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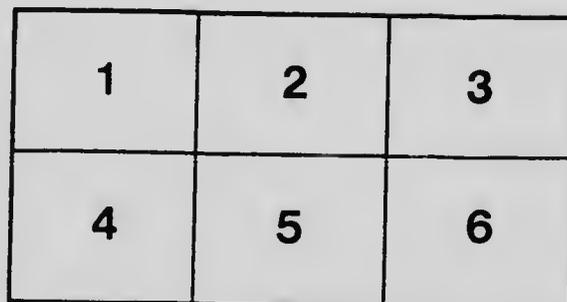
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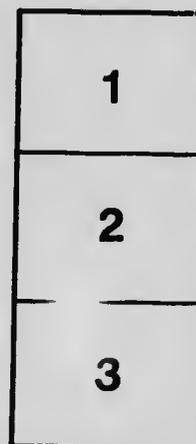
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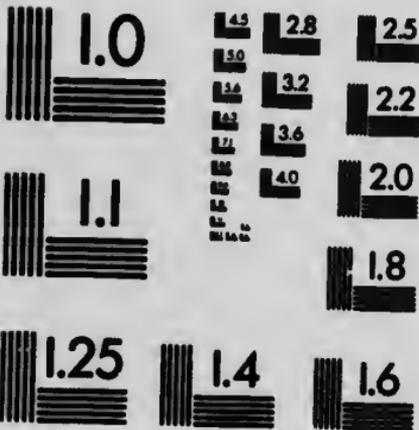
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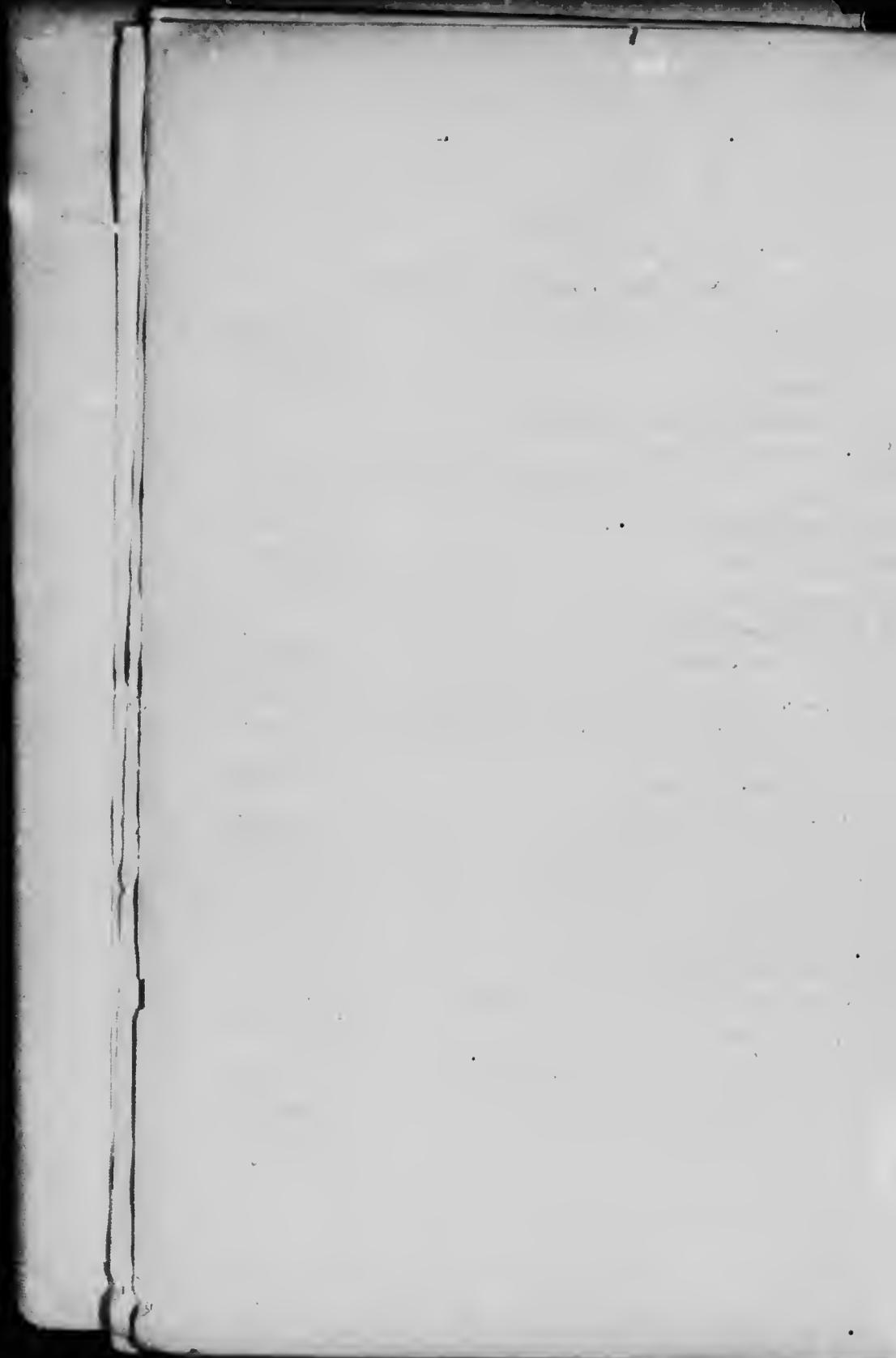
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Ontario Department of Agriculture.
ONTARIO AGRICULTURAL COLLEGE.

COMMON INSECTS AFFECTING FRUIT-TREES

BY C. J. S. BETHUNE, M.A., D.C.L., PROFESSOR OF ENTOMOLOGY,

AND

FUNGUS DISEASES AFFECTING FRUIT-TREES

BY TENNYSON D. JARVIS, B.S.A., LECTURER IN ENTOMOLOGY.

[In June last (1907) a Bulletin on "Common Insects Affecting Fruit-trees" was published and widely distributed. Recently it was found that the edition was exhausted, and consequently it has been deemed advisable to reissue the Bulletin with the addition of some account of the most common fungus diseases that affect fruit-trees and that are likely to cause trouble and loss to the fruit-grower.]

INTRODUCTION.

To treat of all the insects affecting fruit-trees in Ontario would be manifestly impossible within the limits of space assigned to a Bulletin. In the following pages, therefore, reference will be made only to those species that are commonly met with, and that are sufficiently abundant year after year to require attention on the part of the fruit-grower. The remedies prescribed are those that have been found by repeated experiments to be the most effective. Much depends, however, upon the care which is exercised in making up and applying the various spraying mixtures, the time when the work is done, and the methods of cultivation which are employed. It is of little use to attempt to kill some insects on a tree or bush, if suitable and convenient hiding places are left for them close by, or if wild plants of a similar character are allowed to serve as breeding places without molestation. Wild Cherry-trees, for instance, may often be seen covered with the webs of the Tent-caterpillar in the near neighborhood of orchards and no notice whatever is taken of them, while the fruit-grower labors to clear his trees and wonders that after all his efforts a fresh attack occurs each year.

The Mountain Ash, a European tree cultivated for its beauty, is often to be found near gardens and orchards. Being closely akin, botanically, to the Apple, it is attacked by scale and other dangerous insects, and is often a convenient and unsuspected breeding place for many pests of the orchard. It should receive the same treatment as the fruit-

trees or else be removed altogether. The Hawthorns are another class of trees akin to the Apple, and serve in a similar manner as breeding places for orchard pests; none should be suffered to grow near the fruit-trees. Both the Wild Cherry and the Wild Plum are also particularly dangerous from the serious fungus diseases to which they are liable, such as the Black-knot, Plum-pockets, Brown-rot and Shot-hole fungus, and which soon spread from them to healthy fruit-trees; the latter also harbors the Plum Curculio.

Clean cultivation is of quite as much importance as the application of remedies. Twigs and branches cut off when pruning should be burnt, all fallen fruit should be gathered up and destroyed, no rubbish of any kind should be permitted to remain in the orchard or garden. The trees themselves should be kept clean by scraping off all rough loose bark. All this should be done in order to leave no hiding place or shelter for insects during their chrysalis or pupal stage, and to compel them to seek elsewhere for winter quarters or perish. Spring and autumn, when work is not very pressing, are good times for a general cleaning up, and tree scraping may be done at any time during the winter when the weather happens to be mild. But the gathering up of fallen fruit should be done daily in order to leave no time for the Codling-worm, Apple-maggot, or other pest to escape.

The practice of clean cultivation is of prime importance also in checking or warding off the attacks of fungus diseases. The microscopic spores by which these diseases are spread are harbored to a large extent by fallen and rotting fruit, withered leaves, brushwood left from pruning, and rubbish of all sorts that may gather round the trees. The removal and disposal by burning or burying of all such waste matter in the autumn, or during the winter, will get rid of the hibernating forms of a large number of our worst fungus diseases as well as insect enemies.

Fruit-trees, especially the more delicate sorts, are often injured during the winter by severe frosts following a period of mild weather; these injurious effects may be unnoticeable, but they are frequently sufficient to impair the vitality of the tree and to render it liable to the attacks of cankers and other diseases which in a healthy condition it would be able to resist. Furthermore, a tree may be planted in a soil or in a situation which is unsuited to that particular variety and may therefore fail to become sufficiently robust to resist diseases which in proper conditions it would entirely escape. These are matters too often overlooked by the fruit-grower and he is in consequence at a loss to account for the failure of his trees, which may be due to causes of this kind.

In the warfare against noxious insects Nature provides an army of assistants which in a natural condition of things would keep the destructive hordes in check, but where all vegetation is swept away to make room for a few cultivated varieties, the balance is upset and our friends

are insufficient for the task, though they afford material help. All our insectivorous birds should be protected and encouraged, especially the woodpeckers and chickadees, which remain with us all winter. The former destroy an immense number of borers, codling-worms, etc., and the latter pick out many minute insects that spend the winter about the buds and in crevices in the bark of trees. Toads, snakes, and skunks, though generally regarded with aversion, are really most useful creatures, and assist very largely in reducing the numbers of destructive insects.

INSECTS AFFECTING THE APPLE.

THE CODLING WORM (*Carpocapsa pomonella*), Figs. 1 and 2. The insect that causes the greatest amount of annual loss to the Ontario fruit-grower is, no doubt, the Codling Moth (*Carpocapsa pomonella*), and yet probably not one orchardist in fifty has ever seen the moth itself. It is very small, flies only at night, is not attracted by either lights or sweets, and consequently can rarely be obtained except by breeding it from the worm. Everyone, however, is familiar with the worm or caterpillar which feeds in the interior of the fruit. The moth lays her scale-like eggs about the time the trees are in bloom on the leaves, stem or skin of the young apple. In a few days the larva is hatched out and proceeds to burrow into the fruit, usually in the cavity at the calyx end.



Fig. 1. The Codling Moth and its work, showing the different stages.

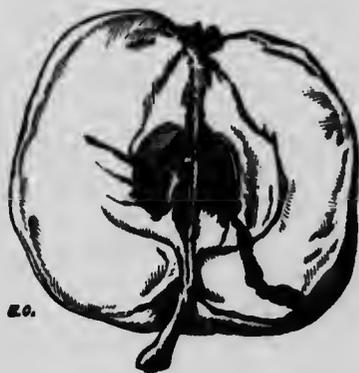


Fig. 2. Apple injured by the burrows of a Codling Worm.

After a time the infested apple falls to the ground, the worm emerges, and usually finds its way to the tree, where it forms its cocoon under the bark or other shelter. Throughout the southern counties of Ontario there are two broods in the year, but east of Toronto and north of that latitude there is usually but one brood, though a small percentage may

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develop early and produce a second. This is a point in the life-history of the insect of very great importance, and every fruit-grower should endeavor to find out whether there are two or only one brood in his own locality.

Where there is but one brood the remedy for the insect is comparatively easy. It consists in spraying the trees with Paris green (combined with Bordeaux mixture for the purpose of warding off fungus diseases) just after the blossoms have fallen and again a week later. This will ensure the destruction by the poison of the majority of the young larvæ. Most of those that escape can be got rid of by gathering up the fallen fruit and feeding it to pigs or burying it deeply in the ground. An easier plan is to let the pigs have the run of the orchard, and they will make away with the fallen fruit themselves.

In all that section of the country where there are two broods it is necessary to adopt further measures in addition to the above. One plan is to spray the trees again towards the end of June and at about ten days' interval till the end of July. A more effective remedy is to bandage the trunks of the trees with burlap, sacking, or other coarse material. The bands should be about eight or ten inches wide and attached to the tree by a string tied tightly around the middle, leaving the top and bottom loose, and fastened to a nail. The worms will go to these bandages as a convenient shelter under which to form their cocoons, and can readily be destroyed. It is necessary to remove the bandages at least as often as every ten days; the larvæ attached to them may be killed by passing the bandages through a clothes-wringer carried on a wheelbarrow. Many, however, burrow into the bark to make their chrysalids, and require to be got rid of by scraping with a wire brush. By adopting these measures the second brood of worms, which is by far the most injurious to the fruit, will be reduced to a minimum. Careful spraying in the spring, continued year after year, will so effectually get rid of the insect that very few will survive to form a second brood, and the fruit-grower may hope to be relieved of the labor and expense of the summer campaign.

A parasite of the Codling-worm has recently been introduced into California, and is apparently doing good work by reducing the numbers of the insect. It is too soon yet to form a definite opinion regarding its permanent usefulness, and experiments will require to be made in order to prove its ability to thrive in the climate of Ontario.

THE APPLE-MAGGOT (*Rhagoletis [Trypeta] pomonella*). This insect attacks the fruit by burrowing in all directions through the flesh which it feeds upon, and leaving brown channels—thus rendering the fruit perfectly valueless. Fortunately it has so far been found in few localities in Ontario, but it is quite common in New York and New England States, and may at any time spread over this country.

The parent is a two-winged fly, somewhat smaller than a house-fly, black in color, with a yellowish head and legs, green eyes and transparent

wings crossed with four irregular black bands. The eggs are laid in early summer beneath the skin of the fruit, and the young maggots which hatch from them become full-grown in about six weeks. The fruit then drops prematurely to the ground, and the maggots soon bury themselves in the soil, where they form their puparia and remain till the following spring. (Fig. 3.)



Fig. 3. Fruit injured by the Apple Maggot (*Trypeta*).

From the habits of the insect it is evident that it cannot be reached by any poison; the only remedy for it that has been found effective is the immediate destruction of the fallen fruit in order to prevent the maggots escaping into the ground. This may most easily be done by keeping a sufficient number of pigs or sheep in the orchard to devour the fruit as fast as it falls. If this should not be practicable, the work must be performed by hand, and the collected fruit fed to stock or otherwise destroyed. All refuse or injured apples in storage should also be similarly disposed of in order to prevent the flies from coming to maturity.

TENT-CATERpillARS (*Malacosoma Americana* and *dissecta*), Figs. 4-8. As soon as the buds open and the young leaves begin to appear, there are hatched out from the eggs in which they have spent the winter, tiny caterpillars which form a web in a convenient fork of the branch for their shelter and concealment when at rest, and from which they travel up and down, leaving a thread of silk as they go, and devouring the tender foliage, completely stripping all leaves from the branch. These are called Tent-caterpillars, and are represented in the accompanying figures. They are easily disposed of by clearing round the trees in the early morning, or towards evening, and clearing out the webs with the enclosed colony of worms. A simple plan is to tie a rag around the end of a long rod, insert it into the nest, and by revolving the stick, wind up the whole web with its inmates. This can be removed and trodden under foot, and the operation repeated till there are none left.

The location of the webs can be learnt while carrying on the spraying for the Codling-worms. During the warmer hours of the day the caterpillars are scattered over the limb, feeding upon the foliage, and therefore it is necessary to attack them when they are all at home in their tent. If they are allowed to grow big, they distribute themselves over the tree, and can only be destroyed by a liberal spray of Paris green or other poison.

The second species, the Forest Tent-caterpillar (*M. disstria*), attacks forest and shade trees of various kinds, and sometimes also invades the



Fig. 4. Apple Tree Tent-caterpillars on their web; c, egg-bracelet; d, cocoon.



Fig. 5. Tent-caterpillar: Male Moth.



Fig. 6. Female Moth.



Fig. 7. Forest Tent-caterpillar: Moth and eggs.



Fig. 8. Forest Tent-caterpillar.

orchard and garden. As the larvae do not live in a "tent," the method mentioned above cannot be employed, but they have a habit of assembling in masses on a carpet of silk on a trunk or limb of the tree they infest, and can then be crushed with a spade or other convenient instrument. Paris green may also be employed.

The eggs of both species are laid in broad rings or bracelets on the twigs of the trees they infest. With a little experience they can be seen on apple and other trees during the winter when the leaves are off. If removed and burnt at that time much further trouble will be saved.

The caterpillars of the two species may be distinguished from each other by the continuous white stripe down the middle of the back in the case of the "American," and the series of spots in the same position on the "Forest" variety. When fully grown the caterpillars wander away from the trees and form their cocoons in any nearby shelter, such as a fence, bits of board, chips or other rubbish. The cocoon is made of whitish silk, within which is a sulphur-like powder producing a yellowish color.

The moths are thick-bodied fluffy creatures, of a dull reddish-brown color; the fore-wings of the "American" species are crossed by two oblique parallel whitish lines enclosing a pale space, while those of the "Forest" have similar lines of a dark brown color and enclosing a dark space. In other respects they are very much alike. They appear early in July, and flying at night are attracted by lights and come into houses, where they dash about, and sometimes cause much annoyance by getting into the cream-jug or butter-dish, and covering the contents with their fluffy scales. The eggs are laid at this time of year, and remain on the trees till the following spring. Usually these insects are abundant for only a few years at a time; there is then a period of freedom from them, caused no doubt by the attacks of parasites and disease.

THE HALL WEB-WORM (*Hyphantria textor*). Late in summer, webs may again be found upon the fruit-trees, larger in size and darker in color than those of the Tent-caterpillar. These are filled with a numerous colony of hairy caterpillars which cover the whole of the leaves where they are feeding with a loosely woven silken web, and live within it at all times. These webs become very unsightly from being filled with the skeletons of leaves and the cast-off skins and excrement of the inmates. As they are very conspicuous there can be no excuse for leaving them on the trees. It is easy to get rid of them by winding them up with a rod in the same manner as the "tents" of the preceding species, or when large by cutting off the affected branch; the colony should be disposed of by crushing under foot or burning, as may be convenient.

The parent moth is pure white without spots on the wings, or sometimes more or less spotted with black. It appears in early summer, having spent the winter in a silken cocoon, and lays its eggs in patches on the under side of leaves, from which the caterpillars emerge in July or August and proceed to form their webs. The caterpillars vary to some

extent in color and are covered with long straight hairs arranged in tufts along the body; when full grown they are about an inch in length.

The attacks of these insects are by no means confined to fruit-trees; their webs are quite as abundant on ash, willow, and many other trees.

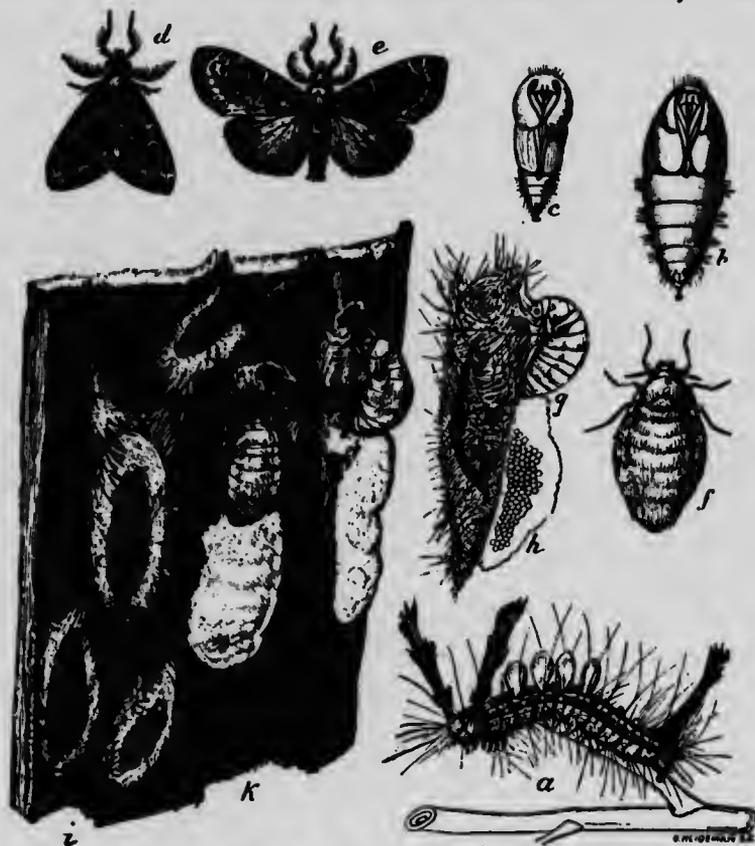


Fig. 9. Tussock Moth in all stages: *a*, caterpillar; *b*, female chrysalis; *c*, male chrysalis; *d* and *e*, male moths; *f*, wingless female moth; *g*, female moth laying her eggs (*h*) on the cocoon from which she has emerged; *k*, female moths, their cocoons and egg masses, on the bark of a tree.



Fig. 10. Tussock Moth; full-grown caterpillar.



Fig. 11. White marked Tussock Moth.

THE WHITE-MARKED TUSSOCK-MOTH (*Hemerocampa leucostigma*), Figs. 9-11. This insect is chiefly known from its attacks upon street shade trees in Toronto and Montreal, and in some other cities and towns, which have caused it to be much discussed in the newspapers and thus made widely known to the public. As it frequently attacks apple and other trees, it may be briefly referred to here. The accompanying figures render description unnecessary. Notwithstanding all the alarm manifested in print, it is really an easy insect to control. The simplest method is to remove and destroy the white egg masses, which are very conspicuous on the trunks and lower limbs of the trees, at any time during the autumn or winter. The wingless female moth on emerging from her cocoon lays her eggs upon it, and covers them with a white frothy substance which soon hardens and protects them from the weather; she then drops to the ground and dies. Numerous other cocoons, without any deposit of eggs upon them, may also be seen; it is unnecessary to remove them, as they contain either the empty shells of the male chrysalids or parasitized larvæ. The young caterpillars are hatched out toward the end of May and may be destroyed, if numerous enough to injure the foliage, by an ordinary spraying with Paris green. In some places there are two broods during the season, the first forming their cocoons about the middle of July and the second in the end of August. Where this is the case spraying should be resorted to, or the egg masses destroyed as soon as possible after they are formed.



Fig. 12. *Datana* Moth.

THE YELLOW-NECKED APPLE-TREE CATERPILLAR (*Datana ministra*), Fig. 12. About the beginning of August the fruit-grower is sometimes surprised at finding a branch on an apple-tree completely stripped of its leaves. On investigation it will probably be found that the culprit is a black and yellow striped caterpillar about two inches long, with a black head and the next segment yellow, from which the name of the insect is derived. These larvæ are gregarious creatures, and are always found clustered thickly together on the limb where they are feeding. When disturbed or alarmed they throw up their front and hind segments with a jerk, and move them from side to side in a curiously threatening manner. They may easily be destroyed by crushing them where they are gathered, or by cutting off and burning the limb. If too high up to reach conveniently, they may be jarred off by rapping the branch with a pole and

then trampled under foot where they fall. The moth is pale brown in color, with darker lines across the wings, and a conspicuous dark velvety patch on the head and thorax.

THE RED-HUMPED APPLE-TREE CATERPILLAR (*Edemasia concinna*), Figs. 13 and 14. This insect resembles the preceding species very much in habits, stripping completely the foliage of the bough where it is feeding and crowding together when at rest. Similar measures may be adopted for its destruction. The caterpillar has a coral-red head and a hump on the back of the fourth segment of the same color, whence its name. The body is adorned with narrow, black, yellow and white lines and rows of black prickles on the back and sides; the hind segments taper toward the tail and are held up when the insect is not crawling.



Fig. 13. Moth of the Red-humped Caterpillar.

Fig. 14. The Red-humped Caterpillar.

THE SPRING CANKERWORM (*Paleacrita vernata*) and THE FALL CANKERWORM (*Anisopteryx pometaria*), Fig. 15. These two species resemble each other so much that they may be considered together. The moths of the former come out during the first warm days in spring; those of the latter late in the autumn, sometimes after the first snow has fallen. In both the females are wingless, and therefore they do not spread from one orchard to another with much rapidity. Usually their arrival may be traced to some nearby forest tree, as they are very general feeders.



Fig. 15. Canker-worm; a, eggs, natural size; b, magnified; c, caterpillar; d, cocoon; e, chrysalis; f, male moth; g, female moth.

The eggs are laid in masses upon the twigs of the trees and the young worms hatch out as soon as the opening buds begin to unfold their leaves. They are slender pale green measuring-worms, so called from their method of crawling by alternately looping up and extending the body; this process is rendered necessary owing to the absence of pro-legs under the middle segments. (Fig. 15, c.) Feeding as they do upon the tender young foliage, they are capable of inflicting great damage both to

leaves and blossoms, but they may be destroyed by a spraying early in the season, just as the buds are opening, with Paris green or other poison.

The chrysalids are formed in the ground, and may be destroyed by deep plowing, and the wingless female moths may be prevented from ascending the trees to lay their eggs by bandages of tar or other sticky material, or by projecting flanges of tin or fine wire-netting.

THE EYE-SPOTTED BUD-MOTH (*Tmetocera ocellana*), Fig. 16. Early in the spring the small brown caterpillars of this insect come out of the silken cases in which they have spent the winter and proceed to attack the opening buds, which are speedily ruined. Both leaf and blossom buds are destroyed, the flowers and leaves being tied together to form a shelter and devoured by the hidden inmate; sometimes, especially in young nursery trees, the caterpillar also bores down into the young shoots and causes severe injury. When full grown, about the middle of June, it is half an inch long, dark brown with a black head and collar; it then pupates and the small moth comes out ten days later. The moth is of an ashen-grey color, with a milk-white blotch across the middle of each fore wing and two eye-like spots, one near the tip and the other at the hind angle of the wing; from these spots it derives its name. From the eggs



Fig. 16. Eye-spotted Bud-moth and caterpillar.

now laid the larvæ are hatched in July and feed for a time on the leaves of the tree and then form their silken winter quarters on the twigs. The presence of the insect may be detected by the bunch of blackened and shrivelled leaves tied together at the ends of twigs. In the case of small trees in a nursery these may be cut off and burnt, but it is far better to ward off the attack both in the orchard and elsewhere by spraying the trees with a strong Paris green wash about the first of May and a week later; in any case the spraying should be done before the blossoms are displayed. It is advisable to combine the Paris green with Bordeaux mixture for the destruction of fungus diseases at the same time. If thoroughly done these sprayings will not only kill the larvæ of the Bud-moth, but also a number of other early insects, such as the Case-bearers, Canker-worms, Tent-caterpillars, etc.

THE OBLIQUE-BANDED LEAF-ROLLER (*Cacoecia rosaceana*), Figs. 17 and 18. This is another spring insect which appears soon after the buds open. The little caterpillars roll up and fasten together the young leaves and thus form a shelter in which they feed securely. When numerous they inflict a great deal of damage upon the foliage and sometimes injure the young fruit by gnawing the skin. The moth, which appears about

the end of June, is of a yellowish brown color with oblique darker bands across the fore wings, flat and broad, somewhat bell-shaped when the wings are closed, the hind wings are a paler yellow. The members of the family of moths to which this insect belongs are called Tortrices or Leaf-rollers, and infest a great variety of plants. Several species, besides the one here referred to, may be found on apple-trees. The sprayings recommended for the Codling-moth should prevent any injury from these small caterpillars.



Fig. 17. Leaf-roller Moth, wings open.



Fig. 18. Leaf-roller Moth, wings closed.

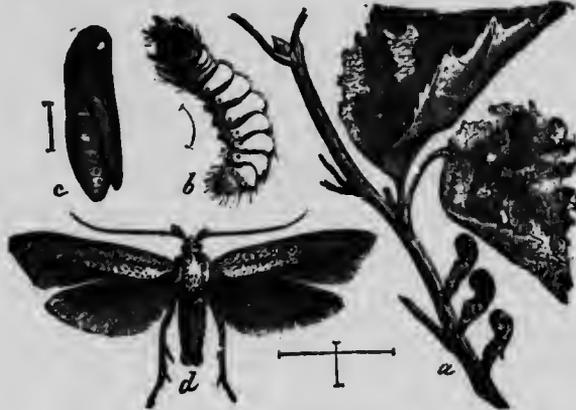


Fig. 19. Apple tree Pistol Case-bearer.

THE CIGAR CASE-BEARER (*Coleophora Fletcherella*) and THE PISTOL CASE-BEARER (*C. malivorella*), Fig. 19. These curious insects are to be found in early spring on the buds of apple and other fruit-trees. They are tiny yellow caterpillars which pass the winter in curved cases formed of pieces of leaves cut out for the purpose; in spring they move to the opening buds and devour the tissue of the leaves. The small shining steel-grey moths of the first species appear about the end of July and lay their eggs, from which the caterpillars are soon hatched, and attain about one-fourth of their growth before winter. At this time they are enclosed in brown leathery cigar-shaped cases and feed upon the soft substance of the leaves; the winter cases are curved and broader. The other species which forms pistol-shaped cases is not so common in Ontario, but may occasionally prove troublesome; its habits are similar to those of the Cigar Case-bearer. Both may be kept in check by the sprayings already referred to.

APPLE PLANT-LICE (*Aphis*), Figs. 20-23. There are at least three species of Plant-lice affecting the Apple in this Province, namely, the Apple Aphis (*A. mali*), the Rosy Apple Aphis (*A. malifoliae*), and the Woolly Aphis (*Schizoneura lanigera*). The first two infest the tender new growth of the branches and the leaves, which they injure very much by sucking the juices and thus checking the development of the shoots and causing the leaves to shrivel. They are minute pear-shaped creatures, soft-bodied, green, pink or blackish in color, destitute of wings for the most part until the autumn, when the winged forms appear. The third

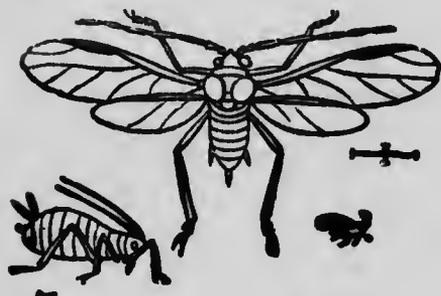


Fig. 20. Winged and wingless Aphis—greatly enlarged.

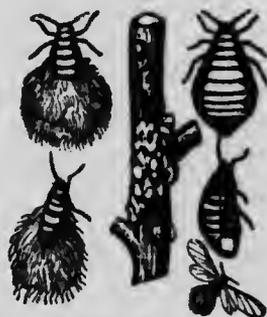


Fig. 21. Woolly Aphis of the apple; much enlarged, except twig.

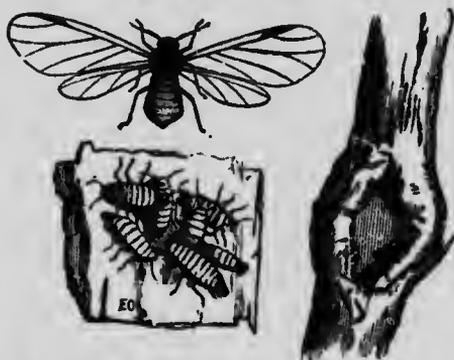
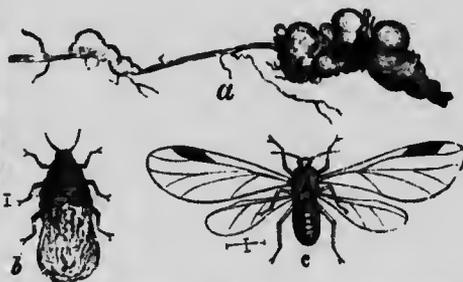


Fig. 22. Woolly Aphis of the apple; Fig. 23. Apple-root Aphis; a, distortions on a root; b, woolly wingless form; c, winged Aphis—greatly enlarged.



species, the Woolly Aphis attacks the roots of the Apple, producing knots and swellings and causing much injury, and also is to be found in colonies on limbs and branches, especially where there is any exudation of sap from cuts or wounds in the bark. They are covered with a delicate white material which looks like cotton-wool and gives the special name to the insect. As these minute creatures live entirely by suction, it is impossible to poison their food, but they may be got rid of by substances

which close up their breathing pores and suffocate them. Kerosene emulsion applied as soon as they are observed in the spring, and repeated whenever the colonies reappear, is an effective remedy. Tobacco decoction and whale-oil soap may also be used with good results, and are to be preferred where only a few trees require to be treated. The underground form is very difficult to get at, but may be destroyed with bisulphide of carbon poured into holes made in the ground above the infested roots and then covered up.

SCALE INSECTS.

The most dangerous enemies of fruit-trees are undoubtedly the Scale Insects, of which we have several destructive species in Canada. The worst of these is certainly the notorious SAN JOSE SCALE (*Aspidiotus perniciosus*), Fig. 24, which is now firmly established in the Niagara fruit district and in the Counties of Essex and Kent; it will probably also be found in some other localities. So much has been published respecting this insect in the Reports of the Entomological Society of Ontario and in the agricultural and horticultural periodicals, and the pest has become so widely known, that it is unnecessary to enter into any details here. While its extermination is hardly to be expected, it can be kept under control and even got rid of in an orchard by persistent and careful spraying with the lime-sulphur wash, provided that it is properly made and

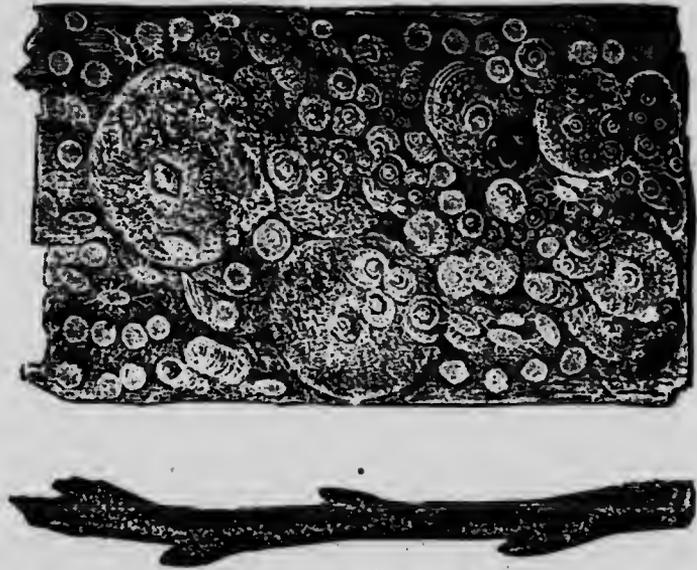


Fig. 24. San José Scale.

thoroughly applied. Recent Bulletins (Nos. 154 and 157) give full particulars as to the ingredients and method of manufacture of this wash; it should be applied toward the end of April or beginning of May before the buds on the trees show signs of opening. One thorough application will destroy almost all the scales, but a very few survivors will soon re-stock a tree, as they are so extraordinarily prolific. It is necessary, therefore, to repeat the spraying year after year until none whatever are left. The task is a disagreeable one, and the labor involved is expensive, but it will pay in a single season through the improved quality and yield of the fruit; while its neglect simply means the speedy death and loss of the entire tree.

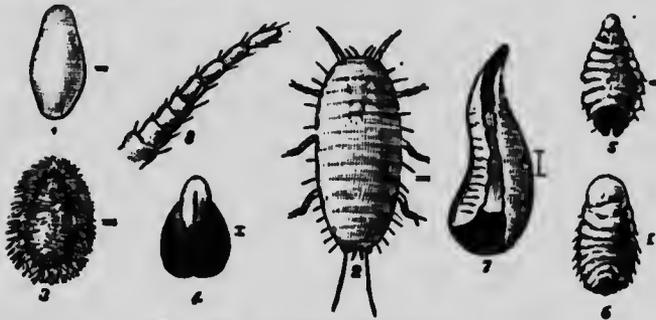


Fig. 25. Oyster-shell Bark-lice.

Fig. 26. A Scale greatly enlarged.



Fig. 27. Scales on a twig.

THE OYSTER-SHELL BARK-LOUSE (*Mytilaspis ulmi*), Figs. 25-27, ranks next to the preceding as a destructive scale insect. It is to be found everywhere throughout the Province, and inflicts an immense amount of damage on Apple and other fruit-trees; it is especially abundant in old and neglected orchards. Fortunately it is single-brooded, and therefore does not increase very rapidly; if it were continuously brooded, like the San José Scale, it would long ago have completely wiped out the Apple and many other fruit-trees of Ontario. It may be readily identified by its peculiar shape, which resembles that of an oyster-shell, and may usually be found in large numbers, sometimes completely encrusting the bark of twigs and branches; occasionally individuals even make their abode on the fruit. During the winter the insect is in the egg stage and protected by the old scales; about the end of May and beginning of June, the yellow lice are hatched out and wander about for a short time, looking for a suitable place where they may attach themselves to the bark. This is done by inserting the beak into the tissue, and there the creature soon becomes covered with a scale and remains for the rest of its life sucking

the sap of the tree. Twice in the season the insect sheds its skin and assumes a larger one, leaving the cast-off portion still attached to the new. In the autumn the adult female lays her eggs and dies. The lime-sulphur wash recommended for the San José Scale is a complete remedy for this one also. When inconvenient to make it, good results may be obtained by a thorough wash with lime alone (one pound and a half quickly slaked to a gallon of water), applied after the leaves fall in the autumn and again before the buds open in the spring. When the lice are first hatched out and are running on the limbs they may be destroyed with kerosene emulsion or a whale-oil soap solution.

THE SCURFY BARK-LOUSE (*Chionaspis furfurus*), Fig. 28, also attacks the Apple and some other fruit-trees, but is not so widely distributed as the preceding species, which it somewhat resembles in shape. The eggs are of a purplish color, and the adult scale is white and conspicuous. The figures will enable anyone to distinguish the two species. Their life-histories and habits are the same, and consequently the same treatment may be adopted for both.

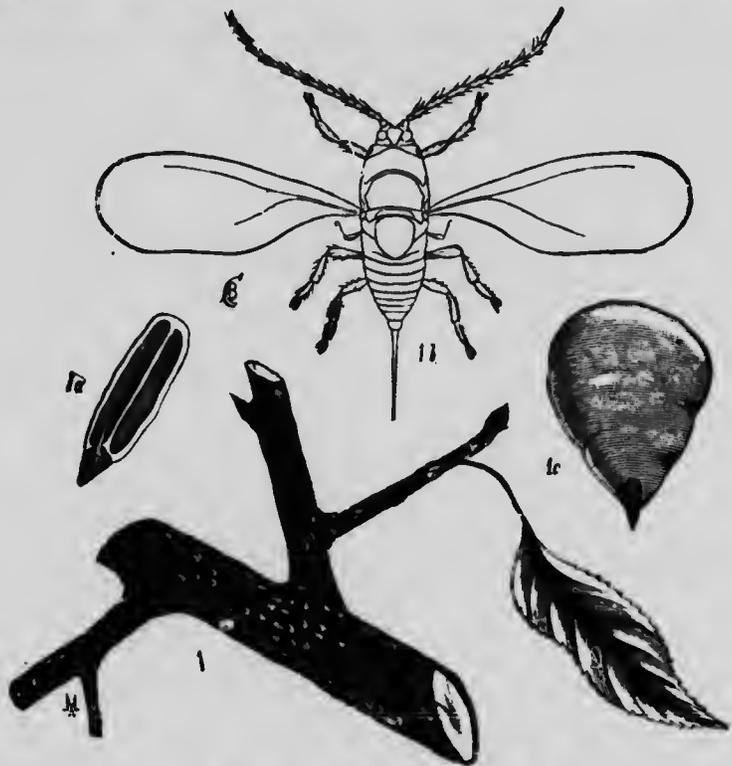


Fig. 28. The Scurfy Bark-louse.

Other Scales, such as the Forbes and Putnam's, may be found on Apple-trees, but thus far have not been abundant, and therefore have attracted little attention. Should they occur in injurious numbers at any time, they may be got rid of with the lime-sulphur wash.

APPLE-TREE BORERS.

THE ROUND-HEADED APPLE-TREE BORER (*Saperda candida*), Fig. 29, is a very serious enemy to young trees. The parent beetle is a handsome insect of a chocolate brown color with two bands of chalky-white extending from one extremity to the other on the upper surface and with long jointed antennæ. The female lays her eggs in an incision which she makes in the bark during the month of June; the young larvæ tunnel under the bark and feed upon the sap-wood, living for three years in that condition, and making larger and deeper burrows as they increase in size. Their presence may generally be ascertained by the little heap of sawdust-like castings at the base of the affected tree. Working under cover as they do, they cannot be reached by ordinary poisons, and can only be destroyed by the insertion of a wire into their boring, or by cutting out with a knife. The former operation is somewhat uncertain, and the latter may injure the tree to a serious extent. The only safe remedy, then, is to prevent the adult from laying its eggs upon the tree.



Fig. 29. Round-headed Apple-tree Borer: a, grub; b, pupa; c, beetle.

When the borers are known to be in a nursery or young orchard, the trees may be protected by wrapping a few sheets of paper around the trunk extending from the surface of the ground to two feet in height. At the bottom the paper should be hilled up with earth, and at the top made tight with a cord of bast or other material that will readily break with the growth of the tree. Above the paper the trunk should be washed from the limbs downward with soft-soap reduced to the consistency of paint by adding a solution of washing soda. Whale-oil or common soft-soap may be used. The object of this is to prevent the beetles from laying their eggs on the base of the tree and hindering those that have completed their transformations from getting out, by means of the paper protection. The wash higher up will deter the insect from laying eggs anywhere else.

THE FLAT-HEADED APPLE-TREE BORER (*Chrysobothris femorata*), Fig. 30, is much more common than the preceding species and differs in many respects in its habits and life-history. The adult beetle is about half an inch in length, somewhat flattened above and with short antennæ. The upper surface is dark metallic brown, while beneath it is bright copper color; the thighs of the fore legs are armed with a stout tooth, from which the insect's specific name (*femorata*) is derived. It delights in the hot sunshine and may be found on logs and the trunks of trees. Like most wood-borers, it chiefly attacks trees that are dying or weakened by disease, and will bore into the limbs and branches as well as the trunk; its chief injuries, however, are done to young and newly transplanted trees. The eggs are laid late in May and in June in crevices of the bark, through which the newly hatched grub bores, and forms its broad burrow immediately under the bark. The channels thus made sometimes extend completely round, so as to girdle and cause the death of the tree or limb.

This larva differs very much from the preceding in having the segment next the head broad and flat and much larger than those following, and is usually to be found with the posterior half of the body very much curved; it takes but a single year to complete its life period. Attacking, as it does, all parts of the tree, the preventive measures suggested for the Round-headed Borer are of no avail unless the wash is applied to limbs and branches as well as trunk. When discovered the grubs may be killed with a knife; but their presence is not readily seen. Woodpeckers, however, have no difficulty in finding out the burrows and devour large numbers, and the presence of these birds in the orchard should by all means be encouraged.

As this beetle attacks a number of forest trees, such as oak, beech, birch, elm, etc., as well as mountain ash and many other cultivated trees, it is necessary to see that no dead or dying trees are left near the orchard to serve as breeding places. They might, however, serve as traps, if care was taken to burn them up before the month of May.



Fig. 30. Flat-headed Apple Tree Borer: a, grub; b, pupa; c, enlarged head and following segments; d, beetle.

2a Bull. 158.

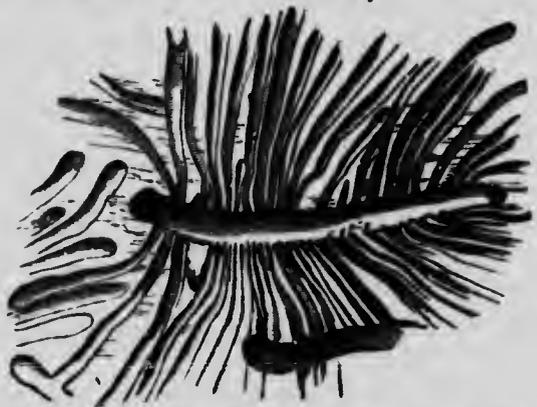


Fig. 31. Tunnels under the bark made by a Scolytus beetle.

THE SHOT-HOLE BORER, or FRUIT-TREE BARK BEETLE (*Scolytus rugulosus*), Fig. 31, is another enemy of Apple and other fruit-trees. The former name is given to the insect from its presence being made known by a large number of small round holes, looking as if they had been made with fine shot from a gun. These are the openings which the beetle has made in penetrating the bark and also in coming out. The mature insect is cylindrical in form and black in color and about one-tenth of an inch in length. Though so small, it does a great deal of damage by making a great number of galleries in the surface of the wood just beneath the bark which cause it to dry up, and by boring vertical tunnels deep into the wood. Being so minute its presence is not known until it has produced the "shot-holes" (which are often indicated by exudations of gum in the case of Cherry-trees), and inflicted much damage. The only remedy seems to be to cut off and burn all affected limbs, and to leave no dead wood lying about to serve as breeding places.

As a general rule this insect attacks only dying trees or diseased limbs; those that have been seriously injured by the Oyster-shell Barklouse or other scale insect are especially liable to be affected by this borer. In some few instances the branches of apparently healthy trees have been attacked; this may have been occasioned by a superfluity of the beetles and the absence of more suitable breeding places.

FUNGUS DISEASES AFFECTING THE APPLE.

APPLE SCAB (*Venturia inequalis*), Fig. 32. The scab of the apple and pear is a very familiar disease in Ontario. It attacks leaves, shoots and fruit, and causes the small apples to fall and the older ones to become irregular and scabby. Dirty olive patches appear first, then enlarging they run together, and become darker in color. These patches are masses of spores which are blown by the wind to other leaves and young fruit. Many generations occur in a season. The fungus hibernates among the leaves on the ground and in the crevices of the tree. Spraying with lime sulphur wash in the winter will doubtless kill many of the hibernating spores. Spraying with Bordeaux mixture before the opening of the buds and once or twice after the "setting" of the fruit is recommended. Removing the fallen leaves will also tend to lessen the disease.

SOOTY BLOTCH (*Leptothyrium pomi*). This disease has been reported from many parts of Ontario as doing injury to Greening and Baldwin Apples. The injury to the fruit at first is chiefly to its appearance, but this is sufficient to greatly lessen its market value. The skin of the apple is ruptured by the fungus, causing the fruit to wilt easily, and thus injuring its keeping qualities. The mycelium or body of the fungus is black and forms a prostrate growth of matted threads which nearly covers the surface of the fruit. The spraying with Bordeaux mixture, as for Apple Scab, will keep this fungus in check. To be most effective the trees should be sprayed when the fruit has attained considerable size.

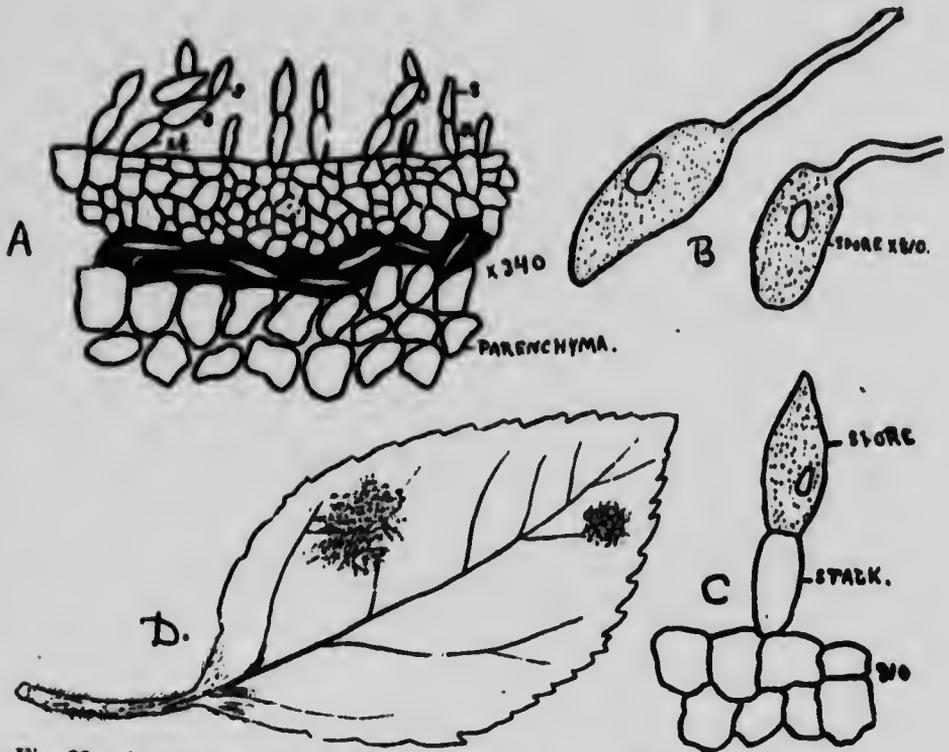


Fig. 32. A, section of an apple showing spores, *s*, and stalks, *st*, on the surface; B, germinating spores; C, part of A on a larger scale; D, leaf affected with apple scab.

APPLE LEAF-SPOT (*Phyllosticta*, sp.), Fig. 33. This is a very common disease of the leaves of the Appl. Light colored spots are found scattered over the surface of the leaves; the spots are somewhat circular or irregular in outline, the lighter portion being surrounded by a reddish ring. In the centre of the light area are usually found darker colored spots, which are the spores. The spots are 2-20 to 3-20 inch in diameter. This is not a very serious disease, and the treatment for Apple Scab will be found quite effective for these leaf spots.

BITTER ROT (*Glomerella rufomaculans*), Fig. 34. Usually appears as small rotten sunken spots when the apple is about half grown. These spots rapidly increase in size, several of them frequently running together and forming a large area. This increase in size is very noticeable in warm weather. Numerous, small dark fruiting pustules arise which are arranged more or less in concentric rings. The whole apple rapidly becomes rotten, the rotten part possessing a very bitter taste. The fungus passes the winter as cankered areas on the branches, frequently at the base of old fruiting spurs. Cutting out these diseased areas, and the treatment for Apple Scab, together with the gathering of rotting fruit, is recommended.



Fig. 33. Apple leaves affected with Leaf Spot (*Phyllosticta pirina*).

BLACK ROT (*Sphaeropsis malorum*). Fig. 35. This is a serious pest of ripe apples. It attacks the leaves, twigs, stems and fruit. On the leaves it appears as little brown spots much like the Apple Leaf-Spot disease. On the twigs or stems it appears as blackish spots and the fruit when attacked turns at first reddish brown and later black. The spores consist of minute black bodies just under the skin. It differs from Bitter Rot in not having the spores arranged in concentric rings. Bitter Rot attacks the green fruit, while the Black Rot only attacks the ripe fruit, and has no bitter taste. Diseased fruits should be destroyed wherever they may be found. The treatment which is used for Apple Scab is also recommended for Black Rot.

POWDERY MILDEW (*Podosphaera leucotricha*). This species of Powdery Mildew often does much injury to young seedling Apple-trees. It appears as a powdery-like covering over the surface of the leaves. In late summer small black bodies appear on the leaf; these contain the winter spores of the fungus. Spray the seedlings shortly after buds open and at intervals of three or four weeks with Bordeaux mixture.

LEAF-RUSTS (*Gymnosporangium*, sp.). Wherever Red Cedar is found in Ontario, leaf-rusts on Apples and Pears are fairly plentiful. This is due to the fungus spending a part of its life on the Cedar. Large yellow spots are to be found on the under surface of the leaves of the Apple and Pear, and sometimes the spots are so numerous as to cover the whole of the under surface of the leaf. Since we know that Cedars harbor these rusts, they should be carefully watched and destroyed if necessary.



Fig. 34. Bitter Rot Canker (after Burrill).



Fig. 35. Two young trees showing cankers due to the Black Rot Fungus, and produced by artificial inoculation by Paddock; a, pear; b, apple.

EUROPEAN CANKER (*Nectria ditissima*), Fig. 36. This disease is usually found on the branches of old and neglected trees, obtaining an entrance into the tissues through wounds. The fungus spreads outwards from its original centre, forming a series of concentric cracks, some of which attain considerable size, thus giving them a very characteristic appearance. The diseased portion is slightly sunken and somewhat darker in color than the normal branch; and has a very rough and scaly appearance due to the bark peeling off. Small red roundish fruiting bodies may be seen along the edge of the cracks. All cankered limbs should be cut out and any large cut surfaces be given a coat of paint to prevent the entrance of the spores.



Fig. 36. Nectria Canker.

INSECTS AFFECTING THE PEAR.

Most, if not all, of the insects that attack the Apple are equally injurious to the Pear, but there are a few additional kinds to which attention must be drawn.

THE PEAR-TREE PSYLLA (*Psylla pyricola*), Figs. 37, 38. Many complaints have been made of late years respecting injuries to Pear-trees by this minute insect. It belongs to the same order as the plant-lice and scale insects which are so prolific and destructive. The winter is passed in crevices of the bark, or in rubbish or other shelter, by the mature winged fly, which is brick-red in color and about an eighth of an inch in length. About the middle of April the fly comes out of its hiding place and lays its yellow eggs on buds and twigs wherever there is a crease or scar to afford protection. In three weeks' time the eggs hatch and the nymphs attach themselves to the leaves or opening buds. Like the aphids, they secrete large quantities of "honey dew" which drips upon the foliage and branches below, and becomes covered with a black fungus growth. As there are several broods, probably four, in the year, the colonies increase and multiply enormously, and are a heavy drain upon the vitality of the tree. Fortunately they are kept somewhat in check by their natural ene-

mies the Aphis-lions (*Chrysopa*) and the Lady-bird beetles, which in both larval and adult stages devour immense numbers of them.

The best remedy for the insect is a thorough application of the lime-sulphur wash in early spring, as recommended for several other insects. Lime alone would be effective, but the addition of sulphur helps to clean off the black fungus, and the complete mixture serves at the same time for the eradication of scale and other pests. If it should be found necessary to treat the trees in summer kerosene emulsion will kill the nymphs, but it is likely at the same time to kill our friends the Aphis-lions and Lady-bird beetles, and may also injure the foliage.



Fig. 37. Pear-tree Psylla, greatly enlarged (after Marlatt).



Fig. 39. Pear and cherry-tree Slug.

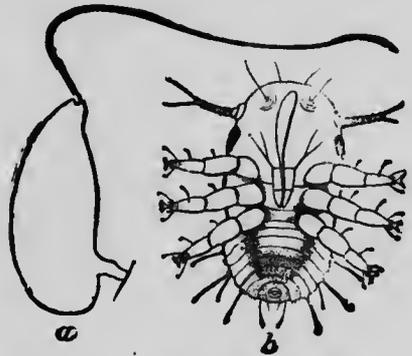


Fig. 38. Pear-tree Psylla; a, egg; b, nymph; greatly enlarged (after Marlatt).

The PEAR-TREE SLUG (*Selandria cerasi*), Fig. 39. Leaves of Pear-trees may sometimes be noticed hanging withered and brown on the twigs, and others with transparent patches where all ought to be green. A close inspection of the latter will usually reveal a small slimy blackish or deep greenish slug, shaped somewhat like a tadpole and having an odor resembling that of red ink. This is the larva of a saw-fly, a glossy black four-winged creature about one-fifth of an inch in length. The fly lays her eggs early in June in slits which she makes in the leaves by means of her saw-like ovipositor; these hatch out about a fortnight later, and the slugs begin to devour the leaves, eating out irregular patches and leaving only the skin of the under surface. A second brood is to be found in August. Spraying with powdered white hellebore in water or with Paris green will speedily destroy the slugs. Dusting with lime is also recommended on account of its burning properties. Dust of other kinds, such as ashes, road-dust, etc., have been tried, but they merely stick to the slimy surface, and when the insect moults, which it does four times, it leaves its old skin and the dust behind. This insect is equally common on Cherry-trees and sometimes on Plum.

FUNGUS DISEASES AFFECTING THE PEAR.

PEAR SCAB (*Venturia pirina*). This fungus is very closely related to the Apple Scab. It is one of the two common diseases in Ontario that cause cracking of the fruit. It may be distinguished from Pear-leaf Scald by the absence of the reddish brown coloration which is conspicuous in spots of the Pear-leaf Scald. The habits of this fungus are much the same as Apple Scab and the same treatment is recommended.

PEAR BLIGHT (*Bacillus amylovorus*). This fungus attacks Pears, Apples, and allied fruit-trees. It attacks and rapidly destroys blossoms, young fruit, young twigs, and the disease often runs down the living bark, killing some of the larger branches. The disease, however, varies greatly in severity. The blossoms are first attacked just when the flower-clusters are about to open; they turn black and dry up as if they had been killed by frost. The disease frequently spreads from tree to tree with great rapidity, the spores being carried from flower to flower by insects. The black appearance of the attacked parts is very characteristic. The remedy is to cut out and burn immediately the affected branches as soon as possible after the disease appears, removing the branch some inches below where the disease can be seen.

PEAR-LEAF SCALD (*Entomosporium maculatum*). This very destructive fungus attacks both leaves and fruit of the Pear; sometimes entirely destroying the foliage. Small pustules appear whose average size is a little less than 1-10 of an inch; these consist of circular spots projecting slightly from the surface of the fruit and leaf and are dark reddish-brown in color. Upon the surface of these may be seen small whitish colored spots which are dotted with black spots irregularly over the surface. Like the Scab, it causes cracking of the fruit. The fungus hibernates on the bark of the host. Spraying with Bordeaux mixture holds the disease in check; the first spraying should be applied, using a very dilute solution, as the leaves are expanding. Clean culture is also recommended.

PEAR-LEAF SPOT (*Septoria piricola*). This is a very common disease of Pear leaves. It appears as distinct circular, oval or subangular greyish spots surrounded by a purplish or reddish border, giving the spots a characteristic appearance. The size varies somewhat, but as a rule they are rather less than 1-10 of an inch in diameter. The spots on the under side of the leaves are brown surrounded by a darker ring. The treatment of Pear-leaf Scald is recommended for Pear-leaf Spot.

The Leaf Rust (*Gymnosporangium*) of the Apple sometimes attacks the Pear and injures it to some extent. The Brown Rot (*Sclerotinia fructigena*) of the Plum is occasionally found on the fruit of the Pear.

INSECTS AFFECTING THE PLUM.

The caterpillars of a number of moths and a few butterflies feed upon the leaves of Plum-trees, such as the large and handsome Plum-tree Sphinx (*Sphinx drupiferarum*), several Dagger-moths (*Acronycta*), and

others. None of them, however, come in sufficient numbers to cause any appreciable injury to the trees and may therefore be disregarded by the fruit-grower. The most formidable enemy is the notorious

PLUM CURCULIO (*Conotrachelus nenuphar*), Figs. 40, 41. The work of this insect is so well known that it hardly needs description. The adult is a very small beetle belonging to the family of Snout-beetles, otherwise known as Curculios or Weevils. It is about one-fifth of an inch in length, dark in color, with a pair of shining black humps on the middle of the back, followed by a pale yellowish band; the snout is short and thick. It looks very much like a rough bit of bark and would therefore escape notice by those unfamiliar with it. The winter is spent in some hiding place by the adult beetle, which comes out when spring days are warm and flies to the trees in readiness for destructive work. I have often found it in the blossoms of plum-trees, probably feeding on the pollen, and waiting till the fruit becomes large enough for its attack.

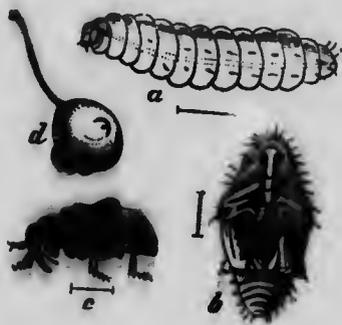


Fig. 40. Plum Curculio; a, larva; b, pupa; c, beetle; d, young fruit attacked.



Fig. 41. Plum Curculio attacking young fruit.

When the plum is as large as a good-sized pea, the female beetle bores a hole in the side, deposits an egg in it, and then cuts a crescent-shaped slit beside it so as to undermine the egg and prevent its being crushed by the growth of the fruit. The tiny grub that hatches from it buries itself in the green flesh and devours the greater part of it, especially around the stone. The injury causes the plum to fall prematurely to the ground; the grub then completes its growth, buries itself in the earth, transforms into the chrysalis state and finally develops into a beetle. Spraying with Paris green immediately after the blossoms have fallen will kill a large number of the beetles before the egg-laying is completed. Another method, which many fruit-growers consider more effective, is to jar the trees by sudden blows upon the limbs and catch the beetles which fall on a sheet below; all that are captured in this way should be destroyed at once before they have time to fly away. This should be done

before and while the trees are in bloom, and be performed morning and evening, when the beetles are more sluggish than in the heat of the day. A further method is to lay pieces of board about the base of the trees and each morning go around and collect the beetles which have found them a convenient shelter during the chill hours of the night. Whatever plan is adopted, it is all important that all fallen fruit should be daily gathered up and destroyed before the grubs have left them to enter the earth.

This insect attacks apples, pears, and cherries also, but is most abundant on plums.

FUNGUS DISEASES AFFECTING THE PLUM.

PLUM LEAF-RUST (*Puccinia pruni*). Some years this disease is very common in many parts of Ontario. It appears as small reddish or brown spots dotted all over the under surface of the leaves and so abundant in some cases as to almost cover the entire surface. On examination these spots are found to consist of a fine reddish brown powder, the spores of the fungus. Clean culture is recommended.

PLUM SCAB (*Cladosporium carpophilum*). This disease is very common on Plum-trees. It is more common on the Wild Plum than on the cultivated species, and hence the danger of having Wild Plums near the orchard. The brownish or olive colored spots appear on the fruit a short time before ripening; these spots run together and sometimes cover the surface of the fruit. Spraying with Bordeaux mixture, the same as for Apple Scab, is recommended.

PLUM POCKETS (*Exoascus pruni*). A fairly common disease of the Plum in Ontario. The "pockets" are quite different in shape from the normal plums, being somewhat roughly oblong bodies of about an inch in length. The fungus attacks the ovaries of the plum; these swell rapidly, the soft tissue of the fruit becoming very spongy, and there is no development of stone. When mature the outside is covered with a whitish bloom. It is a perennial, living from year to year in the young growth of the tree and proceeding thence in spring into young shoots and ovaries. Cutting and burning the affected branches and trees is the only sure way of exterminating the disease.

BROWN ROT (*Sclerotinia fructigena*), Figs. 42 and 43. This is the most injurious disease of the Plum. The infested fruit becomes rotten, then gradually dries up, forming a shrivelled mass which usually hangs on the tree all winter. The surface of diseased fruits is covered with small brownish tufts which contain the spores. These spores, whether on the ground or on the tree, are blown by the wind to the young fruit, where the spores germinate and start fresh rot. By removing the diseased fruits from the tree and ploughing under those that fall to the ground the disease will be greatly lessened. Spraying with Bordeaux mixture after the young fruit has set will also keep the fungus in check.

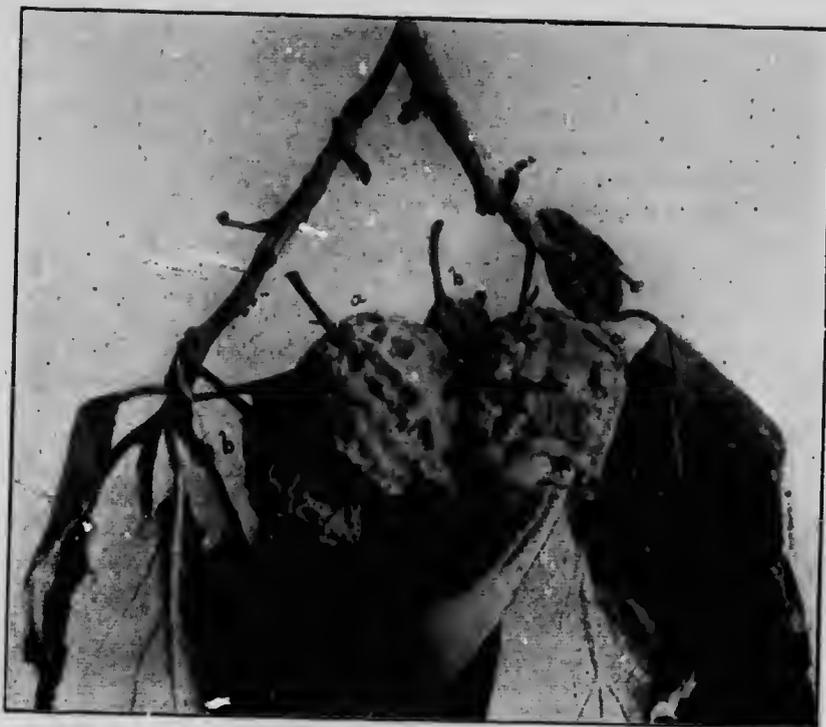


Fig. 42. Brown Rot of Plum (*Monilia fructigena*); a, plum in the soft stage with abundant production of spores; b, plums in the dry, "mummy" stage (after N. Y. Ag. Exp. St. Bulletin).

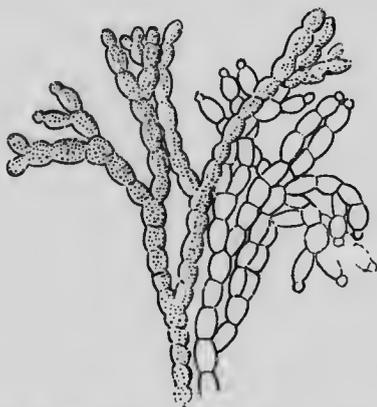


Fig. 43. Spores of Brown Rot of Plum (*Monilia fructigena*).

INSECTS AFFECTING THE CHERRY.

The Cherry is affected by a number of the insects already considered in connection with other fruit-trees. The Pear-tree Slug is quite as abundant on the leaves of the Cherry-trees as on Pear-trees; the Plum Curculio attacks the fruit, often very severely; the Tent-caterpillars, Fall Web-worm, Tussock-moth, Canker-worms, Eye-spotted Bud-moth, Leaf-rollers and Case-bearers all devour the foliage; and the scale insects suck the sap and lower the vitality of the trees. In addition to these formidable enemies attention may be drawn to

THE CHERRY APHIS (*Myzus cerasi*). This insect differs from most of the plant-lice in being black instead of the usual green color. It often appears on the leaves at the ends of the boughs in enormous numbers, causing the leaves to curl up and arresting further growth. The structure and habits of this species are similar to those of the Apple Aphis; it passes the winter in the egg state on the twigs of the tree. The remedies already mentioned are effective in this case also, and should be applied as soon as the first colonies are noticed. Usually the presence of the insect is not observed until it has become very numerous and the terminal leaves all over the trees are affected. Lady-bird beetles (Fig. 44) and Aphis-lions (Figs. 45, 46) are usually to be seen feeding voraciously on the plant-lice and assisting very materially in the reduction of their numbers.



Fig. 44. Lady-bird Beetles.



Fig. 45. Aphis-lion and its eggs.

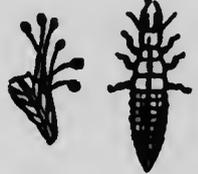


Fig. 46. Eggs and larva of Aphis-lion.

FUNGUS DISEASES AFFECTING THE CHERRY.

POWDERY MILDEW (*Podosphaera oxyacanthæ*). This fungus attacks the leaves of the Cherry, particularly the young ones; also the tender shoots. It appears on the leaves in small white patches, which soon spread and run into each other, forming a thin white felt, which in some cases may cover the entire surface of the leaf. Later on the white felt becomes thickly studded with innumerable minute black spots, which are the "fruit" of the fungus. In later stages leaves become yellowish and spotted and useless to the plant. Spray with Bordeaux mixture after the leaves have fully expanded and at intervals of three or four weeks. Three sprayings should be sufficient.

BLACK KNOT (*Plowrightia morbosa*). This Cherry and Plum fungus causes large and more or less irregular swellings on the branches which are more usually present upon the younger branches and the fruiting twigs. They generally appear on one side of the branch only, thus leav-

ing the other side perfectly healthy. At first the swellings are lightish brown in color, but the color deepens as the season advances until in the fall they vary from dark brown to black. The surface of the swellings is covered with small warty excrescences, which give to them a very typical appearance. The remedy is simple—removing with a knife and burning the knots. Where a tree is badly infested it is advisable to cut it down and burn it and thus prevent the disease spreading to others.

SHOT-HOLE FUNGUS (*Cylindrosporium padi*), Fig. 47. This fungus attacks the leaves of the Peach, Plum, Cherry, Apricot and many wild species of allied plants. It appears as brownish or reddish, circular, oval or somewhat irregular spots on the leaves. The spots vary from 1-20 to 3-20 of an inch in diameter, 1-10 being about the average size. Later on the leaves become perforated by holes caused by the dropping out of the withered spots. In some cases large irregular holes may occur, due to the running together of a number of spots. Many of the spots show concentric rings of different shades of brown. Clean culture and spraying with Bordeaux mixture when the leaves are fully expanded will keep this fungus in check.



Fig. 47. Shothole Fungus of plum and cherry (*Cylindrosporium padi*); a, b, c, leaves in various stages of attack; d, the spores of the fungus (much magnified).

INSECTS AFFECTING THE PEACH.

The war against injurious insects is almost heart-breaking to the peach-grower, as the special enemies of this tree make such serious attacks upon it and its less robust constitution causes it to succumb much more readily than the sturdy Apple and other fruit-trees. It is particularly unfortunate, therefore, that the *San José Scale* should have become established in those southern counties of Ontario where alone the peach will thrive. This deadly insect should be constantly watched for and the prescribed treatment applied as soon as the proper time has arrived. If neglected, the tree is doomed to an early death and might as well be cut down and burnt at once. Where peaches are grown on a large scale, it will pay to fumigate with hydrocyanic acid gas, for which it is necessary to have tents large enough to cover an entire tree. As this is a very dangerous poison, the fumes being destructive of all animal life, it should not be employed by unskilled persons. With proper care and the requisite knowledge, it may be used to great advantage and will be found to clear the trees of injurious insects of every kind that may be upon them.

THE PEACH LECANIUM SCALE (*Lecanium persicæ*). On the twigs and branches may sometimes be found large, soft-shelled, brown scales, very convex and resembling in size and shape the half of a split pea. Like all other scale insects, these live by sucking the sap of the tree and when numbers are present impair its vitality very much. The remedies prescribed for the other scales are equally effective for this. Lecanium scales of many kinds may be found on most fruit and forest trees and upon a great variety of shrubs and plants; usually they are not very numerous or injurious, but occasionally they occur in immense numbers, crowded thickly together, and inflicting much damage. If the affected tree cannot be treated in the prescribed manner, it had better be cut down and burnt in order that it may not become a centre of danger to others. Several of the species do not confine themselves to any one kind of tree, but will spread to all that may be within reach.

THE TERRAPIN SCALE (*Eulecanium nigrofasciatum*), Fig. 48, to which public attention has recently been drawn in the daily press, is a hard hemispherical scale, red in the middle, with black streaks, proceeding to the sides and a black margin; the colors and markings vary to some extent, and individuals may be found with very little red and others with little or no black. When observed on a tree they are usually in immense numbers, thickly clustered together and often overlapping each other. In shape and markings they bear some resemblance to a turtle and have therefore received the name of "the Terrapin Scale." The specimens that we have seen were sent in from St. Catharines, Windsor and Walkerville, and in each case were found on Maple-trees. Many of them were perforated, showing that they had been destroyed by a minute parasitic insect. This scale is widely prevalent in the Northern and Eastern States but is not common yet in Ontario.



Fig. 48. Terrapin Scale (*Eulecanium nigrofasciatum*). Adult females on twig of peach; enlarged about three times (after Sanders, U. S. Dept. Agr.).

It attacks a large number of wild and cultivated trees and shrubs, and is especially injurious to peach trees. As it will readily spread from one tree to another, it is important that any wild trees found to be infested should be cut down and burnt at once. The only remedy for the insect when it attacks fruit-trees is to spray with kerosene emulsion in the fall and winter or in early spring before the leaves come out.

THE PEACH-TREE BORER (*Sanninoidea exitiosa*), Fig. 49. Unlike the borers already referred to, this insect is not the grub of a beetle, but the caterpillar of a moth. Next to the San José Scale, it takes rank as the worst enemy that the peach-grower has, and prior to the arrival of the scale destroyed more trees than all other causes combined. The parent moths are very pretty creatures; the male has a steel-blue body with



Fig. 49. Peach-tree Borer: 1, female moth; 2, male moth.

golden-yellow markings and clear transparent wings which expand about an inch; the female is considerably larger and totally different, the body being more than twice as thick, of a similar glossy steel-blue color, but crossed with a brilliant band of orange; the fore wings, which expand an inch and a half, are opaque and steely-blue like the body, while the smaller hind wings are transparent with a margin of scales of the same

steel-blue color. The moths are on the wing from about the beginning of July to the close of summer, as they do not all come out of the chrysalids at the same time. The eggs are laid in crevices on the trunk of the tree close to the ground, and the larvæ when hatched bore through the bark down towards the root; their presence is usually indicated by a mass of gum mingled with bits of bark and excrement which is exuded from the burrow. As the eggs are laid at different times during the summer, larvæ of all sizes may be found when winter sets in. During the cold weather they remain torpid in their burrows and complete their feeding and transformations in the spring.

All sorts of remedies have been tried for the destruction or the prevention of the attacks of this insect, but no thoroughly satisfactory one has yet been found. On the whole, the best plan is to carefully examine all the trees, one by one, and cut out with a sharp knife the worms whose presence is indicated by a mass of gum. This is a slow and therefore expensive operation. Wrapping tar-paper about the trunk and a few inches below the surface of the soil will keep the moths from depositing their eggs. Mounding up the base of the trees with earth is also done with the same object in view, but there is a danger of injuring the bark and therefore the health of the tree, if the earth is left too long against it. Washes of various kinds have been tried, but most of them are dangerous owing to the tender character of the bark; the only one that seems to be both effective and safe is gas-tar, the smell of which keeps away the moth. It should be used with care and tried on a few trees to begin with before applying to a whole orchard.

Among other insects affecting the Peach may be mentioned the Plum Curculio, which injures the fruit, and a black Aphis which often swarms on the leaves.

FUNGUS DISEASES AFFECTING THE PEACH.

PEACH LEAF-CURL (*Exoascus deformans*), Fig. 50. This disease usually becomes apparent early in the season, when it attacks both leaves and young shoots. The leaves become thickened and much distorted, and the edges curled, giving a characteristic appearance. When only small areas of the leaf are attacked, they become arched and pale yellow or reddish in color. When much of the leaf is involved, such a pronounced curling may be produced as to almost bring the edges of the leaf together. The color of the attacked parts varies from yellow to red. The fungus hibernates in the tissues of the tree and therefore reappears each year. Fallen leaves should be collected and burned; and those branches which bear diseased leaves should be pruned back beyond the point of infection and thus get rid of the perennial part of the fungus. Spraying with dilute Bordeaux mixture just when the leaf-buds are beginning to expand and again at an interval of three weeks will be found of much benefit.



Fig. 50 Peach leaf-curl,—affected foliage.

CROWN FUNGUS (*Dendrophagus*, sp.). Irregular shaped swellings usually about an inch in diameter situated generally at the crown of the root, but also on the younger roots. In some cases the swellings are as large as a man's fist. The outside of the gall is quite rough and irregular; the color at first is similar to that of the root, but later on becomes darker. It is a little softer and not so tough in texture as the normal root; in cross section it is somewhat spongy. This disease is spread in the nurseries, and nursery stock showing signs of the galls should be rejected. Removing infested trees is the only remedy.

THE PLUM SCAB (*Cladosporium carpophilum*) and the Brown Rot (*Sclerotinia fructigena*) of the Plum are often to be found affecting the Peach also. The Shot-hole Fungus (*Cylindrosporium padi*) of the Cherry is another of the occasional diseases of the Peach.

INSECTS AFFECTING THE GRAPE.

THE GRAPE-VINE FLEA-BEETLE (*Haltica chalybea*), Fig. 51. Among the numerous insect enemies of the Grape the first to appear in the spring is this Flea-beetle. It is a small steel-blue creature, sometimes metallic green or purple, about one-sixth of an inch long, with the thighs of the



Fig. 51. Grape-vine Flea-beetle.

hind-legs greatly enlarged, enabling the lively little insect to jump to some distance; hence the name "Flea-beetle." It winters in the adult stage under fallen leaves and other rubbish and comes out as soon as the weather is warm enough to cause the buds to swell. Upon these it feeds, boring into them and devouring them, and to such an extent that some-

times the canes have few leaves left. It soon begins to deposit its minute orange eggs in clusters on the underside of the foliage, and from these there hatch out small dark-brown grubs which eat holes through the leaves and sometimes completely devour them. About the end of June they are full grown, and enter the earth to transform to the pupal stage; two or three weeks later the new brood of beetles appears and feeds upon the foliage of the vine, which by this time is so luxuriant that it is not injured by the attack. Late in autumn the beetles betake themselves to their winter hiding-places.

The chief thing to do in dealing with this insect is to watch for it in the spring, and as soon as any are to be seen to spray or syringe with Paris green to which lime has been added. Another method is to jar the beetles from the vines into a pan of water with some coal-oil floating on the surface, or on a sheet soaked with the oil; this should be done when they are somewhat torpid in the early morning. During the warmer hours of the day they are too lively to be caught in this manner. Later on in the season, should the grubs be seen on the foliage the spraying should be repeated. In the autumn all fallen leaves and rubbish about the vines should be cleaned up and burnt so as to leave no convenient winter quarters for the beetle. As this insect is equally prevalent on the Virginia-creeper, the same treatment should be applied to it if there are any of these favorite plants near by.

THE ROSE-CHAFFER (*Macrodactylus subspinosus*), Fig. 52. Later in the season, when the blossoms appear on the vines, another beetle, but of a different family, makes an attack upon them. It is commonly called the Rose-beetle or Rose-chaffer, from its habit of devouring the bloom of roses, but it is even a worse enemy of the grape, as it destroys the blossoms and with them all hope of fruit. Fortunately it is somewhat local, and is not everywhere a pest. During 1906 it appeared in great numbers in various places from the outskirts of Toronto, which seems to be its eastern limit at present, to the County of Essex; it has been abundant for some years in the neighborhood of London, but does not appear to extend much farther north.

The larva lives upon the roots of grasses in old pastures where the soil is sandy; it has not been found in clay land. The eggs are laid by the female an inch or two below the surface of the ground, and the young larvæ gradually grow to maturity during the summer and spend the winter in that condition, hibernating in a cell that they make somewhat deep down in the earth. In spring they work their way to the surface, transform to pupæ and emerge as beetles in June. This destructive stage lasts from three to four weeks. They appear suddenly in great swarms, completely covering the bloom that they attack, crawling and sprawling over each other and looking anything but attractive. Flowers of almost any kind are devoured by them, and they also carry their work of destruction to the partially formed apples. After being in profusion for about a month they disappear as suddenly as they came.

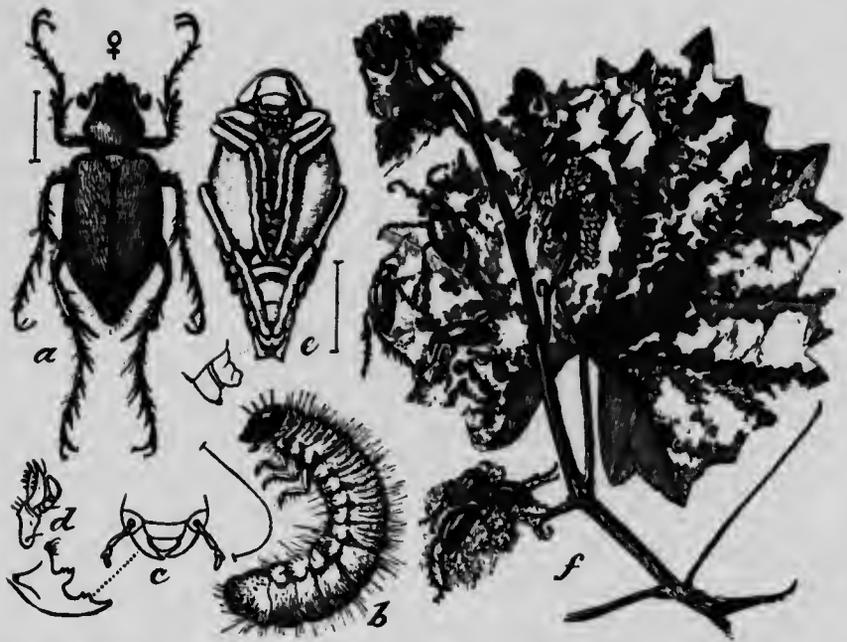


Fig. 52. Rose Chafer (*Macrodactylus subspinosus*); a, beetle; b, larva; c and d, mouth parts of same; e, pupa; f, injury to leaves and blossoms with beetles, natural size, at work (after Marlatt, U. S. Dept. Agriculture).

The beetle is of a dull yellowish brown color, half an inch long with very long, spiny legs, from which it gets its scientific name. It is a difficult creature to do anything with, as Paris green has little or no effect upon it. In gardens the best plan is to destroy the insect by hand-picking, or by jarring from the plants into pans containing a little coal oil; this should be done in the morning and evening when the beetles are not so lively as in the heat of the day. The breeding places, if they can be discovered, should be plowed up and planted with some crop. In any case no pastures should be allowed to remain long in grass, but should be treated in a regular rotation of crops as in the case of other fields; if let alone they gradually become the homes of May beetles or "June-bugs," wire-worms, and other destructive insects.

THE SPOTTED PELIDNOTA (*Pelidnota punctata*), Fig. 53. A third and very much larger beetle is to be numbered among the insects attacking the vine; it is a handsome creature, about an inch and a half in length, oval in shape, and very convex above. The head is black, the thorax somewhat bronzed, and the wing-covers clay-yellow with three black spots on each side; the under surface is dark metallic green. These beetles may be found upon the vines eating the foliage during July and August; they belong to the same family as the Rose-chafer and the May-

beetle, but fortunately do not appear in large numbers. The grubs feed upon rotten wood in decaying stumps and logs, and are not injurious in that stage.

Being so large and conspicuous, it is usually an easy matter to pick the beetles off the vines with the fingers and crush them under foot. They are chiefly to be found in the southern counties of Ontario, and are rarely seen east of Toronto.

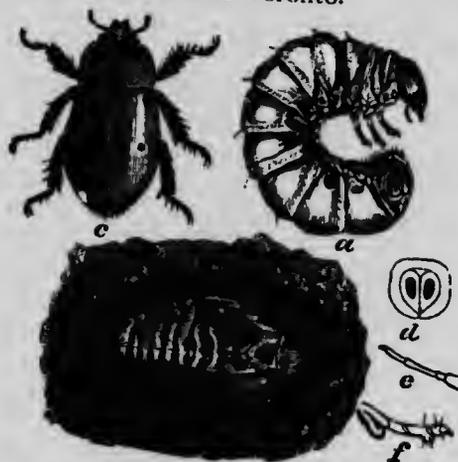


Fig. 53. The Spotted Pelidnota; a, grub; b, pupa; c, beetle.



Fig. 54. Sphinx Caterpillar in characteristic attitude.

GRAPE-VINE SPHINX CATERpillARS. There are at least five different species of these insects to be found feeding upon the leaves of the grape in Canada. The most common is the Green Grape-vine Sphinx (*Darapsa myron*), which may be taken as a representative of the family. The young caterpillars, which are to be found in June, are of a yellowish color with a long blackish horn, or tail, near the posterior end of the body. With each moult the caterpillar changes somewhat in appearance and the horn becomes shorter. When full-grown it is quite two inches long, green in color, covered with small granulations, and adorned with a pale yellow stripe along each side; below this there are seven oblique yellow stripes, slanting backwards. The accompanying figure represents the caterpillar at this stage. (Fig. 54.) Occasionally individuals are to be found of a reddish or pinkish color with markings of a darker brown. The chrysalis is formed in a loose cocoon of leaves drawn together with silken threads at the base of the vine. A second brood of nymphs appears at the end of June, the caterpillars from which mature in September and spend the winter in the chrysalis state, from which the moth comes out in May.

The moth is a beautiful insect (Fig. 55), with long narrow fore-wings expanding about two inches and a half, of a velvety olive-green color, with darker bands across them; the hind wings are much smaller and

rusty red in color without markings. These insects are called Hawkmoths from their swift darting flight from flower to flower at dusk or early evening; they poise on swiftly vibrating wings, like Humming-birds, and suck the nectar from tubular flowers with their long, slender tongue, which coils up beneath the head like a watch-spring when not in use. The name Sphinx is derived from the attitude often assumed by the caterpillars, which hold up their head and front segments so as to present a fanciful resemblance to the mysterious Egyptian Sphinx. (Fig. 54.)



Fig. 55. Green Grape-vine Sphinx Moth.

The other species affecting the vine, the Achemon and the Abbot Sphinx, and the White-lined and Dark-veined Deilephila, are very similar in their habits and their caterpillars feed in the same way. Being large and voracious, they sometimes entirely strip a branch of its leaves. They are kept in check by their parasitic enemies and seldom, therefore, appear in large numbers. As their presence can be detected by the denuded branches, or their large black or brown castings on the ground beneath, they can easily be got rid of by hand-picking. It is only on young vines that they are likely to prove very injurious; the foliage of the older ones is so luxuriant that the loss of leaves in this way is hardly appreciable.



Fig. 56. Wood-nymph Moth.



Fig. 57. Wood-nymph; e and f, eggs; a, caterpillar.

THE WOOD NYMPH CATERPILARS (*Eudryas grata* and *unio*), Figs. 56, 57. Occasionally the grape-vine is found to be severely attacked by scattered caterpillars of a bluish color. On close inspection they are found to be very prettily marked, each segment having an orange band crossing it in the middle and half a dozen black lines on the purplish-blue ground color; the segment behind the head and one near the tail are more con-

spicuously decorated with orange. The adult moths are very beautiful, with fore wings creamy white, broadly bordered with chocolate and olive-green, and the hind wings yellow with a narrow brown border; when at rest the densely scaled front legs are stretched out conspicuously and the wings folded together in roof-shape over the body. As soon as the caterpillars are observed they may be treated with Paris green. Though present on the vines every year, it is only once in five or six years that they are numerous enough to demand attention.

GRAPE-VINE LEAF-ROLLERS AND OTHER CATERPILLARS. A number of caterpillars of other kinds of moths feed also upon the leaves of the grape. As a general rule they are not particularly injurious, but they are liable at times to become so numerous as to require spraying with Paris green.

THE GRAPE-VINE LEAF-ROLLER (*Desmia maculalis*) is nearly always to be found on the vine and may be discovered by the leaves rolled up in cylindrical form which the larva inhabits. The moth is black with some white spots on the wings and white fringes—a beautiful little creature. There are two broods during the year. When disturbed the lively caterpillar drops instantly out of its case and falls to the ground; hand-picking is therefore difficult, but the increase of the insect may be checked by burning the leaves in the fall.

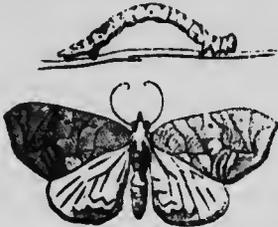


Fig. 58. Grape-vine Geometer: caterpillar and moth.



Fig. 59. A Cut-worm Caterpillar and Moth.

THE GRAPE-VINE GEOMETER (*Cidaria diversilineata*), Fig. 58, is a pale yellowish-green looper or measuring worm, which develops into a pretty yellow moth with fore-wings crossed and recrossed with darker lines. In June these caterpillars are sometimes numerous, but may soon be overcome by the Paris green treatment.

THE YELLOW WOOLLY-BEAR (*Spilosoma virginica*) will feed upon almost any kind of plant, but seems to particularly relish the leaves of the grape. The hairy caterpillar must be very familiar to every one. The moths are soft, pure-white creatures with a few black dots on the wings and orange bands and black spots on the body.

Several species of climbing Cut-worms (*Agrotis*), Fig. 59, attack the buds and foliage of the grape. They are nocturnal in their habits and are therefore not often seen upon the vines. During the night they come out of their hiding-places, climb up the vines and devour the leaves. The

best remedy for them is a mash of poisoned bran made by slightly moistening 25 pounds with water in which some sugar has been dissolved, and then adding 4 ounces of Paris green; the poison should be gradually dusted on the top and stirred all the time, otherwise it will sink through the bran at once and be ineffective. If bran cannot be obtained, flour may be used instead. A handful or two of the mash should be placed at the base of each vine. When the caterpillars come out they will eat this mixture in preference to anything else and then return to their hiding-places to die.

Many other caterpillars, great and small, feed upon the foliage of the grape, and may from time to time become destructive. Spraying with Paris green will get rid of them whenever they appear to be dangerous.

THE GRAPE LEAF-HOPPER (*Typhlocyba vitifex*). This insect is commonly, but erroneously, called "Thrips." It is a minute creature, about one-eighth of an inch in length, and is to be found in great numbers on the under side of the leaves. When disturbed it hops with great agility and quickly takes flight. When seen under a magnifying glass these insects are found to be prettily marked with different colors, red, yellow, etc., and are believed to represent several species. The larvæ appear in June and resemble the adults, except that they are smaller and wingless; they moult several times and the empty cast-off skins may often be found in great numbers sticking to the leaves. These insects belong to the order of true "bugs," and are furnished with beaks for sucking the juices of the plants, not with jaws for biting; consequently they cannot be poisoned through their food, but must be treated with contact remedies such as strong tobacco water, whale-oil soap or kerosene emulsion. Their presence is usually made known by the blotches they produce on the leaves from the exhaustion of the sap; and as they occur in immense numbers they often destroy the whole leaf, causing it to look as if scorched, and to drop from the vine. In winter the adults take refuge under leaves and rubbish, and may be destroyed, with several other of the insects here referred to, by raking up and burning all such material in the autumn.

THE GRAPE PHYLLOXERA (*Phylloxera vastatrix*), Fig. 60. In the wine-producing countries of Europe no insect has a more evil reputation or is more dreaded than this native American species, which has caused enormous losses to the vine-growers and almost destroyed the chief industry of many large districts in France, Spain, Portugal and other countries. Volumes have been written describing its history, habits, distribution and the remedies that have been tried for its control. Millions of dollars would not cover the losses it has entailed. Now, happily, it has ceased to be a serious pest, though it has by no means been exterminated. Relief was obtained in Europe by grafting their own varieties on American stocks which are able to resist the attacks of this insidious foe.

The insect has two forms, one living underground and attacking the roots, producing swellings or galls, which cause rotting and death of the roots, and therefore the loss of the whole vine; the other form attacks the leaves, covering them with small galls and causing their destruction.



Fig. 60. Phylloxera galls on a grape-leaf.

The life-history of the insect is a very remarkable one and may be found in most works on Economic Entomology; to fully describe it here would occupy more space than is available, and seems hardly to be necessary. The figure will serve for the recognition of the gall. The root-infesting form can be overcome by the use of bisulphide of carbon, but the better plan is to grow the resistant stocks on which the choicer varieties may be grafted.

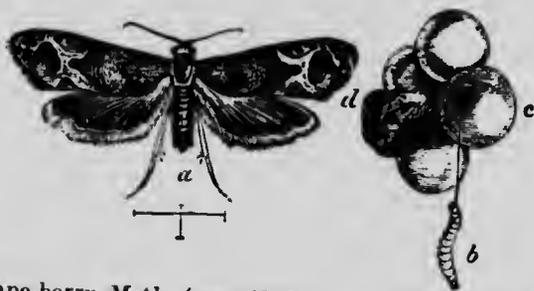


Fig. 61. Grape-berry Moth (magnified); caterpillar and affected fruit.

THE GRAPE-BERRY MOTH (*Eudemis botrana*), Fig. 61. When the grapes are approaching maturity, discolored berries here and there on the bunches may be noticed, and if carefully examined will be found to be inhabited by a small whitish-green larva, which feeds upon the pulp. After consuming the contents of one berry the worm attacks others and draws them together with silken threads mixed with its castings, thus

producing an offensive mass and greatly injuring the value of the whole bunch. When full grown it makes a case out of a portion of a leaf that it cuts for the purpose, and there passes through the chrysalis stage. The tiny moth is slate-blue in color with red-brown markings on the forewings. The winter, so far as known, is spent in the chrysalis stage, and therefore the insect may be destroyed by burning the leaves in the autumn. All fallen fruit should be regularly gathered up and fed to pigs or deeply buried in the earth. Where a few choice vines only are grown it will be quite worth while to cut out all discolored berries as soon as they are noticed and get rid of the worms before they have extended their injuries to others.

FUNGUS DISEASES AFFECTING THE GRAPE.

BLACK ROT (*Guignardia Bidwellii*), Fig. 62. Attacks both leaves and fruit of the Grape, producing conspicuous circular reddish brown spots on the former. The fungus causes the fruit to rot, the color at this stage being brown, but later on the berries become dried up, forming wrinkled, brownish or black, hard mummy-like bodies which adhere to the vine for some time. When the surface of the grape is examined closely it is found studded with innumerable small black dots, the fruiting bodies of the fungus. Spraying with Bordeaux mixture should begin about the first week in June or just before the blossoming period; the second application should be made about three weeks later, and the third about two or three weeks later still. Three thorough sprayings will keep the disease under control



Fig. 62. A cluster of grapes rendered worthless by Black Rot.

DOWNY MILDEW, OR BROWN ROT OF THE GRAPE (*Plasmopara viticola*). This fungus attacks the leaves, petioles and young shoots, tendrils and fruit of the Grape. The disease first appears as yellowish spots on the upper surface of the leaves. These increase rapidly in size and number,

becoming brown as the infested tissues die, and on the under side mouldy or frost-like, being covered with a delicate white film. When badly attacked the leaves fall off in about two weeks, and in this way the vines frequently lose all their leaves, thus preventing fruit development, even if the clusters themselves are not attacked. The treatment for Black Rot is recommended for this trouble also.

POWDERY MILDEW (*Uncinula spiralis*). This fungus attacks leaves, young shoots and fruit; it appears as white or greyish mealy patches on the upper surface of the leaves and on the fruit. Towards the end of the summer the fruits become yellowish and finally almost black; the attacked grapes crack and ultimately wither up. The treatment for Black Rot will also keep the Powdery Mildew in check.

ANTHRACNOSE, OR BIRD'S-EYE ROT (*Sphaceloma ampelinum*). This disease is found on all green parts of the Grape, but more especially on the canes, where it appears as small brown marks which sometimes unite and form lengthened spots. When the berries are affected, they show brownish or blackish specks with a more or less circular outline; the centres of these become grey and surrounding this a conspicuous red ring with a dark border on the outside of it sometimes appears. Berries attacked do not wither or turn brown as those referred to in "Black Rot" or "Brown Rot," but the portion affected becomes somewhat wrinkled, and the berries assume an irregular shape. The spores pass the winter on leaves, fruit or shoots. Thorough spraying with Bordeaux mixture as for Black Rot will keep this fungus under control.

INSECTICIDES.

The following instructions for the preparation of the various insecticides referred to in these pages are those that on the whole have been found the most effective in practice. Experiences will no doubt differ and some prefer a variation in the quantities prescribed, but as already stated, a great deal depends upon the care which is exercised in the preparation and the skill with which it is applied. In this, as in other things, practice makes perfect, and a remedy should not be discarded because it has not proved absolutely effective on its first application.

A Bulletin recently prepared by Professor Harcourt and Mr. Fulmer of the Ontario Agricultural College and published by the Department of Agriculture. "Insecticides and Fungicides," Bulletin 154, should be procured and studied by every fruit-grower.

LIME-SULPHUR WASH.

This is made with 22 pounds of fresh lime, 18 pounds sulphur (flowers), and 40 gallons of water; another formula is 20 pounds of lime and 15 pounds sulphur. The sulphur should be made into a paste with warm

water and added to the lime, which is slaked in about 15 gallons of warm water with continued stirring. The mixture is then boiled for an hour and a half in a kettle, or better, in a barrel with live steam. It should be made up to 40 gallons with hot water, strained into a spraying tank and applied to the trees while hot. The quality of the lime is important; the Beachville and Port Colborne limes are very satisfactory, but those from the neighborhood of Guelph contain too much magnesia to be serviceable.

There are other methods of making the wash which will be found described in Bulletin 154.

SPRAYING REMEDIES.

PARIS GREEN AND BORDEAUX MIXTURE.

Four pounds of fresh lime, 4 pounds of bluestone, and 4 ounces of Paris green, thoroughly mixed in 40 gallons of water. In all cases where spraying with Paris green is recommended in the foregoing pages it is advisable to add the bluestone (or Bordeaux mixture) in order to counteract fungus diseases at the same time as the insects are destroyed. The bluestone (copper sulphate) should be dissolved by suspending it in a wooden vessel containing 4 or 5 gallons of water, and the lime slaked in another vessel; if lumpy, the lime should be strained through coarse sacking. Pour the bluestone solution into a barrel and half fill with water; dilute the slaked lime to half a barrel and mix the two together. The Paris green should be made into a paste with warm water, poured into the barrel and stirred thoroughly. The mixture is then ready for use. The addition of the lime prevents the poison from scorching the foliage.

KEROSENE EMULSION.

The following is the formula recommended by Dr. Fletcher (Central Experimental Farm Bulletin No. 52):

| | |
|---------------------------|----------------------|
| Kerosene (coal oil) | 2 gallons. |
| Rain water | 1 gallon. |
| Soap | $\frac{1}{2}$ pound. |

Boil the soap in the 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 three gallons of emulsion will make 30 gallons of wash.

Kerosene emulsions may also be made conveniently by using an equal amount of sour milk instead of the soap and water in the above formula, and churning for the same time to get the stock emulsion.

Another method is to use lime, which will hold the kerosene in suspension, or the following, where lime cannot be obtained:

The requisite amount of kerosene is placed in a dry vessel and flour added in the proportion of 8 ounces to one quart of kerosene. It is then thoroughly stirred and two gallons of water added for every quart of kerosene; the whole is then vigorously churned for from two to four minutes, and the emulsion is ready for use. It has been found that by scalding the flour before adding the kerosene, an excellent emulsion which does not separate in the least after standing for a week, can be prepared with 2 ounces of flour, by mixing the resulting paste with one quart of kerosene and emulsifying with two gallons of water.

TOBACCO WASH (for destroying Aphis).

Soak 4 pounds of tobacco waste in 9 gallons of hot water for four or five hours (in cold water for four or five days); dissolve one pound of whale-oil soap in one gallon of hot water; strain the decoction into the dissolved soap and apply with a spray pump as forcibly as possible.

SOAP WASHES.

Dissolve one pound of whale-oil soap in four gallons of warm water for black or brown Aphis, and one pound in six gallons for green Aphis.

Another remedy for Aphis is the following: Boil 8 pounds of quassia chips in 8 gallons of water for an hour, dissolve 7 pounds of whale-oil soap in hot water; strain the quassia decoction and mix with the soap solution; then dilute to make 100 gallons. Spray forcibly while hot; this will kill the plant-lice and not injure the trees.

FUNGICIDES.

BORDEAUX MIXTURE.

This is made with four (or six) pounds of copper sulphate (bluestone) and four pounds of fresh lime thoroughly mixed in 40 gallons of water. The larger quantity of bluestone is recommended by many practical fruit-growers, as an equal amount of lime causes the mixture to act more slowly, and to be more liable to clog the machinery. In a wet season it may be of advantage by causing the mixture to retain its efficiency longer. The best quality of quicklime should be used.

In many cases it is better to use the poisoned Bordeaux mixture, which is made, as described above, by the addition of four ounces of Paris

green. This will destroy many kinds of injurious insects as well as fungus diseases.

Test the Bordeaux to find out whether sufficient milk of lime has been added. This is most easily done by means of the ferrocyanide test. A saturated solution of this substance can be purchased at any druggist's for a few cents. In testing, place some of the Bordeaux, which has been thoroughly stirred, in a saucer, and add a few drops of the ferrocyanide. If sufficient lime has been used, no discoloration will appear, but if insufficient, a deep, dark brown color will be produced.

AMMONIACAL COPPER CARBONATE.

This fungicide is useful for application to trees when the fruit is well advanced and might be disfigured by the employment of Bordeaux mixture. The following are the materials used: 5 ounces of copper carbonate, 3 pints of ammonia, and 45 gallons of water. For instructions regarding the preparation of these materials see Bulletin No. 154.

In the foregoing pages descriptions and figures are given of the injurious insects that are commonly found upon fruit-trees. If the reader should meet with others regarding which he desires information, he is requested to send specimens to the Department of Entomology, Ontario Agricultural College, Guelph, and to mention any particulars that he may have observed. Immediate attention will be given to the enquiry and the specimens will be reported upon with any information or advice that can be offered. Living specimens should be enclosed in a small tin or wooden box, with some of the plant upon which they are found; it is not necessary to make any holes for the admission of air. Dried and fragile specimens should also be sent in strong cardboard or wooden boxes to prevent their being crushed in the mail. If the packet is marked "Entomological Specimens," the postage is one cent for two ounces.

Specimens of fungus diseases may be sent in paper or cardboard boxes; the postage on them is that of fourth class matter, viz., one cent per ounce. Twigs, blossoms or foliage may be sent as "Botanical Specimens" at one cent for four ounces.

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