

Blyphylla decemlineate, Lay.	Swan Lake, B.C.
Prionus californicus	Swan Lake, B.C.
Pachyta spurea, Lec. (July, 1912)	Swan Lake, B.C.
Acanthocinus obliquus, Lec.	Swan Lake, B.C.
Clytus planifrons, Lec.	Larkin, B.C.
Xylotrechus undulatus, Lay.	Larkin, B.C.
D. valens	Swan Lake, B.C.
Liptura canadenses, Fab.	Swan Lake, B.C.
Tetropium velutinaum, Lec. (on fir, June 1st, 1912)	Coldstream, B.C.
Ascnium atrum, Esch (June 20th, 1912)	Larkin, B.C.
Monohammus scutellatus, Lay.	Larkin, B.C.
Clerus sphegerus, Fab.	Larkin, B.C.
R. bicolor (on rose, June 1st, 1912)	Coldstream, B.C.
Cicindela vulgaris var. obliqua, Kirby.	
Cicindela 6-guttata, Fab.	
Carabus taedatus near var. agassii, Lec.	
Platynus bogemanni.	
Adoxus obscurus var. vitis, Linn.	
Haltica bimarginata, Say.	
Luperodes varipes, Say.	
Temnochila chloroida, Mann.	
Hydrophilus triangularis, Say.	
Cucujus clavipes var. puniceus, Mann.	
Hippodamia 5-signata, Kirby.	
Hippodamia convergens, Guen.	
Coccinella trifasciata, Linn.	
Coccinella transversoguttata, Hab.	
Coccinella 9-notata, Hbst.	
Cycloneda sanguinea, Linn.	
Eleodes hispilabris, Say.	
Eleodes humeralis.	
Coniontis ovalis, Lec.	
Helops regulus, Blaisd.	
Nemognatha dichroa, Lec.	
Podabius tomentosus var. pruinosis, Mann.	
Cremastochilus pilosicollis, Horn.	
Epicauta puncticollis, Mann.	
Phytonomus punctatus.	
Nocholes torpidus, Lec.	
Silpha ramosa, Say.	
Dichelonyea vicina, Fall.	
Lacnosterna trista, Fab.	
Monohammus confusor.	

LEPIOPTERA.

Sthenopis argenteomaculatus.

REPORT FROM VANCOUVER DISTRICT: INSECTS ECONOMICALLY
IMPORTANT IN THE LOWER FRASER VALLEY.

By R. C. TREHERNE, FIELD OFFICER, DOMINION DIVISION OF ENTOMOLOGY,
EXPERIMENTAL FARM, AGASSIZ.

The object I have in presenting this paper is to record, as best I am able, as a result of the past two seasons' observations, the various insects occurring in the Lower Fraser Valley which are of greater or lesser economic importance to the fruit-growers and farmers. I shall endeavour to describe, for the benefit of all, the

various insects by their most distinctive larval and adult characteristics and their respective injuries to their host-plants, with brief notes on the life-histories under Lower Fraser conditions and remedies suggested for control.

TREE-FRUIT INSECTS.

THE EYE-SPOTTED BUD-MOTH (*Tmetocera ocellana*, Schiff).*

This Tortricid probably ranks first among the various insects attacking the apple in the Fraser Valley. It is destructive only in the larval (worm) stage. The winter is passed in the partially grown larval stage attached to the main limbs and trunks of the trees, securely covered by a silken web. When the buds begin to burst in the spring, the young larvæ cut through their silken coverings and commence to feed on the buds and developing leaves. The larva can be recognized by its colour. It is chestnut-brown, with head, legs, and thoracic shield black, smooth, and shiny. When full grown the larva is $\frac{1}{2}$ inch in length, although in the spring and early summer the larva may vary from $\frac{1}{8}$ to $\frac{1}{2}$ inch.

As all the eggs are not laid at one time and as the hatching from the eggs does not occur conjointly with all the individuals, consequently the larvæ enter their winter quarters in the fall in various stages of growth, and, in turn, appear in the spring with the same variations. The result of this is that larvæ continue feeding to all dates until the last days of July before passing to the next stage of its history, the resting stage, or the pupa. The moth is supposed to be single-brooded, no evidence yet being received to indicate even a partial second brood. On the other hand, pupæ may be formed by the more mature larvæ by the first week of June. The pupa may be recognized, in its turn, by its length and colour. It is chocolate-brown in general colour, with the abdominal segments somewhat lighter than the head, thorax, and appendages; each segment of the abdomen possesses two rows of numerous tooth-like processes, while the last segment possesses several hooked bristles used for the purpose of retaining it securely in its place of pupation. Length, approximately $\frac{1}{8}$ inch. Pupæ of this description may be found in the dried curled leaves so commonly seen on apple-trees in the Lower Fraser during the summer. The pupal stage lasts from thirteen to twenty days and carries over from the first week of June until well into August. The adult moth, which is ashy grey and capable of expanding its wings about $\frac{5}{8}$ inch, then appears from the resting pupa to lay eggs and again produce the destructive larvæ. It is assumed at the present time that all of the eggs hatch and produce larvæ before fall. The eggs are very minute and are laid on both surfaces of the leaves.

The main injury is caused in the early spring, when the young larvæ attack the developing buds, terminal and lateral, preventing the normal growth of shoots and forcing the growth of many side and lateral shoots in place of one, and by affecting the formation of blossom by the attack on fruit-buds. The most efficient remedy is the application of arsenate of lead in the form of a spray at the time of the bursting of the buds and previous to the formation of bloom.

THE LESSER APPLE-WORM (*Enarmonia prunivora*, Walsh).

The life-history of this Tortricid is very imperfectly known, as yet, under our local conditions. It is universally spread over our present fruit areas of the Lower Fraser and Vancouver Island. It is commonly seen in the latter part of the summer, at the time of the fall fairs, on fruit in the orchards. For the reason that its nature of injury closely resembles that of the codling-moth, it was thought advisable to prevent confusion by a brief reference to its characteristics.

The larva of the codling-moth (*Carpocapsa pomonella*, L.), another Tortricid, is when full grown about $\frac{3}{4}$ inch in length, white or pinkish in colour, with a brown head and faint tubercles over the body. A great proportion of the larvæ of the first

* The scientific and common names for the majority of the insects in this paper are those recommended by the American Association of Economic Entomologists in Circular No. 1, June, 1909.

brood enter the apple through the calyx end, some enter at the stem end, and some, when apples are touching, enter through the side. The well-known excreta at point of entrance leaves a clue to the presence of the larva in an apple. The larva after entering the apple penetrates to the core and there remains until full grown, when, as a rule, it works its way by a different route to the side for the purposes of pupation.

The larva of the lesser apple-worm enters the apples from either the calyx or stem end, and also on the side when apples are touching, in these respects resembling the larva of the codling-moth. The larvæ of the former, however, feed to a greater extent on the surface of the apple, devouring the flesh around the calyx and stem basins to the depth of $\frac{1}{2}$ inch. The larvæ undoubtedly penetrate to the core, as do the codling-moth larvæ, but usually only in well-ripened apples. The larva does not appear to form so definite a channel to the core as does the codling-moth larva, appearing to feed more or less continuously on the flesh of the apple en route. The greatest difference between the two, possibly, is the colour and shape. When full grown the larva is not more than half as long as the codling-moth larva and is more pinkish in colour. Furthermore, the terminal portion of the last segment is furnished with a small brown structure consisting of seven teeth.

It may be readily assumed that an arsenate-of-lead spray applied in the spring and again in July would offer the best remedies.

OLETHREUTES, SP.

There is evidently a leaf-roller of the above genus at work in Lower Fraser orchards which closely resembles the bud-moth in habits. The adult moth is larger throughout, however, but of an ashy-grey colour. Its occurrence in the field is very local, and thus far has not been observed in great numbers.

Mr. Arthur Gibson, Chief Assistant, Dominion Division of Entomology, to whom the adult was referred, believed it to be of the above genus and similar to the Eastern species *nimbatana*.

THE FALL WEB-WORM (*Hyphantria cunea*, Dru.).

In 1903 the webs of this Arctiid were very conspicuous in British Columbia.* In recent years this insect has not been so common, but the well-known webs can be observed at times in the Lower Fraser Valley.

The full-grown larvæ are about 1 inch long, covered with long black and white hairs which project from numerous black tubercles. They feed on the foliage of fruit-trees and woodland shrubs, and are confined within a thick silken web and thus are readily distinguishable. Arsenate-of-lead spraying when the larvæ are quite small in the middle of summer, or the removal of the webs when they are more mature, will prevent marked injury to the trees.

THE TENT-CATERPILLAR (*Malacosoma crosa*, Stretch).

Has not been prevalent during this past season. It is subject to years of prevalence and scarcity. It is apparent that parasites play an important part in the natural control of this insect. The following description of the larva is taken from Prof. H. F. Wilson's report of the Division of Entomology in the Biennial Crop Pest and Horticultural Report, 1911-12, Corvallis Experiment Station, Oregon, relative to the species:—

"*M. Erosa*.—Whitish, irregular oval spots on middle of back on all but the first few segments. On either side of these spots and somewhat separated from them is a broad blue band bordered on either side by a brick-red line. Below that, on either side, and reaching to the legs, is a bluish space, characterized by one blackish dot on each segment marking the position of spiracles or 'breathing-holes.' Below the

* 1903. James Fletcher, Annual Report Experimental Farms, Canada, under H. textor. Harr.

caterpillars are dark blue, with oval spots in median on all but first few segments. Over the whole of the caterpillars are numerous, fine, yellowish or cream-coloured hairs."

Insects of this species attack all orchard trees in the Lower Fraser with the exception of the pear, which apparently appears immune. The nature of the injury from these caterpillars is so well known that further reference is unnecessary. Suffice it to say that spraying with arsenate of lead in the early summer and the mechanical destruction of the larvæ are recommended in years of prevalence.

THE APPLE FRUIT-MINER (*Argyresthia conjugella*, Z.).

In 1898 Dr. Fletcher, the late Dominion Botanist and Entomologist, referred to this insect as one of the worst enemies of the apple-grower in British Columbia. Of recent years its presence has not been noted.

THE PLUM-CURCULIO (*Conotrachelus nenuphar*, Hbst.).

It has been considered advisable to mention the characteristics of this insect. The adult is a thick-set snout-beetle about $\frac{1}{4}$ inch long, and it lays its eggs in peculiar but characteristic crescent-shaped punctures on the skin of many orchard fruits, particularly the apple, peach, and plum.

The female weevil first removes a portion of the skin of the fruit with her snout and in the cavity thus formed deposits an egg. She then, by instinct, cuts portions of the skin of the fruit in either direction from the point of oviposition, so that as the fruit swells and grows the pressure will not crush the eggs, the expansion being alleviated around the egg by the two latter formed incisions. Thus a characteristic crescent-shaped puncture is produced. These shaped punctures have been observed on some apple-trees for a long time neglected, growing at Agassiz this summer. Furthermore, verbal reports of the same have been received from Salmon Arm. No eggs, larvæ, or adults have been taken, but as this insect is regarded as one of the worst affecting the fruit orchardist in other portions of Canada, it is well that a sharp look-out be kept in British Columbia.

THE CHERRY FRUIT-FLY (*Rhagoletis cingulata*, Loew).

"This imported insect was recorded by Dr. Fletcher in 1906. He received it from Mr. W. R. Palmer, Victoria, B.C., where it was injuring some cherries. This was its first recorded appearance in Canada, and Mr. Palmer stated that he first noticed the holes in cherries in 1904."*

No further records appear to have been received during recent years regarding this insect and it is hoped it will not appear again. The adult is a fly and it lays its eggs just beneath the skin of the cherry during the summer. Maggots about one quarter inch long may be found in the flesh producing a rot of the fruit.

THE WOOLLY APPLE-APHIS (*Schizoneura lanigera*, Hausm.).

This aphid is probably the commonest-known insect of its class to the fruit-grower in the Fraser Valley. Its conspicuous white flocculent clusters in cracks and crevices of limbs and in pruning scars at once indicate its presence. Root-forms also occur, forming swellings and scars on the finer roots of the trees, but as these forms are hidden from view their importance is lost sight of. The secondary injury caused, allowing fungous disease access to the tree, is as important as the attack on the tree by the aphid itself.

During the winter, on the stems will be found masses of the dead bodies of the summer's generations, but underneath, protected from the effects of temperature, may be found several small aphides of a brown colour. If these survive the winter, as many probably do, in the milder parts of this Province, they commence to migrate to the new wood of the past summer, when the buds begin to open. They begin to

* Extract Annual Report, Dr. C. Gordon Hewitt, Dominion Entomologist, March 31st, 1911. Experimental Farms, Canada.

feed by inserting their beaks into the wood and produce a white waxy excretion as they grow. These all prove to be females, and each one is capable of producing young, which, in turn, produce more young, and so on until early in the fall, when winged forms are produced. These winged forms are black to the unaided eye, with distinct black nerved wings. At this point there appears to be a certain amount of doubt at the present time as to the next step in the life-history. It is supposed that some of these winged forms migrate to the elm and there produce several male and female aphides, which in turn produce eggs.

The actual life-history under Lower Fraser conditions has not, I believe, been studied; consequently we cannot do more at the present time than regard the researches of other investigators as approximate to our own.

The aphides on the stems can best be controlled by a weak dilution spray of kerosene emulsion or by summer-strength lime-sulphur with an addition of Black Leaf 40. Where root-forms are known to exist, these same sprays applied to the roots may be used, allowing the liquid to reach the aphides by partially removing the soil around the tree.

THE ROSY APHIS (*Aphis sorbi*, Kalt).

This aphid occurs in the Lower Fraser, but its presence and the injury caused is probably not associated to the average grower. The fruit is not attacked, but by the indirect influence of the aphid attack on the fruit-bearing spurs and adjoining leaves, the fruit becomes knarled, irregular, and misshapen. These clusters of poorly shaped fruits are commonly to be seen in any orchard of the valley, but we have no definite idea, as yet, on its prevalence or degree of injury in comparison with the attack of other aphides. It is altogether probable that we will find this species the most serious aphid pest of our apple-trees unless due regard is paid to its control.

The life-history of this insect is, like the woolly aphid, only imperfectly known. Colonies may be found on fruit-spurs and in the curled leaves adjoining the blossoms in the spring. These colonies have sprung from an over-wintering egg laid the previous fall and are wingless. Several generations occur during spring and early summer. At Agassiz, at the latter part of June and during early July, winged forms appear and they migrate in numbers from the apple-leaves to some unknown host-plant. All efforts to trace the secondary host-plant failed this past summer. According to Prof. H. F. Wilson, of Corvallis, Oregon, this spring migrant "is in general colour black, abdomen brown, with black markings and a black dorsal square-shaped spot. The antennae are about as long as the body and brown to black. Along each side of the abdomen is a series of dentate tubercles." Later in the year, about September, winged females return again to the apple, giving birth to several forms, which in turn produce eggs.

The knarled appearance of the fruit in the clusters and the absence of any assignable cause, by the migration of the summer forms is liable to confuse the grower, who may expect an explanation of the condition of his fruit.

The remedy suggested has proven itself very efficient, and referring again to Prof. Wilson's work in Oregon, for want of any local experience of our own, we quote: "Lime-sulphur should be used, winter strength, and Black Leaf 40 added at the rate of 1 part to 900 parts of the diluted lime-sulphur. It is very essential for success that this spray be applied just as the buds are opening into leaf. When the leaves commence to curl, spraying cannot be accomplished with proper results."

THE EUROPEAN GRAIN-APHIS (*Siphocoryne avenae*, Fab.).

This aphid occurs commonly on the apple in the Lower Fraser, being often found associated in the colonies of *Aphis sorbi* in the spring on the leaves. Apparently the life-history resembles that of *Aphis sorbi* in the general details, with the exception that more is known of its hosts. It uses the apple as the host in the spring and fall, migrating to small grains and grasses during the summer. At Agassiz, during

the past summer, these aphides under observation migrated to young wheat-plants in the latter part of June. The remedies recommended are similar to those for the rosy aphid.

THE APPLE-APHIS (*Aphis pomi*, L.).

This common green aphid is present in all orchards, and is universally recognized by its habit of clustering in great numbers on the new shoots and under the fresh green leaves of the apple. The shiny black eggs are also common sights to the orchardist during the fall and spring on his apple-trees. The same remedies as before suggested are again of value in controlling this pest, an early application being again necessary. It might be mentioned that the eggs are not amenable to practical treatment.

THE CHERRY-APHIS (*Myzus cerasi*, L.).

This black aphid may be found throughout the summer in the curled leaves of the cherry-tree. The lime-sulphur and Black Leaf 40 spray is again of benefit in the early spring.

THE OYSTER-SHELL SCALE (*Lepidosaphes ulmi*, L.).

This Coccid is very common on all classes of trees in the Fraser Valley. The moist, humid climate of the immediate coastal region is particularly well suited to its life and reproduction. The scale can be recognized from its well-known shape, such as its name implies, and is known to all orchardists. In a general way the scale is not dangerous, as the methods of orchard-culture tend to retain its numbers within reasonable bounds. Branches of trees, however, and, in rare cases, whole trees in neglected orchards or woodlots may be killed by the effects of this scale alone. At certain points in the Fraser Valley wild crab-apple trees may be seen standing dead by the roadside. Undoubtedly the oyster-shell scale and the tent-caterpillar have combined forces to cause their death, but while we do not mourn the loss of these wild crab-trees, yet they stand as examples of what might happen in the orchard if proper precautionary measures are not taken.

The female scale is about $\frac{1}{8}$ inch in length, usually dark brown in colour. In the spring a few may be grey, but this is apparently the result of winter or old age. The male scale resembles that of the female in shape and colour, but is considerably smaller. Eggs are laid in the fall under the scale of the female, and if one of these scales be removed during winter, numerous small white eggs (from 40 to 100) will be noticed.

In the spring these eggs hatch, producing some very minute yellowish insects which are comparatively active soon after hatching. In time each individual will settle down, insert its beak into the plant and commence to suck the sap. At this time the insect is free of any covering or "scale." However, as it grows and molts a waxy excretion covers the body, forming gradually the characteristic "oyster-shell scale." The female scale remains at the one point throughout her life and becomes full grown in from two to three months. The male scales continue their stationary feeding until full grown, when they develop two very minute and delicate wings, fertilize the female, and die. The female insect then, in turn, produces eggs under her scale and dies, and the eggs pass the winter as such, awaiting spring before they hatch. Thus the scale is single-brooded and only capable of producing up to 100 individuals per individual during the season.

As regards remedies, it has been found that the lime-sulphur spray has little effect on the eggs during winter, except perhaps a number of old scales and eggs may be loosened and washed from the tree, but is very efficient against the young insects hatching in the spring. Watch should be kept to determine when this hatching takes place, but as a rule it occurs after blossoming. In the Lower Fraser Valley apples begin to bloom the last days of April, and they bloom for a month; consequently one might spray summer-strength lime-sulphur the second week of May or thereabouts. As a general rule, it will not be necessary to spray every year for this

insect, but as often as the careful discretion of the grower would warrant. It should be remembered that this statement refers only to this insect. In cases where trees have become very badly encrusted with scales, mosses, and lichens, it would be well to apply a dormant winter spray of either a 3-per-cent. caustic-soda solution or 1 lb. of Gillett's lye in 4 gallons of water. This procedure is better not followed more than one in four or five years, as it has a tendency to hidebound the trees.

The scale is heavily parasitized in the Fraser Valley.

THE RED-HUMPED APPLE-TREE CATERPILLAR (*Schizura concinna*, S. & A.).

The name of this caterpillar is obtained from a prominent red hump on the fourth segment of its body. Specimens of the larvæ of this species may at times be met with devouring the leaves of apple-trees. A simple spraying of arsenate of lead will effectively control them.

THE CIGAR-CASE BEARER (*Coleophora fletcherella*, Fernald).

At every orchard in the Lower Fraser visited during the past two years this insect has been found to occur. It cannot, however, be classed as one of the important insects of the orchard. The grower may recognize the species when a small cigar-like case is seen standing erect on the surface of a leaf. This case contains a small caterpillar which feeds on the surface of the leaf. The winter is passed as the larva in its case attached to stems and twigs. Migration to the leaves occurs in the spring, and the adult moths appear in July, giving rise to the next season's generation. Arsenate of lead applied either before or after blossoming will control this species.

THE PEAR-SLUG (*Eriocampoides limacina*, Retz).

A smooth slimy-looking slug may often be met with on the leaves of cherry, pear, and plum. This is the larva of a sawfly. The adult is about $\frac{1}{2}$ inch long, black, somewhat shiny, with four wings, rather dusky in appearance, which are folded over the abdomen when at rest on a leaf.

Adults have been observed flying in the Fraser Valley during May and early June, depositing eggs. Small blister-like areas may be seen on the upper leaf surface, indicating that an egg has been deposited there by the female. Minute larvæ (slugs) have been observed on the leaves during the second week of June. The first brood of larvæ evidently commences about this time. From the middle till the end of July the period of pupation is in progress, as but few slugs can be found on the trees.

During the last days of July and early August adults may again be seen flying and depositing eggs, so that during August and September larvæ are quite common again. Thus this insect in the Lower Fraser is double-brooded. The first larval brood of June may cause injury to the tree, but by arsenate of lead or pyrethrum powder they can be combated. The second brood of larvæ in August can almost be classed as a benefit to the tree, for the attack by defoliation checks the growth and assists the tree to ripen its wood for winter.

CLICK-BEETLES (*Elateridae*).

During the month of May in the Fraser Valley, when the apples are in bloom, large numbers of elater or click-beetles may be seen clustered around the blossoms and developing buds. Several species appear to be involved at the one time. By an experiment, performed to find out what damage was caused, it was shown that these large black beetles were cutting off the pistils and stamens of the blossoms, devouring the calyx-cup and the petals as well as developing leaves of the tree.

There is no question at all that a large number of prospective fruits are destroyed by the destruction of the blossoms and the calyces. Furthermore, the depredations of these beetles are continued during the summer upon leaves and young fruit. Portions of the epidermis and pith of the apple will be devoured. These areas heal over, but fruit attacked in this way, later in the year, show brown and depressed areas on its skin, greatly injuring the marketable appearance of the fruit.

This form of injury is, so far as known, practically unrecorded; consequently we are unable to advise any definite course of remedy. Arsenate of lead applied in the spring might have the right effect so long as the blossoming period and the setting of fruit were not interfered with.

THE FRUIT-TREE LEAF SYNETA (*Syneta albida*, Lec.).

This is another species of beetle found in early spring attacking the blossoms of apple-trees. Its comparative economic importance is not known.

THE BRONZE APPLE-TREE WEEVIL (*Magdalis anescens*, Lec.).

Is present in Lower Fraser orchards, and appears to be secondary and associated with the canker of the stems and trunks of apple-trees. The egg-chambers may be recognized in the bark by a series of minute punctures closely congregated. The adults may frequently be seen in the spring in the vicinity of blossoms and on the new leaves. We have no evidence as yet that this insect is of sufficient economic importance to warrant attention.

THE PEAR-LEAF BLISTER-MITE (*Eriophyes pyri*, Pagnst.).

This Arachnid is to be found in every orchard visited in the Lower Fraser Valley. Its work can be recognized by the rusty, rough, blister-like appearance of the under-surfaces of the leaves. The mites are microscopic in size and can only just be seen with a lens; consequently the orchardist may account for the apparently unassignable cause for the appearance of his leaves. The mites pass the winter in the egg stage in the buds, hatch in spring, and migrate to the leaves when the buds are expanded. Here they burrow between the two surfaces of the leaf and feed and set up an irritation which produces at first the rusty-brown colour on the surface, which later becomes black.

To control these animals great care is required. Lime-sulphur or Bordeaux mixture, or any of the oil emulsions, applied in the fall or spring, under pressure, will be found quite efficacious as remedies.

THE APPLE-LEAF HOPPER (*Empoasca mali*, LeB.).

Causes the peculiar white specking of apple-leaves. Caustic or soap sprays applied in the spring, with special attention being paid to the under-surfaces of the leaves, will retain these insects within reasonable bounds.

SMALL-FRUIT INSECTS.

THE STRAWBERRY-ROOT WEEVIL (*Otiorhynchus ovatus*).

The larva of this weevil is a small white grub which when full grown is about $\frac{3}{8}$ inch in length. It is commonly found in the soil of a strawberry plantation among the roots of the plants, which it devours readily and causes, in so doing, rapid deterioration of the field. The adult is a small dark-brown almost black beetle about $\frac{1}{4}$ inch long. It feeds during the night on the leaves, forming irregular feeding areas on the edge of the leaf. In the adult stage it has not proven destructive, and the appearance in houses during the summer and in fall is not indicative of any harm. In the larval stage it is of great economic importance, and as such is the worst enemy of this class of fruit. The eggs are laid during June, July, and August in the soil to the depth of $\frac{1}{2}$ inch. The larvæ feed lightly on the roots until fall and pass through the winter without causing untoward injury to the roots. In the spring the larvæ continue feeding ravenously until the pupal stage is reached in May and June. From these pupæ which are formed in the soil, from 1 to 3 inches deep, the adults emerge to continue the generation. In the Fraser Valley the weevil is single-brooded and in habit inclined to be gregarious, which means that, provided sufficient food and shelter is at hand, they do not move very much and remain congregated in infestation areas. From these considerations it has been found that plantations suffer more each succeeding year of growth, it frequently happening that

the third season of growth is rendered unremunerative in yield of fruit. All efforts to control this weevil by artificial methods or spraying have proven more or less unsatisfactory. However, by judicious management of crops, by rotation, thorough cultivation, by the use of chickens, and the growth of suitable varieties, the depredations of the weevil will be much alleviated.

THE BLACK VINE-WEEVIL (*Otiorhynchus sulcatus*).

This species is similar in habits to *O. ovatus*. It is larger throughout in all its stages. It is found in strawberry plantations to a minor degree as compared to the smaller species. This species may be mentioned as being more troublesome to garden and greenhouse plants than to strawberries.

SPITTLE-INSECTS (*Cercopidae*).

Are frequently met with in strawberry-fields and in grass and garden plots, and may be recognized by the objectionable saliva-like substance that surrounds them. The amount of their injury, beyond rotting the fruit it may be in connection with, is not very extensive, and no control measures have been proven essential. Should such be required, however, kerosene emulsion applied with pressure will be of use.

THE CURRANT-BORER (*Ægeria tipuliformis*, Clerck).

The adult insect is a moth. It is probably not known to the average grower in the Fraser Valley as the cause of injury to his currant-bushes. Local observations on this insect indicate that the moths are flying the second week of June. On any bright, sunny day at this time of year, by carefully watching the currant-bushes and surrounding vegetation, the moths may be seen darting rapidly about in the air, resting at times on the leaves of plants. On dull days they are not so active, for it would seem that the bright, warm days of summer are more in accord with their nature. If one of these moths be captured, it will prove to be one of the most beautiful of the many insects of the orchard. It is a clear-winged Sesiid about $\frac{1}{2}$ inch in length, with a body of a steel-blue lustre with several bright golden bands around the neck and across the abdomen, while on the last segment is a prominent tuft of long scales.

At the latter part of June the female has deposited her eggs; in one case, under observation, eighty eggs were laid by a single moth. The eggs were very small and yellowish in colour, and were tucked away under corrugations of the bark of the bushes in axils of buds and under the edges of lichens which grow so frequently on the stems of shrubs and trees in the valley. On July 1st the larvæ had hatched from the eggs and had penetrated to the pith of the stems, small amounts of cast-off material indicating the point of entrance. The larvæ feed on the central pith of the currant-bushes and they become half-grown at the approach of winter. The following spring feeding and growth is continued uninterruptedly until May. The full-grown larva is about $\frac{1}{2}$ inch long, yellow, with a brown head. The pupa is then formed in the pith, and it remains dormant about fifteen days until the adult moth is ready to emerge. When ready, the pupa forces its way through a hole to the outside of the stem until it protrudes nearly its whole length from the stem. The anterior portion then breaks open and the adult moth appears ready to commence the generations again.

Affected bushes will show a slight yellowing of the leaves and a general dwarfed appearance of the plant. The insect is very common in the Lower Fraser Valley on currants, and no evidence has as yet been given where bushes die from the effects of this moth alone, although in severe infestations such may prove the case. The remedy is comparatively simple. Prune out all the old wood in the early spring or in late fall and burn the cuttings. The standard form of bush should also be avoided.

THE CURRANT FRUIT-FLY (*Epochra canadensis*, Loew.).

Dr. Fletcher in 1901 reported this insect injuriously prevalent on Vancouver Island and in the Lower Fraser Valley. It is probable that it is still present in

the immediate Coast regions, but not in sufficient numbers to attract attention from fruit-growers. The dryer portions of the Province appear to suit this insect, for from there it is reported recently of economic importance. In short, the adult is a small fly with a fine tapering abdomen. In the early summer the female fly will deposit her eggs just beneath the skin of the fruit and the maggots will devour the pith and seeds. When ready to pass to the pupa, the maggot burrows out of the berry and will drop to the ground, where it pupates just below the surface.

Chickens and cultivation will assist in controlling this insect.

TRUCK-CROP INSECTS.

THE POTATO FLEA-BEETLE (*Epitrix cucumeris*, Harris).

This insect is common to the Fraser Valley and may be seen as minute black specks on the surface of potato-leaves during the summer. The adults devour portions of the epidermis of the leaf, and when disturbed hop freely to great distances. The larvæ and pupæ are found in and around the roots of the plants in the soil. Reports of injury from this insect have been received from the Coast since 1901.*

The adults are very minute, being only about 1/16 inch long, jet black, with yellow antennæ and legs. They are mainly destructive in the early spring, but can be controlled by the use of arsenate of lead. The arsenate can well be mixed with the Bordeaux mixture which is used to offset the ill effects of blight and fungous diseases of the plants. Nicotine sprays are believed to be equally efficacious.

THE RED TURNIP-BEETLE (*Entomoscelis adonidis*, Fab.).

This beetle has been reported at Hazelton and points north of Lillooet, B.C., and from as far north as Dawson, Y.T., as destructive to cabbages and turnips.† During the past summer a report, without specimens, was received from Fort George, probably referable to this insect. It would appear that arsenate of lead would again prove applicable for control.

THE CABBAGE-MAGGOT (*Pegomya brassicæ*, Bouche).

This insect is by far the most serious and important one attacking cabbages, radishes, turnips, cauliflowers, celery, rape, and the various wild cruciferous plants in the Lower Fraser Valley. It yearly exacts a toll from gardeners and farmers far exceeding any other insect of its class. More requests for satisfactory control measures are yearly answered about this insect than any other in the valley. It must be admitted, however, that we yet await a satisfactory and practical remedy applicable, in particular, to field conditions.

The adult is a small fly, smaller but resembling the common house-fly. It appears in April in the Fraser Valley, ready to lay eggs on young cabbage and other plants.

The eggs are laid against the plant-root on the surface of the ground. They are white and thus readily distinguishable to the unaided eye. Small footless white maggots emerge from the eggs and penetrate the root. Here they continue to feed and grow to approximately 1/3 inch long before passing to the pupa in the soil. From the pupa the fly eventually emerges, giving rise to further individuals. The entire individual life-history carries over approximately two months, and two and probably a partial third brood occurs during the summer. The life-history under strictly local conditions has not yet been properly studied; consequently we are unable, as yet, to state exactly what occurs at the latter part of the season. Larvæ in cabbage-roots have been taken in December at Agassiz.

The control of this maggot has been experimented with at Agassiz during the past summer, and while it is not proposed to give the results at this juncture, a few significant points may be stated, and judged accordingly as passing results.

* Dr. J. Fletcher, Annual Report, Experimental Farms, 1901.

† Dr. J. Fletcher, Annual Report, Experimental Farms, 1905-1906.

It is proposed to continue the investigations during the next and future seasons. The main mixture experimented with was the carbolic emulsion. This mixture is made by dissolving 2 lb. of soft soap in 2 gallons of warm water, to which is added 2 pints of crude carbolic acid. This stock solution is then diluted 1-20 and applied at the rate of 5 oz. to each cabbage.

It was figured that 10 cents' worth of the diluted mixture would treat 100 plants once at this rate, not including the cost of labour. It was necessary to treat each cabbage seven times between the end of May and the middle of July; consequently the cost per 100 plants was approximately 70 cents, exclusive of labour.

The past summer's work indicated that the above mixture applied seven times only held a balance in favour of treatment of 33 per cent., covering a great many varieties of cabbages. There is undoubtedly much variation in the degree of resistancy between the various varieties of cabbage; consequently it is not fair to judge the 33 per cent. with too great a degree of detail. It is merely wished to point out that the carbolic emulsion, which is the most recommended mixture for control, has not offered perfect results from treatment.

A greater benefit than maturity was noticed under the above treatments in the individual comparative weights of the cabbages harvested. Without going into details again with the various varieties, it was found that, covering the whole experiment, a net increase of approximately 2 lb. per individual cabbage was figured in favour of the treated cabbages over those left untreated. Quicker maturity of the treated plants also resulted.

The diluted mixtures did not harm any cabbage, not even those in the seed-bed, when treated while growing. Dipped plants at transplanting were apparently checked somewhat, but in the main survived. The eggs were not affected by treatment by either carbolic or kerosene emulsions.

In a large turnip-field experiment performed at Agassiz two significant points appear to have been demonstrated: (1.) The net results in weights of turnips harvested on equal proportions of an acre from roots treated with solutions of kerosene and carbolic emulsions over untreated roots do not warrant the time, labour, or expense of liquid treatment of the roots. (2.) That thinly seeded rows possess more eggs and maggots per root than thickly seeded rows, and that the process of "thinning" the roots in the row again affects the infestation per individual. Consequently, from the past summer's experience, it would seem advisable to seed heavily—roughly, sixty to eighty plants to the lineal foot—and follow this by "thinning" in the month of June.

Experiments performed by others in the past have indicated that good success may follow the use of thin felt-paper tarred disks placed around the neck of cabbages and cauliflowers flush to the ground; that radishes may be screened against the fly; that the old cabbage-stalks and refuse left around the field had best be destroyed as soon as the crop is harvested; and that rotation of land be practised as far as possible.

THE IMPORTED CABBAGE-WORM (*Pontia rapæ*, Sch.).

According to the late Dr. Fletcher in his Annual Report of 1901-1902, this insect was first recorded at Kaslo in 1899. It proved very troublesome in 1901, having spread over the entire Province. During the summer of 1900 it reached Vancouver Island. This insect of recent years, though present, has not attracted very much attention from gardeners and farmers. The white butterflies are noticed early in the spring and are known to all. The caterpillars feed on a number of plants of the cruciferous family. They are green in colour and over 1 inch in length when fully mature.

Arsenate of lead applied before the cabbages "head out" will be found the best remedy.

THE CUTWORMS (*Peridroma saucia*, Hbn.; *Eupsephopoctes procinctus*, Grt.).

Are both recorded for the Lower Fraser Valley. These troublesome insects are known to all, and at times, in years of prevalence, become very destructive. They can be controlled when their damage is observed by the use of a mixture of bran, molasses, and Paris green. The "worms" as a rule only feed at night, so if this mixture is placed near the plants in the evening many cutworms will suffer from the effects of the arsenic.

THE ONION-MAGGOT (*Phorbia cepetorum*, Meade).

Is a species very similar to the cabbage-maggot in characteristics and habits, and can be controlled the same way, with the addition that affected plants can be pulled up whenever seen during the season.

GREENHOUSE AND GARDEN INSECTS.

THE CHRYSANTHEMUM LEAF-MINER (*Phytomyza chrysanthemi*, Kowarz).

This insect is very common in and around the City of Vancouver. It is principally destructive as a greenhouse insect, attacking white daisies and chrysanthemums. It is believed also to breed in the leaves of wild plants in the open.

The adult is a very small black fly, somewhat sluggish in its movements. It lays its eggs just beneath the epidermal layer of the leaf, and the larvæ mine and feed between the two surfaces. Pupæ are formed in the leaf and can be observed to have punctured the epidermis of the leaf to render the escape of the fly somewhat easier, and possibly also for breathing purposes. From the pupæ the fly eventually emerges, to again begin the cycle of life. The generations appear to be very rapid, especially under the heated conditions of greenhouses; consequently a continuous watch must be kept for the fly and the larvæ.

It is believed that the nicotine extracts would prove beneficial as a control for the larvæ and pupæ within the leaves. Hand-picking of the affected leaves is of value, but is troublesome. Both measures followed closely by sulphur or hydrocyanic-acid gas fumigation to prevent the flies from depositing eggs would probably reduce the numbers of the insect effectively.

THE TARNISHED PLANT-BUG (*Lygus pratensis*, L.).

This Capsid has been reported and observed destructive to dahlias, carnations, and chrysanthemums in British Columbia greenhouses. From its proven omnivorous habits it probably attacks many more plants than observed. The adult is about ¼ inch long, somewhat shield-shaped in outline, brown in colour, marked with black, red, and yellow. The displacement of the colour and markings is variable.

Unlike the majority of insects mentioned throughout this paper, which pass from an egg to the larva, to the pupa, and thus to the adult, this Capsid passes from the egg to the nymph, which grows and moults several times before attaining the size and appearance of the full-grown adult. Consequently we may find stages of the nymphal period all at work on our plants conjointly with the adults.

Messrs. F. H. Chittenden and H. O. Marsh, in the Journal of Economic Entomology, Vol. 3, 1910, claim that the eggs of this species are laid on a variety of plants, among them being the kale, turnip, and mullein, on the upper side of leaves, in petioles of leaves and in the stems of plants. From these eggs the nymphs hatch and commence to suck the juices of the host-plants. This insect, while being of economic importance to the farmer, has become a nuisance to the greenhouse gardener. It will attack the young developing buds and flowers of the plant, sucking the juices from one side, so that as the bloom opens up it will be found to have developed on one side only, or malformations in a variety of ways takes place, which hinders the market value of the cut bloom.

As a control in the greenhouse, kerosene emulsion or one of the nicotine extracts sprayed in weak dilution, preferably as early in the morning as possible,

owing to the fact that the bugs are less active at this time of day, will retain the insects within reasonable bounds. For further efficiency spraying had best be carried on more or less once a week.

THE GREENHOUSE THRIP.

It is popularly supposed among florists in Vancouver that this Thrip is a more economic pest than the before-mentioned tarnished plant-bug to bloom in the greenhouse. It is claimed that injury to chrysanthemums is different to the injury caused by the "bug"; that the bud is attacked at an earlier stage by the Thrip, and that the entire bud is destroyed and "thrown blind." We are not in a position to state definitely the actual state of affairs without further study. The main injury by the Thrip is caused to the leaves, which it readily attacks, with attendant loss to the plant. The injury to the bloom is questionable as yet, there being a certain confusion in the respective attacks of the "bug" and the Thrip.

The same control measures as applied for the "bug" will apply to the Thrip.

THE BULB-MITE (*Rhizoglyphus hyacinthi*, Boisd.).

This mite is considered from many shades of opinion. Some of the most prominent entomologists of the United States claim great damage due to the mite, and claim no infected bulbs should reach the planter; others acknowledge the undoubted and primary injury to bulbs by the mites, but their universality and habits prohibit satisfactory quarantine measures, inspection, or control; while others, again, consider the mites as secondary in importance and injury. This mite is present in British Columbia to-day, but we can offer no data as to the extent of its actual injury. Specimens of this mite arrive every year from Europe and Japan, and it is doubtful whether any consignment of bulbs can be considered free. The mites so commonly seen in onions and decaying roots, cabbages, or vegetable matter are probably referable to the same species. There is no doubt that these mites are capable of being the primary injury to sound bulbs, but from their usual association with injuries caused by rots and other insects in roots and bulbs, it is probable that more often their presence is secondary.

The economic status of this animal is only recent in study; consequently no control measure can be considered.

NARCISSUS-FLY (*Merodon equestris*, F.).

Mr. Priestly Norman, of Victoria, in the Proceedings of this Society for 1911, has published as extensive a paper on the habits and prevalence of this insect in this Province as we have for reference. Dr. C. Gordon Hewitt, Dominion Entomologist, in his Annual Report for 1911, refers to this insect under British Columbia conditions, as follows: "In British Columbia it is now a serious pest of bulbs, and Mr. A. E. Wallace reported it as attacking narcissus and daffodil bulbs near Victoria, B.C., about 50,000 bulbs having been destroyed in the year."

We gather, therefore, that this insect is a most serious one on Vancouver Island. Mr. Norman believes it was imported into British Columbia about 1904 on bulbs and has been allowed to increase. On the Mainland, in and around Vancouver, this insect is most decidedly gaining in importance and prevalence. From reports from owners of gardens in the City of Vancouver and from personal observations, it would appear there has been a decided gain in the numbers and injuriousness of this insect within the city. No special endeavour has been put forward up to the present to instruct people in regard to this insect, and, as mention of it has been spontaneous, we are safe in assuming that the insect is gaining ground and liable to become a serious pest.

Mr. Norman, in referring to this insect, desires it to be known that he has only judged this insect somewhat impersonally, and that the following life-history notes are merely opinions gathered from the practical association with bulb-growing.

The adult is a fly resembling a horse-fly, and may be seen from the end of March till September. It is more commonly observed in May. The point of egg-deposition

is in the crown at the surface of the ground. The "grub" or larva then finds its way to the heart and here feeds, grows, and sets up a rot in the bulb. The larva will then remain in the bulb until the following February, when it vacates the bulb and changes to the pupa state about $\frac{1}{2}$ inch below the surface of the ground, and from there hatches to the fly. "The true narcissus type is most susceptible to attack, then come the intermediate season daffodils. *Recurvus* and *Barii conspicuus* are most subject to attack, while 'Henry Irving,' 'Golden Spur,' and 'Princeps' are almost free as are the late daffodils."

Quoting the report of Dr. C. Gordon Hewitt: "The method of eradication which has been found most simple and efficient in Europe is the annual lifting of the bulbs and the destruction of all those which are found to be attacked by the maggots as can readily be seen."

Consequently, in the spring and fall, when bulbs are planted and dug, care should be taken in selection and bulbs found infested should be destroyed. The grub can be detected by pressure of the bulb, indicating a softness within, or by an examination of the root-crown, where infested bulbs will show a point of entrance. The grub may vary in length, but it attains a growth of $\frac{3}{4}$ to 1 inch in length and is broad in proportion. Bulbs should not be left in the ground throughout the summer.

ROSE-LEAF HOPPER.

Frequently rose-bushes and other garden plants will exhibit their leaves finely speckled with minute whitish or yellow dots. Later the dots form areas of discoloration which are white or yellow at first, but later may become brown. On the under-surface of the leaf minute yellowish green insects which hop freely when disturbed will be found. They are the cause of the mischief. It is believed that the winter is passed in the egg stage under the bark of the new wood. In the spring these eggs hatch to form small active nymphs which are at first wingless, but gradually grow by successive moults to the fully winged hopping individual. These adults will have developed by June.

The best remedies are the soap emulsions, kerosene emulsion being particularly satisfactory applied in the form of a spray during May. Particular attention should be paid to forcing the spray to the under-sides of the leaves.

THE OBLIQUE BANDED LEAF-ROLLER (*Archips rosaceana*, Harr.).

This insect is common in Vancouver and is the cause of much disappointment to the amateur rose-gardener. The larva is generally light green in colour, with a dark-brown or black head, and is found in a curled portion of a leaf. It readily devours the leaf, clustering several leaves together, making the bush unsightly. When disturbed, the larvæ become very active, wriggle away, and drop from their nest by means of a thread.

The most annoying injury caused is to the young blossom-bud in the spring. When the rose finally blooms it will be found to be riddled and perforated by a number of feeding areas, totally spoiling the appearance. Frequently the entire bud will be destroyed. When the larva has become full grown the pupa is formed, being light to dark brown in colour and about $\frac{3}{4}$ inch long. Later from these pupæ the moths appear. In Vancouver they fly the first days of July, being attracted in great numbers to electric lights. In general colour they are brown. It is believed that a second brood of larvæ appear in August and September.

As a control, arsenate of lead at the rate of 1 oz. to a gallon of water at once commends itself as an efficient remedy for the larvæ, applied in the form of a spray at the early part of the Spring. Trap-lights set in pans of water will also catch many moths in July.

In summarizing the essential times for spray application to apples in the Lower Fraser Valley, we deduce the following:—

Insect.	Spray.	With what.
Bud-moth	In April	Arsenate of lead.
Lesser apple-worm	In April and in July ..	Arsenate of lead.
Leaf-roller	In April	Arsenate of lead.
Fall web-worm	In July	Arsenate of lead.
Tent-caterpillar	In June	Arsenate of lead.
Woolly aphid	In April and June	Kerosene emulsion.
Cigar-case bearer	In April or June	Arsenate of lead.
Pear-slug	In June	Arsenate of lead.
Click-beetles	In April	Arsenate of lead.
Rosy aphid	In April	Lime-sulphur and Black Leaf 40.
European grain-aphid ..	In April	Lime-sulphur and Black Leaf 40.
The apple-aphid	In April	Lime-sulphur and Black Leaf 40.
Oyster-shell scale	In June	Lime-sulphur.
Pear-leaf blister-mite ..	In April or September ..	Lime-sulphur.

From the above it will be seen that the two essential mixtures are lime-sulphur and arsenate of lead. Black Leaf 40 is also of use against aphides. These three ingredients can be mixed together satisfactorily without injury to the relative effectiveness of any one. It will be seen also that the first spraying on apple-trees is required during April or at the time when the buds are breaking and previous to the formation of blossom. The second spraying should take place in June or after the blossoms have fallen. The third or midsummer sprays will only be required during exceptional cases and relative to special insects. The same applies to the fall sprays and winter spraying. The first two sprayings are necessary, one year with another, in every orchard in the Lower Fraser. The later sprayings are optional to the grower, and need only be applied in special cases of severe infestation and as specially directed remedies against special outbreaks. It should be borne strictly in mind, however, that these spray recommendations can be considered only from the standpoint of the insects. The various fungous diseases are probably more serious to the apple-grower than any existing insect attack, and these diseases have to be fought by special methods and at special times. From information at our disposal, we are informed that three sprayings a year are necessary in the majority of orchards in the valley. The first two coincide with the first two insect sprays—viz., in April and in June—and the third takes place in the fall, in September or October, depending on climatic conditions of the year and as to whether the tree is in fruit or otherwise. The lime-sulphur may be used in the spring sprayings against the fungi as against the insects. Bordeaux or lime-sulphur may be applied in the fall, according to the preference of the grower.

The following insects are believed to be present in the valley, but further records are necessary before further reference is made: The raspberry-cane borer; the raspberry-root borer; gooseberry-borer; several blossom-beetles; *Teras minuta*; apple-buccalatrix; *Archips argysoptila*; apple-scolytids; apple-sawfly; flat-headed apple-borers; round-headed apple-borers; apple-leaf miner; *Aspidiotus ostraformis*; *Pulvinaria innumerabilis*; *Chionaspis furfura*; red spider; clover-mite; *Vanessa antiopa*; *Plodia interpunctella*, with several others of lesser importance.

BEE-DISEASES IN BRITISH COLUMBIA.

By F. DUNDAS TODD, APIARY INSPECTOR, LOWER FRASER VALLEY.

Once upon a time, it is said, a learned gentleman was called upon to prepare a paper for a natural history society upon the subject of "Snakes in Ireland." He disposed of the whole matter in one sentence, "There are no snakes in Ireland."