assuming that the refrigerator would be used for five months of the year it would be necessary to provide for three or four tons or loads of ice for household use; this amount would supply plenty for the household purposes and allow for considerable waste.

Prices.—The cost varies from about $10 to $75 according to insulation, size, and finish. The small size, lined with galvanized iron and insulated only fairly well, costs from $10 to $15. This grade gives very good satisfaction for a small family. No family can afford to be without one at this cost. A large size better insulated and lined with enamel or porcelain and durable for a lifetime costs about $35. The expensive ones, even, are cheap in view of their durability and efficient service. To be without a refrigerator is poor economy indeed.

Suggestions on the use of Refrigerators.

Every refrigerator is furnished with a set of directions and these should be followed closely if one wishes to get the best results from its use. The following are a few of the most important points to watch:—

(1) Keep the refrigerator on a level floor in a cool dry place, and where it can be filled easily and without mussing the kitchen floor.

(2) Fill the ice box regularly and use plenty of ice. Wash ice well before putting into the ice box.

(3) Clean the ice-box and the food chamber thoroughly once a week. The shelves, racks, and flues are all easily taken out, hence the cleaning can be well done in a few minutes. A damp cloth moistened with soda water or with water in which two tablespoonfuls of sweet nitre to the pint has been added is strongly recommended for cleaning the walls of the interior. It is advisable to place a saucer of charcoal in the food chamber to absorb odors and moisture. It will need to be renewed occasionally.

(4) Keep the doors or lids closed as much as possible, and when an article is put into the refrigerator or removed, the door or lid should be closed as quickly as possible afterwards.

(5) Do not cover the shelves with paper or cloth and thereby obstruct circulation which is so necessary in the keeping of perishable products in cool chambers.

(6) Avoid putting hot, steaming or over-ripe, tainted or partially spoiled food or fruits in the refrigerator. If such a practice is followed the food chamber will be damp, foul and altogether unfit for keeping food of any kind in good condition.

(7) Keep the drain always clear.

HARVESTING THE ICE CROP.

Where more than one farmer in a vicinity puts in ice the harvesting should be carried on co-operatively. This would be a very practicable proposition. Greater interest would be taken in this line of work and consequently far more ice would be stored. Time, labour and money would be saved by such a plan and the operations could be performed much more satisfactorily. All the ice for the neighborhood could be harvested in a few days. The ice storages in connection with creameries and cheese factories, etc., could be filled at the same time. The number that would probably form an Ice Harvesting Society or Club in any vicinity would vary greatly, and also the number of tons of ice stored. In any case it would be highly advisable for the co-operation to procure an up-to-date equipment for harvesting the ice. Below is given a list of tools, etc., also photo-engravings of the most important ice tools and of harvesting scenes. The equipment lists, Set No. 1 and 2 below, were prepared, and sent to me by a certain Ice Tool Company. I obtained the prices from their 1911-12 catalogue and the discounts from a separate list, and then calculated the total outlay as given for each case. The duty on this kind of goods is about 25 per cent., and discount about 25 per cent. on the average. These two sets will serve as a guide in computing the probable outlay for any case. I think they are probably more complete then might be really necessary, so the cost might be reduced somewhat.

The Iceman's Harvest—Note the Stack of Ice.

SET No. 1.

"Suitable for harvesting 100 to 500 tons of ice, using three to six men and one horse, alternating plowing and raising ice with the horse, and hoisting into one room with one grapple:

"If plowing and raising are to be done at once, two horses and more men will be required."

Number of tools required	Name of tool	Cost, less discount
1	8 in. 5 tooth special Plow.......	$22.50
1	Plow Rope....................	1.40
1	5 ft. Ice Saw..................	3.85
1	Plow Grapple and Handles......	2.97
1	Fork Bars....................	3.20
1	Caulking Bar..................	2.00
1	Bar Chisel....................	2.45
1	Floor Shaver..................	1.06
1	Ring Splitting Chisel...........	1.75
1	Line Marker..................	.60
1	Sieve Shovel..................	1.22
3	4½ ft. Ice Hooks................	1.66
1	6 ft. Ice Hooks................	.61
1	12 ft. Ice Hooks................	.82
1	12 in. Upper Gin...............	4.92
1	12 in. Lower Gin...............	6.75
		Total, $57.76

Set No. 2.

"Suitable for harvesting 1,000 to 3,000 tons of ice, using say, ten men and two horses, hoisting into two rooms with one grapple."

Number of tools required	Name of Tool	Cost less discount.
1	8 in. Swing Guide Plow for ice 12 in. thick................	$21.00
1	for 14 in. ice..................	42.70
1	Plow Rope..................	1.40
2	5 ft. Saws..................	7.70
2	Grapples and Handles..........	5.95
1	Splitting Fork................	2.50
2	Caulking Bars................	4.00
2	Bar Chisels..................	4.90
2	Floor Chisels................	2.00
1	Ring Splitting Chisel...........	2.06
1	Needle Bar..................	1.5.
1	3-tined Needle Bar............	2.63
1	Line Marker..................	.63
1	Sieve Shovel................	1.22
8	4½ ft. Ice Hooks..............	4.44
2	6 ft. Ice Hooks..............	1.23
2	10 and 16 ft. Ice Hooks.........	2.10
1	24 in. Boston Tongs............	1.07
2	12 in. Upper Gins..............	9.90
2	12 in. Lower Gins..............	13.50
		$91.08

Thus a very complete and up-to-date equipment for harvesting upwards of 500 tons of ice can be secured for about $60; for a harvest of 1,000 to 3,000 tons of ice the cost would be about $100. Five hundred tons of ice will supply 20 or 25 farmers, so that the cost of equipment to each should not exceed two or three dollars. The tools, if well cared for will last for many years. By co-operative harvesting the farmers ought to be able to store their year's ice for about 20 or 25 cents per ton. This method should appeal very forcibly to any neighborhood of farmers as their ice can be harvested so easily, quickly and cheaply. The accompanying illustrations show several of the ice tools in operation, for example, the ice plow, saws, a simple convenience for loading ice on sleighs, apparatus for hoisting the ice into the top of the ice house, etc. The device for loading the cakes on to the sleighs is worthy of special attention, as it is a very essential part of the outfit, because it saves much time and a great deal of hard, disagreeable work in loading the heavy cold, wet cakes. A handy man can make it very cheaply. The harvesting of ice is therefore comparatively easy work, when the proper tools and conveniences are provided for.

The Iceplow and Its Work.

If the ice is 1 foot thick it will require an area of about 6 feet square for one ton, and an area 50 feet square for 40 tons. The ordinary sized cake about 20 inches square and 1 foot thick will weigh about 150 lbs. and 20 or 25 cakes, say 1½ or 2 tons is about as much as can be carried conveniently on a sleigh.

Loading Ice—How Easily It's Done.

STORING THE ICE.

Suggestions on the Storage of Ice.

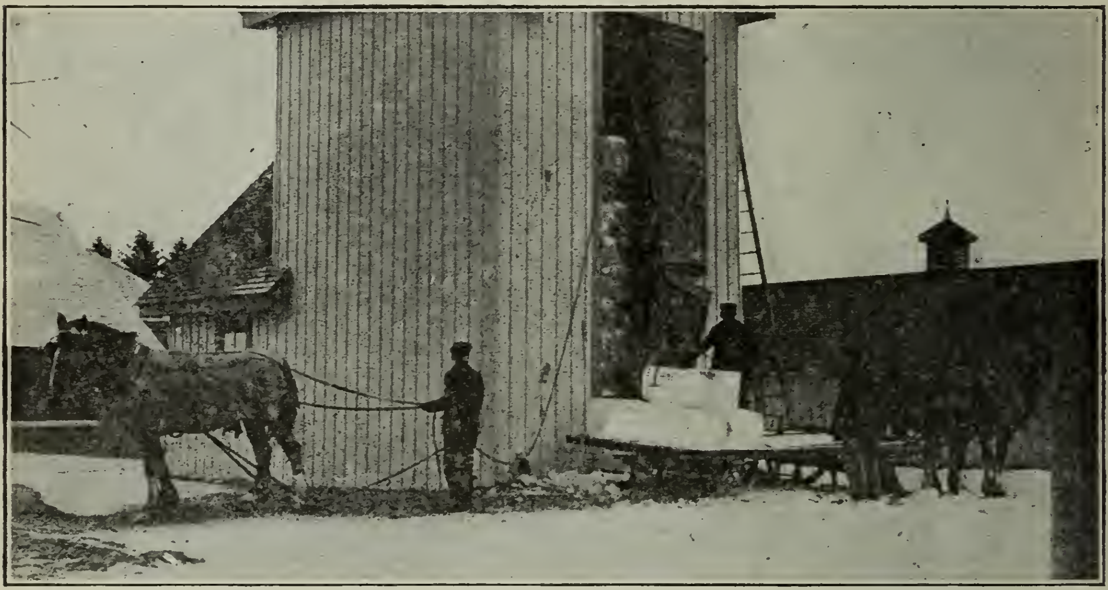
1. Take the ice from a clean, pure and deep lake, pond or stream. Do not by any means store snow or poor ice.

2. The ice should be at least 1 foot thick.

3. Store the ice preferably on very cold days. It will handle more satisfactorily and keep better.

4. Put plenty of dry sawdust on the bottom of the ice-house, at least 1 foot, before beginning to store the ice.

5. Pile the ice cakes as closely as possible in rows and layers, breaking the joints, and fill the chinks with small pieces of ice or snow. The air space should be reduced as much as possible.



Storing Next Summer's Supply of Ice at the Ontario Agricultural College.

6. Do not fill the spaces among the cakes with sawdust. This practice is not advisable and is therefore going out of date.

7. Leave at least 1 foot space between the ice and the wall of the ice house and pack it well with a good quality of dry sawdust as the ice is put in.

8. After all the ice is stored put a foot or two at least of sawdust over the top. An extra amount will not be amiss to refill the settling of the sawdust at the sides. Two or three feet of wild hay is a very good covering for the top of the ice if plenty of sawdust cannot be obtained, and wild hay or straw chopped would do for the sides if about twice as much is used.

9. See to it that the ice is kept well covered throughout the summer, especially after any ice is removed.

Size of the Ice Cakes.

The standard sizes for commercial use are 22 inches by 22 inches and 22 inches by 32 inches. These are rather too large for storage on the farm, although the large cakes keep better. A cake 18 inches by 18 inches would be about right. A cake 18 inches by 18 inches and 1 foot thick would weigh about 130 lbs. and if smaller pieces are required for use these cakes can be divided after they are taken out of the sawdust.

The Tonnage-Space of Ice.

The following data is given by Madison Cooper on this point in his excellent little monthly publication entitled "Cold":—

"It is customary to figure from 40 to 50 cubic feet for a ton of ice, house measurement. By house measurement is meant the inside dimensions of the ice storage room. Where the house is small and the ice is packed in sawdust or other packing material in the old fashioned way, it is customary to allow about 50 to 55 cubic feet for a ton of ice; in larger houses less in proportion.

"In the modern houses such as are used in connection with the Cooper Cold Storage Systems no packing material is used, whether at the sides or on the top, as the walls, floor and ceiling are thoroughly insulated. In such a house 40 cubic feet is ample to allow for a ton of ice.

"Forty-two cubic feet is the figure which has probably been used more than any other in connection with the storage of natural ice for retail purposes. This allows for packing every third tier at least on edge. It takes a little more space where part of the ice is packed on edge.

"The actual space occupied by a ton of solid ice is only about 35 cubic feet, so you will see that all of these figures are simply estimates to allow for loss of space from various causes when packing the ice in the house."

The Cost of Handling and Storing Ice.

The cost per ton varies from 20 to 75 cents, according to conditions, such as season, cost of labor, distance of supply from storage, quantity stored and so on. In Ontario it costs from 30 to 50 cents to store one ton of ice in a commercial ice-house on water front and having a capacity of about 5,000 tons. In the United States the cost of handling ice for small houses is 20 cents a ton on the average, and the cost to our farmers should not exceed this if they would harvest their ice co-operatively as has been suggested.

ESSENTIAL CONDITIONS FOR SUCCESSFUL STORAGE OF PERISHABLE PRODUCTS.

Preparation for Storage.

(1) All the storage rooms and corridors should be thoroughly cleaned, white-washed, and aired each year after all the stored goods are removed or shipped out. While the rooms remain empty they should be kept

very clean, dry, and well aired. Keep the ventilation system working well. The white-wash will act as a disinfectant and fungicide. Two coats of white-wash should be used; the first very thin, the second thicker, or of a pasty consistency. The slaking of the lime should be done carefully and slowly. A good quality of dry sawdust or quicklime is useful on the floors to take up moisture. Chloride of Calcium is a good absorbent of moisture and odors.

(2) Too little attention is usually given to the condition and care of the products just before storage. No class of goods will come out of storage in a satisfactory condition unless it was in a first-class condition when stored. Careless storage is ruinous to the cold storage man, the customer and to commerce. Do not store hot, tainted, bruised, over-ripe or diseased products. Eggs, for example, should be carefully candled, graded, and packed, and fruit cautiously picked, well sorted, allowed to cool off some, and then packed carefully in proper crates.

(3) Crates, barrels, etc., should be somewhat open on all sides to allow good circulation of air throughout all the goods, and to permit the gases emanating from the goods to escape. Closely constructed barrels and packing boxes should not be used. All wrappers should be porous.

(4) Too much attention cannot be given to the careful handling of the goods on the way to the storage, and while being stored away in the rooms. One bruise is often responsible for a heavy loss.

(5) Do not forget that cold storage is not a cure-all for all the defects, natural or otherwise, of perishable products, and that if they are put into storage in an imperfect condition they will be sure to come out in as bad, if not a worse, condition.

Arrangement and Packing of Goods in Storage Rooms.

(1) Goods should be kept a few inches away from the walls, floors and ceiling to allow the air to circulate well around all the sides.

(2) Nor should they be packed tightly but with spaces. At least one-half inch space should be allowed around all sides of egg cases, fruit crates, etc. In our best storages, egg cases for example, are piled in tiers with a small space between the cases in the tiers, and each tier is separated from the one above it by an inch strip. This arrangement permits of thorough circulation around the eggs.

(3) Large quantities of different classes of goods should not be stored in the same rooms for any length of time, as some goods taint others, and all do not require the same temperature. Eggs and butter are easily tainted, and these should not be stored with fruit or vegetables or with any other goods in fact. No specific rule can be laid down to suit all conditions, but for regular storage it is highly advisable to have a separate room for each class of goods. In small storages this is not

possible, so many goods are stored together and often without serious results, if the period of storage is not very long.

Cold Storage and Freezing Temperatures for Our Most Common Products of Storage.

Mr. Madison Cooper furnishes the information contained in the following table of storage temperatures. It is reliable and up-to-date.

Apples	42	Maple Sugar	45
Asparagus	33	Maple Syrup	45
Berries, Fresh (few days only)	40	Meat (fresh) (ten to thirty days)	30
Bulbs	34	Meats, fresh (few days only)	35
Butter	14	Meats, salt (after curing)	43
Cabbage	31	Milk (short carry)	35
Canned Fruits	40	Nursery Stock	30
Canned Meats	40	Nuts in shell	40
Carrots	33	Oatmeal	42
Celery	32	Oils	45
Cheese (long carry)	35	Onions	32
Cheese (cool cooling)	50	Oxtails	30
Cider	32	Oysters, iced (in tube)	35
Cranberries	33	Oysters (in shell)	43
Cream (short carry)	33	Parsnips	32
Cucumbers	38	Peaches (short carry)	50
Currants (few days only)	32	Pears	33
Cut roses	36	Plums (one or two months)	32
Dried fruits	40	Potatoes	34
Eggs	30	Poultry (after frozen)	10
Ferns	28	Poultry (dressed, iced)	30
Fish, fresh water (after frozen)	18	Poultry (to freeze)	0
Fish, salt water (after frozen)	15	Raisins	55
Fish (to freeze)	5	Ribs (not brined)	20
Fruit Trees	30	Salt Meat, curing room	33
Fur and fabric room	28	Sauerkraut	38
Furs (undressed)	35	Sausage Casings	20
Game (after frozen)	10	Shoulders (not brined)	20
Game (short carry)	28	Strained Honey	45
Grapes	36	Sugar	45
Hams (not brined)	20	Syrup	45
Hogs	30	Tenderloin, etc.	33
Hops	32	Tobacco	42
Huckleberries (frozen long carry)	20	Tomatoes (ripe)	42
Ice Cream (for few days)	15	Veal	30
Ice Storage room (refrigerated)	28	Watermelons (short carry)	40
Lard	40	Wheat Flour	42

Humidity in Storage Rooms.

The term "humidity" is another name for dampness, and the term "Relative Humidity" refers to the percentage of moisture in the air. If the air is saturated the relative humidity is 100 per cent., if half saturated 50 per cent., etc. The humidity is an important factor in the storage of some classes of goods; for example in the storage and curing of cheese; if the air is too dry the cheese lose excessively in weight, if too damp, they mold; likewise with eggs, fruit and vegetables. It is important, therefore, that these goods be stored under the proper conditions of humidity. With such products as butter, meats, fish, and all goods held at very low or freezing temperatures, the matter of humidity is not so important. Eggs, vegetables, and fruit should be held at a relative much moisture. Eggs, vegetables, and fruit should be held at a relative humidity of about 80 per cent. Cheese about the same, or maybe a little less, though it is usually higher in many of our small curing rooms. If the storage rooms are provided with adequate circulation of pure air and with trays holding Calcium Chloride there will not be any particular trouble with the question of moisture. Humidity determinations are made by an instrument called a hygrometer and a set of tables. Space will not permit a description of this instrument or the method of use here, but information about it may be procured from the writer.

Length of Storage Periods.

The length of time that perishable products may be held in cold storage depends on many conditions, such as the class of goods, condition at time of storage, temperatures maintained in rooms, humidity, packing, handling, etc. From reports of Canadian Cold Storage Warehousemen it is learned that eggs are usually held for 8 or 10, or even 15 months with good results, apples 8, butter 8 to 10, poultry 10 to 12, meats 6, fish 8 or more, and lemons, etc., 3. There is no doubt that most of these goods could be held much longer than these periods if it were necessary, but that they come out of storage in good condition at the end of these periods is a very significant fact.

The following paragraph by S. H. Fulton, Pomologist, of the U. S. Department of Agriculture, in Bulletin 108, Bureau of Plant Industry, should be noted with interest in this connection:

The Length of Time Small Fruits Keep in Cold Storage.

The length of time small fruits keep in cold storage depends upon the variety, the conditions under which the fruits are grown, and the methods of handling them in picking, packing, shipping, etc. In the Department tests, with fruit handled under good commercial conditions, strawberries kept from one to two weeks in good condition so far as appearances were concerned, but the flavor usually began to deteriorate after three or four days. Some of the firm-fleshed varieties, like Gandy, kept even longer than two weeks, when picked dry, and carefully handled, while tender varieties, like Tennessee, went down much more quickly. Red raspberries usually began to mould after two or three days in storage. Black raspberries kept in sound condition for a somewhat longer period. Most varieties of blackberries kept a week, while some of the firmer fleshed sorts kept several days longer. Dewberries behaved similar to blackberries. Currants kept well for two weeks with slight loss to flavor. Gooseberries retained their normal appearance and flavor, after which the fruit turned red and became unsalable. Cranberries kept throughout the winter and were withdrawn the last of April in good commercial condition.

These statements are based upon tests with small fruits packed in the customary way as for market and stored in a temperature of 32°F. Wrapped fruit and fruit stored in moderately tight packages kept for somewhat longer periods."

The following facts regarding the storage of fruits have been pretty well borne out in experiments in United States and Canada:

(1) Bartlett pears keep in good condition for six weeks in cold storage at a temperature of 32°F. if stored within 48 hours after packing. When storage was delayed four days after picking there was a loss of from 20 to 30 per cent. from softening and decay. The Kieffer if packed and stored right after picking will keep until spring. Pears should be picked before they are mature, and if kept for long periods a wrapper is a great advantage.

(2) Powell and Fulton give the following summary in their Bulletin 48, Bureau of Plant Industry, on the apple in cold storage:

"An apple usually should be fully grown and highly colored when picked, to give it the best keeping and commercial qualities. When harvested in that condition, it is less liable to scald, of better quality, more attractive in appearance, and is worth more money than when it is picked in greener condition.

"An exception to the statement appears to exist in the case of certain varieties when borne on rapidly growing young trees. Such fruit is likely to be overgrown, and under these conditions the apples may need picking before they reach their highest color and full development.

"Uniform color may be secured by pruning to let the sunlight into the tree, by cultural conditions that check the growth of the tree early in the fall, and by picking over the trees several times, taking the apples in each picking that have attained the desired degree of color and size.

"Apples should be stored as quickly as possible after picking. The fruit ripens rapidly after it is picked, especially if the weather is hot. The ripening, which takes place between the time of picking and storage, shortens the life of the fruit in the storage house. The fruit rots multiply rapidly if storage is delayed, and the fruit becomes heated. If the weather is cool enough to prevent after-ripening, a delay in the storage of the fruit may not be injurious to its keeping quality.

A temperature of 31° to 32°F. retards the ripening processes more than a higher temperature. This temperature favors the fruit in other respects.

"A fruit wrapper retards the ripening of the fruit; it preserves its bright color, checks transpiration and lessens wilting, protects the apple from bruising, and prevents the spread of fungous spores from decayed to perfect fruit. In commercial practice the use of the wrapper may be advisable on the finest grades of fruit that are placed on the market in small packages.

"Apples that are to be stored for any length of time should be placed in closed packages. Fruit in ventilated packages is likely to be injured by wilting. Delicate fruit, and fruit on which the ripening processes need to be quickly checked, should be stored in the smallest practicable commercial package. The fruit cools more rapidly in small packages.

"Apples should be in a firm condition when taken from storage, and kept in a low temperature after removal. A high temperature hastens decomposition and develops scald.

"The best fruit keeps best in storage. When the crop is light it may pay to store fruit of inferior grade, but in this case the grades should be established when the fruit is picked. The bruising of the fruit leads to premature decay.

"The scald is probably caused by a ferment or enzyme which works most rapidly in a high temperature. Fruit picked before it is mature is more susceptible than highly-colored, well-developed fruit.

"After the fruit is picked its susceptibility to scald increases as the ripening progresses.

"The ripening that takes place between the picking of the fruit and its storage makes it more susceptible to scald, and delay in storing the fruit in hot weather is particularly injurious.

"The fruit scalds least in a low temperature. On removal from storage late in the season the scald develops quickly, especially when the temperature is high.

"It does not appear practicable to treat the fruit with gases or other substances to prevent the scald.

"From the practical standpoint the scald may be prevented to the greatest extent by producing highly-colored, well-developed fruit, by storing it as soon as it is picked, in a temperature of 31° to 32°F., by removing it from storage while it is still free from scald, and by holding it after removal in the coolest possible temperature.

"A variety may differ in its keeping quality when grown in different parts of the country. It may vary when grown in the same locality under different cultural conditions. The character of the soil, the age of the trees, the care of the orchard—all of these factors modify the growth of the tree and fruit, and may affect the keeping quality of the apples. The character of the season also modifies the keeping power of the fruit."

(3) Reynolds and Hutt of the Ontario Agricultural Colloge give the following summary in their Bulletin 123 on the Cold Storage of Fruit:

"1. Apples and pears keep best when wrapped singly in paper, and packed in a shallow box, not larger than a bushel. They ship best when, in addition, they are packed in layers with excelsior between.

"2. Apples keep better at a temperature of 31° than at a higher temperature. Our experiments do not show what is the best temperature for pears.

"3. Cold storage cannot make bad fruit good; neither can it keep bad fruit from becoming worse. Only good specimens will keep for any length of time in cold storage, or will pay for storage.

"4. For long storage, it pays to select the best fruit and to pack it in the best manner known. The extra labor and the cost of material are more than repaid in the greater quantity and better quality of fruit left at the end of the storage period.

"5. With apples and pears at least, and, it seems likely, for most kinds of fruit, the fruit should be picked and stored in advance of dead ripeness. The maturing process goes on more slowly in cold storage than on the tree or bush.

"6. With the two kinds of fruit tried, apples and pears, the medium sizes of fruit keep longer than the largest, all being perfect specimens and picked at the same time. It would, therefore, be an advantage, especially with pears and peaches, to pick the larger specimens first, and leaves the smaller to mature later.

"7. Fruit, on being removed from cold storage, should be allowed to warm gradually, and moisture should not be allowed to deposit upon it. But if the wetting cannot be prevented, then the fruit should be spread out and dried as quickly as possible.

"8. With all kinds of fruit, there is a time limit beyond which it is unprofitable to hold the fruit in cold storage, or anywhere else. That limit, for sound fruit, is dead ripeness. Duchess pears can be kept profitably until late in December; Fameuse, or Snow, apples, until March or April. The time limit has to be determined for each kind of fruit.

"9. In addition to proper conditions in the storage room, the most important points in the storage of fruit are the selection of sound fruit, grading into uniform sizes, one variety only in a case; and careful packing. Therefore, the results of these experiments can be made use of by the family, in preserving fresh fruit for their own use; by the fruit-grower, in securing better prices for good fruit later in the season, in the local markets; and by the shipper, in enabling him to take advantage of the higher prices offered in foreign markets."

(4) Peaches may be kept two to four weeks in good condition if they are picked at just about full ripeness, wrapped in paper, and packed in small cases at a temperature of 36°F.

(5) Grapes may be kept well for 6 or 8 weeks, depending somewhat on the variety. The early grapes usually keep the best. Dryness is very essential to the keeping of grapes in storage, hence the practice in places of packing them in sawdust and ground cork.

(6) Plums will not keep much longer than a month under the best conditions.

(7) Tomatoes have been kept about two months when picked as they are beginning to redden, wrapped in tissue paper, and packed in cases with excelsior. Green tomatoes may be held for months.

CANADIAN BULLETINS AND REPORTS ON COLD STORAGE.

DOMINION.

Published by J. A. Ruddick, Dairy and Cold Storage Commissioner, Ottawa, Canada.

1. "Creamery Cold Storage." Bulletin No. 10.
2. "Ice on the Farm." Bulletin No. 20.
3. "Subsidies for Cold Storage Warehouses." Bulletin No. 16.
4. "Plans and Specifications of a Cool Cheese Curing Room." Bulletin No. 7.
5. The Commissioner's Annual Reports contain very valuable information on Cold Storage work in our Dominion. They also may be had by writing to Mr. Ruddick, at Ottawa. See Reports from 1906 up to the present time.
6. Mr. Ruddick's evidence before the Select Standing Committee on Agriculture and Colonization, of the House of Commons. See copies of this report for years 1906-07, 1907-08, 1909-10.

PROVINCIAL.

Published by the Department of Agriculture, Toronto, Ontario

1. "Plans and Specifications for Cold Storage Buildings" (The Hanrahan System), also Acts in regard to Provincial aid (1900).
   NOTE: This pamphlet is out of print I understand.
2. "Ripening of Cheese in Cold Storage," compared with ripening in the ordinary curing-room.
   Bulletin No. 121, by Professors Dean, Harrison, and Harcourt, of the O. A. C. Revised in 1903 as Bulletin 131.
3. "Cold Storage of Fruit." No. 123, by Professors Reynolds and Hutt.

MISCELLANEOUS REPORTS.

1. "Cold Storage of Cheese and Butter." 1904 Report of the Ontario Agricultural College, Guelph.
2. "Cold Storage Experiments," J. B. Reynolds, 1900 Report of the Ontario Agricultural College.
3. "Cold Storage for Fruit and Other Products." See Ontario Fruit Growers' Association Report for 1900.
4. "Cool Curing of Cheese." By J. A. Ruddick and Ballantyne, Ontario Dairymen's Association Report for 1902; also see 1901 Report.
5. "Fruit Shipments to Britain." See Fruit Growers' Association Report for 1901; also 1910 and 1911 Reports of the Fruit Branch, Department of Agriculture, Toronto, Ontario.

NOTE.

A second bulletin dealing with the mechanical systems of refrigeration, cold storage warehouses, pre-cooling, insulation, cold storage legislature, etc., is being prepared for publication by the writer.

ACKNOWLEDGMENTS.

I am very greatly indebted to Mr. J. A. Ruddick, Dairy and Cold Storage Commissioner, Department of Agriculture, Ottawa, for a great deal of this Bulletin, also to Mr. Madison Cooper, of Calcium, N.Y., who has helped me very much on many occasions in its preparation. Mr. M. T. Smith, an O.A.C. student, did the drawings.

BULLETIN 208.] [JANUARY, 1913.

Ontario Department of Agriculture

DISTRICT REPRESENTATIVES

Farm Poultry and Egg Marketing Conditions

IN ONTARIO COUNTY

BY J. H. HARE AND T. A. BENSON.

INTRODUCTION.

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

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

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

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

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

Fig. 1.—A Typical Farm Flock.

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

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

FARM POULTRY AND EGG MARKETING INVESTIGATIONS.

Form used for Investigating Conditions on the Farm.

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

CHARACTER OF FARM:

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

POULTRY ACCOMMODATIONS:

HOUSES—

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

NESTS—

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

RUNS OR RANGE—

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

POULTRY KEPT:

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

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

EGG PRODUCTION:

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

KEEPING FOR MARKET:

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

METHODS OF FEEDING:

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

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

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

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

INVESTIGATION OF FARM POULTRY CONDITIONS.

The Farmer's Attitude Toward Poultry.

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

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

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

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

Our findings are as follows:

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

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

Table No. 2.—Showing Proportion of Large and Small Flocks on 448 Ontario County Farms.

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

Flocks on Most Farms Too Small.

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

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

Age to Which Hens are Kept.

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

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

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

General Practice in Breeding.

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

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

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

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

Serious Mistakes in Incubation.

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

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

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

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

ARTIFICIAL METHODS OF INCUBATION AND BROODING.

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

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

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

METHODS OF FEEDING.

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

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

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

Dearth of Scratching Material.

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

Unsanitary Conditions Propagate Disease.

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

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

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

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

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

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

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

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

THE PREVALENCE OF DISEASE.

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

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

INSECT PESTS.

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

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

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

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

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

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

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

TABLE NO. 7.—SHOWING PREVALENCE OF RED MITES.

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

CARE OF EGGS UPON THE FARM.

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

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

Table No. 9.—Showing Relation of Number of Nests to Number of Hens on 448 Ontario County Farms.

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

Improper Methods of Keeping Eggs Preparatory to Marketing.

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

Washing Eggs.

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

Fig. 5.—A "found" nest.

Marketing of Partially Incubated Eggs.

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

Removal of Male Birds After the Breeding Season.

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

REVIEW OF PRESENT METHODS OF MARKETING EGGS AND CONSEQUENT LOSSES.

The Flat Rate System and the Country Merchant.

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

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

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

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

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

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

The Huckster.

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

Fig. 7.—Market day in a country town.

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

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

Fig. 8.—Candling and grading eggs.

The Local Market.

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

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

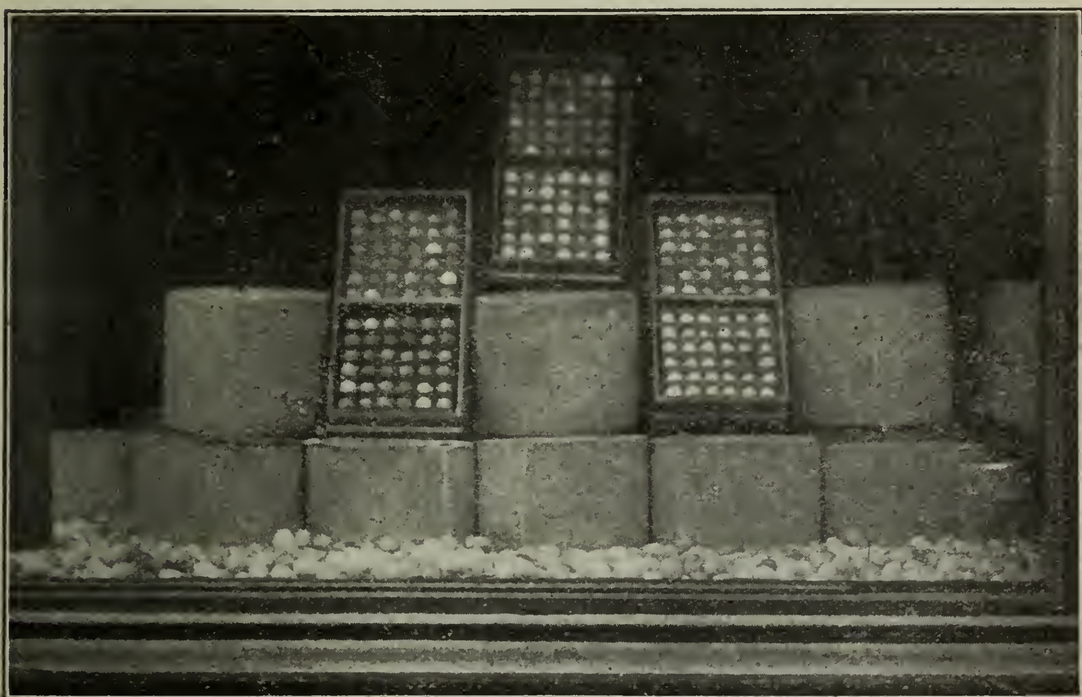


Fig. 9.—Spoiling eggs by subjecting them to the direct rays of the hot sun—a common mistake of the retailer.

CANDLING AND GRADING MARKET EGGS.

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

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

The Town or City Retailer.

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

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

THE NEED OF EDUCATION.

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

THE DEMONSTRATION POULTRY HOUSE.

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

Fig. 10.—Demonstration poultry house.

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

A BREEDING STATION.

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

CO-OPERATION IN THE MARKETING OF EGGS.

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

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

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

The Movement in Ontario County.

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

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

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

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

CONSTITUTION AND BY-LAWS.

Constitution.

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

2. The Association seeks to reach its object:

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

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

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

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

(e) By the dissemination of poultry knowledge.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

By-Laws.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

A FEW CONCRETE CONCLUSIONS.

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

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

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

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

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

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

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

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

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

10. Disease is prevalent to an alarming extent.

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

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

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

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

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

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

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

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

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

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