# DOMINION DEPARTMENT OF AGRICULTURE

SCIENCE SERVICE—DIVISION OF ENTOMOLOGY

Published by Authority of the Right Hon. James G. Gardiner, Minister of Agriculture

Vol. 6
REPORT
NUMBER 1

FOREST INSECT INVESTIGATIONS
BI-MONTHLY PROGRESS REPORT
OTTAWA, CANADA

Jan.-Feb.
1950

# CURRENT ACTIVITIES

## MARITIME PROVINCES

***Spruce Budworm Moth Flight on Green River Watershed.***—One of the objects of the spruce budworm studies on the Green River Watershed was to determine whether the anticipated infestation would develop from the local endemic population, or whether it would be caused by invasions of moths from heavily infested areas to the west. To aid in detecting moth invasions, light-traps were established as early as 1945 and have been operated each year at the Green River Laboratory and on several fire towers.

The first evidence of an increase in larval population occurred in 1947 and in that year the first moths were taken in light-traps. Until 1949, the increase in the number of moths taken was in accordance with the increase in local population. If any influx did occur then it was of such a low and gradual nature as to go undetected. In 1949, there is evidence of a large flight of moths entering the Watershed from heavily infested areas outside. This evidence is as follows:

1. The highest spruce budworm moth catch for any night in any year preceding 1949 was 5. On July 28, 1949, at Green River Laboratory, 1,520 moths were taken. The highest catch for any other night in 1949 was 28. This suggests that the suspected flight of moths did not remain near the laboratory. On this night, spruce budworm moths comprised 66 per cent of the total catch of Lepidoptera, while the highest for any other night was 19 per cent.

2. At the Green River Tower, 10 miles south of the laboratory, an unusually high catch was recorded on the preceding night and at the Wild Goose Tower, 7 miles north of the laboratory, it occurred on the following night. This indicates that the high catch was not merely the result of favourable weather conditions on the local moth population. The high catch was sustained for several succeeding nights at Wild Goose Tower suggesting that at least part of the flight remained in the extreme northern part of the Watershed.

3. The ratio between the total number of spruce budworm moths caught at all light-locations on the Watershed and the pupal population, per tree, as measured on several permanent plots, was roughly 10 in 1947 and 6 in 1948. If the moths of the suspected flight are disregarded, this ratio for 1949 is 12, but if regarded, the ratio then becomes 140.

4. Meteorological conditions (wind, temperature, humidity) on the night of July 28 were not sufficiently distinctive to account for such an increase in the activity of local moths. Similar conditions have been recorded at other times during the moth period without unusually high catches.

5. Wind directions during and preceding the flight, from the surface to the zero isotherm, were favourable for the movement of moths from heavily infested areas to the Green River Watershed.

Female moths comprised 20 per cent of the catch but this does not indicate the sex ratio of the migrating moths, because the males are much more strongly phototropic. The females caught in light-traps had a mean oöcyte complement of 70.

Larval sampling and defoliation surveys in 1950 will provide further information on the suspected flight, particularly as to whether a part of it settled in the northern part of the Watershed.—D. O. Greenbank.

***A Key to Some Lepidopterous Larvae Associated with the Spruce Budworm.***—In studying the spruce budworm on the Green River Watershed, difficulty has been experienced in separating small larvae from other larvae of the same or allied families feeding upon the new foliage of fir and spruce. A project has been completed on the morphology and life-history of these associated species on the Green River and the following key is presented for the use of other investigators who may be having the same difficulty. It is applicable to all instars and, in so far as possible, is based on macroscopic characters which may be used in the field.

The following points on nomenclature should be noted. *Recurvaria* sp. may be *Recurvaria piceaella* Kft., but a revision of the genus is necessary before positive determination can be made. *Tortrix* sp. is an undescribed tortricid close to *Tortrix afflictana* Wlk.

1. Head capsule dark in colour (black or dark-brown)..2
   Head capsule light in colour (yellow or pale-green)..6
2. Body colour solid....................................3
   Ground colour of body superimposed with stripes..5
3. Body colour pale greenish-yellow.....*Acleris variana* Fern.
   Body colour light- to dark-brown..................4
4. Anal comb with seven or eight teeth all of the same shape................*Choristoneura fumiferana* Clem.
   Anal comb with six teeth; inner pair large and sickle-shaped.
   Length of larva less than 10 mm.......*Recurvaria* sp.
5. Body colour reddish-brown with seven to nine narrow longitudinal dark-brown stripes in early instars; ultimate instar with two wide lateral dark-brown stripes.. *Dioryctria reniculella* Grt.
   Body colour yellowish-brown with two wide lateral stripes slightly darker in colour. Early instar........ *Zeiraphera fortunana* Kft.
6. Body colour predominantly green.................7
   Body colour not green.............................8
7. Body emerald-green with a dorsal and subdorsal dark-green stripe...........*Archips persicana* Fitch.
   Body emerald-green dorsally, yellowish-green on lateral surface and intersegmental folds............. *Tortrix packardiana* Fern.
8. Anal comb absent....*Zeiraphera ratzeburgiana* Ratz.
   Anal comb present.................................9
9. Body colour solid; light-brown to cinnamon-brown.10
   Ground colour of body superimposed with stripes..11
10. Pinacula large, raised and white in colour; on the dorsal surface they appear as two longitudinal stripes *Tortrix* sp.
    Pinacula small, not easily seen. Inner pair of teeth of anal comb sickle-shaped...........*Recurvaria* sp.
11. Anal comb with six to eight teeth all similar in shape ..........................................12
    Anal comb with inner pair of teeth sickle-shaped. Ground colour of body ivory, with three reddish-brown stripes..........*Eucordylea atrupictella* Dietz.
12. Prothoracic shield with a black posterior border. Ground colour of body yellow with three wide longitudinal dark-brown stripes. *Zeiraphera fortunana* Kft.
    Prothoracic shield yellow. Ground colour of body yellow with three indefinite orange-brown longitudinal stripes.....................*Griselda radicana* Wlshm.

—C. A. Miller.

***Cankerworms and European Winter Moth in Nova Scotia.***—Since the early 1930's outbreaks of "cankerworms" have been more or less continuous at points along the South Shore of Nova Scotia. It has been generally considered that the species responsible were both fall cankerworm (*Alsophila pometaria* Harris), and spring cankerworm (*Paleacrita vernata* Peck), but positive identifications have not been made of the latter species. In recent years, the existence of a species other than the spring cankerworm has been suspected. Observers have reported spring cankerworm population as mainly responsible for defoliation in certain localities, but apparently there was no spring emergence of adults. Possibly the most generally preferred hosts of the questionable species are apple, oak and elm.

In an attempt to determine what species were present at various localities and in what proportions, a series of sample trees was prepared with tanglefoot barriers during the fall of 1949. Regular counts and collections were made of the material trapped. From this work, which was carried out jointly by the Nova Scotia Department of Lands and Forests and the Dominion Unit of Forest Insect Investigations, adults were obtained for positive identification.

Among the adults emerging were two species, *A. pometaria* and one other. The latter has been identified tentatively by Mr. D. C. Ferguson as *Operophtera brumata* Linn., the European winter moth. Mr. C. C. Smith has kindly provided further information obtained independently from collections of larvae made at several points in Nova Scotia last summer. Several hundred adults were reared which have been identified by Dr. T. N. Freeman as *O. brumata*.

Larvae of *O. brumata* are superficially similar to *P. vernata* and lack the vestigial pair of prolegs which are present on *A. pometaria* larvae. The adults of *O. brumata*, presently so-called, emerge in the late fall along wtih adults of *A. pometaria*.

As yet no positive record of *P. vernata* from Nova Scotia has been found. It is quite probable that past references to outbreaks of the "spring cankerworm" in Nova Scotia refer to this apparently introduced European species. Certainly this note should be considered as a correction of the reference to "spring cankerworm" outbreaks in Nova Scotia by Hawboldt (1), during the past year.—L. S. Hawboldt and F. G. Cuming.

1. Hawboldt, L. S. Report of the Dept. of Lands and Forests, Nova Scotia, 1948, p. 36.

## NORTHERN ONTARIO

***Seasonal History Notes on Pityokteines sparsus Lec.***—In previous issues of this report, reference has been made to the role played by associated insects in the death of balsam fir trees severely weakened by spruce budworm defoliation, and to the seasonal history of one of these species, the black sawyer beetle, *Monochamus scutellatus* Say. Observations on the seasonal history of the other important species, the balsam bark-beetle, *Pityokteines sparsus* Lec., are presented here. The accompanying diagram illustrates the seasonal history, the information being the result both of field observations and the closer study of caged logs cut from infested trees.

In the diagram, horizontal bars indicate the time of occurrence of each stage. "Attack" signifies the tunnelling of the adults into uninfested trees and the establishment of nuptial chambers and brood galleries. The adults making the earliest attacks in the spring (upper left of diagram) emerge from the original host trees shortly after oviposition and establish new attacks in other uninfested trees. Thus two broods are established in different trees by the same adults in the first half of the summer. Both adults and larvae overwinter, and during the spring, the difference in developmental stage is largely overcome so that all oviposition establishing the first brood of the season takes place during a comparatively short period in early summer, regardless of how the parent forms overwintered.—R. M. Belyea.

## SOUTHERN ONTARIO

***The Termite Situation in 1949.***—Two thousand bait-stakes, planted in the City of Toronto and in woodlots throughout southern Ontario in the spring of 1948, were re-examined in September and October, 1949. The results were very much the same as those recorded in 1948 (Bi-Monthly Progress Report, Vol. 4, No. 5; Vol. 5, No. 1). The only stakes which showed evidence of termite attack were in the southeastern quarter of Toronto. Stakes attacked in 1948 after about 4 months in the soil were again heavily attacked in 1949. In a few instances stakes which had not been attacked in 1948 were found to be damaged in 1949. There was very little spread noted and the Toronto infestations are undoubtedly extremely local.

A report was received from the Toronto office of the Plant Protection Division in late November to the effect that termites were causing serious damage to stocks of paper and cardboard in a factory building in Scarborough Township, which is just east of the Toronto city limits. This new infestation is slightly less than 2 miles east of the nearest outbreak in the city itself.

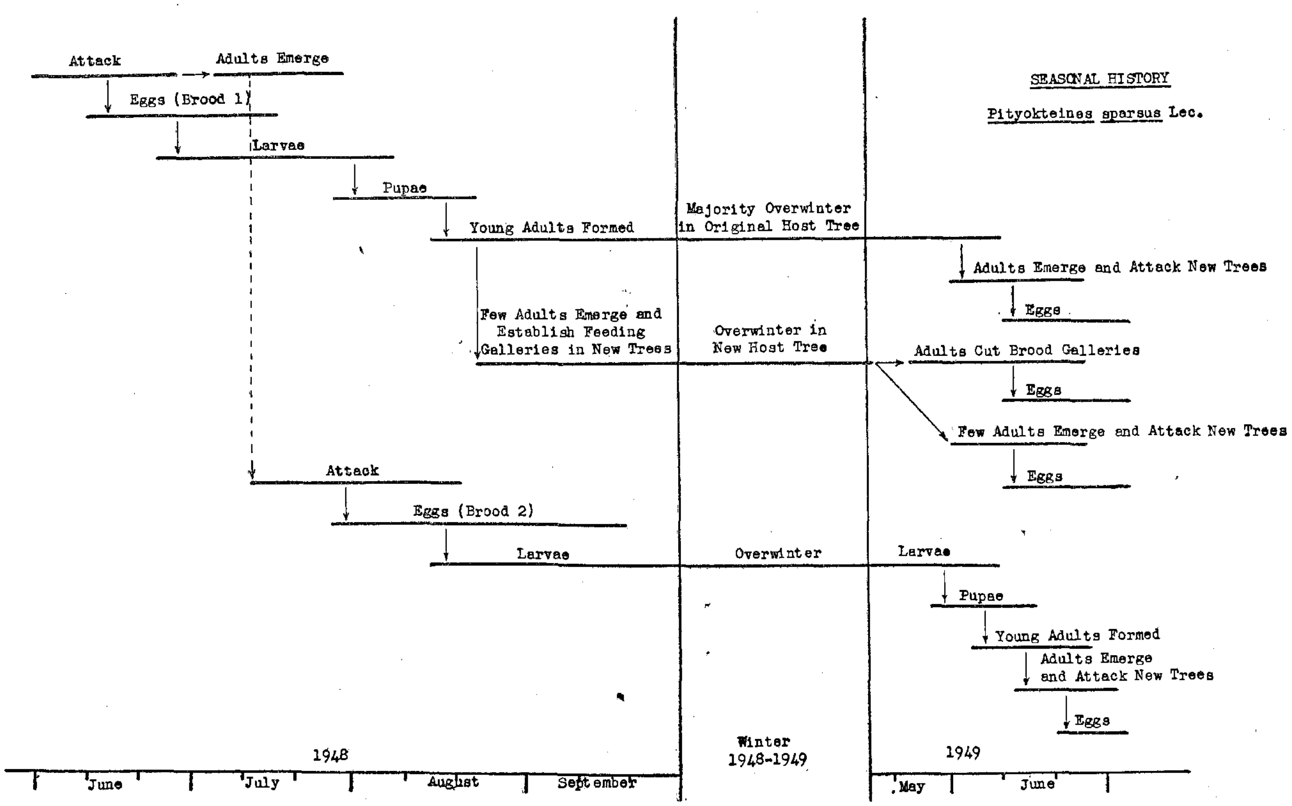
Particular attention was paid to the 75 bait-stakes which were planted in Point Pelee National Park. No signs of termite damage were noted in these stakes, nor could any insects be found in the summer under logs, fallen branches, and in other wood debris. Apart from Toronto, Point Pelee is the only place in Ontario where termites were ever known to occur, a few specimens having been collected there in 1929. The species of termite in southern Ontario is probably *Reticulitermes flavipes* (Kollar) but positive identification cannot be obtained until winged adults are collected. To date, only workers and soldiers have been found.—E. B. Watson.

## PRAIRIE PROVINCES

(FORESTED AREA)

***The Effects of Moisture on Larch Sawfly Cocoons.***—The effects of flooding on larch sawfly cocoons were studied under field conditions during 1949. The results obtained indicate the importance of precipitation and water levels in tamarack swamps in regulating the abundance of the larch sawfly.

The first series of experiments were performed on overwintered cocoons in which the sawfly larvae were in diapause. Treatments commenced in May and were continued to midsummer. No significant mortality of larvae in diapause resulted from submerging cocoons for a period of four weeks or less. Beyond that point, however, the mortality rate began to rise sharply and after eight to ten weeks of continuous submergence all the larvae were dead. Developing post-diapause stages in cocoons could not resist flooding nearly as well. These invariably succumbed to a flood period of between one to two weeks' duration. The number of these developing stages in field material reached a peak between



June 8 and June 23, in 1949, the number of cocoons containing developing larvae, pupae or teneral adults ranging from 35 to 75 per cent. When cocoons were not killed by submergence, development was simply delayed until the moisture was removed.

A second set of experiments was performed on newly spun cocoons collected in mid-summer. Results differed greatly from those obtained on overwintered cocoons. In general, flooding for a period of two weeks killed all cocoons which were less than two weeks old when treatment started. As the cocoons aged, resistance to flooding gradually increased to the point where cocoons ten weeks old survived immersion periods of over one month. Indications were that by freeze-up these cocoons had built up a resistance to flooding comparable to that found in overwintered material.

That larch sawfly populations in the field may be altered drastically by precipitation can be readily surmised from these results. A wet spring, not too prolonged, where tamarack swamps are generally flooded, should kill few cocoons. It will simply delay development and subsequent defoliation. On the other hand, it is expected that many cocoons would be killed in a normal or dry spring followed by heavy precipitation in mid-June because then the greatest number of developing stages are present. Still greater mortality could be anticipated from heavy rains during late July and most of August when the newly-spun cocoons are in the ground. Probably few cocoons would be killed by fall rains in September or October.—D. Burbidge and R. R. Lejeune.

(AGRICULTURAL AREA)

***The Fall Cankerworm, Alsophila pometaria Harris.***—Artificial control studies of the fall cankerworm were undertaken in three ways: (1) foliage sprays applied during the larval stage, (2) ground sprays applied just before adult emergence to prevent oviposition, and (3) tree-trunk sprays applied at the same time as (2).

The following insecticides were used in the tests: the halogenated hydrocarbons, compounds 118 (octalene) and 497 (octalox); DDT (Deenate 50); parathion (Thiophos 3422); toxaphene (chlorinated camphene); BHC (benzene hexachloride); and chlordane.

Abbott's formula was used to calculate the per cent controls in all cases.

*Foliage sprays.*—Compounds 118 and 497, at concentrations of ½ lb. and 1 lb. per 100 gallons of water, were applied to hand-infested, potted, Manitoba maple transplants. Compound 497 at both concentrations, and compound 118 at the ½ lb. rate gave 93 per cent control; compound 118 at the 1 lb. rate gave 100 per cent control.

DDT and parathion, at concentrations of ⅛ lb. per 100 gallons of water, and an emulsified concentrate of chlordane at a concentration of 3/10 gallons per 100 gallons of water, were applied to infested field shelter-belts. At the time of application the cankerworm larvae were in the late third and early fourth instars. The DDT, chlordane, and parathion treatments gave per cent controls of 76, 75, and 72 respectively.

*Ground sprays.*—Compounds 497 and 118, DDT, and parathion were applied as water suspensions to square-yard infested plots, at the rate of 1/5 of an ounce of insecticide per square yard, just before adult emergence. Each treatment was replicated four times. Egg laying was reduced from 1 egg cluster per female in the untreated plots to ⅗ per female for 497, ½ for parathion, ⅛ for 118, and 0 for DDT.

*Tree-trunk sprays.*—DDT, 497, parathion, 118, BHC, and chlorinated camphene were applied as water suspensions just before adult emergence, at the rates of 5 and 15 lb. of insecticide per 100 gallons of water, to poplar poles set in an infested field plot. Each treatment was replicated five times. DDT, applied at the 15 lb. rate, and emulsified with Triton X-100, (1) reduced the average number of eggs laid per female by 4/5, (2) reduced the average number of egg clusters per female from ·7 to ·2, and (3) shortened the average life of the females by one half. Compound 497, applied at the 15 lb. rate, (1) reduced the average number of egg clusters per female from ·8 to ·4, and (2) shortened the average life of the female by one half. The remaining treatments were ineffective.

Chlordane, parathion, chlorinated camphene, and DDT, all at the rate of 20 lb. per 100 gallons of water were applied to field shelterbelts with almost similar pupal populations. The average number of new egg clusters per branch sample following adult emergence was 1·1, ·6, ·6, and ·1 respectively. The average number per untreated branch was ·7. DDT again gave indication of good control.

To test the effect of the insecticides when applied direct to the insect, adults were collected immediately upon emergence, sprayed in screen cylinders, and released in cloth-lined field cages for subsequent observations. DDT, BHC, and chlordane, at concentrations of 2 and 5 lb. per 100 gallons of water, prevented the females from ovipositing. Chlorinated camphene, parathion, 118 and 497, at the same concentrations, shortened the life of the adults but failed to prevent oviposition.—F. R. Hammond.

***Forest Insect Survey.***—In 1949, 1,050 farm shelter-belts were inspected in the agricultural area of the Prairie Provinces. Separate surveys were made for the detection of the most important species wherever possible while the insects were in their most destructive stage. In previous years, surveys were conducted on a territorial basis. In all, 952 collections and 1,000 reports were received. The number of collections was lower than in 1948, but it is considered that more critical reporting in 1949 compensated for the reduction.

The yellow-headed spruce sawfly continued to be a major pest of spruce in farm shelter-belts. In Manitoba, the most serious infestations were reported from the southwestern agricultural districts; in Saskatchewan, from the northern and eastern agricultural districts. The infested area extended into central Alberta.

The balsam-fir sawfly was more serious in southwestern Manitoba than the yellow-headed spruce sawfly. It was present in northern and eastern Saskatchewan and there is reason to believe it is becoming more abundant in Saskatchewan where it occurred in native stands as well as farm shelter-belts. It was not serious in Alberta.

The pine needle scale was still an important pest of spruce in farm shelter-belts in Manitoba and Saskatchewan.

Infestations of the spruce spider mite were moderate in comparison with the severe infestations reported in 1948.

The fall cankerworm was serious in southern and Central Saskatchewan. The infestations in the eastern part of the Province and in western Manitoba increased in severity. The effects of parasitism and the heavy frost on May 23 were discussed in the July-August, 1949, issue of the Bi-Monthly Progress Report.

The outbreak of the western willow leaf beetle, which was general in the park-belt area in Manitoba, Saskatchewan, and Alberta in 1948, persisted mainly in Saskatchewan. Several reports were received, in early summer, of adult beetles migrating to farm shelter-belts. Very few reports on injury by this species were received from Manitoba and Alberta.

The large aspen tortrix occurred in outbreak proportions near Glaslyn, Sask. Second growth aspen poplar on 600 square miles of agricultural lands was affected. Defoliation ranged from 40 to 60 per cent. In 1948, a much smaller area had been affected but defoliation was more severe. Some trees which were completely defoliated in 1948 failed to produce foliage in 1949.—Margaret E. P. Cumming.

## ROCKY MOUNTAIN REGION

***Bark Beetles.***—The number of described species of bark-beetles which may occur in the Rocky Mountain region of Canada is approximately 50. During the 1949 survey season, 23 species of bark-beetles were collected. These included 4 species of *Dendroctonus,* 7 *Ips,* 1 *Scolytus,* 1 *Polygraphus,* 2 *Orthotomicus,* 2 *Pityophthorus,* 1 *Pityokteines,* 1 *Pityogenes,* 2 *Dryocoetes,* and 2 *Trypodendron.* Among the more interesting recoveries was *Ips radiatae* Hopk. from Waterton Lakes National Park in *Pinus flexilis.* As far as known, this is the most easterly record of this species in Canada. *Ips pini* Say from Northern Alberta seems to be distinct from *Ips oregoni* Sw. from Yoho National Park in *Pinus contorta latifolia. Orthotomicus caelatus* Eichh. from Slave Lake in *Pinus Banksiana* is another interesting record since this species was recorded by Dr. Swaine (Canadian Bark-Beetles Pt. II Tech. Bull. 14) from Eastern Canada and Eastern United States.—G. R. Hopping.

***Fauna of Forest Soil.***—The literature on the fauna of the forest duff and soil seems to be rather meagre, particularly in Canada. In 1949, some preliminary work was done in connection with the ecology of forest type plots at the Kananaskis Forest Experimental Station. The animal population found in one square foot of duff and soil taken from beneath a scattered stand of trembling aspen may be of some interest. The organisms were segregated into two lots, one from the soil and one from the duff, and they were recovered by using a Berlese funnel. The square foot litter sample was approximately one and one-half inches in depth and the soil underneath was taken to a depth of about two inches.

The following organisms were recovered from the duff or litter sample: 1 psocid nymph, 5 mealy bugs, 3 nymphs of Thysanoptera, sub-order Tubulifera, 3 pyralids and 4 sawfly larvae (probably fell from plants of the ground cover), 1 nymph of a bug, 11 beetle larvae, 1 ant, 201 white and 26 bluish springtails (Collembola), 464 mites, 12 small spiders, 3 pseudoscorpions, 1 round worm and 12 millipedes. In the soil there were 41 beetle larvae, 1 chrysomelid adult, 1 ant, 1 mealy bug, 176 white and 12 bluish springtails, 368 mites, 35 small spiders, 1 pseudoscorpion, 6 round worms and 1 empty snail shell. No earth worms were present in either of the samples. Thus, in a sample of duff and soil aggregating about 504 cubic inches, 1,390 animal organisms were found exclusive of microscopic forms.—W. C. McGuffin.

## BRITISH COLUMBIA

***Northern Infestation of Bark-beetles.***—In 1948, an extensive area of dead timber was sighted from the air in the Meziadin Lake area. Due to the remoteness of this area further examination was not possible until August, 1949, when ground and aerial examinations were undertaken by Mr. M. T. Hughes, Insect Ranger.

Dead timber extends over an area of approximately 300 square miles in the Upper Nass River valley. Observations from the air show light, scattered mortality commencing some 4 miles above the junction of the Nass and Cranberry Rivers and extending northward along the west slope of the Nass Valley. Northward, the number of dead trees increases until an area of dead timber covers the entire valley bottom for an estimated width of 8 miles. The margin of an old burn on the west bank of the Upper Hanna River marks the northern limit of this heavy tree mortality. Killing has been restricted chiefly to dominant and co-dominant spruce.

When examinations of dead timber were carried out in the Meziadin Lake area, it was found that the bark-beetle, *Dendroctonus borealis* Hopk. was responsible for the damage. Although no signs of present activity were discovered, it was evident that the infestation had been active over a considerable period of years, apparently originating in the vicinity of the burned area previously mentioned.—H. A. Richmond.

***Western Forest Insect Conference.***—The organization of the "Western Forest Insect Conference" was effected at the meeting of the Western Forestry and Conservation Association at Portland, Oregon, in December, 1949. It is international in membership and has been organized to meet annually for a review of current insect conditions in the western forests and for an exchange of technical information. Membership is open to forest entomologists and others who are primarily concerned in the technical aspects of the theory and practice of forest entomology. An executive of seven members was elected, the secretary being Mr. Philip Johnson, forest entomologist, Coeur d'Alene, Idaho.—H. A. Richmond.

***Western Hemlock Looper.***—Forest insect survey records showed that there is an area of light looper activity in the Terrace region of the Skeena River valley. This area extends from Terrace west to Kwinitsa and down the lower Skeena some 40 miles. Hemlock looper larvae were found in greatest abundance in the vicinity of Kitsumgallum Lake and in the Kasiks River area at Salvus. In these two areas, the number of larvae obtained averaged about ten per collection, each collection representing the looper population obtained by beating branches of three trees over a 7- by 9-foot sheet.

A survey for overwintering eggs was conducted to ascertain the probable trend in population for 1950. Results of this survey failed to reveal any fresh eggs in either the Kitsumgallum Lake region or in the Salvus area on the Kasiks River. In both areas, hatched egg shells were found; the average number of eggs per half square foot of moss was 3·2 at Kitsumgallum Lake and 2·5 at Salvus. The total absence of fresh overwintering eggs is not readily understood. From the evidence on hand, however, there is no indication of any serious increase for 1950.—M. T. Hughes.

## RECENT PUBLICATIONS


Barter, G. W. and W. J. Brown. On the identity of *Agrilus anxius* Gory and some allied species (Coleoptera: Buprestidae). Canadian Entomologist. Vol. LXXXI No. 10, 1949. pp. 245-249.

Schedl. Karl E. A new species of *Alniphagus* (Col. Scolytidae) from Canada. Canadian Entomologist. Vol. LXXXI No. 9, 1949. p. 236.

Baldwin, W. F. and H. C. Coppel. The biology of *Phorocera hamata* A. and W., a Tachinid Parasite of Sawflies. Canadian Entomologist. Vol LXXXI No. 10, pp. 237-245.


OTTAWA: Printed by EDMOND CLOUTIER, C.M.G., B.A., L.Ph., Printer to the King's Most Excellent Majesty, 1950.

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OTTAWA

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SCIENCE SERVICE—DIVISION OF ENTOMOLOGY

Published by Authority of the Right Hon. James G. Gardiner, Minister of Agriculture

VOL. 6
REPORT
NUMBER 2

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# CURRENT ACTIVITIES

## MARITIME PROVINCES

***Notes on the European Winter Moth in Nova Scotia.***—In the Bi-Monthly Progress Report for September-October, 1949, it was stated that the spring cankerworm, *Paleacrita vernata* Peck, was numerous at Halifax and along the south shore of Nova Scotia from Chester to Liverpool. This, however, was incorrect because adults reared from the larvae concerned were identified as *Operophtera brumata* Linn., by T. N. Freeman who pointed out that this is the first record of the species in North America. In Europe, it occurs as a pest on certain fruit and shade trees and is known as the winter moth. In Nova Scotia, it was found on a wide variety of hosts: apple, choke cherry, hawthorn, basswood, oak, elm, white ash, hop-hornbeam, red maple, white birch, and yellow birch. While defoliation was generally heaviest on apple and hawthorn, the other trees also suffered severe defoliation. Complete loss of foliage was noticed in many apple orchards between Chester and Liverpool.

Fall cankerworm larvae were also found on the same trees with the winter moth. The two species were separated by means of the differences in the prolegs and were reared in screen cages outside. The larvae of the winter moth completed their development between June 14 and 20 and entered the soil to a depth of ½ to 1 inch, where they spun a light silken cocoon. Pupation was completed 5 days later, but the pupae remained dormant throughout the summer. Emergence of adults commenced on October 15, and ended on November 14 when it was cut short by winter conditions. These conditions prevented some fully developed adults from emerging, amounting to about 5 per cent of the total number of pupae. The mean date of emergence was November 6. During the period of emergence the lowest air temperature recorded was 20° F. On November 6 and 10, respectively, 0·7 and 2·7 inches of snow fell but emergence continued on both occasions after the snow had melted. When the temperature 1 inch below the surface of the ground fell to 36° F. or less, emergence ceased. Emergence of males began a few days earlier than females. Of a total of 494 adults, 277 were females. A few adults of two species of Diptera, *Hylemya cana* Macq. and *Phryxe pecosensis* (Tns.), were obtained in the emergence cages, but it is not certain that they were parasitic on the winter moth.

The seasonal history and habits of this insect are very similar to those of the fall cankerworm. The following difference were noted. The larvae are somewhat more tapered towards the head. Like the spring cankerworm, they lack the vestigial pair of prolegs found in the fall cankerworm. Very often they rolled the leaves in the final stage, particularly on apple, choke cherry and hawthorn. Pupation took place within 2 or 3 days after the larvae entered the ground, whereas the fall cankerworm remains in the prepupal stage for about a month. The eggs were laid in small masses of from 6 to 15 eggs compared with an average of about 150 eggs in the case of the fall cankerworm.

It is very probable that the control measures which have been found to be effective for the fall cankerworm will also be effective for the winter moth.—C. C. Smith.

***Bud Galls on White Spruce.***—In recent years a bud gall has been common on white spruce in New Brunswick. The enlarged bud is quite noticeable in spring, when it has a rosette appearance due to drying and reflexing of the bud scales. This exposes soft, pale, papery, inner scales at the gall apex.

The insect responsible is the spruce bud midge, *Rhabdophaga swainei* Felt. The adults are in flight during late May and early June. The eggs are laid between the basal scales of the bursting buds or on the needles of the elongating shoots. They hatch within 4 or 5 days. The young larva enters the tip of the elongating shoot where it feeds within one of the new buds causing it to enlarge, and forming a hard-walled cell in the centre. It overwinters within the cell as a prepupa and pupates next spring. The immature stages are pink to reddish in colour.

Though many trees are heavily attacked the damage is not serious. Some bushiness of growth results and when the terminal bud of the leader is attacked, a lateral shoot gradually grows upright and a crook in the stem develops. These terminal attacks have been found only on small trees, however, and the crooks are overgrown and straightened before the trees reach pole size. Occasionally two laterals replace the leader and a forked tree results.

Black spruce seems to be immune and red spruce is only lightly attacked. Two Norway spruce trees were examined and found to be as susceptible to attack as the native white spruce.—J. Clark.

## NORTHERN ONTARIO

***Value Loss Through Degrade in Fire-killed Pine.***—During the summer of 1949, the Forest Insect Laboratory at Sault Ste. Marie carried out field studies of woodborers and other agents of deterioration in fire-killed white, red and jack pine in several parts of the Mississagi area burned over in May-June, 1948. Over two hundred trees were felled and deteriorating agents studied in blocks at 16-foot intervals throughout the bole. Although the data have not been completely analysed, the influence of the deteriorating agents varied greatly in the different species and in trees injured to varying degrees by the fire.

A special study of mill output and grade of the lumber from fire-killed trees was undertaken in November, 1949. Trees killed outright by crown fire in 1948 and others dying gradually during the next year or more as a result of injury to the roots and lower portion of the trunk were selected in different stands, felled and made into logs. In sawing, each log was converted into 1-inch and 2-inch lumber, and all pieces, numbered as they fell on to the conveyor, were assembled for recording data on borer holes, sap-stain, decay and cull. Later, grades of each piece were determined by Mr. T. M. Callaghan of the White Pine Bureau as follows: (A), "original" grade which reflected the inherent quality of the lumber as influenced by knots, decay and other conditions antedating the fire; (B), "actual" grade which reflected the influence of borer holes and sap-stain; (C), "potential" grade which made allowance for possible elimination of borer holes and sap-stain along the edges of pieces and the recovery of a higher valued product even though of reduced dimensions. The original, actual, and potential values of each piece were obtained by application of current wholesale prices of the ten grades of white pine, the five grades of red pine and the four grades of jack pine.

The following conclusions are abstracted from a recently issued report on this special project: (1) Decay of the heartwood, antedating the fire and responsible for cull or reduced grade, was prevalent in white and jack pine, but uncommon in red pine. Deterioration following death was caused by the larvae of wood-boring beetles and by sap-staining fungi. Borer holes and sap-stain were almost equally important as causes of degrade in white pine; sap-stain was primarily responsible for degrade in red pine; and borer holes were primarily responsible for degrade in jack pine. (2) Value loss in white pine and red pine trees which were dying gradually during 1949 averaged only 2·4 per cent and 4·4 per cent respectively. (3) Value loss in white pine trees killed outright in May, 1948, was related directly to the original quality and value of the lumber. For example, in logs the contents of which had an original value of approximately $53 per M the loss was about 12 per cent but increased to about 57 per cent in logs having an original value of about $121 per M. (4) In red pine trees, killed outright in May, 1948, value loss ranged from about 8 per cent to about 18 per cent in different stands, but there was no direct relationship between loss and original value, as in white pine. (5) The recovery value of lumber from red pine logs seventeen months after the fire was greater than that of lumber from white pine logs despite substantially higher original value of the latter. (6) Value losses in the overmature jack pine averaged about 5 per cent. However, the original value was already depreciated because of incipient decay, and the results would probably not apply to jack pine stands of good quality. (7) Although the burn characteristics of the tree as a whole were indicative of the extent of deterioration following fire, the extent of bark-charring which occurred in the respective log lengths showed no relation to deterioration within the log.—M. L. Prebble and R. F. Fytche.

## PRAIRIE PROVINCES

(FORESTED AREA)

***Larch Sawfly Parasites.***—During 1948 and 1949 a number of areas in Saskatchewan and Manitoba were surveyed for larch sawfly parasites. Several thousand cocoons were collected each year and dissected to determine species and abundance of parasites. The two main species were *Mesoleius aulicus* Grav., and *Bessa harveyi* T.T. The following table shows the distribution of these parasites according to region and the degree of parasitism. As normally a large number of eggs of *Mesoleius* laid in the host fail to hatch and are not known to harm the host, the degree of parasitism by this parasite was divided into two categories: (*a*) sawfly cocoons containing only *Mesoleius* eggs, and (*b*) cocoons containing *Mesoleius* larvae.

| Data | Parasitism by Regions | | | | | |
|---|---|---|---|---|---|---|
| | Manitoba | | | | Saskatchewan | |
| | Southern | Eastern | Western | Riding Mtn. National Park | Eastern | Central |
| 1948 | | | | | | |
| *Mesoleius* eggs only... | 11·3 | 4·9 | 11·4 | 23·8 | 17·6 | 9·4 |
| *Mesoleius* larvae only. | 1·7 | 0·4 | 2·9 | 3·2 | 2·2 | 1·3 |
| Per cent *Mesoleius* eggs hatched....... | 13·1 | 7·5 | 20·3 | 11·8 | 11·1 | 12·1 |
| *Bessa harveyi*......... | 1·2 | 18·8 | 2·5 | 15·7 | 1·6 | 0·7 |
| 1949 | | | | | | |
| *Mesoleius* eggs only.. | 0·5 | 1·4 | 8·7 | 11·8 | 4·3 | 22·9 |
| *Mesoleius* larvae only. | 4·0 | 2·6 | 5·4 | 1·8 | ·5 | 7·0 |
| Per cent *Mesoleius* eggs hatched....... | 88·9 | 65·0 | 38·3 | 13·2 | 10·4 | 23·4 |
| *Bessa harveyi*......... | 13·5 | 17·4 | 7·4 | 9·9 | 4·7 | 1·7 |

In 1948, the highest parasitism by *Mesoleius* occurred in western Manitoba, Riding Mountain National Park and eastern Saskatchewan. In 1949, however, the highest parasitism occurred in central Saskatchewan. It remained about the same in Riding Mountain National Park but decreased noticeably in eastern Saskatchewan. The species also decreased to a lesser degree in southern and eastern Manitoba. A very marked improvement in the percentage of *Mesoleius* which hatched in 1949 was noted.

*Bessa harveyi* was again most abundant in eastern and southern Manitoba in 1949 but it also increased in eastern and central Saskatchewan. The highest parasitism by this species seems to occur where larch sawfly populations are subsiding.

Through the co-operation of the Dominion Parasite Laboratory, Belleville, a large number of parasites were made available for release in 1949. Liberations were made in six selected areas in Saskatchewan and Manitoba in the following quantities:—

7,885 *Mesoleius aulicus* Grav. in 6 areas
54,000 *Tritneptis klugii* Ratz. in 3 areas
3,000 *Aptesis basizonia* Grav. in 1 area

The establishment of these parasites in the release areas will be followed carefully.—V. Hildahl.

(AGRICULTURAL AREA)

***The Caragana Seed Chalcid, Bruchophagus sp.***—Oviposition by this chalcid in caragana seed pods commenced about June 7 and was at a peak level from June 22 to June 25. There was a positive correlation between the percentage of seeds infested and pod diameters up to the 2·5 mm. size but for pods of greater diameter there was no correlation. There was also no correlation between the percentage of seeds infested and the mean maximum temperature or the mean relative humidity of the surrounding atmosphere.

Twenty-five females killed one day after they emerged as adults had an average per female, of 61 ova in all stages of development; the maximum and minimum numbers were 159 and 16 respectively.

In samples of seed from the Dominion Experimental Station, Scott, Sask., 21 per cent of the chalcid larval population in *Caragana frutescens* and 27 per cent of the larval population in *C. pygmaea* were parasitized.—A. F. Hedlin.

***The Fall Cankerworm, Alsophila pometaria Harris.***—It was erroneously reported in the Bi-Monthly Progress Report, January-February, 1950, under the heading "Tree-trunk sprays" that, "Chlordane, parathion, chlorinated camphene, and DDT, all at the rate of 20 lb. per 100 gallons of water were applied to field shelter-belts with almost similar pupal populations." Parathion (15% wettable powder) was applied at the rate of 10 lb. actual per 100 gallons of water in this study.—F. R. Hammond.

## ROCKY MOUNTAIN REGION

***Lodgepole Needle Miner.***—The biological control picture in connection with the lodgepole needle miner appears considerably brighter after determining parasitism of early stage larvae by sectioning. Parasitism of this portion of the population combined with that of later stage larvae and pupae gave a figure varying from 50 to 75 per cent in older portions of the outbreak area. Extremely cold weather prevailed in Banff Park in January. The mean minimum temperature was -26·65° F. at Banff and the mean maximum, -5·25° F. Once during the month the temperature reached -60° F. and twice -50° F. Spot sampling will soon be carried out in advance of the main population sampling, to get some idea of the effect of these low temperatures on needle miner mortality.—G. R. Hopping.

## BRITISH COLUMBIA

***Ambrosia Beetles.***—The defect in lumber caused by ambrosia beetles, and known to the Industry as "pinworm" damage is a problem of world-wide importance. In British Columbia it received its greatest initial publicity in 1928 and in subsequent years, when B.C. timber entering the Australian market failed to pass the quarantine standards of that country because of the presence of live beetles in the lumber. Inspections of the cargoes were costly and further losses were sustained when infested material was treated or ordered to be destroyed. The expense and delays were so serious that shipping and commission merchants in Vancouver insisted that their suppliers give them guarantees that timber furnished by them was free from this borer. Restrictions in the export trade, are, however, not the only effect produced by beetles.

The efforts of a country to exclude foreign ambrosia beetles can be understood by reference to the nature of losses incurred by these insects. The losses originate through the severe degrade and devaluation of the better classes of lumber perforated by the beetle tunnels. The ultimate economic losses, however, are not always readily appreciated, and although concern over the defect is expressed by millmen from time to time, no accurate appraisal of loss has been made. This lack of precise information can be attributed to two main causes.

In the first instance, the governmental log rules, allowing a margin in scaling to provide for such eventualities as the one here being considered, have led to a degree of acceptance of the damage. The fact is that the presence of severe beetle damage, leading to increased slabbing waste, may reduce the overrun of the mill, which would otherwise be clear profit.

In the second instance, the problem of assessing the losses is an extremely complex one. Since the defect is technical rather than structural, the loss is not a simple all-or-none phenomenon to be measured as a direct volume loss. Neither is it to be measured simply by comparing the actual value of the lumber yielded from logs, with the value which would be represented if ambrosia beetle damage were absent. In addition to losses through degrade there are more obscure losses relating to the efficiency of mill production.

In order to avoid degrade as much as possible, the sawyer may alter the cut to produce different classes of lumber in which the defect is less important or an attempt may be made to eliminate the beetle-damaged wood by removing thicker slabs of wood with the bark. The implication of this procedure is that the mill obtains a smaller lumber output than would be expected from the logs which it manufactures into lumber. In other terms, this signifies an increase in manufacturing costs. Sometimes it is necessary for the head sawyer to run extra cuts until all beetle tunnels are eliminated from the face of the log. Since the production of a mill is geared to the capacity of the head-saw, the effect of the extra manufacturing on the head-rig is a slowing of mill output.

The source of the damage on the British Columbia coast is the infestation of green felled-and-bucked timber exposed to ambrosia beetle attack from April until November. Frequently, large inventories of logs remain exposed for several months prior to yarding and removal to the mill. It might, therefore, be theoretically possible to minimize the losses by

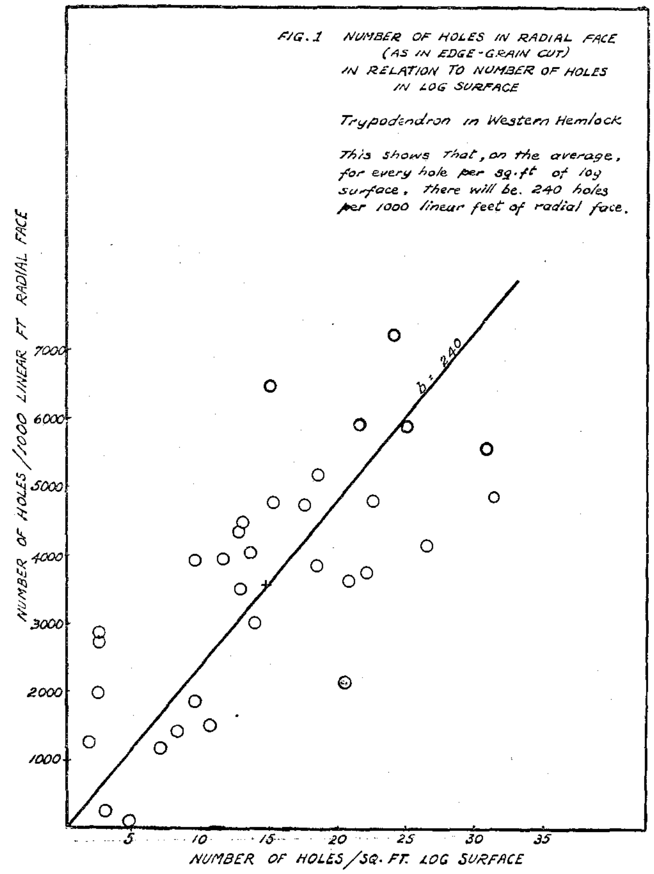


FIG. 1 NUMBER OF HOLES IN RADIAL FACE (AS IN EDGE-GRAIN CUT) IN RELATION TO NUMBER OF HOLES IN LOG SURFACE

*Trypodendron* in Western Hemlock

This shows that, on the average, for every hole per sq. ft of log surface, there will be 240 holes per 1000 linear feet of radial face.

reducing the size of the inventories held at any one time. To a large degree, however, that suggestion may not be compatible with the existing economics of logging. It ignores the use of large machinery requiring capacity operation. It overlooks the hazard of yarding too close to fallers. It does not consider the possibility of shut-downs for fire, nor the practice of building up log inventories against the eventuality of labour shortage. Thus control by alteration of logging schedules will be acceptable only if it can be proved to be economically sound. This requires accurate appraisal of losses. Similarly the application of chemicals for the protection of logs can be justified only when further information is available on the losses caused by ambrosia beetles. These losses can be determined only under normal mill conditions.

The results of a mill study would be only an isolated example of the loss which may occur, if there is no means of stating, in objective terms, the severity of beetle damage in the logs milled. It would be difficult to state whether the losses determined represented conservative or extreme conditions. Two phases of the project were studied. The Forest Products Laboratory obtained the data on milling and the Forest Insect Unit undertook the study of defining the condition of the logs.

The following account deals with the latter problem, i.e. the definition of a "damage index".

The defect by ambrosia beetles in a log presents essentially a problem of the frequency distribution of the holes in the wood. The extent and severity of the injury should be proportionate to the frequency and depth of holes and the proportion of the log volume which the injury involves. Their measurements *will eventually provide the damage index which can be translated, from the results of the mill studies, into terms of value loss for each log species, diameter class and grade of log.*

Observations were obtained on Douglas fir and western hemlock infested with *Trypodendron cavifrons* Mann. Measurements were recorded from slabs coming off the edger, the slabs bearing numbers assigned to them on the transfer chain, relating them to particular logs followed through their complete course from the jack-ladder to the finished product. Sampling of the condition in each log was based on two slabs, 4 feet in length, from opposite sides of the log. The edges of these slabs had trimmed faces to at least the full depth of the beetle holes. Thus the two slabs from each log presented altogether four faces, approximately radial, in different quadrants of the log. The average value of the data recorded from these faces was used as being representative of the average condition in the log.

The slabs were stripped of bark, the dimensions recorded and the number of holes on the surface tallied according to species of beetles. The occurrence of *Trypodendron,* almost exclusively, was a decided advantage in the subsequent analysis of data. All the holes in the trimmed edges of the slabs were tallied according to depth to the nearest tenth-inch interval, this interval being chosen as combining the merits of a practical degree of precision with ease of mathematical manipulation. In the treatment of the data these measurements of depth of holes were rearranged to show the frequency of occurrence of holes in each tenth-inch interval of depth for each log. This described the distribution radially toward the centre. The total number of holes in the four radial faces representing each log was reduced to an average number per linear foot of radial face. To avoid fractional values the number was stated in terms of 1,000 *linear* feet.

If correlations and consistency occur, the data should not be restricted to the case at hand but may be presented as generalizations. Thus the problem of describing the damage observed in the logs was considered as being not merely that of presenting all of the pertinent variables, but also of determining whether any correlations existed between the variables and whether the character of certain individual variables exhibited mathematical consistency. The immediate problems were those of determining (*a*) whether consistent relationship existed between the number of holes in the log surface and the number in the average radial face, and (*b*) whether any predictable relationship exists between depth and frequency of occurrence of holes.

Correlation analyses showed that with *Trypodendron* infestation in hemlock, for every hole per square foot of log surface there were 240 holes per 1,000 linear feet of radial face, the correlation coefficient being 0·694 (n=32 logs). In Douglas fir the ratio was 220 holes per 1,000 linear feet of radial face, the correlation being 0·827 (n=10 logs). It should be noted, however, that this consistency occurs because *Trypodendron* completes its attacks and boring in a short period. Consequently all galleries studied had reached their limit. Consistency would not be expected for *Gnathotrichus* or *Platypus.*

The mean number of holes in each tenth-inch interval of depth was determined for 32 hemlock and 10 Douglas fir logs respectively. To provide a generalization, the frequency at each depth was converted to percentage of total. Expressed in two histograms (one for hemlock, one for fir) the frequency distribution showed the greatest proportion near the surface and diminishing in frequency with depth. Summing the proportion of the total number in the outer ½, 1, 1½, 2, 2½ inches of radius, there were, respectively, in hemlock, 48 per cent, 75 per cent, 91 per cent, 98 per cent of the holes. In Douglas fir the percentages were 80 per cent, 97 per cent, 100 per cent for depths of ½, 1 and 1½ inches. At this stage of

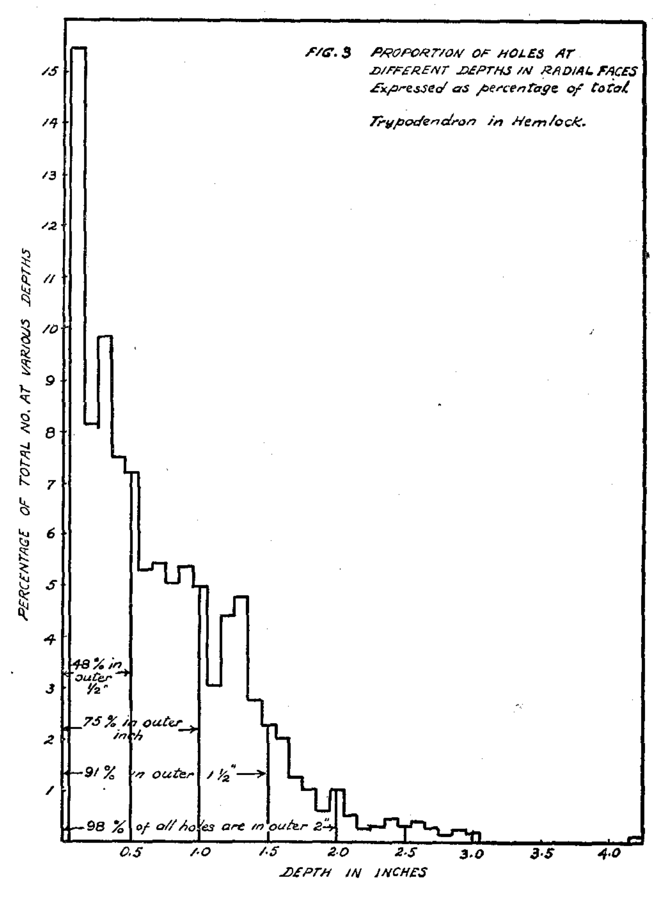


FIG. 3 PROPORTION OF HOLES AT DIFFERENT DEPTHS IN RADIAL FACES Expressed as percentage of total

*Trypodendron* in Hemlock.

the analysis, the data merely describe the average distribution of the holes in all of the logs studied. It remained to be ascertained whether the number of holes at any depth or in any specified outer layer of the log were in conformity with a natural law, and hence predictable. To be predictable, the frequency distribution must comply with simple mathematical relationships. The distribution was then studied on the basis of this premise.

It was to be expected that the frequency of holes appearing at successive points in depth would involve a root function either of frequency or depth or both, and indeed the histograms exhibited what appeared to be exponential characteristics. Correlation analyses proved that an inverse straight line relationship occurs between depth and logarithm of frequency. The inverse correlations approached mathematical perfection, with −0·938 for *Trypodendron* in hemlock, and −0·920 in Douglas fir. It can thus be stated with reasonable certainty that the observed distributions of holes with depth may be regarded as a general description of *Trypodendron* infestation in logs. A different picture may hold for other genera of ambrosia beetles. (It should be noted that the difference between hemlock and Douglas fir are attributable to the fact that in hemlock there is no sharp delimitation of sapwood depth to impose a restriction on the free diffusion of beetles into the logs, and they may penetrate to a depth of 4½ or 5 inches. In Douglas fir, the sharp distinction of heartwood from sapwood marks the maximum depth to which ambrosia beetles penetrate, in this series of logs, 1½ inches. In some Douglas fir logs the sapwood is 2 or 2½ inches in thickness.)

In summary, the foregoing analyses show, for *Trypodendron* attacks, that the total number of holes appearing on an edge-grain surface is directly proportionate to the number of beetle entrance holes in the log surface. A relatively constant relationship holds, moreover, for all densities of attack. Thus, in hemlock, for every hole per square foot of log surface, there are, on the average, 240 holes per 1,000 linear feet of edge-grain face, or 1 every 4 linear feet. If there are 100 holes per *square foot* of log surface as is not infrequent, there would be 24,000 holes per 1,000 linear feet, or 24 per foot of edge-grain face.

The distribution in depth is such that for all densities of attack, certain definite proportions of all holes occur at stated depths. From the point of view of a mill operator, the important consideration is not what percentage occurs at any stated depth but what percentage occurs in the outer 1, 1½, 2, 2½ inches so that he will have an idea of how much of the defect will be slabbed away with the bark in normal milling procedure. These percentages were presented above.

For purposes of mill studies or of log deterioration, involving *Trypodendron*, the number of holes in the log surface will generally suffice as the "damage index" denoting the *severity* of injury inside the log. The proportion of the total log content exhibiting the damage will be inversely related to log diameter. The amount of lumber degraded, and the severity of degrade will be related to, and thus described by, beetle attacks per square foot of log surface, proportion of log contents involved by the attack, and the grade of the log. Future mill studies will employ these measurements in the definition of the material examined. In reverse, then it will become possible to assess the value loss simply and speedily.—Kenneth Graham and H. A. Richmond.

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OTTAWA: Printed by EDMOND CLOUTIER, C.M.G., B.A., L.Ph., Printer to the King's Most Excellent Majesty, 1950.

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DEPARTMENT OF AGRICULTURE
OTTAWA

# DOMINION DEPARTMENT OF AGRICULTURE

SCIENCE SERVICE—DIVISION OF ENTOMOLOGY

Published by Authority of the Right Hon. James G. Gardiner, Minister of Agriculture

VOL. 6
REPORT
NUMBER 3

**FOREST INSECT INVESTIGATIONS**
**BI-MONTHLY PROGRESS REPORT**
OTTAWA, CANADA

May-June
1950

# CURRENT ACTIVITIES

## MARITIME PROVINCES

***On the Apparent Spread of Birch "Dieback".***—The first signs of the condition of birch which is now known as "dieback" were noted in south-central New Brunswick in 1932, although it was not definitely recorded until 1935. By 1939 the injury was evident in all parts of the Province, and also in Cumberland and Colchester counties in Nova Scotia, in northern Maine, and in Quebec south of the St. Lawrence River. At this time many dead and dying trees occurred in the areas first affected. Plot studies and general surveys have indicated that there has been a continual increase in the size of the area affected. It now includes practically all the yellow birch regions in Canada east of Ontario.

The cause is not yet fully understood. Studies by the Fredericton Laboratory have shown that the condition cannot be explained simply as the result of outbreaks of the bronze birch borer, although this insect has contributed to the injury in the later stages. No satisfactory evidence has yet been found that a fungus, or other micro-organism or virus, is responsible. It has frequently been suggested that the "dieback" is a purely physiological condition induced by unfavourable climatic factors, the results of which have been intensified by extensive opening up of stands by severe cutting, and by overmaturity.

Before any explanation is accepted, it must be found to fit the following facts. The injury has appeared on practically all birch over extensive areas and caused severe damage and much mortality over a period of from 5 to 10 years. It has not, however, appeared simultaneously over the whole of the Maritime Provinces, but over a steadily increasing area as though spreading from the general region of central New Brunswick. It became evident, for instance, in northern New Brunswick some 5 years later and on Cape Breton Island at least 10 years later. A physiological cause would seem most likely to have its origin in climatic conditions, the most plausible of which would be a period, or periods, of drought. It is difficult to fit such an explanation unless some reasonable correlation can be found between periods of severe drought and the appearance of the symptoms.

In order to check on the observations of "spread" and possible correlations with dry periods, studies have been made of the ring growth of yellow birch at a number of points throughout the affected area. Hard maple and beech trees were used as checks. In 1949 special attention was paid to a comparison between stands near Fredericton, N.B., where "dieback" was first definitely noted about 1935 and surviving birch are now recovering, and on Cape Breton Island, where it appeared latest in the Maritimes about 1945. Increment cores were obtained from 200 severely injured (classes 3B and 4) yellow birch in stands within these areas which had not been disturbed. Cores were also taken from 80 hard maple in the same stands. The trees chosen were dominant or co-dominant, comparable as to age, and not considered overmature.

Precipitation records since 1918 were examined for 8 stations in New Brunswick, and a similar number in Nova Scotia, extending from Edmundston, N.B., to Sydney, N.S. As the growth period in the Fredericton area has been found by dendrometer studies at D.B.H. to last from about mid-May to about mid-August, the records were summarized for the 12-month period of September to August and also for the 4-month period of growth. In addition, the daily precipitation data were examined for long rain-free periods during the growing season which might be masked in the totals for the season.

The following conclusions have been drawn:—

1. There is a fair correlation between the growth of the three hardwood species and precipitation up to the time of the appearance of "dieback". After this time the growth of the maple and beech continued to fluctuate normally while that of the birch dropped rapidly.

2. A marked decline in ring growth of birch accompanied the appearance of "dieback", but there was no evidence that the symptoms were preceded by a period of reduced growth. The time of appearance of abnormal reduction of growth was not related to age, or rate of growth, although the eventual damage has been greater in the older or slower growing trees.

3. Reduced growth due to "dieback" occurred on Cape Breton Island 10 or 11 years later than in central New Brunswick. At intermediate points in Cumberland and Colchester counties, N.S., it occurred about 5 years later; in Madawaska County, N.B., about 4 years later; and on the Grand Cascapedia River, Gaspe Peninsula, P.Q., about 6 years later. These results coincide with reports of appearance of symptoms.

4. There is no corresponding difference in the precipitation data for these regions. More severe deficiencies and corresponding growth reduction occurred in New Brunswick during the years 1921 to 1924 (particularly 1921) than during the years 1929 and 1930 which preceded the onset of "dieback" in that Province. A far greater precipitation deficiency occurred on Cape Breton Island in 1921 than in any subsequent year and yet no symptoms of injury resulted. Greater growth reductions resulting from precipitation deficiencies took place during 1921 and 1930 on Cape Breton Island than in central New Brunswick. A considerable growth reduction also occurred on Cape Breton Island during the three dry years 1932 to 1934, when "dieback" symptoms were appearing in central New Brunswick, but normal growth was resumed and no symptoms appeared in that area until more than a decade later. By that time recovery from "dieback" was evident in New Brunswick.

5. Unless more exact methods of measuring the effects of precipitation deficiencies and other meteorological factors on the physiology of birch can be devised, and based on greater knowledge of the seasonal water requirements of the tree, it is not possible to explain "dieback" as a direct result of drought. The apparent spread of the symptoms suggests that an organism or virus is involved. If such a pathogen exists, it is still possible that its epidemiology and pathogenicity are determined by climatic or other factors influencing the vigour of birch stands.—G. W. Barter and R. E. Balch.

## NORTHERN ONTARIO

***Wood-borers in Fire-killed Pine.***—A preliminary identification has been made of larvae of wood-boring beetles which were recovered in analyses of fire-killed white, red and jack pine trees in the Mississagi area in the course of studies carried out during 1949. Seven species have been identified including *Monochamus notatus* (Drury), *Monochamus scutellatus* Say, which bore deeply into the wood; *Xylotrechus* sp. and *Tetropium cinnamopterum* Kirby, which enter the wood but not deeply enough to be serious agents of deterioration, and *Acanthocinus obsoletus* Oliv., *Asemum moestum* Hald., and *Stenocorus lineatus* Oliv. which were found feeding under the bark, but not entering the wood. Three other species have been recovered, but their identity is still unknown. The field studies carried out in 1949 included sectioning of trees which had been killed outright by the fire in June of 1948, and others which were dying gradually during 1949 as a result of less severe injury at the time of the fire. Field studies have been resumed in 1950 and will be concerned primarily with beetle attack in trees and stands which are gradually dying as a result of root or crown injury suffered in 1948.—L. M. Gardiner.

## PRAIRIE PROVINCES

(AGRICULTURAL AREA)

***Forest Insect Survey.***—The departure of the forest insect rangers marks the beginning of the field season. The rangers begin their field work about the time the boxelder is in half leaf, and general phenological conditions indicate that insect activity will begin very shortly.

The lateness of the present season may be gauged by comparing the hatching dates (field), of the fall cankerworm, *Alsophila pometaria* (Harr.), for the last four years. Cankerworms hatched May 10, 1946 (Herbert, Sask.); May 10, 1947 (?); May 24, 1948 (Candillac, Sask.); April 28, 1949 (Shaunavon, Sask.). As yet (May 29, 1950), no record of hatching has been received for the current season. The above localities are all situated in the short-grass prairie of south-western Saskatchewan where the climatic conditions are approximately similar.

Some phenological conditions observed at Indian Head on May 29, 1950, are as follows: Boxelder—stamens dropped, first leaf unfolded; green ash—pollen shed, first leaf unfolded; Colorado spruce—scales bursting from male cones; lilac (*S. vulgaris*)—first small leaf unfolded; honeysuckle (*L. tatarica*)—first leaf unfolded. The above list indicates the lateness of the season; ordinarily these phenomena take place early in May.—C. E. Brown.

***Notes on the Conifer Aphids, Genus Cinara.***—The following species of *Cinara* have been identified to date:—

| | | |
|---|---|---|
| *C. hottesi* Gillette and Palmer | white spruce | Que., Ont., Sask. |
| | Engelmann spruce | B.C. |
| *C. fornacula* Hottes | white spruce | Que., Ont., Sask. |
| *C. coloradensis* Gillette | white spruce | Que., Ont., Sask. |
| | Engelmann spruce | B.C. |
| *C. lasiocarpae* Gillette and Palmer | balsam fir | N.B., Que., Ont., Sask. |
| | alpine fir | B.C. |
| *C. curvipes* Patch | balsam fir | N.B., Que., Ont., Sask. |
| | alpine fir | B.C. |
| *C. laricis* Hartig | tamarack | Que., Ont. |
| *C. pergandei* Wilson | jack pine | Sask. |
| | Mugho pine | Ont. |
| *C. atra* Gillette and Palmer | jack pine | Ont. |
| *C. pini* Linnaeus | Scotch pine | Que., Ont. |
| *C. strobi* Fitch | white pine | Que., Ont. |
| *C. rubicunda* Wilson | common juniper | Que., Ont. |

Other species, not identified as yet, have been collected from white spruce, jack pine, red pine, and red juniper.

Each species of *Cinara* is restricted to one genus of host tree; for example, the species occurring on *Pinus* are never found on *Picea* or *Abies*.

The aphids are subject to severe attack by predators and parasites, and various habits have been evolved in order to avoid complete extinction. Certain species are always found in dense colonies, protected from their predators by hordes of attending ants. *Cinara atra* Gillette and Palmer is an excellent example of this type of protection. There is always an ant colony close to the aphid colony and the ants and aphids occur in almost equal numbers on the trees. Most predators are driven off by the ants, so that the aphid colony enjoys relative freedom from attack. *Cinara pergandei* Wilson on the other hand relies on wide dispersal to escape its enemies, and rarely are two individuals of this species found together, even the newly produced young being immediately left to shift for themselves.

Another adaptation which helps protect the aphids from their predators is the production of a waxy secretion which spreads out over the surface of the body from the cornicles, and which appears to have a repellent effect on other insects. This secretion is lacking in *C. atra*, the body being glabrous, with a polished appearance, but it is well marked in *C. pergandei* and the other species.

The most important habit in relation to the preservation of those species which occur in large unprotected colonies, is the rapid production of winged forms. The chief predators of these aphids are coccinellid beetles. The aphid population, having developed from the overwintering eggs on the host tree, has an initial advantage over the coccinellids, which must first locate the colony, lay their eggs, and develop to about the stage of half-grown larvae before they become really effective as predators. Before predation becomes too severe, however, the aphid colony has produced a winged generation of partho-genetic females, which immediately leave the original host tree and establish a multiplicity of small colonies on other trees of the same species, leaving the coccinellids behind to devour the remaining wingless females of the preceding generation. Trees which supported vast numbers of aphids in the early part of the season are usually left completely free of aphids later on in the year.—G. A. Bradley.

## ROCKY MOUNTAIN REGION

***Lodgepole Needle Miner.***—In the Bi-Monthly Progress Report for March-April mention was made of the possible effect of extremely cold weather in January on the population of the lodgepole needle miner. From spot sampling and the beginning of more detailed population sampling, the winter mortality can now be indicated. On the floor of the Bow Valley, between Banff and the Great Divide, larval mortality is over 99 per cent. On the slopes at 500 feet above the valley floor the mortality is between 80 and 90 per cent; while at the 1,000 to 1,500 foot levels, the mortality in some places may not exceed 70 per cent. Unfortunately the parasites of the needle miner suffered in proportion.

This heavy kill is probably due to the low temperatures cited in the previous report. There are two plausible explanations for the progressively higher survival with an increase in elevation on the slopes. Temperature inversion may have been present during the colder periods. At Calgary, it is not uncommon in winter to have a "chinook" over-riding a cold air mass near the ground. On the other hand, it may have been due to a greater burden of snow at the higher levels affording added insulation and enabling the more vigorous larvae to survive. The temperature inversion factor during winter will be investigated further.

One interesting feature was the survival of larvae in green twigs blown down in a heavy windstorm in November, 1949. These wisps of foliage were covered by several feet of snow during the cold period. The survival in this material was between 50 and 60 per cent. However, this breakage occurred only on a few exposed points and was not prevalent throughout the forest. These larvae may attempt to regain the foliage of nearby trees but the mortality in transit probably would be severe. In any event, these larvae represent an extremely small fraction of the population.—G. R. Hopping.

***Spruce Budworm.***—Spruce budworm larvae had not emerged from hibernacula by May 15. Apparently they have suffered some winter mortality but the full extent will not be known until more intensive sampling has been completed. Preliminary spot sampling indicates a larval mortality varying from 42 to 60 per cent between Hawk Creek and Marble Canyon in Kootenay National Park. This is the result of the examination of 82 hibernacula. In the Bow Valley, between Johnson's Canyon and mile 24 west of Banff, the mortality ranged from 51 to 60 per cent, based on examination of only 24 hibernacula. Five parasites were found, three of them living.—R. F. Shepherd.

***Forest Insect Survey.***—The Rocky Mountain Region is experiencing one of the latest springs on record. Snow is still deep in the mountains and no excessive run-off has occurred. The leaves of deciduous trees such as poplars in Calgary are only about half developed and the aspens in the vicinity of Banff are just beginning to bud. Activity of conifer buds is scarcely apparent. Consequently insect activity has been retarded and only a few collections have been received. All insect rangers, with one exception, are in their respective districts and are using the period before the main collecting season to complete ranger headquarters and establish permanent sampling areas.—G. R. Hopping.

## BRITISH COLUMBIA

***Spruce Bark-Beetles.***—Studies on a bark-beetle infestation in the Bolean Lake region northwest of Vernon have been undertaken this year by personnel from the Vernon and Victoria laboratories. Although reports on hand indicate that the outbreak is only about 150 acres in extent, its importance lies in the fact that it is a recent development adjacent to a carefully managed logging operation. The development of this infestation is a matter of some significance as it is close to extensive stands of timber which have been preserved for future operations. Inspection in April, 1950 showed evidence of winter activity by woodpeckers and while many infested trees had been almost stripped of bark, it appears that the broods of bark-beetles below a six-foot snowline and in slash were protected. An intensive study of the activities and life-history of this insect was started in May and the effects of logging will be studied also in an effort to determine how present plans can be modified to cope with this rising insect hazard.—H. A. Richmond.

***Oak Looper.***—Although outbreaks of most of the defoliating insects which reached epidemic proportions in 1945 have now subsided, the oak looper (*Lambdina somniaria* Hlst.) has continued to defoliate and disfigure the oaks over the southern portion of Vancouver Island. The infestation is still active and spreading, and now occurs in almost all areas within the range of Garry oak on the Island. Egg counts made in April, 1950 indicate a population approximately the same as that in 1949. Although a decrease has occurred in areas of initial attack, an increase appears at the extremities of the infestation. The quantity of eggs deposited in the fall of 1949 shows that a marked increase in the number of larvae would have occurred in 1950. A heavy egg mortality, however, has greatly reduced the number of viable eggs. This is probably the result of severe winter conditions. In reviewing past records of this outbreak, disease has played a major role in natural control and in some areas dipterous parasites have been important factors. The following table shows the various causes of larval mortality.

| Control Factor | Per Cent Mortality of Larvae | | |
|---|---|---|---|
| | 1947 | 1948 | 1949 |
| Hymenopterous parasites | 0·3 | 1·3 | 0·3 |
| Dipterous parasites | 11·7 | 1·6 | 2·7 |
| Disease | 19·7 | 32·3 | * |
| Miscellaneous | 48·2 | 51·6 | 83·8 |

*Disease and miscellaneous not segregated at time of writing

While the above figures are of value only in a relative sense, they are believed to be indicative of current trends. A full-scale study of this insect is now in progress.—H. A. Richmond.

***Forest Insect Survey.***—Activities on the more southern coastal regions are under way but the extreme lateness of the season has retarded work very much. The vessel *J. M. Swaine*, is operating among the Gulf Islands but will proceed northward in early June to cover the areas north of Rivers Inlet. The following insect rangers are now in the field: M. T. Hughes, Prince Rupert District; D. C. Collis, northern portion Vancouver Island; H. West, southern Vancouver Island; W. D. Taylor, lower mainland, and E. G. Harvey, in charge of the *J. M. Swaine*. These men are assigned to those regions for the summer and may be contacted through the Provincial Forest Service or through the Forest Insect Laboratory, Victoria, B.C.—H. A. Richmond.

## RECENT PUBLICATIONS

Lejeune, R. R. The effect of jack pine staminate flowers on the size of larvae of the jack pine budworm, *Choristoneura* sp. Canadian Entomologist 82 (2): 34-43. 1950.

Sullivan, C. R. and G. W. Green. Reactions of larvae of the Eastern tent caterpillar, *Malacosoma americanum* (F.), and the spotless fall webworm, *Hyphantria textor* Harr., to Pentatomid Predators. Canadian Entomologist 82 (2): 52. 1950.

Bergold, G. H. The multiplication of insect viruses as organisms. Canadian Journal of Research, E, 28: 5-11, February, 1950.

## NOTICE

The July-August number of the Bi-Monthly Progress Report will be devoted exclusively to an account of the Laboratory of Insect Pathology, recently completed at Sault Ste. Marie, Ontario, and of the projects which are being carried out there on the diseases of insects.

It is believed that foresters, entomologists, and other parties concerned with the welfare of the forest will be interested to know something about this new laboratory and of the research work being done there. Dr. J. MacBain Cameron is officer in charge of the new laboratory.

OTTAWA: Printed by EDMOND CLOUTIER, C.M.G., B.A., L.Ph., Printer to the King's Most Excellent Majesty, 1950.

# DOMINION DEPARTMENT OF AGRICULTURE

SCIENCE SERVICE—DIVISION OF ENTOMOLOGY

Published by Authority of the Right Hon. James G. Gardiner, Minister of Agriculture

Vol. 6 REPORT NUMBER 4

FOREST INSECT INVESTIGATIONS
BI-MONTHLY PROGRESS REPORT
OTTAWA, CANADA

July-Aug. 1950


# THE LABORATORY OF INSECT PATHOLOGY SAULT STE. MARIE, ONTARIO

## INTRODUCTION

Although biologists have for many years been aware of the importance of pathogenic micro-organisms as factors in the control of insect outbreaks, and although many more or less abortive attempts have been made to use these organisms in control operations, it is only in very recent times that, thanks to some remarkable advances in microbiology, the practical application of this method on a large scale has become feasible. The spectacular reduction of the European spruce sawfly outbreak by a virus disease and several important and very similar developments in the control of other destructive species have materially stimulated the interest of scientists and of the general public in the possibilities of combating insect pests by artificial propagation and distributon of disease organisms. These are, in a general way, the motives that prompted the Government of Canada to erect a laboratory specially equipped for the study of insect diseases. In many respects this is a pioneer effort, and serious difficulties were encountered both in the planning and in the execution of the project. Many of the features incorporated in the structure and the equipment were patterned after facilities in laboratories in Canada and the United States where research in microbiology has been in progress for some time. On the other hand, some of the structural and mechanical devices are original and, it is hoped, will prove of interest to other institutions contemplating similar work. Our indebtedness to all the scientists who have assisted us with advice and suggestions, to the architects and engineers of the Canada Department of Public Works, to the National Research Council of Canada, and to the manufacturers of equipment is hereby gratefully acknowledged. Very special thanks are due to the members of the Forest Insect Control Board individually and collectively for their support and encouragement in the initiation and completion of the enterprise.

## DESCRIPTION OF THE LABORATORY

The Dominion Laboratory of Insect Pathology, which was designed and built under the auspices of the Department of Agriculture, was turned over to that Department by the contractors, on May 19, 1950. The building is located at 1195 Queen Street East, Sault Ste. Marie, Ont., on a site overlooking the St. Mary's River, on ample grounds to permit future expansion. It is about 84 x 86 feet and consists of a basement floor and main floor, with a 25 x 25 foot underground extension of the basement. The construction is of reinforced concrete faced with brick, lined throughout with insulating cork. All windows are of the Twindow type, with fixed sash.

There are three entrances to the building. The main entrance leads to a central lobby with offices at either side. On the east and west sides, entrances lead to a food-receiving and a diagnosis room, respectively. From each of these there is a pass-box through the wall to the laboratory room immediately behind, and a chute leading to the basement for disposal of debris. All incoming food and insect material pass through one or other of these rooms.

Three passages, which lead from the main lobby to the laboratory space, are so arranged that one-way traffic may be enforced. Men and women have separate entrances, through locker and shower rooms; the exit is through the basement and up a staircase to the lobby. The doors at the foot of the stairs are controlled by electric locks, operated from the office, so that entrance, except through the showers, is under control at all times.

The laboratory rooms are designed to avoid cross-contamination. Entrance to each room is through an air-lock with two doors, one being closed before the other is opened. Individual air-conditioning units supply each room and its associated cubicles, and the air from the cubicles is exhausted from the building rather than re-circulated. Light switches have been eliminated from the rooms insofar as possible, and are centralized in the general office, under control of the switchboard operator. The press-to-talk button on the intercommunication system is set in the wall just above the floor, where it is operated by toe pressure. The intercommunication unit is covered by an aluminum diaphragm sealed into the wall.

Insects are reared in "Horsfall Units", boxes constructed of stainless steel, about 18 x 18 x 17 inches. The units are arranged on racks, three rows of seven units to a rack. Each row of seven units has an independent air supply from an individual conditioning unit, so is sealed off completely from the room. The exhaust air from the units is not re-circulated but passes out of the building.

In addition to being conditioned, the fresh air supply for the entire building is sterilized. As it comes into the supply ducts it passes first through an electric "Precipitron" unit where most of the particulate material is removed. It then goes through a bank of ultra-violet lamps, and finally through an oil-treated mechanical filter. From this filter it is distributed to the various conditioning units where it again passes over germicidal lamps. Exhaust air from the cubicles and the Horsfall units, where contamination is apt to be high, is also sterilized before being discharged. Within the building, areas subject to contamination, such as cubicles, corridors, etc., are all equipped with germicidal lamps for sterilization.

Among the instruments provided for the laboratory is an electron microscope. In order to reduce to a minimum the troublesome vibrations frequently encountered with these instruments, a section of the floor in one of the basement rooms is separated from the main floor slab by a half-inch space filled with mastic. This section rests on three concrete-filled steel piles driven down to bedrock.

The room set aside for culture preparation is equipped with two autoclaves and a pouring bench. The bench is recessed under a hood in which there are three germicidal lamps, and is provided with a cooling section where the top is chilled to about 45° Fahrenheit. This cooling permits the rapid setting of culture plates, while at the same time they can be bathed in ultra-violet rays, thus reducing to a minimum accidental contamination while plates are cooling.

A room is provided for cleaning of laboratory glassware. It is equipped with an autoclave in which old cultures and other contaminated material are sterilized before being discarded. The sink has a garbage disposal unit so that waste material can be flushed down the drain, rather than collect for periodic disposal. A dry oven is provided for the drying and sterilizing of glassware following washing.

The underground extension referred to earlier, as well as one room in the main building, is devoted to chemical and physical investigations. It includes a small balance room with concrete pedestals which project through the floor slab into the earth to serve as vibrationless stands for the balances. In this section also is located the ultra-centrifuge, as well as the more usual equipment such as photometer, spectrophotometer, supersonic generator, etc.

All laboratory rooms in the building are supplied with electrical outlets, hot and cold softened water, distilled water, compressed air, vacuum and gas. To maintain these services, as well as the air-conditioning, an extensive mechanical installation is provided. There are two boilers of 50 horse-power each which generate steam at 50 pounds pressure by means of oil burners. The steam is used for the heating of the building, the hot water supply, the autoclaves and the making of distilled water. The water-still is located in the roof space, and from the 50-gallon storage tank, the water is distributed through plastic pipes to the laboratory rooms. Approximately 125 horse-power of refrigeration is provided, of which 100 horse-power is used for the air-conditioning needs of the building, the balance being utilized in the cooling and dehumidifying that is required for the Horsfall units, for the maintenance of low temperature in the two cold-storage rooms, the cooling of the preparation room table-top, and other similar small cooling jobs in the laboratory. All equipment is automatic in operation, governed by a system of pneumatic controls.

Two air compressors, one of 15 horse-power and one of 10 horse-power, are installed to provide the compressed air for the laboratories and also as motive power for the turbines of the centrifuges. A 3 horse-power vacuum pump serves the vacuum lines of the laboratory. There is also a gas-fired incinerator for the disposal of refuse from the various operations carried out in the building.

The present staff of the laboratory includes nine persons with specialist training in the fields of virology, mycology, bacteriology, histology and biochemistry. They are supported by a staff of eleven technicians, together with several seasonal assistants during the summer. Services are provided by a maintenance staff of five and an office staff of three. Project work is integrated closely with that of the Forest Insect Laboratory, and especially of the Forest Insect Survey from which much valuable material is received.—J. MacBain Cameron.

## RESEARCH ON INSECT VIRUSES

Research on insect viruses is about 100 years old and names of distinguished scientists, like Pasteur and v. Prowazek, are connected with it. Yet a better knowledge of these insect viruses has been reached only in the past few years since modern methods have been applied. It was the new methods of protein research in general and of the field of high molecular chemistry and physics in particular that made possible the great advances in the research of insect viruses. For these methods, very special equipment is necessary which is available only in a few laboratories in the world. The Laboratory of Insect Pathology is well supplied with this equipment, providing highly favourable working conditions for the staff of specialists.

The program of research is based on insect viruses, but much of the information gained is expected to be applicable to virus diseases of other hosts as well. Fundamental research is carried out on such projects as: microdetermination of amino acids; general chemical microanalysis; determination of nucleic acid; physical characterization of serum and virus particles using ultracentrifugation and diffusion measurements; ultrasonic and enzymatic treatment of virus particles; and morphological investigations using the electron microscope, in the search of a life-cycle and the mode of reproduction.

In addition to the fundamental studies, problems in the application of viruses to insect control are investigated. This part of the program is based largely on previous experience with other insects, and includes diagnosis of virus diseases; rearing of test insects; experimental infection; transmission, isolation, and purification of viruses; and mass multiplication of virus material for field or other large-scale use.—G. H. Bergold.

The possibility of correlating chemical constituents with biological specificity of the insect viruses is under consideration. Since the viruses and their accompanying polyhedral or capsular materials are of a protein nature, the present approach is through the constituent amino acids. However, investigation of the chemical constituents of insect viruses is limited by the small amounts of purified material available for this work to ultramicrotechniques. Paper chromotography is such a techinque for the determination of amino acids, and this procedure is being developed so as to be applicable to quantitative analyses.—E. F. Wellington.

## HISTOLOGY

The study of the normal histology of the spruce budworm, *Choristoneura fumiferana*, Clem., has been undertaken to form a background for histopathological studies stemming from the investigation of various pathogenic organisms. The project consists of the collection of the budworm in various stages and the study of the tissues, both living and morbid, in the process of growth, functioning, and breakdown. Since insect tissues have fewer component types of cells than, for instance, the vertebrates, the study of necessity becomes cytological. Consequently it involves many special techniques for the collection of information on intracellular structures. In addition, because of the cyclic nature of the development, particularly in the larval stages, the cytology has to be based on a knowledge of the intra-instar age of each animal. Initially a study of morbid larval tissues treated by standard haematoxylin and eosin technique was carried out with the emphasis on the sixth or last instar. This is now being enlarged by a study of living and vitally stained tissues. The next problem will be to refer back to the morbid tissues, continuing the standard methods but, in addition, using special treatments. The foregoing would produce a sufficiently complete picture to permit an investigation with histochemical tests. Some of the latter are important because of the significance in physiological processes of the substance tested, and some are of interest because of changes in their positions or quantities in pathological conditions.—S. S. Morton.

## HISTOPATHOLOGY AND EPIDEMIOLOGY OF INSECT VIRUSES

Histopathology is concerned with the study of the histological and cytological changes caused by the invasion and multiplication of viruses within the insect. This involves the study of tissues and cells of normal insects and insects infected with viruses. Permanent slides are prepared to show the normal condition and stages of the infection processes, and the abnormalities caused by the invasion of and multiplication in insect tissues by viruses. The electron microscope is also used in these studies.

The results of such studies are used in the diagnosis of virus infections and fundamental information is obtained on the multiplication of viruses, formation of virus inclusion bodies, and transmission of viruses from infected adults to their progeny. The results also form the basis for assessing the effect of various physical factors on the acceleration or retardation of virus infection processes.

Intensive studies of this nature have been conducted on the virus disease of the European spruce sawfly, *Gilpinia hercyniae* (Htg.) and similar studies are in progress on virus infections of the spruce budworm, *Choristoneura fumiferana* Clem. and the European pine sawfly, *Neodiprion sertifer* (Geoff.).

Epidemiology is concerned with the estimation of the control effected by virus diseases in naturally occurring or artificially induced epidemics affecting insect populations, and the continual search for new virus diseases. Immunity and resistance, virus specificity, the effect of various physical factors of the environment on the development of viruses within the insect and the hardiness of viruses outside the insect, and methods of virus transmission, are problems in the field of epidemiology.

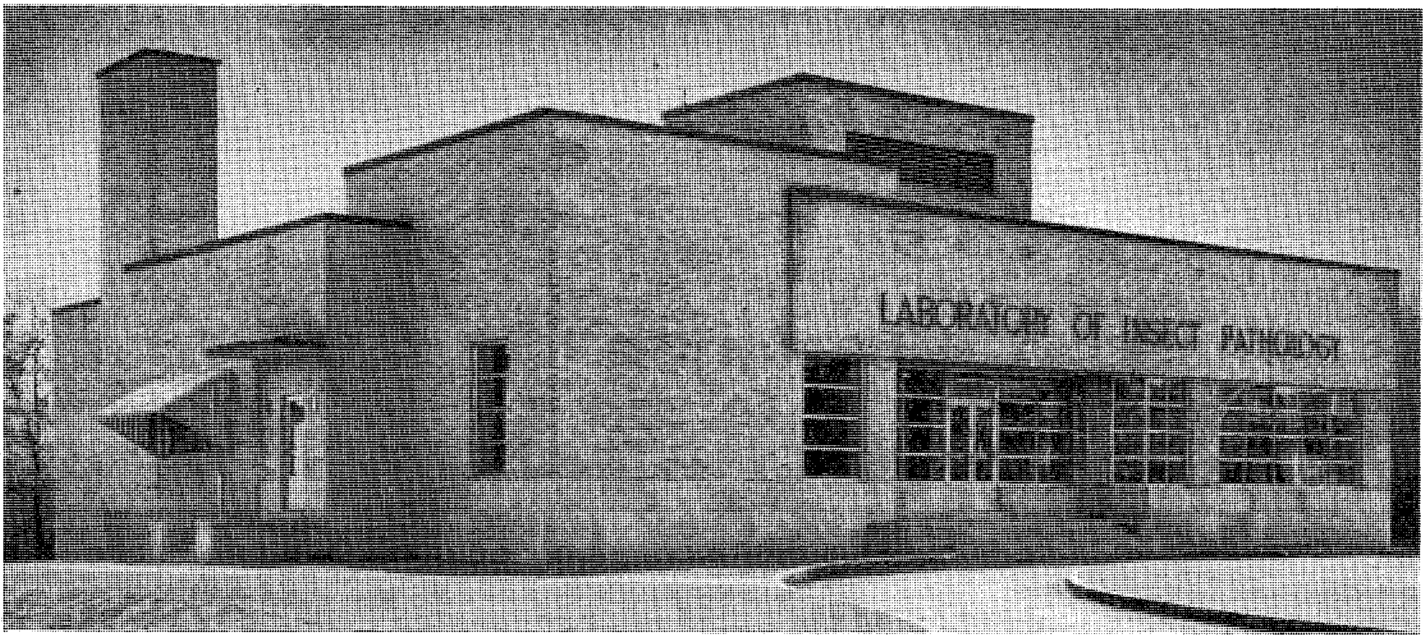
Many factors tend to control insect outbreaks. The control effected by parasitic and predaceous insects, predatory animals, climate, and other pathogenic diseases (fungi, bacteria, protozoa) must receive the same careful study as the virus disease whose effectiveness it is desired to estimate. Such a study is, therefore, a co-operative study between the various specialists of this laboratory as well as with specialists in the general field of entomology.

Epidemiological studies on the virus disease of the European spruce sawfly have been in progress in Canada since 1940. Similar studies are now in progress on virus infections of the spruce budworm and the European pine sawfly.

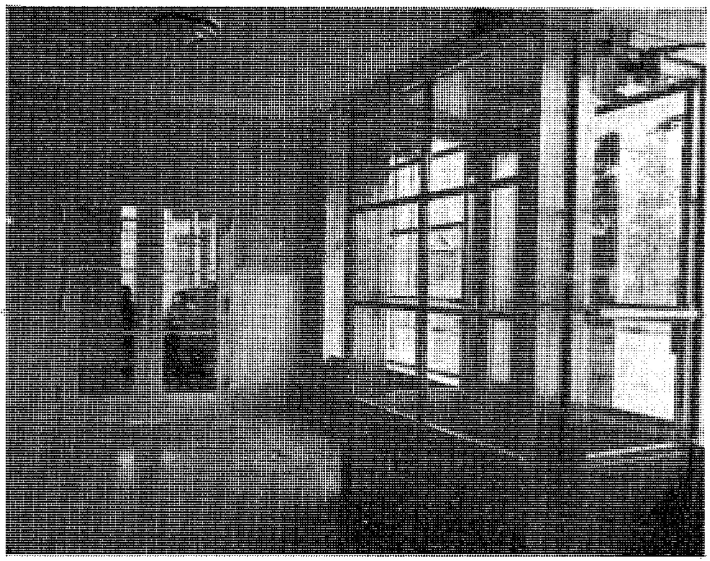
Studies are in progress on the artificial dissemination of viruses affecting the European spruce sawfly, *Gilpinia hercyniae* (Htg.) and the European pine sawfly, *Neodiprion sertifer* (Geoff.). In the latter study, a virus discovered in Europe and unknown in Canada, has been introduced in heavily infested pine plantations in southern Ontario. Heavy mortality from the disease resulted when the virus was disseminated in isolated infestations and indications are that this effort will be successful.—F. T. Bird and M. M. Whalen.

## RESEARCH ON ENTOMOGENOUS FUNGI

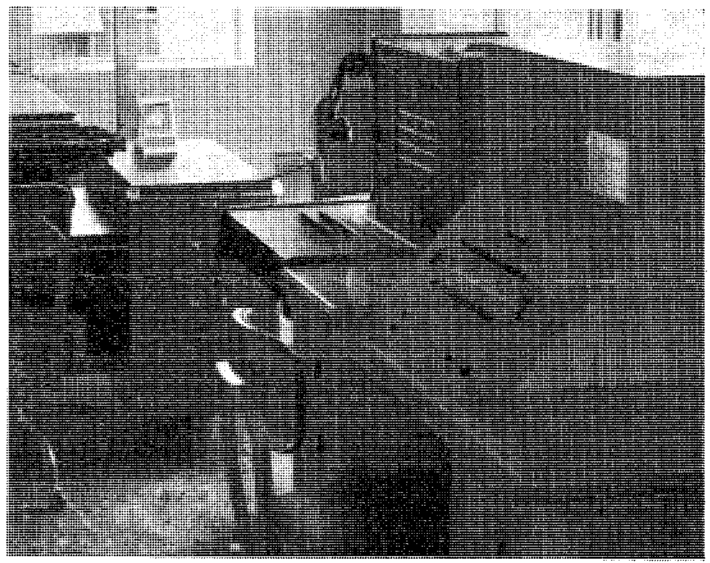
Investigations concerning the relationship existing between parasitic fungi and insects were undertaken in an endeavour to study the problem of utilizing disease-causing organisms in the control of insect pests. The



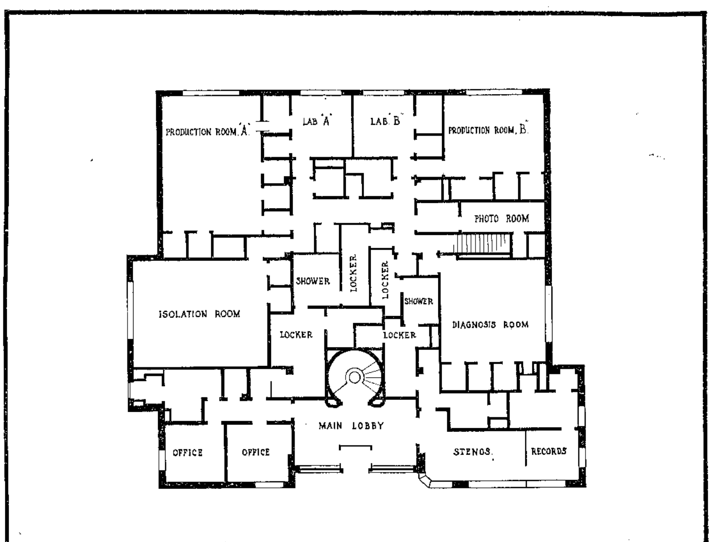

Dominion Government Laboratory of Insect Pathology.



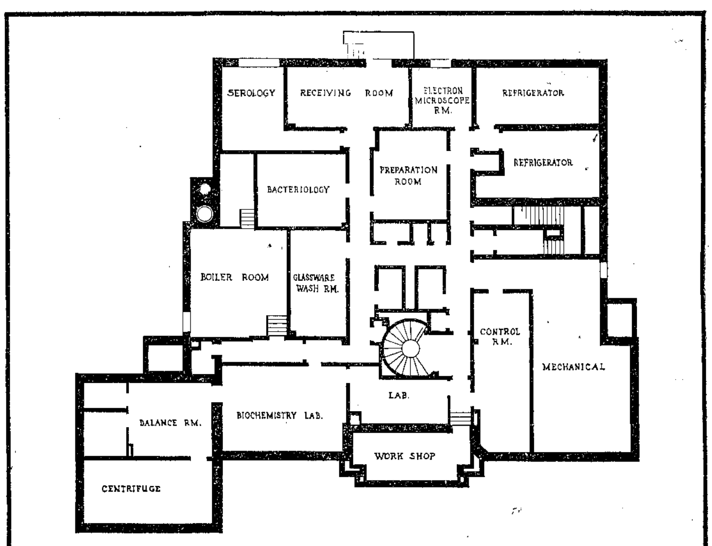
The main entrance lobby and general office.



Communications.

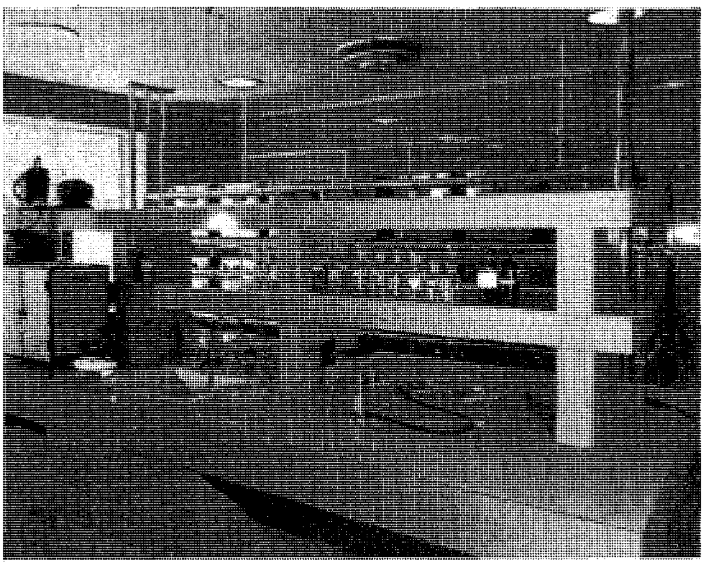



Plan of the main floor of the Laboratory.

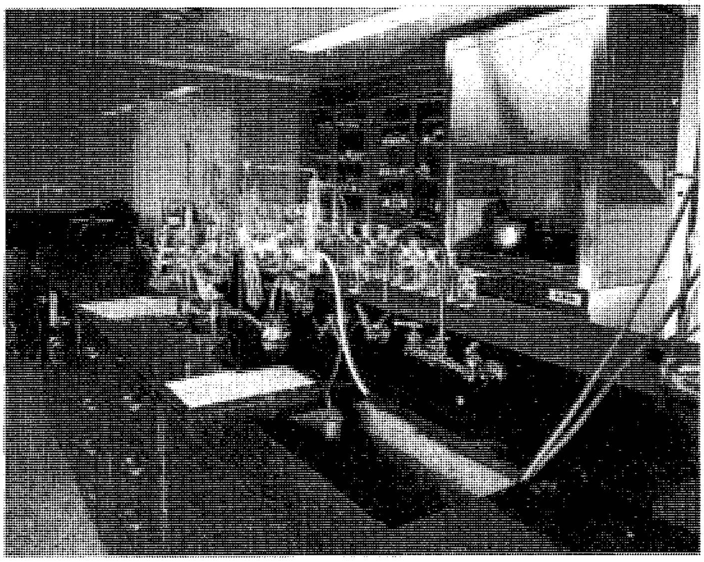



Plan of the basement floor of the Laboratory.

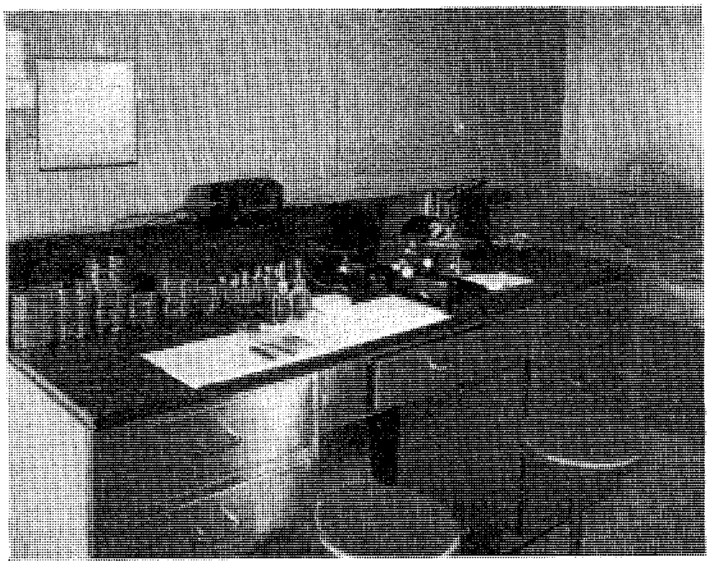
*Photographs by D. C. Anderson.*



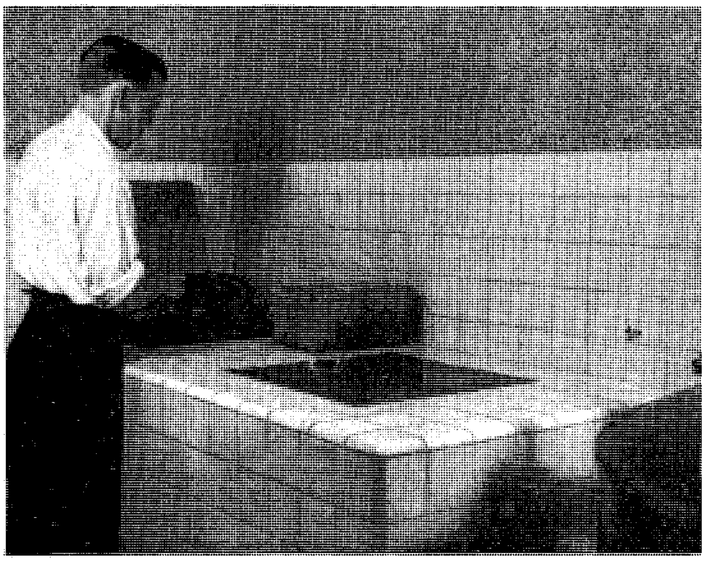
Histology Laboratory.



Biochemistry Laboratory.



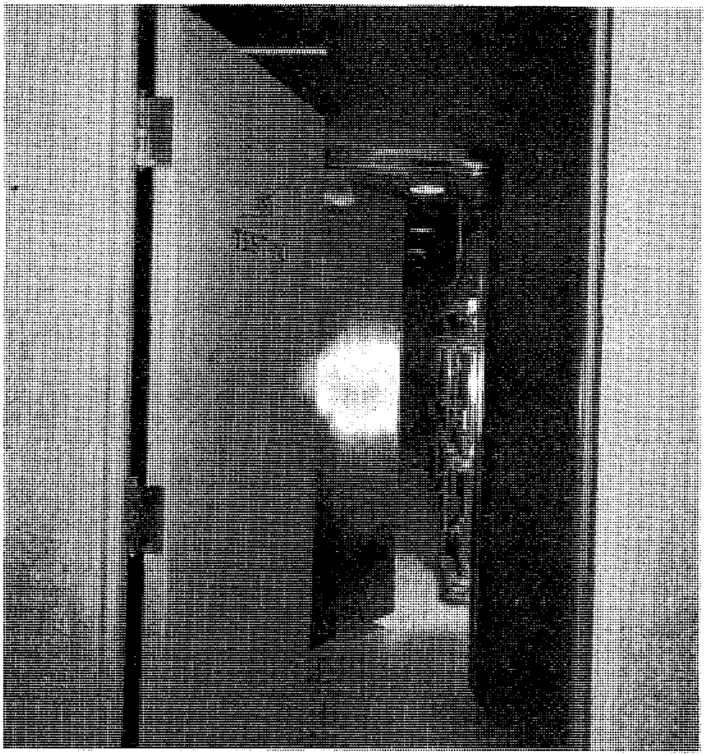
Diagnosis Laboratory.



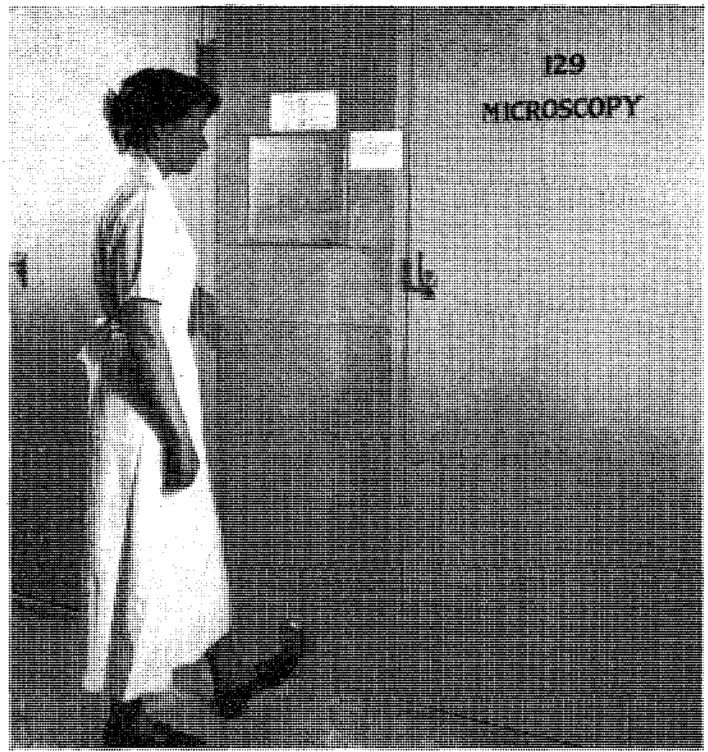
Placing food in the pass-box.

Removing food from the pass-box.

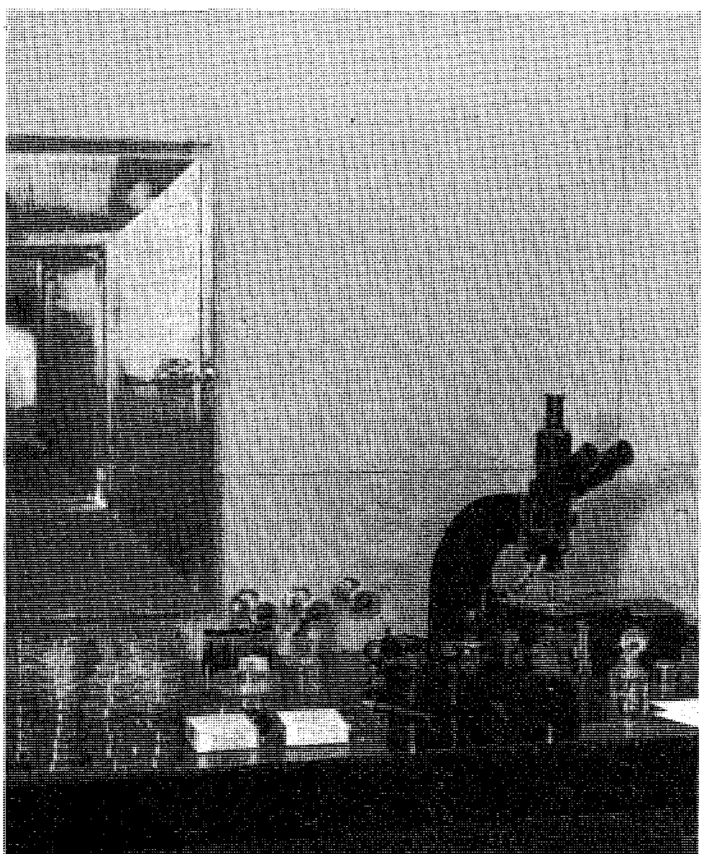
*Photographs by D. C. Anderson.*



Double doors provide an air lock at the laboratory entrance, Horsfall Units in background.



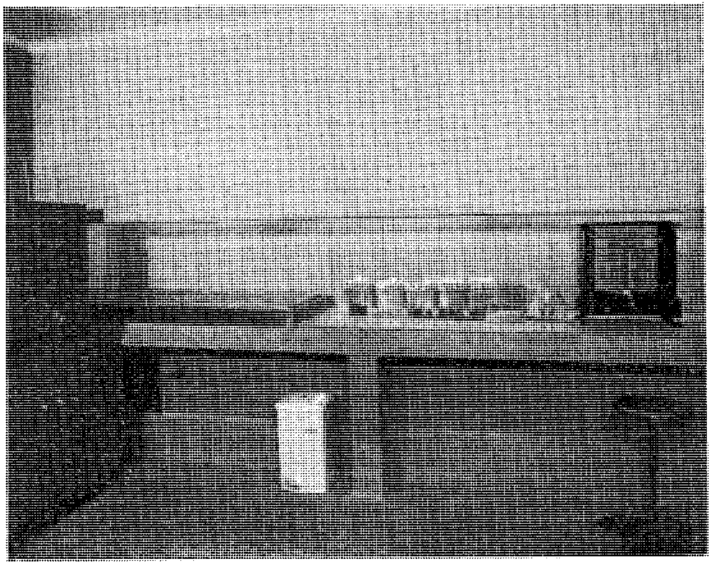

The Laboratory Inter-communication unit.



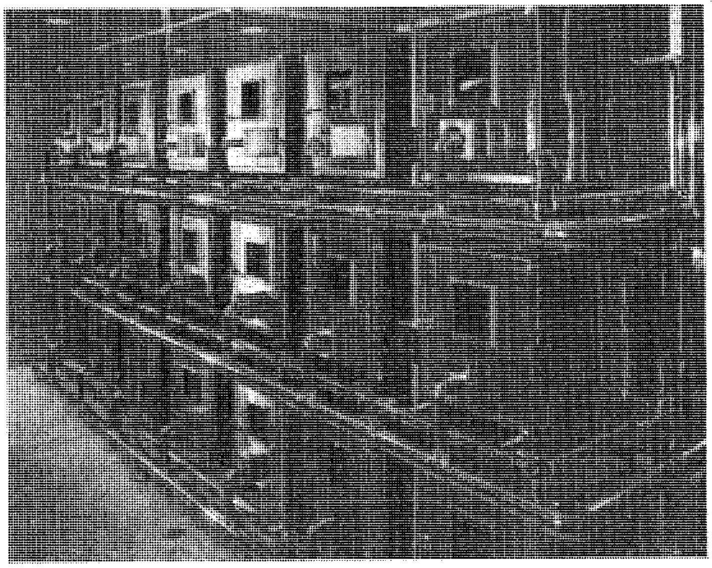
Examination of experimentally infected insects.

The Electron Microscope.

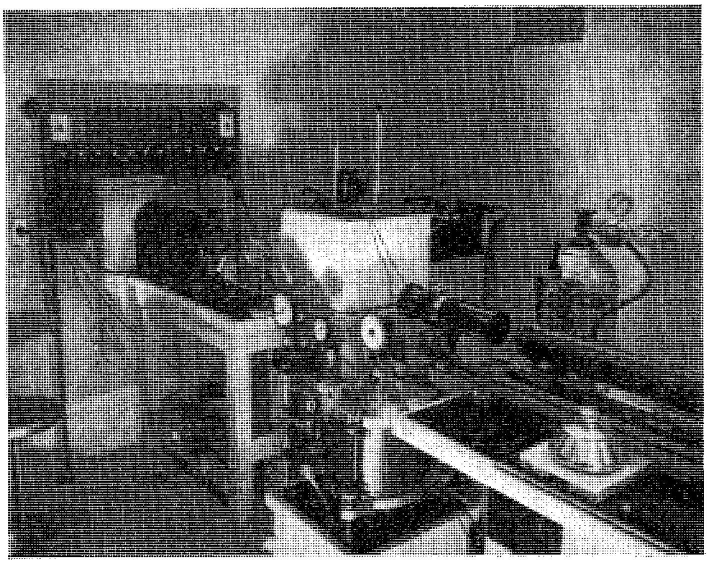
*Photographs by D. C. Anderson.*



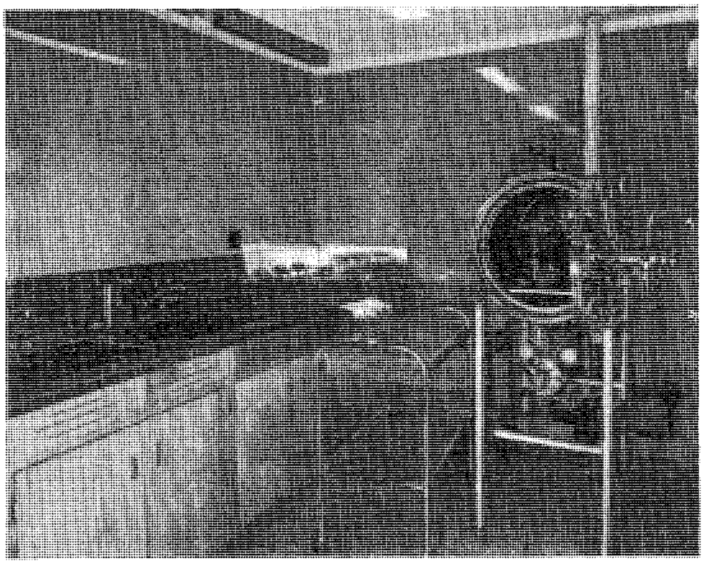
The preparation room showing the protective hood and the cooling table.



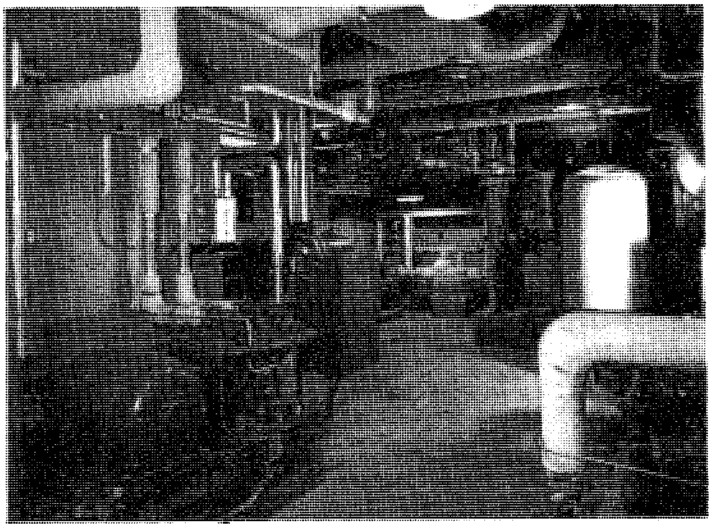
A section of Horsfall Unit Racks.



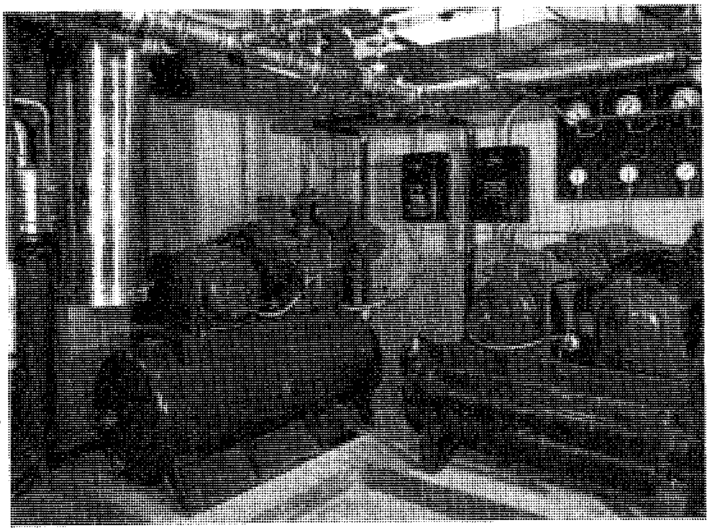
The Ultra-centrifuge and associated equipment.



The glassware washroom is provided with an autoclave.

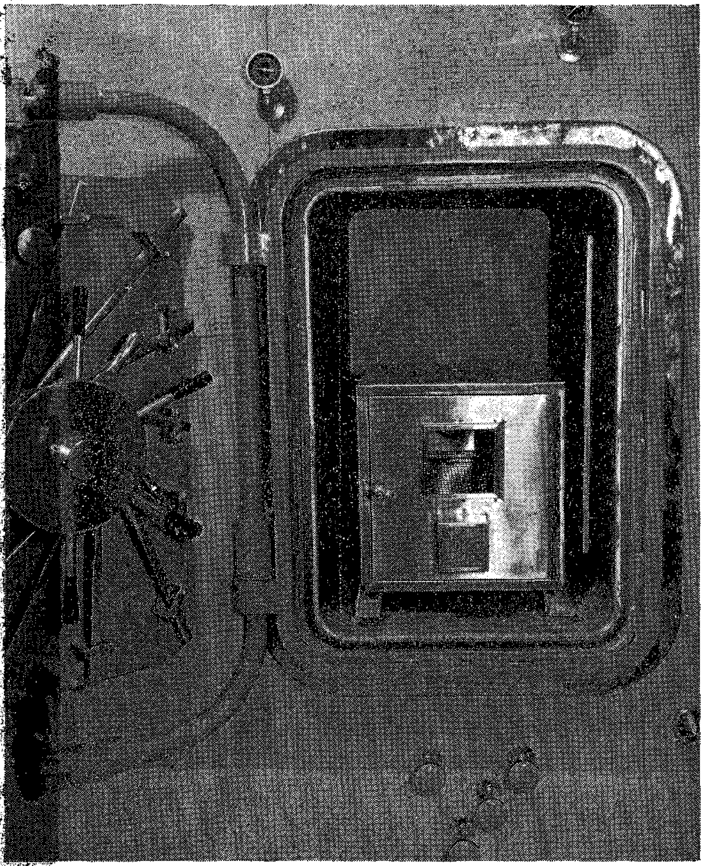


A view of the Compressor Room.

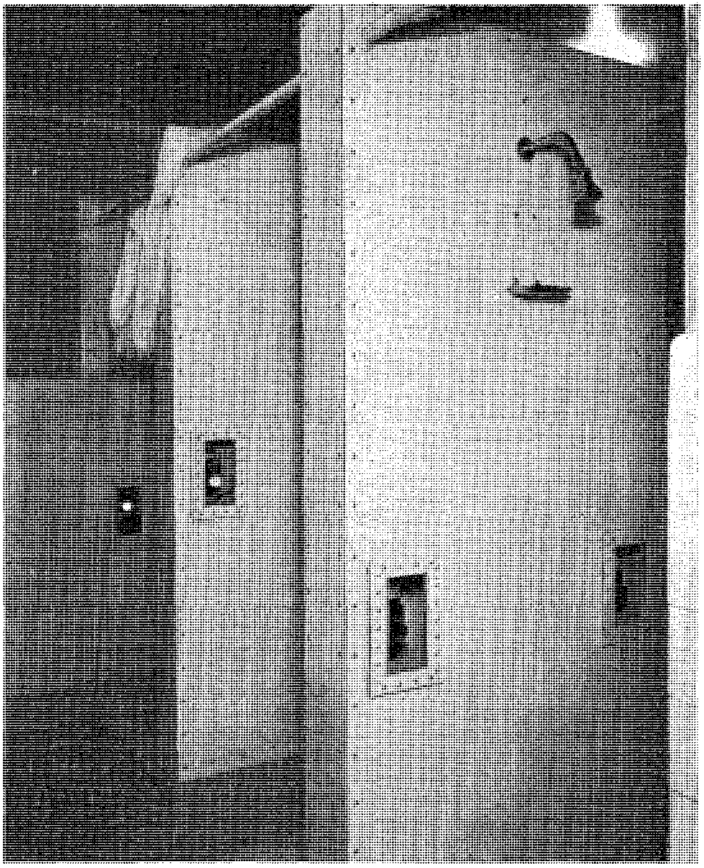


Compressors

*Photographs by D. C. Anderson.*



**The large autoclave for sterilizing Horsfall units and other bulky equipment.**



**The automatic showers showing arrangement of electric eye.**

*Photographs by D. C. Anderson*

initial approach to the study, which involved a survey of insects throughout the forested areas of Ontario, as well as some from other provinces, was made possible through the co-operation of the Forest Insect Survey staff of the Forest Insect Laboratory.

Results from the survey have shown that many of the insects are susceptible to a number of diverse entomogenous fungi. The more important isolates are representatives of the following genera:—*Hirsutella, Sorosporella, Cephalosporium, Isaria, Empusa* and *Beauveria*.

In the study of entomogenous fungi, emphasis has been placed on the taxonomic phase of the work, since taxonomy is an essential basis for any comparative endeavour on a group of organisms. This study includes both morphological and physiological characteristics of the various strains isolated in each genus. At the moment, emphasis is being placed on strains from the genus *Beauveria* because of their recurrent association not only with insects in Canada but also in various countries throughout the world. Comparisons are also being made with cultures obtained in the United States and Europe. It is hoped that studies of this nature may lead to a clearer concept of the nature of the fungi associated with insects, and to a more fundamental understanding of the resulting disease condition.

In conjunction with taxonomy, investigations will be conducted on the physiology and biochemistry of the organisms. This is important since the production of different organic acids, pigments, antibiotic substances and growth factors by particular strains and species often differ more strikingly than do the specific morphological characters.

Besides the studies on the fungi as entities, it is important to know the relationship between them and their host insect. To this end, the immediate program includes investigations of the histopathology of diseased insects, and the mode of penetration of the fungus. This latter point is of importance in attempting to increase pathogenicity, for instance by increasing enzymatic activity of the organism.

Despite the fact that entomogenous fungi are associated with insects so frequently that they must exert a continuous influence on the population, and that laboratory tests indicate a high degree of pathogenicity, artificial creation of field epidemics has had relatively little success to date. This may be due to a number of physical factors, such as temperature, humidity, and light, or of physiological factors, such as stage of development of the host, age and virulence of the spores, etc. Field studies will be necessary to assess the importance of all these factors.—D. M. MacLeod.

## RESEARCH ON BACTERIA

A study of the bacteria associated with forest insects has been initiated. This study has been divided into a number of sub-projects including: bacteria associated with healthy insects, bacteria isolated from dead or abnormal insects, and bacteria pathogenic for forest insects. A number of related studies have been carried out, or are in the process of completion, including decontamination of foliage used in feeding, persistence of ingested organisms in the larval gut, and the development of more suitable culture media.

Plans for the immediate future include such studies as comparative pathogenicity and specificity of bacteria pathogenic for insects, isolation of bacteria pathogenic for specific forest insects, and mode of action of certain pathogenic bacteria. To this end a stock culture collection has been started, and will be enlarged. Type cultures are being assembled as opportunity permits. Using this material, it is hoped that physiological studies will contribute to a knowledge of the taxonomic position of bacteria associated with forest insects.

The part played by bacteria in the control of insects has in the past proved to be a difficult field of investigation. With equipment available, and especially with the close association with mycology, virology and histology, many of the problems should be more easily solved.—T. A. Angus.

OTTAWA: Printed by EDMOND CLOUTIER, C.M.G., B.A., L.Ph., Printer to the King's Most Excellent Majesty, 1950.

# DOMINION DEPARTMENT OF AGRICULTURE

SCIENCE SERVICE—DIVISION OF ENTOMOLOGY

Published by Authority of the Right Hon. James G. Gardiner, Minister of Agriculture.

Vol. 6 REPORT NUMBER 5

FOREST INSECT INVESTIGATIONS
BI-MONTHLY PROGRESS REPORT
OTTAWA, CANADA

Sept.-Oct. 1950


# CURRENT ACTIVITIES

## MARITIME PROVINCES

***The Spruce Budworm in the Maritime Region.***—An analysis of samples received by the Forest Insect Survey indicates a general increase in numbers in New Brunswick and parts of Nova Scotia. Only in the northern part of New Brunswick, however, have severe outbreaks occurred.

In New Brunswick, the insect was collected in all counties over a wider area than last year. Sampling showed a fourfold increase in numbers throughout the Province, the average number of specimens per tree sample being 6·4 as compared with 1·7 in 1949. Aerial surveys showed five areas of severe defoliation, 400 square miles in total area. These outbreaks are located approximately as follows:

1. Between Portage Brook on the Nepisiquit drainage and the headwaters of the south branch of the Upsalquitch River.
2. Three small areas adjacent to the Stewart Highway near Black Brook, Veneer Siding and Beaverbrook.
3. Areas adjacent to Long Lake, Trouser's Lake and Gulquac Lake in Victoria County.
4. The headwaters of the Jacquet River and the middle and south branches of the Charlo River in Restigouche County.
5. Between the Quisibis and Green Rivers in Madawaska County.

When these areas were checked from the ground, the defoliation of new growth balsam fir was found to range from 60 to 100 per cent. Some feeding on the old foliage was also apparent. Defoliation of spruce was less severe.

In Newfoundland, numbers have decreased at Bowring Park and at Bell Island where small areas have been rather heavily infested for several years. Small numbers have been received from Bonavista South, Grand Falls, Humber and White Bay.

In Nova Scotia, numbers have increased slightly, particularly on Cape Breton Island. Here, as many as 24 larvae were taken from one tree. Populations are still too small, however, to cause noticeable defoliation.

The budworm was not collected on Prince Edward Island.—R. S. Forbes.

***Native Parasites of the Spruce Budworm in the Maritime Provinces.***—A summary has been prepared of the spruce budworm parasites reared from the Maritime Provinces up to the end of 1949. The records were obtained by the Forest Insect Survey and from earlier rearings prior to the inception of the Survey in 1937. Twenty-two identified species have been obtained. The distribution of species by families is as follows: *Tachinidae* (Dipt.)—7; *Chalcidae* (Hym.)—2; *Encyrtidae* (Hym.)—1; *Pteromalidae* (Hym.)—1; *Braconidae* (Hym.)—3; and *Ichneumonidae* (Hym.)—8.

Although the budworm has increased annually since 1944, the population was generally light until 1949. Consequently all the recent parasite records, with the exception of those from a small infestation in eastern Newfoundland, are from areas of light budworm population. The value of native parasites in periods of light host population is not easily appraised by extensive surveys, but relative numbers may be taken as an expression of the importance of the various species. The most abundant species in 1949 was *Apechthis ontario* (Cress.). Two others, *Glypta fumiferanae* Vier. and *Apanteles fumiferanae* Vier., have been very scarce during the present period of rising population, although they were abundant and widely distributed during the severe outbreak that commenced in New Brunswick in 1913. It appears that the parasite complex may vary with the host population.

Fourteen of the 22 parasites have been recovered from other hosts. *Pimpla pedalis* (Cress.) was reared from as many as 7 species of insects. Among the most common of these other hosts were the black-headed budworm, *Acleris variana* (Fern.), and the hemlock looper, *Lambdina fiscellaria* (Guen.). Those species that have been reared only from the spruce budworm in the Maritime Provinces include *Apanteles* sp. near *fumiferanae* Vier., *G. fumiferanae*, *Horogenes cacoeciae* (Vier.), and *Epimasicera caesar* (Ald.).—W. A. Reeks and R. S. Forbes.

***Flights of Balsam Twig Aphid Detected from Aeroplanes.***—While engaged in an aerial survey on July 4 and 5, L. E. Williams noted large flights of a small insect at many points over central and northern New Brunswick. These were recognized by large numbers of light-green spots on the windshield of the plane but the insects were difficult to capture owing to the speed of the air-stream. A number were eventually taken on a piece of cloth in an apparently living condition at 2,000 feet, and these were all identified as the balsam twig aphid, *Mindarus abietinus* Koch.

The spotting of the windshield was reported at altitudes from 500 to 5,000 feet. The weather was clear and warm with a wind velocity of 10 to 15 m.p.h. Small buoyant insects of this kind are capable of being carried considerable distance in horizontal air currents after being lifted by convection currents. Although proof of ability to survive at high altitudes is lacking, these observations suggest that mass 'flights' occur in the upper air in warm weather with light winds, and thus ensure the wide distribution and intermingling of populations of such species. While winged forms like this aphid are more buoyant, small wingless species can also be carried in the air, buoyancy increasing inversely with size. The crawler stage of the balsam woolly aphid has been shown to be carried by surface winds, but it is not known whether it reaches high altitudes.

The balsam twig aphid was more than usually numerous this year in the Maritime Provinces. It feeds on the young new shoots of balsam fir and spruce and causes a curling and disfiguring of the needles and shoots. The injury, however, is seldom severe.—R. E. Balch.

## ONTARIO

***Injury to White Spruce Cones by Spruce Budworm.***—In the course of investigations on insects affecting white spruce cones, traces of the spruce budworm, *Choristoneura fumiferana* (Clem.), and of the spruce needle worm, *Dioryctria reniculella* Grt., were found on various white spruce near Stittsville, Ont. Although the larvae had fed to some extent on the current year's foliage, most of the feeding appeared to be on the new cones.

As these two larvae have been generally considered to be foliage feeders, further detailed observations were made. Collections of samples proved *D. reniculella* to be present only in traces, while on one particular tree the spruce budworm was present to an extent which approached a light infestation. On this tree, spruce budworm larvae were observed to feed in and on the cones and in most cases in preference to the foliage. Although some of the cones were completely destroyed, many were gnarled and curled as a result of lighter feeding. Exuded gum, resulting from light feeding, would prevent the cones from opening properly to release the seed.

Counts were made to determine the approximate percentage of cones damaged by the budworm. In making these counts the number of cones damaged by *D. reniculella* was assumed to be insignificant as this species was present only in very small numbers.

Tree D—Cones examined—325
Cones with budworm injury—144
Percentage damaged—44·3
Tree E—Cones examined—252
Cones with budworm injury—56
Percentage damaged—22·2
Total cones examined—577
Total cones with budworm injury—200
Percentage damaged—34·6

Convincing data on spruce budworm feeding on cones were obtained. A number of cones on Tree E were covered with cotton bags in order to determine the egg-laying period of *Laspeyresia youngana* (Kearf.). Each bag enclosed about 12 inches of branch with considerable foliage and about one dozen cones. With the exception of two days, these bags remained over the cones from May 26 to the end of June or later. On July 5, a bag with its contents was removed for examination. Upon examination, it was found that the foliage was fresh and without any signs of feeding, but 5 out of the 12 cones were wholly or partially destroyed by a chewing insect. A battered moth and an empty pupa case were present and from the pupa case and the genitalia of the moth, the insect was identified as the spruce budworm. This was the only insect present in the bag. Examination of other bags at later dates gave similar results.

An adult *Dioryctria* was reared from a pupa inside a cone collected at Angus, Ontario, and this adult was identified as *reniculella* by examination of colour pattern on the hind wing and by the morphology of the genitalia.—Howard A. Tripp.

***The Dissemination and Propagation of a Virus Disease Affecting the European Pine Sawfly, Neodiprion sertifer (Geoff.).***—A virus disease affecting the European pine sawfly, *Neodiprion sertifer* (Geoff.), was artificially disseminated in heavily infested pine plantations in southern Ontario in 1950. The disease, unknown in Canada, was discovered in Europe and virus-killed larvae were sent to the Sault Ste. Marie laboratory in 1949. Studies showed it to be particularly virulent against the Canadian population of European pine sawfly, and similar in its effect on this insect to the virus, apparently accidentally introduced from Europe, which controlled the outbreaks of the European spruce sawfly in Eastern Canada some years ago.

Heavily infested pine plantations near Strathroy, Ont., were chosen for studies on the artificial dissemination and propagation of the virus for possible large-scale control operations in 1951. Plots were established to determine the quantity of virus necessary to spray on the foliage to effect control, and the time of spraying which would ensure the transmission of the virus to succeeding generations and adjacent infestations without further artificial aid.

The stock suspension of virus from which the various sprays were prepared consisted of 2,000 virus-killed larvae in 2,000 c.c. of water. It was found that 0·1 c.c. of this suspension in three gallons of water resulted in an infective spray. The rates of larval mortality increased with the concentration of the virus. Data collected in one plot 15 days after the application of the virus are shown in Table 1.

TABLE 1

THE EFFECT OF VARIOUS CONCENTRATIONS OF VIRUS ON RATES OF LARVAL MORTALITY

| Concentration of virus suspension in three gallons of water | Number of colonies of larvae examined | Condition of colonies*, % | | |
|---|---|---|---|---|
| | | All larvae living | Larvae part living and part dead | All larvae dead |
| 0·1 c.c. | 69 | 4·6 | 47·7 | 47·7 |
| 1·0 c.c. | 66 | 1·5 | 9·1 | 89·4 |
| 10·0 c.c. | 84 | 0 | 1·2 | 98·8 |
| 100·0 c.c. | 51 | 0 | 0 | 100·0 |
| 250·0 c.c. | 118 | 0 | 0 | 100·0 |

* A colony was considered as a group of 10 or more larvae. Individual larvae which might have migrated from other trees were ignored.

The quantity of the suspension required for application on one tree is very small. In these preliminary experiments all the foliage was drenched with the spray. Three gallons of virus suspension were used to spray 20 trees about four feet in height. Relatively larger amounts were used in spraying larger trees. Mortality from disease resulted, however, in rows of trees 3 to 15 feet from those sprayed. The unsprayed trees were protected, in so far as possible, from the spray by large mats placed between the two trees. The time of spraying was either early in the morning or late in the evening when air currents were at a minimum. The incidence of disease was highest in rows of unsprayed trees adjacent to rows of trees which received the highest concentration of virus. This is shown in Table 2. The data were collected 19 days after spraying.

The infection of larvae in unsprayed trees adjacent to those sprayed was probably due to the drifting of virus suspension at the time of spraying. No mortality from disease was found in 353 colonies of larvae about 200 feet from sprayed trees when examined 15 and 19 days after spraying.

TABLE 2

THE INFECTION OF COLONIES OF LARVAE IN UNSPRAYED TREES ADJACENT TO SPRAYED TREES

| Concentration of virus suspension in three gallons of water applied to adjacent trees | Number of colonies examined | Incidence of disease in unsprayed trees | | |
|---|---|---|---|---|
| | | Condition of colonies, % | | |
| | | All larvae living | Larvae part living and part dead | All larvae dead |
| 0·1 c.c.— 1·0 c.c. | 26 | 84·6 | 11·5 | 3·9 |
| 1·0 c.c.— 10·0 c.c. | 36 | 52·8 | 36·1 | 11·1 |
| 10·0 c.c.—100·0 c.c. | 34 | 29·4 | 17·7 | 52·9 |
| 100·0 c.c.—100·0 c.c. | 38 | 26·3 | 44·9 | 28·8 |
| 100·0 c.c.—250·0 c.c. | 86 | 11·7 | 23·2 | 65·1 |
| 250·0 c.c.— 10·0 c.c. | 67 | 79·1 | 16·4 | 4·5 |

A plantation of pine infested with the sawfly was sprayed with virus (concentration 50 c.c. in three gallons) and the results checked by the method of larval samples. Larval samples were taken 12 days after infection in the sprayed plot and in a control plot 200 yards from the sprayed plot. The results are shown in Table 3.

TABLE 3

RESULT OF THE DISSEMINATION OF VIRUS CHECKED BY THE METHOD OF LARVAL SAMPLES

| — | Number of samples | Total number of larvae | Larvae living | Larvae dead |
|---|---|---|---|---|
| Sprayed Plot | 16 | 2,887 | 415 | 2,472 |
| Control Plot | 10 | 2,361 | 2,361 | 0 |

In addition, pine plantations were sprayed with the virus and the results checked by the method of cocoon population counts. The first plot was divided into three sections. It was intended that the first two sections should be treated similarly, but the spraying operation was interrupted by heavy rains for two days. Since many of the larvae were maturing and spinning cocoons at that time, considerable difference in survival resulted in the first two sections which received the same amount of virus. The results are shown in Table 4.

TABLE 4

RESULTS OF THE DISSEMINATION OF VIRUS CHECKED BY THE METHOD OF COCOON COUNTS

| Plot | Amount of virus suspension in three gallons of spray | Date of spraying | Number of square feet of soil examined | Number of cocoons per square foot | Percentages of cocoons | | |
|---|---|---|---|---|---|---|---|
| | | | | | Sound | Para-sitized | Dead |
| Plot A | | | | | | | |
| Section 1 | 50 c.c. | June 2nd | 80 | 8·1 | 38·2 | 26·1 | 34·0 |
| Section 2 | 50 c.c. | June 4th | 80 | 12·7 | 34·3 | 21·4 | 40·4 |
| Section 3 | 10 c.c. | June 6th | 80 | 28·8 | 22·8 | 21·0 | 53·4 |
| Plot B | 5 c.c. | June 8th | 80 | 24·9 | 74·2 | 16·8 | 7·5 |
| Plot C | Control | | 120 | 34·3 | 59·0 | 29·3 | 10·2 |

The smallest number of cocoons was found in the plot receiving the highest concentration of virus at the earliest time of application. Many dead larvae were found on the foliage and on the ground in the three sections of plot A. Very little mortality occurred in plot B and it was only after extensive searching that virus-killed larvae were found on the foliage. The virus was applied too late and most of the larvae spun cocoons.

High percentages of dead cocooned larvae were found in plot A. This appears to be the result of the virus, but the difficulty of diagnosing cocooned larvae for virus, and the fact that entomogenous fungi had mummified the larvae, made it difficult to determine whether the larvae had died as the result of virus infection alone, whether the larvae were weakened by the virus and subsequently destroyed by the fungi, or whether the fungi alone had killed the larvae. The latter seems improbable, since much smaller percentages of dead larvae were found in plot B and the control plot.

The percentages of parasitism of cocooned larvae are about the same for the three plots (about 23 per cent). Parasitism is, therefore, an important control factor, but apparently inadequate to prevent population increases.

The propagation of the virus was very successful. Several hundred thousand virus-killed larvae were obtained from mass larval collections placed in a large open tray and sprayed with the virus. In addition, many thousands of dead larvae were collected on the ground in the sprayed plots. It was possible for two men to collect about 6,000 dead larvae per day beneath trees which had been sprayed with the virus. The limiting factor was the difficulty in picking up flaccid larvae.—F. T. Bird.

## PRAIRIE PROVINCES

(FORESTED AREA)

***Forest Insect Survey.***—By mid-September, 4,465 collections had been received at the Forest Insect Laboratory, Winnipeg. Despite a late season and delays in getting field work under way because of the flood, this is an increase of 1,300 over 1949.

The Survey for 1950 revealed that the jack-pine budworm, *Choristoneura* sp. and the spruce budworm, *Choristoneura fumiferana* (Clem.) were present only in Manitoba. Populations of these two insects were lower and defoliation was considerably less than in 1949. The effect of feeding was masked by the excellent terminal growth of jack pine and spruce.

Samples of the larch sawfly, *Pristiphora erichsonii* (Htg.), were received from as far west as the Alberta border. In Saskatchewan, the area of severe defoliation moved west to the eastern boundary of Big River Provincial Forest. In Manitoba, the area most severely hit spread northward to Sherridon, Thicket Portage and Oxford House. High water-levels in southern Manitoba delayed emergence and evidently killed a large number of cocoons as defoliation was light to medium.

Poplar was heavily attacked by a number of insects. The most conspicuous damage was caused by the large aspen tortrix, *Archips conflictana* (Wlk.), which was found in most poplar stands in Manitoba and Saskatchewan. The Glaslyn area in Saskatchewan was again heavily defoliated. The small infestation found near The Pas, Manitoba, in 1949, has grown in size, and poplar, from The Pas north to Sherridon, was severely defoliated. Widespread and conspicuous leaf injury was caused by a poplar leaf-miner, *Lithocolletis* sp. The forest tent caterpillar, *Malacosoma disstria* Hbn., was widely distributed throughout Manitoba and was also present in the Meadow Lake District of Saskatchewan. This insect caused no serious defoliation this year.

There was a general increase in the number and species of insects feeding on birch. The exception was the birch sawfly, *Arge pectoralis* (Leach), which was reported from several widely scattered points but caused little defoliation. The birch tubemaker, *Acrobasis betulella* Hlst., increased sharply and was present on most birch stands in Manitoba.

The ugly-nest tortrix, *Archips cerasivorana* (Fitch), was again common on all young choke cherry. The high parasitism which has occurred will probably reduce populations in 1951.

There appeared to be a general increase in the number of insects attacking deciduous trees and a decrease in those attacking coniferous trees, with the exception of the larch sawfly. It is also interesting to note that an increase in the Microlepidoptera on deciduous trees was accompanied by a decrease in the Macrolepidoptera.—W. J. Turnock and R. Prentice.

***Effect of high water on several infestations of the larch sawfly.***—Abnormally heavy rains in the fall of 1949 and the spring of 1950 afforded an excellent opportunity to observe the effect of flooding on larch sawfly populations in the Whiteshell Forest Reserve, Manitoba.

In several stands along the Whiteshell River, spring water rose to a point about 6 inches above the highest ground level for a period of eight to nine weeks. The water did not begin to recede until mid-July. In these stands, defoliation dropped from 60 per cent in 1949 to practically nil in 1950. Stands bordering the Rennie River were inundated for about five weeks in the Spring. In these, defoliation dropped from 40 per cent in 1949 to 15 per cent in 1950. In a third area inundated for about one month, defoliation decreased from 50 per cent to 15 per cent. In two other stands, water-levels receded rapidly and more or less normal conditions prevailed. In one, defoliation increased from 35 per cent to 65 per cent and in the other, it dropped slightly from 90 to 70 per cent.

These observations indicate that overwintered cocoons, which are highly resistant to moisture, may experience natural conditions under which they cannot survive or which will greatly reduce the population. On the other hand, chlorotic foliage in some of the most severely inundated stands indicates that the trees may have been damaged by the prolonged flooding. It is planned to compare the diameter growth of trees in the flooded areas with those on drier sites which were more heavily defoliated by the sawfly.—R. R. Lejeune and D. Burbidge.

(AGRICULTURAL AREA)

***Caragana Seed Chalcid, Bruchophagus sp.***—The average infestations in 1950 in Manitoba, Saskatchewan and Alberta in *Caragana arborescens*, based on seed samples collected at different points, were 32, 27, and 24 per cent respectively. These figures suggest an increased infestation in Manitoba and Saskatchewan and a decrease in Alberta as compared with the figures for 1949.

*Habrocytus* sp. and *Amblymerus* sp., parasites of the chalcid, emerged during the period June 21 to July 10. A survey of the area around Scott, Sask., where, in 1949, a large number of parasites was obtained, revealed no parasitism during the current season.

In preliminary control experiments BHC, Aldrin and DDT were applied to samples of infested caragana seed on the ground, at concentrations of ·04 oz. and ·08 oz. of active material per square foot. BHC gave complete control, Aldrin very good control, but DDT gave only fair control.—A. F. Hedlin.

***Strawberry Root Weevil.***—Reported insect injury to the roots of young spruce at Estevan, Sask., was investigated on July 3, 1950. The insect causing the damage proved to be the strawberry root weevil, *Brachyrhinus ovatus* (L.).

A plot containing approximately 500 trees between 6 and 10 years of age was severely infested, the weevils showing a preference for the smaller trees, so that the infestation was spotted over the plot. Evidence of similar infestation in previous years could be seen in the stunted growth of the spruce; trees which were estimated to be from six to eight years old were only ten inches high and about ten inches across.

During the current infestation the weevil larvae had devoured many of the fibrous roots and stripped the cambium from the larger roots. The most intensive feeding apparently took place while the new twig growth was being formed, resulting in very short twigs with small needles. The loss of water from the roots, due to the insect feeding, caused the new growth to wilt severely. The condition of the new twigs together with the stunted growth of previous years gave the trees a very compact, dwarfed appearance.

Several of the affected trees, along with considerable earth containing larvae and pupae, were placed in tubs and brought back to the laboratory for further study. The larvae and pupae were found to be concentrated from 2 to 5 inches below the soil surface. Adults began to emerge from the potted material about July 10 and continued to emerge until the end of August.—C. E. Brown.

## ROCKY MOUNTAIN REGION

***Lodgepole Needle Miner.***—Completion of the population sampling has provided more critical estimates of winter mortality of the larvae in the Rocky Mountain National Parks. The high kill indicated for the Bow Valley in the May-June report was not evident in Yoho Park, the mortality there ranging from 25 to 43 per cent. The winter-kill of larvae near Mount Edith Cavell in Jasper Park varied from 2 to 14 per cent. Destruction of the parasites was proportionally heavy in the Bow Valley. Shipments of parasites from the Idaho needle miner outbreak were received from the Belleville Parasite Laboratory and were liberated in the Cascade Valley, tributary of the Bow. Three species were represented, *Apanteles californicus* Mues., *Sympiesis* sp., and *Dicladocerus* sp. The latter apparently was not present in the Banff outbreak areas prior to liberation.

Cold-hardiness tests are now in progress in an attempt to determine whether the larvae were killed by the extreme cold weather in January, or by low temperatures before diapause in the fall, or after diapause terminated in spring. The first series of tests indicated that larvae before diapause are not seriously affected by exposure to 10°F. for 24 hours but exposure to 0°F. for the same period caused 60 per cent mortality. The survivors were definitely injured and it is doubtful whether more than one or two could have continued development. The 50 per cent mortality point for pre-diapause larvae appears to be somewhere between 0°F. and 10°F. for the 24-hour exposure. Further tests will be made immediately after diapause, in mid-winter, and after the breaking of diapause in the spring.

At the suggestion of R. W. Stark, plots have been laid out in a young pine stand near Mount Eisenhower on which various degrees of thinning will be carried out to see what effect this may have on the needle miner population in relation to increased growth and tree vigour.—G. R. Hopping.

## BRITISH COLUMBIA

***Forest Insect Survey (Interior).***—Although the start of the field work this year was retarded by an exceptionally late spring, this was offset by very favourable collecting weather throughout the balance of the season. As a result, the number of collections received by the Vernon Laboratory has exceeded that of 1949.

The most important insects in this region this year have been the spruce budworm and the mountain pine beetle. Extensive infestations of the spruce budworm have been discovered in spruce-balsam stands in the Prince George Forest District. Through the co-operation of the British Columbia Forest Service several reconnaissance flights were made over areas that are inaccessible by roads or trails. The outbreak was found to extend from the vicinity of Bouron Lake to north of Pine Pass, a distance of close to 200 miles, and with the severest defoliation in stands above an elevation of about 3,000 feet. It is believed that the entire outbreak consists of 2-year life-cycle budworm. This has been a flight year for this form and in 1949 no discolouration of foliage was observed in a reconnaissance flight over a portion of the infested area. Moreover, in previous studies made on parts of the area only 2-year cycle budworm was found.

The spruce budworm has also continued active in various spruce-balsam stands on the high plateaux in the Kamloops Forest District, with the heaviest budworm population on Silver Hills, east of Lumby. In Fountain Creek Valley near Lillooet, the budworm population on Douglas fir remained sufficiently high for the mass collecting of material by the Biological Control Unit for the recovery of parasites for liberation in Eastern Canada.

The infestations of the mountain pine beetle, *Dendroctonus monticolae* Hopk., reported last year in lodgepole pine in the East Kootenay district, have continued active and several new infestations in the same district have been found this year, the most important of these being on Windermere Creek. Infestations of the same species of bark-beetle, but in western white pine, have also continued in the Revelstoke and Shuswap areas and, when feasible, the logging of the infested stands is being recommended.

The infestations of the Douglas fir tussock moth previously reported in the Kamloops Forest District apparently have subsided completely. The larch sawfly population is at its lowest ebb in British Columbia since it was first reported in the Province in 1933.—W. G. Mathers.

***Spruce Budworm.***—Marked activity by this insect has been recorded in British Columbia during the current season. In view of the present outbreaks in Oregon this increase in British Columbia is not unexpected. The main infestation is located over an area of some 550 square miles of spruce-balsam forest in the Babine Forest and is bounded on the north by Babine Lake and on the south by Burns Lake and the Endako River. The region has an elevation of 2,330 feet to 4,500 feet at a latitude of approximately 54 degrees. In view of the forest type, the elevation and latitude, it is probable that the insect has a 2-year cycle. Defoliation thus far has not been particularly severe, averaging about 25 per cent over the infested region, but reaching as high as 50 per cent in some sections. The balsam understory in such stands was completely defoliated. Natural control at present appears to be of minor significance.

Other areas from which the spruce budworm was recorded are as follows: through the Fraser Valley from Hope to Vancouver, Powell River, Ocean Falls, Mathieson Channel, Princess Royal Island and Work Channel north of Prince Rupert: on Vancouver Island—Goldstream, Cowichan Lake, Nanaimo Lakes, Alberni and Cumberland. In only one area was the spruce budworm in outbreak proportions, namely, Burns Lake.—H. A. Richmond.

***Forest Insect Survey (Vancouver Island and Coastal Area).***—A total of 2,342 collections have been received at the Victoria laboratory up to August 28 representing over 4,800 separate rearings. This is a slight reduction over 1949, due in part to the delayed spring and to the transportation stoppage in August.

No important population of the western hemlock looper was encountered, but survey returns show it to be present in small but increasing numbers from Chilliwack to Vancouver, at Hope, Bella Coola, Devastation Channel, Douglas Channel and at Kitsumgallum Lake in the Prince Rupert District. A marked reduction was recorded in the latter area as compared with 1949. The infestation of the alder sawfly, which was abundant and widely distributed in 1949, was greatly reduced in 1950, although final reports on the Queen Charlotte Island outbreak are not immediately available. The oak looper on Vancouver Island was still active but generally reduced in numbers.—H. A. Richmond.

***Deterioration of Hemlock looper-killed Timber on Vancouver Island.***—From recent studies on the deterioration of western hemlock on Vancouver Island since the outbreak in 1946, it is evident that it will be economically unfeasible to salvage this timber after another year has passed. Breakage is the principal cause of loss in volume, although advanced decay accounts for a further loss in those portions of the tree suitable for salvage. By this year the tops (representing about one-quarter of each crown) have been broken off, and most of the remainder of the limbs have fallen. This lack of crown, along with the deep penetration of *Fomes pinicola*, has predisposed the heavy loss due to breakage. Although the number of wood-boring insects now attacking these dead trees has increased greatly over previous years, their economic importance in causing direct loss of value is negligible when compared with the loss due to incipient and advanced decay.

In current salvage operations, some stands yield only one 40-foot log per tree; this is a loss of at least 50 per cent of the merchantable volume.—J. M. Kinghorn.

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OTTAWA

# DOMINION DEPARTMENT OF AGRICULTURE

SCIENCE SERVICE—DIVISION OF ENTOMOLOGY

Published by Authority of the Right Hon. James G. Gardiner, Minister of Agriculture

VOL. 6 REPORT NUMBER 6

FOREST INSECT INVESTIGATIONS
BI-MONTHLY PROGRESS REPORT
OTTAWA, CANADA

Nov.-Dec. 1950


## STATUS OF THE DUTCH ELM DISEASE IN CANADA—1950

Since the discovery of the Dutch elm disease in the Province of Quebec in 1944, the Division of Plant Protection, with the co-operation of the Quebec Department of Lands and Forests and the Ontario Department of Agriculture, has conducted annual surveys to delimit the area infected and to make all reasonable efforts to retard its spread.

The disease is now known to occur in 45 counties in the Province of Quebec, which, in fact, includes almost all of the province where the elm is an important tree with the exception of the counties west of Argenteuil in the Ottawa Valley and the counties of Huntingdon and Châteauguay south of the St. Lawrence River.

It has been most severe in the counties on both sides of the St. Lawrence River from Montreal to Quebec City and in a number of counties north and west of the City of Sherbrooke. The disease has been less intense in counties surrounding this heavily infected area and during the past two years, surveys and control measures have been restricted to these counties.

Although surveys were conducted annually in Ontario, beginning in 1945, no signs of the disease were found until 1948 when 14 cases were located in six counties in the extreme easterly section of the Province extending from a point 25 miles west of Ottawa to the Quebec border. Of these 14 cases only one, a tree located in the City of Ottawa, showed definite symptoms of the disease, but in the other 13, which were dead or dying trees at the time of sampling, the Dutch elm disease fungus was saprophytic and did not contribute to their weakened and dying condition.

No evidence of the disease could be found in Ontario in 1949 but in May, 1950, samples submitted from the City of Windsor were found to be infected, and an intensive survey of Essex County during the summer revealed a fairly heavy infection in Windsor and as far east as St. Clair Beach and Maidstone. The number of trees known to be infected during the season in that area was 91, and every effort is being made to have them cut and either burned or treated with an insecticide.

Survey work was also conducted throughout southern and eastern Ontario resulting in 15 cases of the disease being located in eight additional counties. First records were established in the counties of Welland (3), Peel (1), Prince Edward (1), Leeds (1), Frontenac (1), and Glengarry (2). One positive culture was recorded from Prescott County and five from Carleton, three of which were from symptomatic trees in Ottawa; the disease had appeared for the first time in these two counties in 1948.

It would appear that the infection in eastern Ontario, at least, is the result of spread from the Province of Quebec where the disease has continued to spread rather slowly in spite of efforts to control it. It would seem logical to assume that the Essex County outbreak had its source somewhere in the east Central States but there are no recent authentic records of the disease in that area. It is of interest to note, however, that, following the discovery of the disease in Windsor, a report on which was made to the Michigan authorities, a local survey was organized in the Detroit area and a number of infected trees were located during the present season.

In addition to the work in Ontario and Quebec, the staff of the Division of Plant Protection has carried on surveys in the Maritime Provinces for several years but no evidence of the disease has been found.

The only known insect vector in eastern Ontario and Quebec is the native elm bark-beetle, *Hylurgopinus rufipes* (Eich.), but in southern Ontario the European species, *Scolytus multistriatus* (Marsh.), has been discovered in several counties during the last two years. The presence of both species of bark-beetles may account for the rapid build-up of the outbreak in the Windsor area and the same situation may develop within the next few years throughout southern Ontario unless strenuous efforts are put forth to remove infected trees and to maintain elms in a healthy condition.—L. L. Reed, Division of Plant Protection, Ottawa.

## CURRENT ACTIVITIES

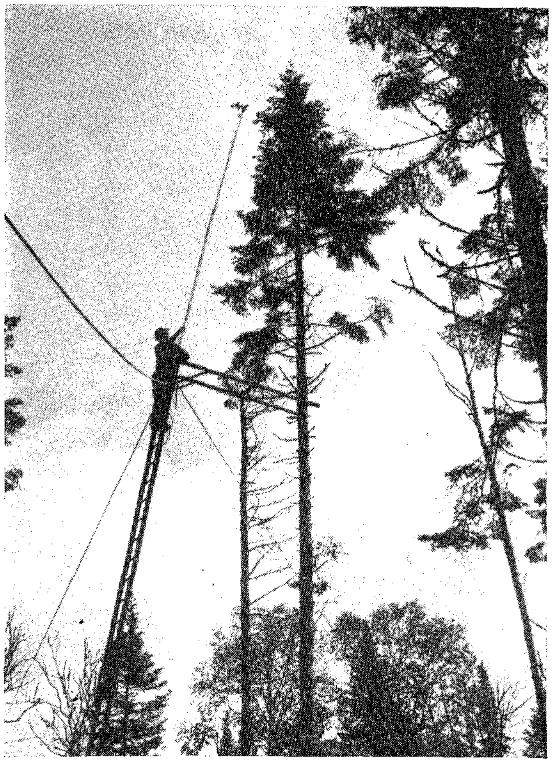
### MARITIME PROVINCES

***Technique for Population Sampling on Standing Trees.***—The direct measurement of insect populations on tall trees has always presented a serious problem in forest entomology. The felling of sufficient numbers of merchantable trees for this purpose is not always permissible. Furthermore, a proportion of the insects on the foliage is usually dislodged when the tree strikes the ground. A study of this factor on the Green River Watershed, in which mature balsam trees were felled on large sheets of canvas, shows that this felling loss may exceed 50 per cent on some trees during the late larval and pupal stages of the spruce budworm. A third objection is that the tree can be sampled only once after it is felled. For most forest insect populations the major source of variance is inter-tree, and if successive samples can be obtained from the same trees they are often found to be significantly correlated. There is, therefore, a statistical advantage in using standing trees since changes in population from one stage to another can be detected with greater sensitivity.

For young trees up to 30 or 35 feet in height, the entire length of the crown can be reached quite easily with aluminum pole-pruners made up of 5-foot interlocking sections. The cutting blade is operated by a pull-cord, and a spring clamp attached to the blade holds the cut branch until it is swung out of the crown and released over a small ground-sheet.

For taller trees a modified ladder was recently devised during a conversation with Mr. C. C. Thomson, who was interested in obtaining samples of seed from standing trees. A 38-foot extension ladder is fitted with a folding brace which holds the pole operator about 8 feet from the trunk of the tree, thus permitting unobstructed access to any part of the crown (see photo). The bottom section of the ladder is held upright, the extension is raised by means of a pulley, and the ladder is then allowed to tip until the brace is against the tree. Three guy ropes are used to manoeuvre the ladder and to hold it steady after it is in position. As an added precaution, the operator attaches himself to the top of the ladder with a safety belt. As in the case of the smaller trees, the cut branches are released from the pole-pruner so that they fall to a canvas sheet under the ladder.

This technique was tested for spruce budworm sampling during 1950 and found to be very satisfactory for trees up to 70 feet in height. Aluminum extension ladders are now available and will be substituted in 1951 for the wooden ladder to permit greater ease in handling. The sample branches are whole primaries selected, as nearly as possible, to represent each vertical quarter of the crown. A knowledge of crown-structure permits equal intensity of sampling in each quarter so that the results represent a true estimate of population on the tree, regardless of how the insect may be distributed vertically in the crown. Special sampling by both vertical and horizontal crown sections was used to study the distribution and variance of the population within the tree. Samples were taken from the same trees during the early larval stage, the pupal stage, and the egg stage of the budworm, but as the amount of foliage removed at each sampling generally did not exceed 5 per cent of the total, the effect on the trees was not serious. It was found that a crew of four men could obtain samples from 15 to 20 mature trees in a day by this method. After the ladder was in position the guy ropes were attached to nearby trees, leaving three men free to measure the branches as they fell and to cut them into smaller pieces either for examination on the spot or for subsequent laboratory examination. The method is applicable to intensive studies on permanent plots rather than to extensive surveys.—R. F. Morris.



Use of extension ladder and pole-pruner for obtaining samples from tall trees. The small branch held in the pruner will be released to drop to a ground-sheet under the ladder.

## PRAIRIE PROVINCES

### (FORESTED AREA)

***Mesoleius aulicus*, a Parasite of the Larch Sawfly.**—*Mesoleius aulicus* (Grav.) was imported into Canada from England in 1912 and was liberated near Treesbank, Manitoba. Other colonies were liberated in Ontario and Quebec in 1916. Graham[1] recorded parasitism of 19 per cent by this species near Treesbank in 1916, 88 per cent, with an average of 75 per cent over a considerable area, near Treesbank in 1927, and parasitism of 30 per cent at Glen Murray, Quebec, in 1929. Sweetman,[2] in a study of most of the numerous attempts to control pest insects through the use of parasites and predators up to 1936, considered that only 25 of these attempts could be termed "unusually successful." The control of the larch sawfly by *M. aulicus* was one of these 25 cases.

Since 1940, studies on *Mesoleius aulicus* in Manitoba and Saskatchewan have indicated that this parasite is exerting practically no control in the present larch sawfly outbreak. The principal reason for the decreased effectiveness is the failure of most *M. aulicus* eggs to hatch in the host larvae. Thus, although a high percentage of sawfly larvae are frequently parasitized by *M. aulicus*, the number of parasites reaching maturity and killing their hosts is extremely small, rarely exceeding 5 per cent. In British Columbia, however, *M. aulicus* is apparently still relatively effective in controlling the larch sawfly. Several thousand *M. aulicus* adults were reared from British Columbia larch sawfly cocoons and released in the Prairie Provinces in 1949 and 1950.

The evidence collected to date indicates that the failure of the eggs of *M. aulicus* to hatch in the larch sawfly larvae is the result of a natural immunity reaction on the part of the host. The development of the parasite is inhibited by the blood cells collecting around the parasite egg in the body of the host larva and forming a capsule around it. Work still in progress has disclosed much information on the nature of capsule formation around the egg and its effect on parasite development. Results of this research will be published in subsequent issues of the Bi-Monthly Progress Report.—J. A. Muldrew.

[1] Graham, A.R. The Present Status of the Larch Sawfly (*Lygaeonematus erichsonii* Hartig) in Canada with Special Reference to its specific Parasite, *Mesoleius tenthredinis* Morley. Can. Ent. **63**: 99-102. 1931.

[2] Sweetman, H.L. The Biological Control of Insects, pp. 352-356. Comstock Publishing Company, Inc., N.Y. 1936.

***Starvation of Larvae of the Larch Sawfly.***—During heavy infestations of the larch sawfly it is not uncommon for the host tree to be completely defoliated. Under such conditions the larvae may become subject to the effects of starvation. During the past summer a study was undertaken to determine the consequence of inanition on larval development and survival.

Fourth instar larvae were collected in the field and after moulting were divided into six series and subjected to various degrees of starvation. Dessication of the starved larvae was minimized by rearing them under conditions of high relative humidity.

The results of these rearings are summarized in the following table.

| Series | Initial Number of larvae | Treatment | Per cent mortality | Number of days in 5th instar prior to cocooning |
|---|---|---|---|---|
| I........ | 50 | Fed throughout (controls)........ | 0·0 | 9·4 ± 1·7 |
| II....... | 47 | Fed 3 days, then starved......... | 93·6 | 13·3 ± 1·7 |
| III...... | 41 | Fed 5 days, then starved......... | 63·4 | 8·0 ± 0·0 |
| IV....... | 50 | Starved 3 days, then fed......... | 0·0 | 11·8 ± 0·5 |
| V........ | 50 | Starved 5 days, then fed......... | 100·0 | ............. |
| VI....... | 50 | Starved throughout.............. | 100·0 | ............. |

All the larvae of Series I (controls) and Series IV (larvae starved for three days prior to feeding), survived to spin cocoons. Development of larvae of the latter groups was, however, somewhat prolonged as compared with the controls. Larvae in all the other series exhibited high degrees of mortality. Those larvae in Series II which did survive were much smaller than the controls and their cocoons were poorly constructed. Surviving larvae in Series III were, on the average, slightly smaller than the controls. It is possible that the ability of these larvae to overwinter successfully may have been affected by partial starvation. This aspect of the study is being investigated.

During the initial stages of starvation (3-4 days), the larvae exhibited a marked tendency to wander. Following complete inanition for four or five days, they became completely immobilized. When placed on foliage in this condition (Series V), they were unable to establish themselves and subsequently died.

Under the conditions of the present experiment, larch sawfly larvae in the fifth (ultimate) instar, exhibited little resistance to the rigours of complete inanition. When the duration of starvation exceeded half the normal feeding period, larval mortality was complete or nearly so. (Series II, V, and VI). It would seem, therefore, that exhaustion of the food supply, even during the final stages of larval development, would have a very marked effect in reducing populations of this insect.—R. J. Heron.

### (AGRICULTURAL AREA)

***Yellow-headed spruce sawfly, Pikonema alaskensis (Roh.).***—An investigation of the parasitism of this insect was undertaken as a phase in the problem of sawfly control in farm shelter-belts. In the summer of 1949, a series of five sawfly-infested trees in a field shelter-belt at Dahlton, Sask., was prepared for cocoon collection. The soil under the canopy of each tree was removed to a depth of 6 inches, discarded to eliminate the cocoons accumulated in previous years, and replaced with fresh soil. After the larvae had entered the ground and spun up, the cocoons were recovered by sifting. The cocoons were overwintered in screened boxes in the ground, and were brought into the insectary in the spring for adult emergence.

The distribution of parasites by trees, the families represented, and the number of species in each family are shown in the table.

| Tree Number...................... | 756 | 757 | 758 | 759 | 761 |
|---|---|---|---|---|---|
| Number of Cocoons................ | 695 | 645 | 254 | 361 | 147 |
| Parasites | | | | | |
| Ichneumonidae (9 species).......... | 181 | 118 | 60 | 70 | 32 |
| Bethylidae (2 species).......... | ........ | 11 | ........ | 3 | ........ |
| Tachinidae (1 species).......... | ........ | 1 | ........ | ........ | ........ |

The total number of cocoons collected was 2,102. From these, 465 sawfly adults and 489 parasite adults emerged. The high mortality among both the parasitized and unparasitized sawflies was apparently caused by mechanical injury during the sifting of the soil.—G. A. Bradley.

***Forest Insect Survey Notes.***—An aphid on American elm, *Myzocallis ulmifolii* (Monell), occurred in outbreak proportions in Regina, Sask., in late July and early August. Damage to the foliage was so severe and the secretion of honeydew so copious that a city-wide control campaign was undertaken. Reports of a similar outbreak in Lethbridge, Alta., were received.

The European lecanium scale, *Lecanium corni* Bouche, was thought to be killing young American elm in a field shelter-belt near Regina, Sask. An extensive survey showed that 11·6 per cent of the 608 trees in the shelter-belt were dead, and many more were unhealthy. One-half of the dead trees had been severely infested with the scale, the other half only lightly infested, or not at all. Most of the dead trees were in a part of the belt where heavy pruning had been carried out. The scale probably lowered the vitality of the trees which were infested and may have contributed to their death, but it is not considered to have been the primary cause of death. —Margaret E. P. Cumming.

## ROCKY MOUNTAIN REGION

***Forest Insect Survey.***—Field sampling by the insect ranger staff terminated in the second week of September. Up to this time collections totalled 3,443, not including 71 special reports. This represents almost a sixfold increase over the number of collections in the first year of the Rocky Mountain survey in 1948.

The great reduction by winter-kill of the population of the lodgepole needle miner, *Recurvaria milleri* Busck, has been mentioned in the previous report. In Jasper Park, however, some increase in the higher population areas has been noted, particularly in the upper Athabasca River Valley. The trees were noticeably browned from Poboktan Creek north to the junction of the Whirlpool and Athabasca rivers. In the north, the outbreak reached almost to Henry House, about 10 miles down the Athabasca River from Jasper. On the west, it extended for 3 miles west of Geikie in the Yellowhead Pass. On the east, the miner has been found along the Maligne River as far as the lower end of Maligne Lake.

The spruce budworm, *Choristoneura fumiferana* (Clem.), also suffered severe winter mortality but was still numerous enough to cause considerable foliage discoloration in spruce stands with a high percentage of balsam in the understory. The most severe injury occurred near Marble Canyon in Kootenay Park, around Lake Louise, in the vicinity of the Spiral Tunnel in Yoho Park and at Saskatchewan Crossing in Banff Park.

The black-headed budworm, *Acleris variana* (Fern.), was found in practically all the forests, being slightly more abundant in the northern districts. The populations remain in an endemic condition.

Populations of the larch sawfly, *Pristiphora erichsonii* (Htg.), remained low in the vicinity of Cold Lake.

The population of the mountain pine beetle, *Dendroctonus monticolae* Hopk., remained at a very low level in all the lodgepole pine stands of the National Parks and on the Eastern Slope of the Rockies.

The grey pine looper, *Caripeta angustiorata* Wlk., was not so abundant this year on the areas in Jasper Park where it appeared to be increasing to outbreak numbers in 1949.

The western tent caterpillar, *Malacosoma pluviale* (Dyar), is on the increase in some northern sections of Alberta and outbreaks can be expected within the next year or so. Larvae were particularly abundant in the vicinity of Smith in the Northern Alberta Forest District.—W. C. McGuffin and R. W. Reid.

***Lodgepole needle miner, Recurvania milleri Busck.***—The study of the bionomics of the needle miner disclosed a new development in egg-laying habits, or at least one not observed previously. At the time when the moths were expected to be ovipositing, intensive examination was made of the foliage but only a few eggs were found on the needles and twigs. Most of the eggs were found in small groups within the old mines. The eggs were situated from one to three millimetres from the exit holes, singly or in groups up to 14 in number. Since the number of fully formed eggs is from 16 to 30 in the ovary, a moth presumably oviposits in more than one location. Moreover, there are sometimes as many as 120 immature eggs in the four ovarioles. This peculiarity of the moths laying eggs in the old mines suggests the possibility of a "snowballing" effect causing more eggs to be laid on previously heavily attacked trees. This would increase the inter-tree population variability more than would be expected from a random distribution of eggs.

Apparently larval diapause is not obligatory but is dependent mainly on temperature. Measurements of the larval mines have been made weekly on 15 marked needles in Kicking Horse Canyon beginning September 2. Feeding continued during warm periods until October 20 even though night temperatures had previously reached a minimum of −10°F. Snow coverage on the trees probably made the temperature within the mines considerably warmer than this. Moreover, larvae in the needles of potted pines brought into the laboratory continued development with no tendency to go into diapause. On November 20 these larvae were about three times the size of larvae in the field. Larvae brought from the field on November 10 commenced feeding again under room temperature conditions of about 70°F., increasing the average length of larval mine by several millimetres during the ensuing week.

Dr. K. Graham has determined the relationship of the number of branch tips to tree height. A high degree of correlation was obtained using a semi-logarithmic plotting. This will give a more precise estimate of total population when the proper mensuration data are determined for a particular stand.—R. F. Shepherd.

## BRITISH COLUMBIA

***Chemical Control of Ambrosia Beetles.***—The recent successful results of investigators in the United States using benzene hexachloride sprays to combat ambrosia and bark-beetle infestations in felled timber has prompted a small-scale field test to find a carrying medium that will reduce the cost and fire hazard of the treatments and also remain effective. The experiment was carried out at Cowichan Lake adjacent to a small area of recent logging slash which carried a moderate insect population. Eight second-growth Douglas fir of uniform size (average d.b.h. 17·4 inches) on the margin of the slash were felled on July 17, limbed and marked off into eight 5-foot treatment sections which were separated from each other by 2-foot buffer zones. The tops were bucked off at 58 feet to prevent excessive drying.

All the chemicals were formulated and mixed by Dr. K. Graham who established the following eight treatments:—

A—Untreated control.
B—No. 2 Fuel oil.
C—Benzene hexachloride plus benzene in fuel oil.
D—Methyl benzoate and Triton X-100 emulsion in water.
E—Benzene hexachloride emulsion with methyl benzoate and Triton X-100 in water.
F—Furfurol and Triton X-100 in water.
G—Benzene hexachloride emulsion with furfurol and Triton X-100 in water.
H—Phenothiazine emulsion with methyl benzoate and Triton X-100 in water.

On July 20 these treatments were applied to the logs in an arrangement in keeping with the conditions of the Latin square experimental design so that each treatment occurred once on each tree and on each longitudinal position from butt to top. A garden sprayer developing a pressure of 50 to 80 pounds per square inch was used to apply the sprays at the rate of 1 gallon per 60 to 100 square feet of surface area, or, 1 gallon for 200 to 300 board feet.

Superficial inspections prior to analysis in November showed that attacks by the Douglas fir bark-beetle, *Dendroctonus pseudotsugae* Hopk., began as soon as the trees were felled and continued for several weeks. On the other hand, ambrosia beetle attacks (exclusively a species of *Gnathotrichus* Eich.) did not commence until the last week in August but continued until the first week in October. When the bark was removed, the presence of Cerambycid and Buprestid larvae indicated that eggs had been deposited in July and August. At present, only six of the eight logs have been analysed in detail, and although the effect of the treatments cannot be tested statistically, the results as indicated by the following table are, for the most part, obvious. All the benzene hexachloride treatments (C, E and G) appear to be equally effective in reducing all three types of insect damage. It is particularly encouraging to note that the water emulsions are as effective as the oil solution even after two months of moderate precipitation.

| Treatment | Total number of entrances in six 5-foot sections | | |
|---|---|---|---|
| | Ambrosia beetles | Douglas fir bark-beetles* | Cerambycids and Buprestids |
| A | 327 | 82 | 125 |
| B | 495 | 32 | 60 |
| C | 4 | 6 | 18 |
| D | 396 | 78 | 120 |
| E | 16 | 6 | 3 |
| F | 325 | 55 | 82 |
| G | 12 | 18 | 25 |
| H | 132 | 54 | 49 |

* Adult galleries only.

Statistical tests of these data and a more detailed analysis will reveal the great variation that has become evident in the cursory examinations of the intensity of attacks between trees, between positions along the trunks and between sides of the logs.

A further check on the persistence of the benzene hexachloride treatments has been made possible by the fact that no attacks have occurred on the stumps. Four of the stumps were originally sprayed with treatment C, while the other four were partially sprayed with treatment E. By delaying the stump examination until next summer, these treatments will be subjected to as severe conditions as the majority of field problems present.—J. M. Kinghorn and W. Webb.

## UNITED STATES

***Forest Pest Control Organization in New York State.***—In order to provide for state-wide coverage in forest pest detection, investigation and control matters, the New York State Conservation Department has designated one member from each of the 14 state forest districts as a forest pest representative on the district forester's staff.

The main objective of these appointments is to provide a specialist in forest pest problems. This is along the same line as the other specialists in each district such as personnel directing fire control, forest recreation, forest management, etc. The representatives under the direction of the district forester will reply to forest pest inquiries, investigate, study and survey forest insect and disease problems and handle the necessary publicity concerning these matters. They will be alert to notice any forest damage occurring in their respective districts and report to the district forester as well as the Albany office of the Conservation Department. Also all future control problems will be carried on under the direction of these specialists.

In order to assist the representatives in getting started uniformly in all districts by providing them with the same basic information, it was decided to have an indoctrination course in forest insects and diseases. A conference for this purpose was held at the New York State College of Forestry at Syracuse University on October 4, 5 and 6, 1950.

The entire program was in the form of a round table discussion. The discussion of forest entomology was led by Ray C. Brown, Senior Entomologist, Division of Forest Insect Investigations, U.S. Department of Agriculture, New Haven, Connecticut, who was ably assisted by J. V. Schaffner and Thomas McIntyre, members of his staff; Dr. Donald Collins, Entomologist, N.Y. State Science Service and Professor MacAndrews who is in charge of the Department of Forest Entomology at the College of Forestry.

Forest disease discussions were conducted by Dr. Ray Hansbrough, Senior Pathologist, Division of Forest Pathology, U.S. Department of Agriculture, New Haven. He was assisted by Dr. Spaulding of his staff and Dr. Ray Hirt who is in charge of the Department of Forest Botany at the Forestry College.

The representatives also heard descriptive reports on the White Pine Blister Rust and Gypsy Moth Control projects by William Clave and W. V. O'Dell respectively, from the Bureau of Forest Pest Control, Albany office staff.—C. J. Yops, Superintendent, Bureau Forest Pest Control.

***Matsucoccus sp. in New York State.***—A report has been received from the New York State Conservation Department to the effect that a scale insect, *Matsucoccus* sp., previously recorded from Connecticut, has been found on red pine near New York City and on Long Island. It is a very destructive insect and has already killed many young red pines in Connecticut. It may spread rapidly and might possibly become the most serious pest ever to attack the red pine.

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