

THE WESTERN CEDAR (*Thuja plicata*).

The majority of the large cedars in the park are dead-topped, which injury is said to be due to a fungus-disease. So far no discovery of extensive insect-damage to this species has been recorded in the park. The twigs of the cedar are attacked by a leaf-miner belonging to the genus *Argyresthia*; the damage done is not extensive, however.

## DAMAGE TO OTHER SPECIES IN THE PARK.

The shrub *Gaultheria shallon* (salal), which is abundant in the park, is rendered unsightly in places by the work of a lepidopterous leaf-miner (*Phyllorhynchus (Lithocolletis) gaultheriella* Wlsm.). The life-history of this species has been partially studied.

Elders (*Sambucus*) growing in the park were found to have been attacked, and in a few cases killed, by a Cerambycid larva belonging to the genus *Leptura*.

## CONTROL MEASURES AND IMPROVEMENTS.

It was shown by experiments carried out by Mr. R. C. Treherne in 1914 that the attacks of the spruce gall-cherms could be readily controlled along the driveways and places where the spruce was accessible. By means of a modern power-sprayer equipped with abundant hose, a solid-stream nozzle, and extension ladder the foliage could have been sprayed up to 140 feet in height. Lead arsenate could have been used to control the caterpillars on the hemlock, and a contact spray, such as kerosene emulsion, fish-oil soap, or nicotine extracts, employed in the case of the cherms. Unfortunately the survey of 1914 showed that the condition of the spruce along the driveways would not warrant the expenditure which would be entailed in the purchase of a power-sprayer, and the crisis of the attack on the hemlock having come and gone, the idea of employing spraying as a method of control was for the time abandoned. At the present time attention is being given to the subject of treatment from a silvicultural standpoint; the measures proposed entailing clearing up and cutting out of the dead and sickly trees, and the employment of an artificial system of regeneration such as would be easily carried out in a confined area like Stanley Park. The Douglas fir has been recommended as a suitable tree to plant on the areas which are to be regenerated, and it is to be sincerely hoped that in the near future adequate measures will be taken to restore the beauty of the park, and render it a worthy object of care to the city, of which it is an inseparable part.

## SOME ORCHARD INSECTS OF ECONOMIC IMPORTANCE IN BRITISH COLUMBIA.

By R. C. TREHERNE, FIELD OFFICER, ENTOMOLOGICAL BRANCH, DOMINION DEPARTMENT OF AGRICULTURE, AGASSIZ, B.C.

We are approaching very rapidly a condition in the Province of British Columbia, in regard to insects of importance to the agriculturist and fruit-grower, which will very soon demand most serious consideration. We are reaching a point in which the whole system of orchard-management in relation to spraying will have to be reconstructed and viewed from a different light than heretofore. The importance of such pests as the codling-moth, San Jose scale, pear-thrips, woolly aphis, and black currant bud-mite cannot be too lightly dealt with. The fruit-growers of British Columbia, as will become evident in the pages that follow, have since the inception of the fruit-growing industry relied on two main considerations: (1) The youth of their industry and the production of fruit free of serious pests which beset fruit-growers in other sections of Canada; and (2) the wise considerations of the Provincial Government and the Provincial Board of Horticulture, who have dealt with insect pests in most drastic manners, both through an efficient system of quarantine and inspection at the ports of entry, and through careful and pains-

taking effort in the control of incipient outbreaks of such pests which experience have shown to be injurious in other countries. To those of us who realize the gradual ascendancy that many of these insects are gaining in the Province, and who recognize the possible danger that awaits the orchardist in the course of a few years, it is a matter of great concern to know how to influence and advise the grower before it is too late. There can be no question that, unless the orchardist keeps fully advised on the development of the more serious insect pests, there will come a time when many dollars will be lost from lack of preparedness. I do not believe that we will be able to keep these insects out of the Province for an indefinite length of time. That is impossible; but by being equipped with the most approved spray-machines and chemicals each individual grower will be in a position to check, very materially, the progress of a pest and retain it within reasonable bounds before it becomes deeply entrenched.

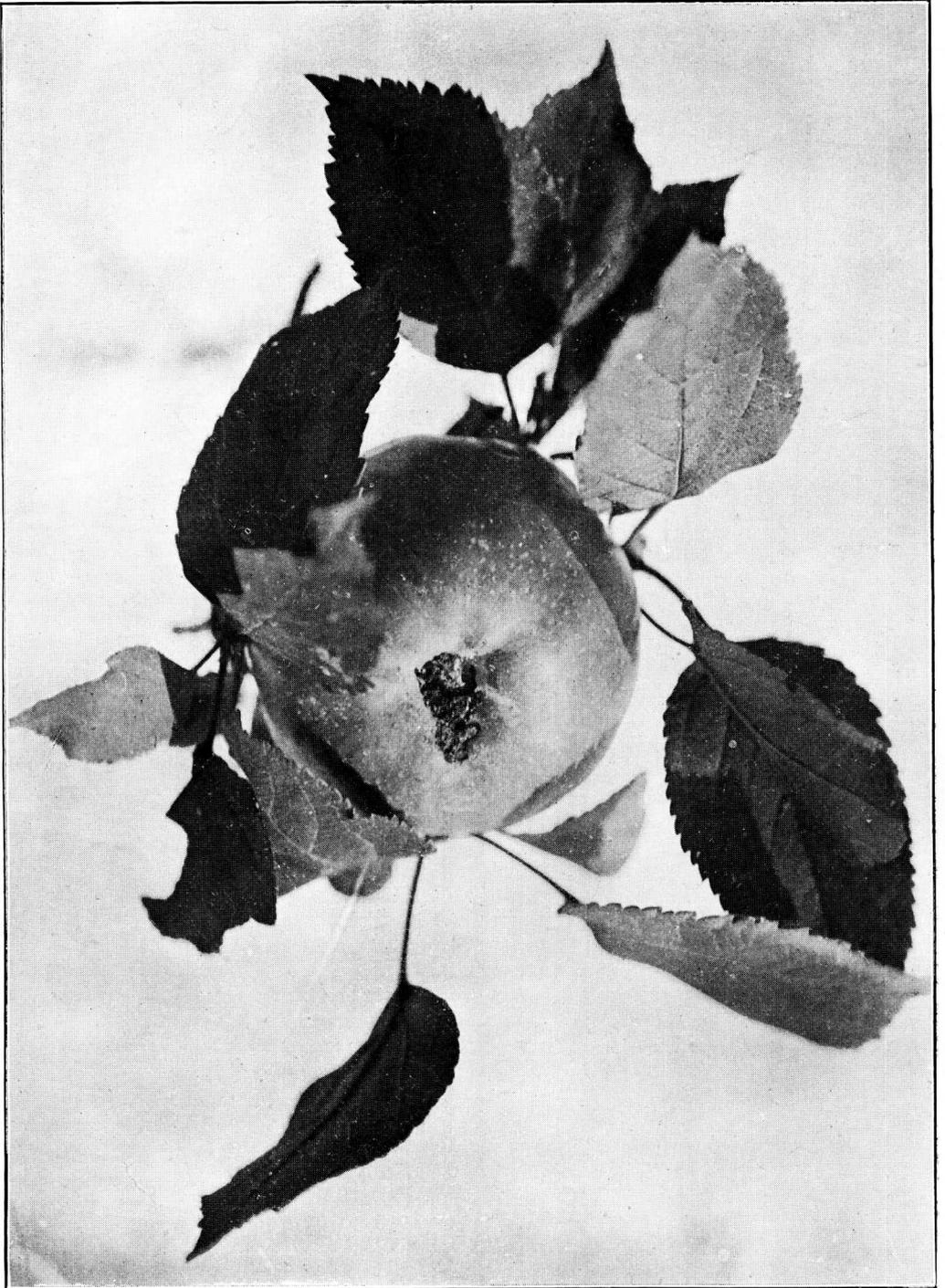
In the year 1892 the insects we find most usually recorded as injurious in the Province are the following: Aphides, cutworms, wireworms, horse-flies, bot-flies, black-flies, mosquitoes, Tipulid larvæ, and locusts, or "grasshoppers."\* All of these are such as one would expect to be present in a country just developing its agricultural resources. With the rapid economic development of the Province from this time on, new agricultural problems and new pests came into prominence. The most important of these will be dealt with in the following pages. It is hoped that in detailing these insects the point will be realized that it is important that the fruit-grower shall recognize his position and act accordingly. It is impossible for us, as entomologists, to do more than offer our best services and advice. The development of the Province has gone beyond the state when radical control measures can be reasonably enforced. Hence the obligation most assuredly devolves upon the orchardist in this Province, as in other Provinces, to hold his own on his own estate.

THE CODLING-MOTH (*Cydia (Carpocapsa) pomonella* Linn.).

*Historical.*—The codling-moth, as all fruit-growers fully realize, is one of the most serious of all insects affecting the fruit of the apple in North America. It has been a matter of surprise that this moth has not established itself as a general orchard pest in the Province before now, when it is considered that it has been for many years a serious insect in the States of Washington and Oregon, and when we know the importation of apples into the Province from infested localities has been continuing for so long. The credit for such immunity as we do possess is due to the efficient system of fruit inspection that is in vogue within the Province and to the prompt eradication methods that have been put into practice immediately an outbreak is recorded.

The first record of the codling-moth having been reared from apples grown in the Province is reported by Dr. J. Fletcher in his report as Dominion Entomologist for 1905. In this instance he received "an undoubted specimen of the codling-moth" from Mr. J. W. Cockle, Kaslo, B.C., and he remarks that until this record came to hand he "had never been able to learn of the occurrence of this insect in British Columbia." In 1905, again, the Rev. J. H. Keen took a specimen of the adult codling-moth in his house at Metlakatla, B.C. This specimen is now in the national collection of the Entomological Branch, Ottawa, but it was undoubtedly bred from imported fruit and not from home-grown apples. In 1906 Mr. Cockle again bred this moth within the limits of the town of Kaslo, and reported the same both to Dr. Fletcher and to the Provincial Department of Agriculture. It is interesting, in passing, to note that a parasite (*Pimpla sp.*) was bred from this material in 1906. In the same year Mr. Stuart Wood, of Kamloops, B.C., forwarded specimens of a "worm" which had been attacking the apple-crop of the city for two or three years to Dr. Fletcher at Ottawa. Dr. Fletcher in his report for 1907 acknowledged the insects above mentioned, and on examination found them to be undoubted specimens

\* Second Report of the Department of Agriculture of British Columbia, 1892.



Damage caused to apple by the lesser apple-worm. The injury resembles the work of the codling-moth larva, but it will be noticed that the lesser apple-worm larva feeds more on the surface of the fruit around the calyx. The codling-moth larva, if entrance is made through the calyx, usually passes direct to the core of the fruit. (Photo by R. C. Treherne.)

of the codling-moth. So far as I have been able to gather from local hearsay, the introduction of this moth into Kamloops, which originally occurred about 1904, was brought about by an importation of a consignment of boxes of Ontario apples at Christmas-time. These apples were admitted and stored before an inspection was given the boxes. This outbreak at Kamloops persisted until about 1914, a period of nine years, during which time the Provincial Fruit Inspectors waged a campaign of extermination. As recorded in the Proceedings of the British Columbia Entomological Society, 1914, page 69, approximately 3,000 trees were regularly sprayed and inspected, with a result that to-day, January, 1916, it may be stated that the moth is of no importance and possibly does not exist.

Again, about 1904 another outbreak of the moth occurred near Victoria, B.C. It is supposed that the insect on this occasion gained access to the orchards through the medium of infested pears from California. This outbreak has persisted until the present time (1915). In 1909\* an area containing 17,582 trees was involved, and in the summer of that year as many as 7,610 larvæ were taken from individual fruits within that area. During the past summer the infestation still occurred in a few orchards, but the number of larvæ taken barely reached three hundred (291).

Between the years of 1904 and 1911 no further outbreaks occurred, and the Provincial Department of Fruit Pests was engaged in controlling the infested areas around Kaslo, Kamloops, and Victoria.

It is interesting to remember at this point that the fruit-growing industry has practically developed since 1900. The number of trees coming into bearing has increased very remarkably since 1910, and the output of fruit has assumed considerable proportions during the past few years. The first power spray-machine was operated in the Province during the summer of 1910. These facts indicate the youth of the fruit-growing industry, and partly explain the reason why the codling-moth has not obtained a hold in the country. Provided bearing orchards are comparatively few, somewhat scattered, and located a few miles away from railway or shipping centres, and provided an efficient system of orchard inspection is maintained, the chances for the introduction of the codling-moth are reduced to a minimum. Such has been the experience in the Province up to the present, but it is only fair to realize the fact that, even supposing the quantity of codling-moth material imported to-day through the medium of infected cars and fruit is the same as in years gone by, the chances of present and permanent infestation are increased a hundredfold. The number of bearing orchards have increased to a great extent; they are nearer shipping centres, where a moth may transform and fly a short distance to find conditions to its liking; and the area in orchard land to-day is too large for a complete survey by field inspectors. Hence we must realize the situation that, as regards the codling-moth in the Province, we will soon have to accept it as a general orchard pest, controllable only by individual effort.

Let us notice what has occurred in recent years. In the autumn of 1911 a family from Ontario, settling at Rutland, B.C., a locality near Kelowna, brought some cocoons in the cases containing their personal effects. Some old cocoons were found in cracks of some boxes in their possession, and on inquiry it was found that these boxes had been stored in a fruit-cellar on an Ontario farm. During September, 1912, infestation from the codling-moth was discovered in adjoining orchards and evidence clearly pointed to this Ontario family as the immediate cause of the introduction.† The exact area of infestation proved to be one mile in extent. By a system of inspection and spraying, ably described by Mr. W. H. Lyne in the Proceedings of the British Columbia Entomological Society, No. 7, 1915, page 12, the moth was exterminated, and for the past two years no further sign of it has been found.

\* Proceedings of the British Columbia Entomological Society, No. 4, 1914, page 69; No. 7, 1915, page 33.

† Proceedings of the British Columbia Entomological Society, No. 2, 1912, page 70; No. 7, 1915, page 12.

In the spring of 1912, again, Mr. W. H. Brittain, at the time Provincial Entomologist, discovered a larva in an apple at Armstrong, B.C. On reporting this discovery the Provincial Department of Fruit Pests immediately took steps to "round up" the infestation. According to Mr. Lyne, in the reference just quoted, twenty trees in three orchards of 800 trees were found infested. It is not quite clear how this infestation was started, but it is believed that the cocoons were introduced on some packing-cases containing nursery stock from Oregon, U.S.A. Close attention was paid to controlling this outbreak, and the methods employed are described by Mr. Cunningham in the Proceedings of the British Columbia Entomological Society, No. 2, 1912, page 68. Evidently success attended the efforts of the Provincial authorities, because no "worms" were found at Armstrong the following season of 1913, and none have been found since (1915).

In 1913, however, another outbreak occurred in the City of Kelowna, introduced through the medium of infected cars. In the spring of 1915 this infestation still required attention, but the number of larvæ taken was very few (eight).

During this past summer, 1915, we unfortunately have to report two of the most serious outbreaks that have as yet appeared in the Province, one at Westbank and the other at Okanagan Landing. The first was reported in August and the latter did not become apparent until late September, when many larvæ were entering hibernation. It is not possible at this time to give any further information on these two outbreaks, as they occurred during the past season, but enough has been shown to indicate that the status of the codling-moth in British Columbia is assuming alarming proportions. In the Annual Report of the Ontario Entomological Society, 1912, I drew attention to the fact that in 1912 the moth was frequenting orchards in Washington State about thirty miles south of the British Columbia boundary-line. I have not received any later information that it had approached closer than thirty miles, but we cannot avoid the fact that with the information given in this article we must regard the codling-moth as an orchard pest that we will soon be called upon to fight.

A third occurrence of some larvæ in the fruit of apples growing at Eburne, B.C., near Vancouver, was discovered in September of the past summer (1915), but at present there is no more information offering on this outbreak. It is believed, also, that another centre of infestation occurred at Kelowna during the past year.

You will, no doubt, be pleased to hear that Dr. C. Gordon Hewitt, Dominion Entomologist, has arranged for the preliminary studies into the life-history of this moth under conditions that pertain to the Okanagan Valley. A commencement of this study will be begun during the coming season (1916) with the main object in view to advise the fruit-growers more intelligently on local methods of control.

#### CODLING-MOTH CONTROL.

For the purpose of placing before the fruit-growers of British Columbia, more particularly those residing in the Okanagan, a few notes on the control of the codling-moth, in anticipation of this insect assuming importance as a pest in the Province, it has been thought advisable to mention a few important considerations bearing on its life-history and methods of control.

We have not had any opportunity, as yet, to make a searching inquiry into the life-history, the number of broods, or the relation of the movements of the larvæ to the development of the apple under conditions that prevail in the Okanagan Valley. As has already been stated, several small outbreaks have occurred from time to time at one or two points, but the efforts of the Inspectors have been directed mainly towards extermination of the insect rather than to any serious attempt to determine the important points in the life-history of the moth, which would naturally govern the effectual methods of control. It is not supposed that the habits of the moth will vary very much from its habits in the States of Washington and Oregon, in districts of similar climatic influences; consequently, until we have experimental

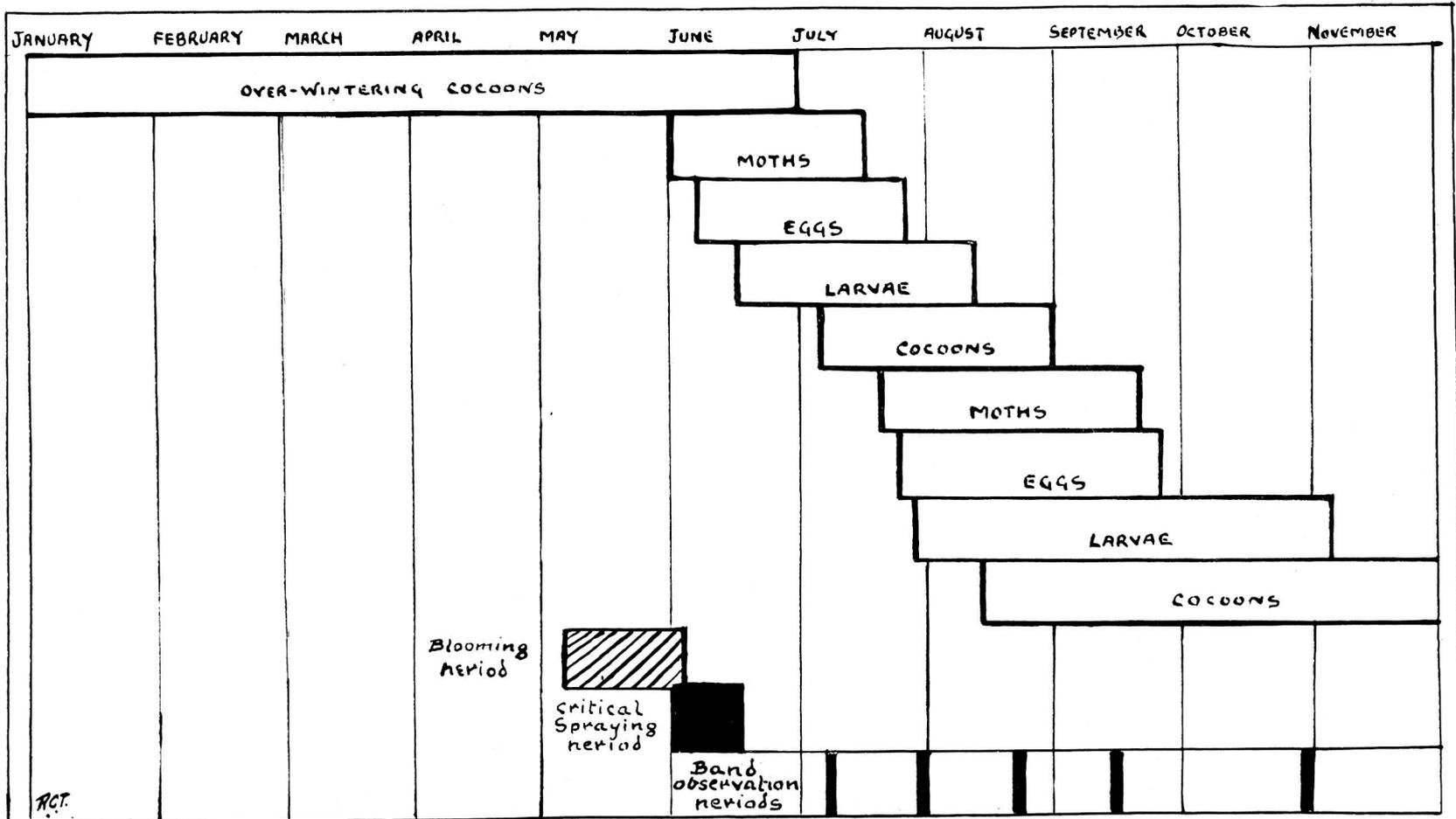


DIAGRAM OF THE LIFE HISTORY OF THE CODLING MOTH

evidence of our own to bear out or to modify the experience of others, we may accept evidence from the South to approximate our conditions.

With the understanding, therefore, that we do not as yet know with certainty the details of the life-history of this insect under Okanagan conditions, the following notes are given:—

*The Life-history in General.*—The adult, as the name implies, is a moth, and three distinct and different stages are undergone before the adult moth is formed—namely, the egg, the larva, and the pupa. It passes the winter as a “worm” or larva inside a silken cocoon in cracks and crevices of the bark, in shelters under leaves or stones on the ground, and in varied locations in fruit-sheds and store-rooms. In the spring this “worm” forms a chrysalis or pupa inside the silken cocoon, from which the adult moth will eventually emerge. The emergence of the moth occurs during the latter part of May, during June and part of July also. After emergence the adult females prepare to deposit eggs, laying them in due course on the leaves and on the young developing fruits. The eggs eventually hatch to very small larvæ, which penetrate to the core of an apple by way of the calyx. Later, when full-grown, these larvæ leave the apple, as a rule, through the side of the fruit, and form cocoons in places as mentioned above. In northerly latitudes these cocoons are the ones that pass the winter, giving rise to the moths in the spring; but, unfortunately, in the Okanagan there is little doubt that the number of “heat units” that prevail will be sufficient to force development to such an extent that the first eggs, larvæ, and pupæ of the spring will undergo their transformations in shorter time, so that the moths will develop from these early stages, during part of July, in August, and in September. These second-generation moths lay eggs which develop to larvæ, causing a common form of injury known as “side worm-injury,” which means the penetration of the fruit by these young larvæ through the side. These worms attain their full growth before winter in the apples, and pass the dormant season in the usual manner as larvæ in cocoons. In southerly and warmer climates the number of “heat units” are sufficient to force a very rapid development, with a result that we find sometimes three and at times four generations occurring during the course of the year.

In the entire Okanagan Valley there is little doubt that the climatic conditions will favour two complete broods, and there is a possibility that in the southern sections of the valley a third or partial third brood will be found. Future investigation will determine this point, which, as may readily be supposed, is of great importance to the fruit-grower, in that it governs the requisite number of sprays. The chart facing page 70 is offered as suggestive of what is implied in the foregoing paragraphs. No excuse is made for inaccuracies which may become apparent when the investigation is pursued, hence the drawing must be taken as an approximate diagram of the life-history of the moth, showing in addition the approximate spray dates and the examination periods of the “bands.”

*The Control of the Codling-moth by Spraying.*—The most effectual method of combating the codling-moth is by applying a poisonous liquid to apple-trees in the spring and during summer.

*The Machine* used for applying this spray should be a high-power gasoline outfit capable of generating over 200 lb. pressure. The hose should be guaranteed to stand at least 300 lb. pressure. Hand-power pumps are effective if time and care is taken in directing the spray. A hand-syringe would also be of use if the application be made correctly. However, the time required and the relative effectiveness of the spray varies in due proportion to the type of machine used. A gasoline-power outfit, for instance, might be expected to handle 20 acres of large (20-year) trees or 40 acres of small (8-10 year) trees at the critical period in the spring. A hand-power might be expected to handle, respectively, from 5 to 10 acres. A hand-syringe or knapsack pump might spray from six to twelve small trees. The last two machines are, of course, not recommended in practice.

*The Object of the Spray* is to fill the calyx-cup of the apple with particles of insoluble poison, so that the young worm which usually enters through the calyx will be killed by arsenical poisoning. Pressure and care in directing the spray are requisite for effectiveness, so that particles of arsenic are even forced into the cup between the stamens surrounding the calyx.

*The Time to Spray* is immediately after the blossoms have fallen, after the fertilization of the flower has taken place. The calyx-cup will be found to be most receptive in shape and condition at this time. It is doubtful whether more than ten days will be allowed the orchardist to finish this spraying, so rapidly does the growth of the young apple proceed in the spring. If the calyx-lobes are closed the object and effectiveness of the spray is offset in due proportion to the degree of development.

*How many Times to Spray* depends on future investigation under local conditions. However, for the present, a single *thorough* spray applied after the blossoms fall ought to suffice for the season. A second poison spray, applied ten days from the first spraying, is advisable in heavily infested localities. A third and even a fourth spraying is often applied in those sections where the generations of the moth are more frequent.

*The Spray Material* advised for use is arsenate of lead mixed at the rate of 2 lb. to 40 gallons of water, Bordeaux mixture, or diluted lime-sulphur solution.

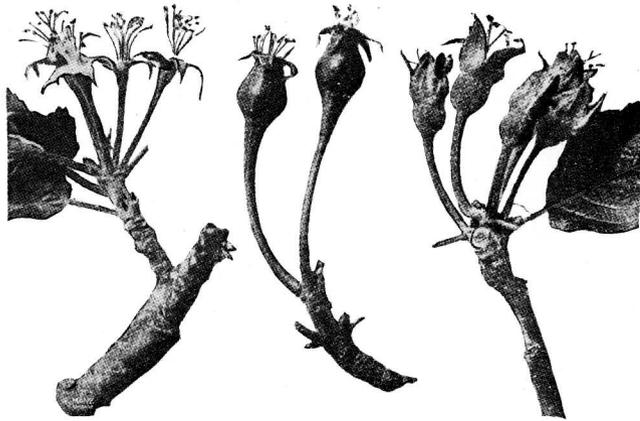
*The Type of Spray-nozzle* required is one capable of throwing a coarse driving stream set at an angle of 45 degrees to the spray-rod.

*The Amount of Material required per Tree* varies considerably according to the type of the tree and the amount of bloom the tree is showing at the time. Experience will offer the most reliable guide, but for the sake of assisting those with no experience the following formula is suggested:—

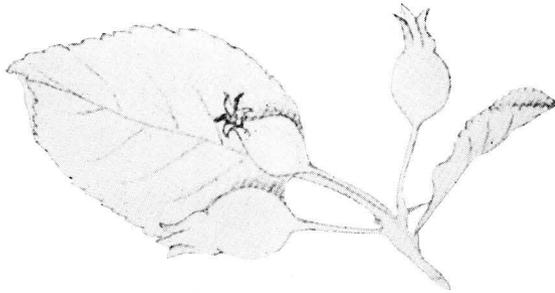
For a heavy-blooming tree multiply the age of the tree by  $\frac{3}{4}$ , or with a light amount of bloom multiply the age by  $\frac{1}{2}$ , and the result in each case will give the approximate amount of the diluted mixture required for spraying that individual tree. For instance, if we had five twelve-year-old apple-trees in heavy bloom, to estimate the amount of liquid required,  $12 \times \frac{3}{4} \times 5 = 45$  gallons. This amount of diluted spray would require 2.1 lb. of arsenate of lead; consequently in this way a fruit-grower will, with little difficulty, be able to estimate the amount of material required to be on hand.

*Other Methods of Control* consist in applying bands around the trees, removal and destruction of wormy apples at all times, and the treatment of moths in store-rooms. The virtues of the last-named methods require no explanation; the first method, however, might be mentioned further.

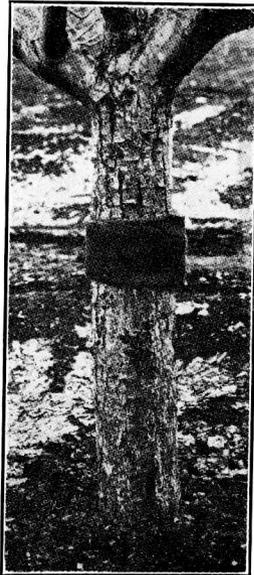
*Banding* consists in tying a piece of cloth or a strip of burlap about 8 inches wide around a tree about 18 inches from the ground. The object of this can be readily surmised from a study of the life-history, previously mentioned. The larvae after completing their growth prepare for pupation, in the summer as well as in the autumn, and in doing so seek the most convenient and suitable place ready at hand. A cloth band on the trunk of the tree is evidently preferable to a flake of bark or a crevice, hence they have no hesitation in forming their cocoons under this band, which becomes a trap. The band may be placed early in July and may be left on until the end of November. The whole effectiveness of this plan, however, depends on the occasional examination of these bands and the destruction of the cocoons found under them; otherwise, if left untouched, the bands become breeding centres most suitable to the propagation of the moth. This point, therefore, should be carefully watched and the bands examined every ten days to two weeks. The most convenient method of setting the bands is in the use of long finishing-nails driven through one end of the "band" half-way into the tree. The band then can be loosely passed round the tree and drawn over the nails and fixed.



Showing calyxes of apple ready for first spraying against the codling-moth. A trifle early on left; a trifle late on right; about right in the centre. (After Ball, Utah.)



"Too late to spray." (After Ball, Utah.)



A band in place on trunk of tree. (After Ball, Utah.)

The control of the codling-moth by spraying and banding.

THE SAN JOSE SCALE (*Aspidiotus perniciosus* Comst.).

The San Jose scale is universally regarded as the most serious of the insects affecting fruit-trees and ornamentals in North America. In British Columbia we have been fortunately very successful in thus far maintaining a practical degree of immunity from this pest. Conditions are such that to-day (January, 1916) we are still able to claim that the insect is not a general orchard pest. We are not able to claim, with the same assurance as we used to in the years gone by, that the pest is not known to exist, because unfortunately it has made its appearance at least at one point in the Province.

It would be interesting to review briefly the history of this insect in the Province; points at which its presence is recorded, and methods of its introduction.

In the first place, Fletcher states in his annual report as Dominion Entomologist for 1894 that "on two or three occasions it (the San Jose scale) has been reported to me as occurring in British Columbia; but I had at first the impression that the insect referred to was the scurfy bark-louse (*Chionaspis furfurus* Fitch.) or something else. During the past summer, however, undoubted specimens of *Aspidiotus perniciosus* on apple have been received from British Columbia and have been identified by Mr. L. O. Howard."

This, so far as can be gathered, is the first recorded instance of the presence of this scale in British Columbia. That it was a severe infestation may be gauged by the fact that the "apple-boughs were entirely encrusted with the scales." There was no evidence in Dr. Fletcher's report for 1894 to show where the outbreak was located or how the scale had entered the Province. However, in his report for 1895, he reports a visit he made to British Columbia to investigate the existence of the San Jose scale in the Province, as "undoubted specimens had been received at Ottawa for identification," with the statement that "they had been collected in the Okanagan Valley." The locality in which the scale had been discovered was Kelowna, because in the Report of the Department of Agriculture for the Province of British Columbia for that year it is stated that on the trip to British Columbia by Mr. James Fletcher, 1895, Kelowna was visited on July 25th, when "special examination was made for traces of the San Jose scale." Fletcher was unable to find any sign of the San Jose scale in any of the orchard land existing at that time (1895) around Kelowna. He reported his observations in person to the fruit-growers at their annual meeting of that year held at Agassiz, B.C. In Bulletin No. 3, Department of Agriculture, British Columbia, in the Proceedings of the Second Annual Farmers' Convention on August 1st and 2nd, 1895, Dr. Fletcher's speech is quoted as follows: "Some time ago authentic specimens of the San Jose scale were sent to me from British Columbia . . . with the statement that the insect was doing harm to apple-trees. I am pleased to be able to tell you . . . that although the insect certainly did occur . . . for the identification was confirmed by Mr. L. O. Howard . . . it is safe to say it does not now exist in any of the orchards around this original locality."

It is interesting to note that the scale at this time (1895) was only just beginning to make its appearance in Ontario. In fact, with the exception of a locality in Kent County, Ontario,\* in which the San Jose scale was observed in 1893, Kelowna, B.C., has the doubtful honour of being the first infested locality in Canada. Prompt remedial measures were advised by Dr. Fletcher on the first intimation of the outbreak at Kelowna, with the result, as above stated, that in 1895 no sign of the scale existed either at Kelowna or at any other point in the Province.

The next year, however, 1896, brought forth another report of the existence of this scale in British Columbia, but on this occasion it was found near Victoria, on Vancouver Island.†

Mr. R. M. Palmer, at the time Provincial Inspector of Fruit Pests, deserves the credit for discovering the scale in this new locality. Specimens of infested wood

\* Evidence, Dr. J. Fletcher, before Select Standing Committee, 1906-1907.

† Report of Dominion Entomologist, 1896, page 254.

were sent to Ottawa, and Dr. Fletcher and, through him, Dr. L. G. Howard confirmed Mr. Palmer's supposition as to the identity. Mr. Palmer reports that certain trees in two orchards were infested, but that these trees were cut down and destroyed.

There seems little doubt that both the Kelowna outbreak in 1894 and the Victoria outbreak in 1896 were true and authentic instances of the presence of the scale in the Province. Inasmuch as no further record has been made of the scale from these localities up to the present time indicates that prompt and successful initial steps were taken towards eradication.

In 1897 two reports of the scale were made as occurring on Saltspring Island and at Nanaimo, B.C., but these reports were contradicted later, with the statement that "no San Jose scale now occurs in the Province" (R. M. Palmer, November 21st, 1900).

The rapid increase of the scale in Ontario and the danger of introducing it into new localities through the medium of nursery stock induced the Dominion Government to pass the "San Jose Scale Act" on March 13th, 1898. This Act was, in 1900, amended to allow for the process of fumigation at ports of entry for incoming nursery stock into the various Provinces. Vancouver was selected as the port of entry for British Columbia, and all incoming nursery stock was dealt with there in accordance with the provisions of the Act.

In 1905, however, two outbreaks of the San Jose scale occurred in the Province, according to Dr. Fletcher's report for 1905. One of these appeared at Kaslo, B.C., and was reported by Mr. J. W. Cockle. The other, as reported by Dr. Fletcher in 1908, occurred at Spences Bridge, B.C. In both these cases it was evident that infested trees were imported into the Province previous to 1900 and the consequent enforcing of the fumigation regulations. The Kaslo infestation was soon eradicated, but the Spences Bridge outbreak has persisted until the present day (November, 1915).

In connection with this latter outbreak, which apparently had its origin from infested young apple-trees imported from Ontario, a "whole orchard was cut down" in 1908.\*

In 1912 I had the opportunity of examining some twigs of apple from Spences Bridge which were infested with the scale. Mr. Thomas Cunningham, Provincial Inspector of Fruit Pests, dealt with the matter as he deemed advisable, which resulted in a certain number of trees being cut down and full instructions regarding spraying being given for the remainder. In the summer of 1913 Mr. Cunningham authorized Mr. F. H. Getchell, Field Inspector, to visit Spences Bridge and report on the condition of the scale. Mr. Getchell was able to find one wild cherry-tree that was infested growing on some waste ground near the Canadian Pacific Railway track. This tree was promptly cut down. In October, 1915, I was surprised to receive a consignment of apples from Mr. M. H. Ruhmann, Assistant to the Provincial Plant Pathologist, Vernon, B.C., which were badly infested with the San Jose scale. Inquiry into the origin of these fruits resulted in the information that they were grown at Spences Bridge and that he had received them, in turn, from Mr. L. L. Palmer, Assistant Inspector of Fruit Pests. Mr. W. H. Lyne, Assistant to Mr. Cunningham, at the latter's request, immediately visited the infested locality and carried on a campaign of extermination; time will show with what success.

In October, 1915, again I received information that some San Jose scale was present at Chase, B.C., in small quantity. This report has not as yet been substantiated, but it is thought probable that the scale is *Aspidiotus ostryaeformis*. A similar report occurring at about the same time from Kelowna proved to be this latter species, which, while universally distributed over the Province, is not considered of prime importance as an orchard pest.

In the Annual Report of the Entomological Society of Ontario, 1912, I took the opportunity of drawing attention to the fact that the San Jose scale is gradually

\* Report of Dominion Entomologist, 1907-1908.

advancing up the Okanagan Valley from the State of Washington, and that it was only a question of time when the scale would occur in British Columbia as a general orchard pest. In the *Canadian Entomologist*, XLVII., No. 4, April, 1915, it is stated that the scale had reached a point in 1912 at the junction of the Columbia and Okanagan Rivers, a point approximately sixty miles south of the British Columbia boundary-line.

The history of this scale, therefore, in British Columbia has been very interesting, and we are watching with a great deal of concern its future developments. It is to be hoped that the fruit-growers of the Province properly realize the importance of this insect, and that these statements above will assist them in gauging the present conditions as they exist.

A thorough drenching of the trees infested by the scale with commercial concentrated lime-sulphur solution diluted 1-8, applied in spring as the buds break, will effect control.



Showing typical injury to apples by the rosy aphid. Frequently at the season of the year when the above is noted no aphides are seen in the cluster of leaves or apples. This is accounted for by the fact that the aphides have migrated from the apple-trees to some other food-plant. The injury, as seen, is a result of an early spring attack. (Photo by R. C. T.)

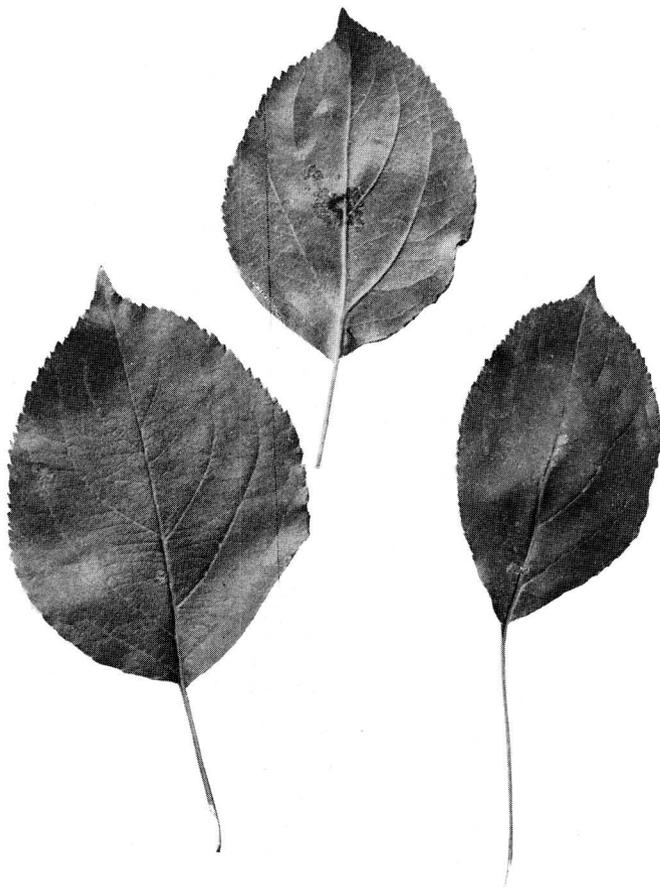
#### THE WOOLLY APHIS (*Eriosoma lanigera* Hausm.).

In the year 1892 this well-known insect was reported to occur at Aldergrove, Chilliwack, Maple Ridge, Saltspring Island, and Comox. In 1893, according to the Provincial Department of Agriculture reports, it was reported from Langley, Cheam, Hammond, Port Moody, Victoria, and Comox, and to have increased noticeably in area over previous records of infestation. Nevertheless, we are informed that the "woolly aphid used sometimes to be noticed in 1893,"\* which would indicate that in that year this insect was not considered common in the Lower Fraser Valley. Its occurrence, as may be seen from the foregoing localities, was confined to the Lower Mainland and to Vancouver Island, particularly, it would seem, to the latter locality, according to Mr. E. Hutcherson, Provincial Inspector of Fruit Pests, in the Second Report of the Department of Agriculture, 1892, who claims that this aphid

\* Proceedings of the British Columbia Entomological Society, No. 4, 1914, page 69.

is "present to an extraordinary degree in every orchard or nursery visited in the Victoria District."

In the year 1894\* this aphid continued to increase and to spread its area of infestation on the Lower Mainland. At this time it was not known to occur in the Okanagan Valley, except at Okanagan Mission, where, it was supposed, a few specimens existed in 1893. Fruit-growers in the valley at the time were advised to "exclude this pest from their midst" and to use care in the selection of nursery stock for fear of its introduction. For many years the Okanagan Valley remained free from this pest, but there is no evidence to show any spread from original points of introduction. In 1912 Mr. W. H. Brittain synopsized the situation in the Okanagan Valley as follows: "Fairly common everywhere throughout the season . . . no root forms seen . . . not a serious pest in well-cared-for orchards."† In passing, it is interesting to note in the same report that Mr. M. S. Middleton, Assistant Provincial Horticulturist, stationed at Nelson, B.C., makes the statement that the aphid has not made its appearance in the Kootenay Valleys.



Showing the work of the young larva of the bud-moth on apple-leaves in late summer and autumn. The upper leaf shows the under-side with the larva feeding on the tissues. The other two leaves show the work of the larva as viewed from the upper surface. As the leaves commence to fall the young larva migrates to some sheltered crevice on the twigs or trunk of the tree, and thus over-winters. (Photo by R. C. T.)

\* Fourth Report of Department of Agriculture, 1894, "Insect Pests."

† Proceedings of the British Columbia Entomological Society, No. 2, 1912.

In July, 1913, Mr. L. L. Palmer refers to the woolly aphid as one of the most serious pests to the orchardist around Vernon, and draws attention to the presence of root-infesting forms in that locality.

In the meanwhile, in the Lower Fraser Valley the woolly aphid has grown to the rank of the most common orchard insect in the valley. It occurs everywhere on root and stem from Vancouver to Agassiz.

In 1914, according to Mr. M. H. Ruhmann, in the Proceedings of the British Columbia Entomological Society, No. 7, 1915, the woolly aphid "was present in all the older orchards throughout the Okanagan Valley, the root form not being so often met with."

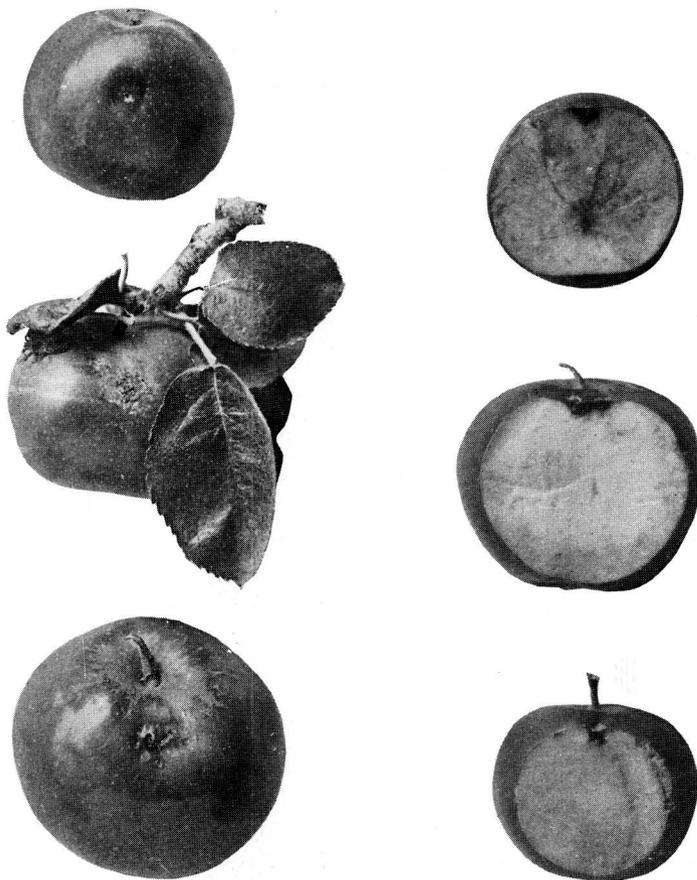
During 1914 I had the opportunity of visiting the Okanagan Valley for the first time after having spent two years in the Coast districts. If there was one thing more than any other that struck me on that visit it was the "comparative" absence of this woolly aphid, and the report from many quarters of its increase in many localities. There seems little doubt that, while the woolly aphid may have been present in the Okanagan Valley since and before 1893, it has not as yet spread over the existing orchard area to the same extent as it has done on the Coast. I am inclined to think that the woolly aphid, like the oyster-shell scale, is an insect particularly adapted to a humid moist climate, where it would be more liable to find conditions suitable to optimum development than in arid sections. However, there is no doubt that climatic conditions in the Okanagan would suit it well enough to enable it to cause a considerable amount of injury; therefore it is advisable that due regard be paid to its spread and reproduction in the Upper Country.

#### THE BUD-MOTH (*Tmetocera ocellana* Schiff).

The first report of the bud-moth occurring in British Columbia is that recorded in the Fifth Annual Report of the Horticultural and Fruit-growers' Association of British Columbia, 1894. In that year specimens of the bud-moth were reported from the vicinity of Vernon, B.C. This appears to be the first report for the Province appearing in print, but the impression is given both in the 1894 Report as well as in the 1892 Report, that the insect occurred at the time in the Lower Fraser Valley. Dr. J. Fletcher, in his report as Dominion Entomologist, 1895, mentions receiving specimens of the bud-moth from the orchard of Mr. C. F. Pound, St. Elmo, B.C., and remarks that these were the first specimens he had received from British Columbia. Even in 1903 this insect did not occur commonly in the Province. Since 1911 it has been found present in every orchard visited in the Lower Fraser Valley. Adults have been bred and compared with Eastern Canadian specimens and their identity is certified. It is well to say this, because we are yet a little doubtful as to the identity of some other "bud-worms" very similar in nature to the bud-moth. In this year (1915), however, we may state that the bud-moth (*T. ocellana*) occurs commonly both on Vancouver Island and on the Lower Mainland. In the Okanagan it remains somewhat scarce. Mr. Brittain reports it as working in several orchards in the Kelowna District in the summer of 1913, but "not in sufficient numbers to do a great deal of harm." In August, 1914, I visited the Okanagan and made a special endeavour to determine the distribution of the bud-moth. I realized that doubt had been expressed as to the probable species involved in injury of a similar nature, hence I was careful in determination. I am of the opinion that the bud-moth (*T. ocellana*) occurs at Vernon, Kelowna, and at Penticton. Kelowna was the only point where bud-moth injury attracted attention; at other points careful examinations had to be made because the insects were not common. It is to be hoped that the next few years will throw more light on the identity of the species of "bud-worms" involved, because at present there is much confusion. At any rate, the important point is apparent that every year adds a little more area to the extent of infestation in the Okanagan; consequently growers are advised to watch the advance of this insect for fear it becomes as well established as it is at present in the Lower Fraser Valley.

## TWO PESTS NEW TO BRITISH COLUMBIA.

I regret very much to have to record two new pests which have made their appearance in British Columbia during the past year (1915), and both from Vancouver Island. The first and the most important, both in point of numbers and injuriousness, is the pear-thrips (*Taniothrips pyri* Daniels), and the second is the black currant bud-mite (*Eriophyes ribis* Nalepa). The appearance of these two pests is both interesting and extraordinary. Neither has been recorded for Canada previous to this occasion, and the latter in particular has not, to my knowledge, as yet been reported as occurring in open field plantations in North America. The



Showing the typical injury to mature apples at pickling-time caused by the young larvæ of the bud-moth. Apples are frequently disfigured and rendered of lower value by injury of this nature. The injury is shown in sectional view and the depth to which the larvæ work. This form of injury assists decay in storage. (Photo by R. C. T.)

former, however, is known to occur at several but widely separated fruit areas in the United States. The history of their occurrence in British Columbia is somewhat as follows:—

THE PEAR-THRIPS (*Taniothrips pyri* Daniels).

During April, 1915, Mr. T. A. Brydon, fruit-grower, Royal Oak, reported to Mr. Thomas Cunningham, Inspector of Fruit Pests, that the first-spring spray that he had used on the latter's suggestion had injured his trees, so much so that the blossom-clusters were turning brown, and it was evident that little fruit was setting. Mr. Brydon, believing this apparent injury due to the spray applied, did not spray



Showing an advanced condition of attack by the larvæ of the bud-moth in the early spring months. Note how the buds are destroyed and development checked. An early spring spray containing arsenate of lead will reduce injury. (Photo by R. C. T.)

the remainder of his orchard which still required applications. He was astonished, a few days later, to note that these unsprayed trees also showed signs of injury similar to the sprayed trees. He accordingly reversed his opinion on the effect of the spray and reported the state of affairs both to Mr. R. M. Winslow, Provincial Horticulturist, and to Mr. Cunningham. Mr. Winslow immediately visited Mr. Brydon and noted the presence of thrips in the blossoms of peach, plum, pear, prune, apple, and cherry. Mr. E. W. White, on Mr. Cunningham's instruction, visited the orchard about the same time and noted the same conditions.

Mr. Winslow immediately took steps to have the insects identified, attributing the injury to them. Specimens were sent to Mr. S. W. Foster, San Francisco, and to Berkeley University, California. Through the medium of Mr. White I received specimens also, which I tentatively identified as the pear-thrips. Specimens were in due course forwarded to Dr. C. Gordon Hewitt, Dominion Entomologist, Ottawa, who, to satisfy our determination, forwarded some to Washington, D.C., for substantiation. In the course of a few days reports from all sources were received and the identification in each case was identical. The species involved was *Taniothrips pyri* Daniels. Immediate steps were then taken to estimate the extent of injury and the area involved. As a result, it was found that an area approximating twelve square miles was involved in the outbreak, with centres of infestation at Royal Oak, Keatings, and Gordon Head.

On May 7th and 8th, at the request of Mr. Winslow, I made a survey of the district and arranged a series of meetings with the fruit-growers at each of the three places mentioned. Simultaneously, through the energy of Mr. Winslow and

Mr. Cunningham, remedial measures in the form of soap-emulsion sprays were applied wherever deemed advisable, but it has to be acknowledged that a part of the spray, at any rate, was applied too late for best results. Most of the injury had been caused, and the thrips were naturally leaving the trees during the first days of May. The fruit-growers were therefore advised fully as to their danger and the serious nature of the insect, and strongly urged to take efficient steps to safeguard their interests for the coming spring of 1916.

The life-history of the thrips, according to Californian reports, is such that the nymphs, after leaving the trees in May, penetrate into the soil and do not appear until the blossoming period of the following year. The safest spray to apply under our present knowledge of conditions around Victoria is a mixture of whale-oil soap and nicotine sulphate.

The following formula is recommended until our knowledge is further supported by experimental data: Nicotine sulphate (B.L. 40),  $\frac{3}{4}$  pint; water, 100 gallons; whale-oil soap, 5 lb. A pressure of at least 200 lb. is advisable, and two, and if possible three, early-spring applications are required.

There is no explanation of an exact nature which can be offered explaining the outbreak of these thrips around Victoria.

Mr. Brydon, who is responsible in the first place for having drawn attention to the insects, believes them to have been present in his orchard at least six or seven years previous. The blighted condition of blossoms in the spring had been noted in his orchard for that length of time, but the cause was usually attributed to some slight frost at a critical period. There seems little doubt that the thrip has been present in the district for several years, and that with the unusually mild winters and early springs that have been experienced in that locality during the past two years, conditions were suitable for optimum development. It is possible that the past winter (1915-16), which has been somewhat unusually cold, may have the desired effect of checking the outbreak, but it is well to be on the safe side and prepare for a continuance of the outbreak. I am pleased to inform you that Dr. C. Gordon Hewitt is making arrangements for a complete study of this insect in respect to its biology and control, and the initial steps in this connection will be begun this spring (1916).

#### THE BLACK CURRANT BUD-MITE (*Eriophyes ribis Nalepa*).

This mite has frequently been taken at inspection stations in Canada, arriving in consignments of black currants from Europe. It is only this past spring, however, that we are forced to record its presence in the open field plantations in British Columbia.

On the evening of April 7th, 1915, I was accorded the pleasure of delivering an address before the Natural History Society of Duncan, V.I. In the discussion that followed, Mr. R. Glendenning, Secretary of the Society, asked whether or not the black currant bud-mite was known to occur in Canada. I was forced to admit that the mite was not known to infest our field plantations in Canada. He thereupon stated that some injury very similar to that of the bud-mite, as he knew it in England, was present on some currant-bushes he had in his garden, which he had, in the first place, bought from a local nursery, and which had originated in England.

Mr. Glendenning accordingly, the following morning, on my request, produced some supposedly infested twigs. There was no doubt that the buds were infested by *Eriophyes ribis*. My determination was later supported by Dr. C. Gordon Hewitt, Dominion Entomologist, who was satisfied that the species was identical with the bud or gall mite of Europe.

On inquiry it was found that this mite must have been working in the field plantations to some extent for the past five or six years. The bushes found infested at Duncan had been sold by the "Vancouver Island Nursery Company," Somenos, V.I. As far as could be learned, approximately 5,000 currant-bushes had been disposed of by this firm between the years of 1910-13, and all these bushes apparently

were sold to local growers on Vancouver Island. For the past two years the nursery has ceased to exist, and the owner is at present on military service in Europe. The books of the company, therefore, are closed and we are not able to obtain the names of purchasers.

The importance of this mite is well understood by those who have experienced its ravages in England; consequently prompt and efficient steps are urgently required to stamp it out. Growers of currants are advised to report its presence to the Government if their suspicions are aroused. Affected bushes are most easily observed in the early spring, when the buds of such bushes swell abnormally, eventually dropping off or setting no fruit. The only remedy advised in consideration of the present status of the currant industry of the Island is to destroy affected bushes by burning.

### SUPERHEATING AS A CONTROL METHOD FOR INSECTS WHICH INFEST STORED PRODUCTS.

BY ARTHUR GIBSON, CHIEF ASSISTANT ENTOMOLOGIST, DEPARTMENT OF AGRICULTURE, OTTAWA.

There are several important insects which collectively are responsible every year for serious losses to flour, stored grain, etc., in various parts of Canada, such losses amounting to many thousands of dollars. The Mediterranean flour-moth (*Ephestia kuehniella*) is largely a flour insect, but it also works in other manufactured foods. The Indian-meal moth (*Plodia interpunctella*) has a wide range of food, attacking, freely, grain and other seeds, meal, dried fruits, nuts, etc. The meal snout-moth (*Pyralis farinalis*) is some years found causing considerable injury to stored grain, etc. The Angoumois grain-moth (*Sitotroga cerealella*) is occasionally found in shipments of corn-seed imported from foreign countries. The power of granary-weevils and similar small beetles to destroy grain and other stored products when held for any length of time in stores or warehouses is enormous. The weevils which cause the greatest damage are the grain-weevil (*Calandra granaria*) and the rice-weevil (*Calandra oryzae*). In addition to these weevils there are several small reddish-brown beetles which commonly infest stored grain and mill products. Breakfast foods, flour, meal, dried fruits, nuts, etc., are all attacked.

Recently the Entomological Branch has had opportunities of experimenting with high temperatures for the control of insects infesting mills and warehouses, and the results obtained have been highly satisfactory. In the superheating method of control it is necessary to install a system of heating which will give and maintain a temperature of from 120° to 125° Fahr. for about six hours. In stores or warehouses the established heating system will require to be augmented by coal, wood, or gas stoves, particularly in autumn and during the colder months. A number of flour-mills in the United States which are heated by steam have installed additional radiation at a cost not exceeding the expense of one fumigation with hydrocyanic-acid gas, which has been used to such an extent in the past for destroying insects infesting flour and other stored products. The additional system of radiation is permanent, and one application of the superheating method each year has been found to be sufficient to control such insects. In Canada, also, the superheating method has been adopted in flour-mills to control the Mediterranean flour-moth. In the Montreal district, for instance, the flour-mills are regularly, each summer, subjected to high temperatures to destroy this insect. In instances where mills and warehouses have been infested with such small beetles as the confused flour-beetle (*Tribolium confusum*), and fumigated with hydrocyanic-acid gas, it has been found that the gas did not penetrate sufficiently deep into all cracks, etc., to kill the insect in every stage. The superheating method, however, reaches the places inaccessible to gas and destroys any insects which may be present.

The following brief statement will indicate the value of high temperatures as a control measure for such insects as I have mentioned:—